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Special Issue on

MODERN RESEARCH IN HUMANITIES, ARTS AND SCIENCE

Editors-in-chief

Dr. MANIMANGAI MANI | Dr. VEERAMOHAN VEERAPUTHRAN
Dr. J. JOHN SEKAR | Dr. S. BALAKRISHNAN

BODHI

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The journal welcomes publications of quality papers on research in humanities, arts, science. agriculture, anthropology, education, geography, advertising, botany, business studies, chemistry, commerce, computer science, communication studies, criminology, cross cultural studies, demography, development studies, geography, library science, methodology, management studies, earth sciences, economics, bioscience, entrepreneurship, fisheries, history, information science & technology, law, life sciences, logistics and performing arts (music, theatre & dance), religious studies, visual arts, women studies, physics, fine art, microbiology, physical education, public administration, philosophy, political sciences, psychology, population studies, social science, sociology, social welfare, linguistics, literature and so on.

Research should be at the core and must be instrumental in generating a major interface with the academic world. It must provide a new theoretical frame work that enable reassessment and refinement of current practices and thinking. This may result in a fundamental discovery and an extension of the knowledge acquired. Research is meant to establish or confirm facts, reaffirm the results of previous works, solve new or existing problems, support theorems; or develop new theorems. It empowers the faculty and students for an in-depth approach in research. It has the potential to enhance the consultancy capabilities of the researcher. In short, conceptually and thematically an active attempt to provide these types of common platforms on educational reformations through research has become the main objective of this Journal.

Dr. S. Balakrishnan
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Associate Professor Dr. HAZLINA ABDUL HALIM

FOREWORD

I wish to extend my warm welcome to all speakers, presenters and participants to the 4th. Bodhi International Conference on Humanities, Arts and Science, which was first held in 2018 and has grown to become the exchange ground for theoretical conceptions, research insights and practical experiences in various disciplines. For those participants visiting Malaysia for the first time, I wish you *Selamat Datang* toour beautiful country, and hope you enjoy your stay. This year, we are thankful to be able to overcome COVID-19 that has disrupted almost every aspects of our lives. We are grateful that we are able to conduct the conference once again, face to face. Thus, it is hoped that this conference will serve as an excellent international platform for networking and exchanging new ideas, as well asto disseminate the latest research results and findings.

I thank all contributors for their time and support in making this conference a success and I sincerely hope that this join collaboration will spark new ideas for the betterment of mankind and knowledge.

"With Knowledge We Serve"

Thank you

Associate Professor Dr. HAZLINA ABDUL HALIM
Dean
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Universiti Putra Malaysia
Malaysia

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43400 UPM Serdang,
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Malaysia

Associate Professor Dr. ARBAAYAH ALI TERMIZI

FOREWORD

It is indeed with great honour, I welcome all delegates to the 4th Bodhi International Conference on Humanities, Arts and Science (BICOHAS - 2025). I am pleased to acknowledge that this collaboration which was initiated in 2018 between the Department of English, Faculty of Modern Languages and Communication, Universiti Putra Malaysia with Bodhi International Journal of Research in Humanities, Arts and Science, India has never ceased in action despite the 2-year lockdown due to COVID-19 pandemic. It is my sincere hope that the conference would continue to be the sustainable platform for new and existing researchers, scholars, practitioners, and graduate students to network and exchange ideas in the field of humanities, arts, and science.

With this opportunity, I would like to extend my appreciation to the organising committee of Bodhi, International Journal of Research in Humanities, Arts and Science India and Department of English, Faculty of Modern Languages and Communication, Universiti Putra Malaysia in making this event a great success. May all well that ends well and happy conferencing.

"With Knowledge We Serve"

Thank You

Associate Professor Dr. ARBAAYAH ALI TERMIZI
Head
Department of English
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Dr. MANIMANGAI MANI

MESSAGE FROM CHAIRPERSON

It is great honour to welcome all of you to our 4th Bodhi International Conference on Humanities, Arts and Science (BICOHAS-2025). This conference is jointly organised by the Department of English (UPM), Bodhi International Journal of Research in Humanities, Arts and Science, India and Co-organised Institutions from India. I would like to extend my heartfelt gratitude to Dr. S. Balakrishnan for his long-standing support and for his efforts in collaborating with our university. His vision and dedication have made it possible for scholars from India to attend this conference in Malaysia, providing a unique opportunity for interdisciplinary exchange and collaboration. It is my sincere hope that this assembly of scholars and researchers will act as a platform to share ideas and start some networking among scholars in India and Malaysia. I believe only through research and practice that we would be able to contribute to the nation and the world at large with the advances and innovations in the field of humanities, arts and science. This conference will also act as a steppingstone for new researchers and post graduate students to attend and present papers in other international conferences.

Finally, this conference would not have been a success without the support of UPM's Vice Chancellor, the Dean of Faculty of Modern Languages and Communication, Head of Department of English Language and all the committee members of BICOHAS-25 from India and Malaysia for their tireless efforts in organizing this conference.

"With Knowledge We Serve"

Thank you

Dr. MANIMANGAI MANI
Senior Lecture
Department of English
Faculty of Modern Languages and Communication
Universiti Putra Malaysia, Malaysia

ಕರ್ನಾಟಕ ರಾಜ್ಯ ಅಕ್ಕಮಹಾದೇವಿ ಮಹಿಳಾ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ, ವಿಜಯಪುರ
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CHAIRMAN'S MESSAGE

Greetings!

It gives me a great joy to know that Universiti Putra Malaysia (UPM), Malaysia and Bodhi International Journal Jointly organising the 4th International Conference (BICOHAS-25) at Universiti Putra Malaysia (UPM), Malaysia during 26, 27, 28 February and 1, 2 March 2025.

The research is the space where one can both explore and innovate as well us channelizing the spirit of exploring, probing and analyzing. In this competitive realm, the focus of a researcher should not narrow down to one particular discipline, there are numerous ways of combining the research of one field to that of another and that should be of paramount importance when attempting a research area. Here is an effort to combine research worldwide.

I strongly believe this conference is a step towards bringing in more interrogative spirit and creating a new epistemology with this pedagogical practice. The motive of this conference is also one such effort to create a holistic relationship between various fields of knowledge pertaining to Science, Arts and Humanities. This amalgamation will produce a beautiful platform to explore newer forums in present and future.

I congratulate the conference team and look forward to fruitful collaborations and outcomes.

With Regards

Prof. P. KANNAN
Senior Professor & Chairman
Department of PG Studies & Research in English
Karnataka State Akkamahadevi Women's University, Karnataka

NAGALAND UNIVERSITY

(*A Central University established by the act of Parliament, 35/1989*)

Department of English

Kohima Campus, Meriema, Kohima-797004

HEAD'S MESSAGE

Dear Professors and Research Scholars,

On behalf of the Department of English, Nagaland University, we extend our sincere gratitude to you for your invaluable collaboration with us for the upcoming 4th BODHI International Multidisciplinary Conference, scheduled to take place from February 26 to March 2, 2025, at Universiti Putra Malaysia (UPM), Malaysia. This conference, focusing on *Modern Research in Humanities, Arts, and Sciences*, promises to be an exciting opportunity for sharing knowledge and fostering academic dialogue across various disciplines. Your initiation and support play a crucial role in enhancing the success of this conference, and we are confident that it will be a platform for enriching discussions and future collaborations.

We are eager to continue fostering our partnership with you for future conferences, research collaborations, and publications. We truly appreciate your commitment and look forward to many more fruitful collaborations in the years to come.

Warm regards,
Prof. NIGAMANANDA DAS
Head, Department of English
Nagaland University
Kohima, Nagaland

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Dear Esteemed Members of the Academic Community,

It is with immense pleasure and a profound sense of pride that I present the proceedings of the 4th BODHI International Multidisciplinary Conference on "Modern Research in Humanities, Arts, and Sciences". We are honored to co-host this outstanding event at Universiti Putra Malaysia (UPM), Malaysia, alongside our esteemed partners.

Since 2018, Vivekananda College has nurtured a fruitful collaboration with the BODHI International Journal of Research in Humanities, Arts, and Science, beginning on an academic journey that has significantly enriched our community's intellectual landscape. This year marks our second collaboration with UPM, through BODHI, further solidifying our commitment to fostering global connections and promoting scholarly excellence.

The theme of this year's conference invites participants to dive into the depths of modern research, encouraging a vibrant exchange of ideas and innovative research methodologies across diverse disciplines. The papers included in these proceedings exemplify the rigorous academic standards and creative exploration that characterize our joint efforts.

I extend my deepest gratitude to Dr. S. Balakrishnan, Director of the BODHI Journal, Dr. K. Kaviarasu, Assistant Professor of English at Vivekananda College, and the BICOHAS team, whose uncompromising dedication and vision have been significant in making this collaboration a resounding success.

To all participants and contributors, your involvement enriches our conference and strengthens the academic bonds across continents. I trust that the proceedings will serve not only as a testament to the innovative works presented but also as a beacon of inspiration for future research endeavors.

Thank you for your engagement and contribution to research in humanities, arts, and sciences. I wish you all a stimulating conference filled with insightful discussions and meaningful connections.

Sincerely,

T.S. Jayanthi

NIRMALA COLLEGE FOR WOMEN
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PRINCIPAL'S MESSAGE

Greetings!

It is with great delight that I extend my appreciation to all esteemed academicians, research scholars, and students participating in this International Academic Conference. This conference serves as a vibrant forum for intellectual exchange, fostering interdisciplinary, multidisciplinary, and transdisciplinary discussions that align with the visionary goals of the National Education Policy (NEP) 2020.

As we navigate the evolving landscape of education and research, this conference provides an opportunity to engage with innovative ideas, cutting-edge research, and meaningful collaborations. By bringing together erudite leaders from various domains, we aim to inspire critical inquiry and contribute to the advancement of knowledge that has a lasting impact on academia and society.

My appreciation extends to ' Bodhi International Journal ' Publisher Dr.S. Balakrishnan for his strenuous efforts in organising this Conference connecting institutions, academicans, and scholars by providing a platform to present their research, engage in discussions, and forge new academic partnerships. May this conference be a catalyst for new perspectives and transformative learning experiences.

Best wishes for a successful and enriching conference. God Bless all.

Rev Sr. Dr. MARY FABIOLA
Principal
Nirmala College For Women
Coimbatore, TamilNadu, India

DEAN'S MESSAGE

Dear Members of Academic Community
Greetings

It is my great pleasure to welcome you to the 4th Bodhi International Conference on Humanities, Arts and Science on behalf of Gandhigram Rural Institute (Deemed to be University) Gandhigram, Dindigul, Tamil Nadu. The Motive of this Conference is to enhance and upgrade research development taken by Conference team ensures excellent opportunities for sharing and gaining knowledge and brings out the recent trends, innovative methodologies and developments in the field of humanities, arts and sciences. This international conference not only promotes research culture but initiates organizations to upgrade scope of professional network and collaborative activities. The process involved in the selection of quality papers for publication is highly appreciated and gratitude to all the authors and presenters of this conference.

The efforts taken by the organizing team deserves great endorsement.

Dr. S. BALASUNDARI
Dean & Professor School of English and Foreign Languages
Gandhigram Rural Institute (Deemed to be University)
Gandhigram, Dindigul, Tamil Nadu

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PRINCIPAL'S MESSAGE

Good morning esteemed guests, distinguished speakers, award recipients, faculty members, and dear students.

It is my immense pleasure to welcome you all to the International Conference on Modern Research in Humanities, Arts, and Sciences, held in conjunction with the prestigious Bodhi International Awards conference. This platform aims to foster innovation, interdisciplinary dialogue, and excellence in academic research.

This conference focused on contemporary literary theories, digital humanities, and cultural studies, with significant emphasis on postcolonial literature, gender studies and Presentations included explorations of visual arts, performing arts, and the integration of technology in artistic expression. Researchers presented groundbreaking studies in environmental science, data science, and innovations in medical research.

The Bodhi International Awards celebrated excellence in academia by honoring distinguished scholars and researchers for their outstanding contributions. The award categories included Best Researcher Award, Best Academician Award, and Best Resource Person Awards and other category awards. Congratulations to all the awardees for their remarkable achievements and inspiring contributions.

This conference has not only provided a platform for sharing knowledge but also paved the way for future collaborations and research endeavors. I extend my heartfelt gratitude to all participants, the organizing committee, and Bodhi International for making this event a grand success.

Thank you all, and I wish you continued success in your academic and research pursuits.

Rev. Sr. Dr. MARY PRAMILA SANTHI
Principal
St.Antony's College of Arts and Sciences for Women
Dindigul, Tami Nadu, India

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Dr. S. BALAKRISHNAN

Publisher & Managing Editor

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CONFERENCE CONVENER'S MESSAGE

I am delighted to extend a warm welcome to the participants of BICOHAS-25.

This conference, after scholarly discussions and deliberations, have been planned and organized as a value-added conference, adding value to the existing realms of knowledge. I firmly believe that this conference would bring in a sea change in the gamut of research and academics as we return to India from Malaysia, discussing and debating on emerging domains of interdisciplinary and multidisciplinary research. At this juncture, we as Indians, would experience an emotional bonding united as Indians, in a foreign land, Malaysia, despite the divergence of language and culture of our land. I could ascertain that this bond that emerges within us would be natural and could not be created artificially. We will definitely experience that, and it will be a great feeling. Not everyone will be afforded this prospect. We are fortunate to have this opportunity. I believe that we are intended to own this experience.

Respected professors, researchers, scholars and friends, the experience which we are going to get through BICOHAS-23 is going to be memorable lifelong. During these 5 days we are not only going to familiarize the culture and heritage of our fellow participants but also the language, culture and the people of Malaysia. This travel experience, as writers and research erssay, is going to unveil the new realms in our mind and remain within us as a precious eternal memory. Having this in mind this conference is planned not only as an academic enterprise but also as a cultural endeavor.

The efforts and pains taken by the organizers and advisors in planning and organizing this conference would leave a remarkable imprint in your academic as well as personal memoir.

I thank the Chief Patrons, Patrons, Convenors, Academic Convenors, Organising Secretaries and Coordinators from the joint-organizing institution, University Putra Malaysia (UPM), Malaysia and the co-organising institutions from India. A special word of thanks to the Chairperson Dr. Manimangai Mani for her ardent support in making all the arrangements in Malaysia along with the Vice-Chairperson, and the UPM Organising team. I feel proud and happy to be part of this organizing team leading you all towards this fruitful academic venture.

Thank you.

With warm regards,
Yours truly,

S. Balakrishnan

(S.BALAKRISHNAN)

From the Desk of the Editors…

It is with great enthusiasm that we present this special issue, featuring selected papers from the International Multidisciplinary Conference on Modern Research in Humanities, Arts and Sciences, jointly collaborated &organized by Universiti Putra Malaysia and BODHI International Journal on February 27–28, 2025, in Kuala Lumpur. It was co-organised by Nagaland University, Karnataka State Akkamahadevi Women University, Vivekanand College, Nirmala College for Women, St. Antony's College of Arts and Sciences for Women, and The Gandhigram Rural Institute. This conference brought together scholars, researchers, and practitioners from diverse fields, fostering a rich intellectual exchange that underscores the growing significance of multidisciplinary research in addressing contemporary challenges.

In an era where complex global issues demand collaborative approaches, multidisciplinary conferences such as this serve as crucial platforms for knowledge integration, bridging gaps between disciplines, and fostering innovative solutions. The manuscripts included in this volume reflect the dynamic interplay of ideas from fields as varied as literature, linguistics, social sciences, digital humanities, management studies, higher education, environmental studies, and emerging technologies. By publishing these contributions, we ensure that the rigorous discussions and pathbreaking insights shared during the conference reach a wider academic and research community, inspiring further enquiry and cross-disciplinary collaboration.

A thriving research ecosystem is essential for academic institutions to foster innovation, encourage critical thinking, and drive societal progress. Encouraging faculty members, early-career researchers, and postgraduate students to engage in scholarly publication strengthens the foundation of knowledge in their respective disciplines. Conferences like this provide *a unique opportunity for scholars to present their findings, receive constructive feedback, and refine their research for wider dissemination*. Such engagements not only enhance individual academic growth but also contribute to the larger research community by building networks, promoting interdisciplinary learning, and shaping future directions of inquiry.

Further, academic publishing plays a pivotal role in knowledge dissemination, and ensures that research findings reach relevant stakeholders, including policymakers, industry leaders, and educators. The publication of conference proceedings and edited volumes provides a credible platform for researchers to showcase their work to a global audience. As academic discourse increasingly transcends borders, it becomes imperative for institutions and journals to support and facilitate the publication of high-quality, peer-reviewed research that advances scholarly debates and contributes to the development of knowledge economies.

We extend our sincere gratitude to all contributors, peer reviewers, and organizing committee members who made this conference and its subsequent publication possible. We hope this collection not only documents the intellectual vibrancy of the event but also serves as a valuable resource for scholars and researchers seeking interdisciplinary perspectives in their respective fields.

Editors

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Aim & Objectives

Academic Excellence in research is sustained by promoting research support for young Scholars. Our Journal on Humanities, Arts and Science of research is motivating all aspects of encounters across disciplines and research fields in a multidisciplinary view, by assembling research groups and consequently projects, supporting publications with this inclination and organizing programmes. Internationalization of research work is the unit seeks to develop its scholarly profile in research through quality of publications. And visibility of research is creating sustainable platforms for research and publication, such as series of books; motivating dissemination of research results for people and society.

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Communication

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CONTENTS

SYNTHESIS, SPECTRAL AND BINDING STUDIES OF SCHIFF BASE COMPLEXES

J. JEEVITHA RANI
Assistant Professor, Department of Chemistry
St.Antony's College of Arts and Science for Women, Dindigul

Abstract
Novel Cobalt (II), Copper (II), Nickel (II) and Iron (II) complexes are synthesized from bidentate Schiffbase ligand derived from condensation of benzaldehyde with ethylene diamine. The synthesized compounds are subjected to various spectroscopic techniques such as UV-Visible, FT-IR and ^{1}HNMR spectral studies. The biological activity of the ligand and their complexes are tested against different strains of bacteria such as gram positive (Staphylococcus aureus) gram negative (Escherichia coli, Pseudomonas aeruginosa) and fungus candida albicans. The binding studies of the cobalt and copper complexes with BSA are carried out. This study enables us to test the binding nature of biomolecule BSA with Cobalt and Copper benzalen complexes.
Keywords*: biological activity, binding studies, BSA, spectroscopic techniques*

Introduction

Transition metal complexes with Schiffbases have expanded enormously and diversified areas of organometallic and various aspects of bioinorganic chemistry [1]. Schiffbase ligands are considered as most "privileged ligands" containing an azomethine group (–CH=N) because they are easily prepared by the condensation between aldehydes and primary amines [2]. Schiffbase complexes have been extensively used as catalyst, pigments, dyes and intermediates in organic synthesis and as polymer stabilizers [3]. Several transition metals like copper, nickel cobalt, containing Schiffbases have been widely studied and displayed a wide variety of biological applications such as antibacterial, antifungal, antiviral and anticancer agents [4,5] Schiffbase ligands containing N and O donor atoms which possesses broad biological activities and incorporation of metals in the forms of complexes [6].

Nowadays, the interaction of transition metal complexes with biomolecules such as DNA and protein is an emerging field in bioinorganic chemistry. Proteins are the most abundant macromolecules present in living organisms and the major targets of many types of medicines in the body [7]. Serum albumin is the most abundant protein in blood plasma [8]. It plays an important role in bio-regulatory functions like maintenance of the colloidal osmotic blood pressure, blood pH and as a transporter of a variety of endogenous and exogenous substance such as fatty acids, hormones, drugs and metal ions [9]. Among the serum albumin, Bovine Serum Albumin (BSA) is an attractive macromolecule generally used in biophysical and biochemical studies because of its structural homology with human serum albumin (HSA). BSA is usually preferred for protein binding studies because of its availability, low cost, stability, medical importance and ligand binding properties [10, 11].

A.M.I. Jayaseeli and S. Rajagopal studied the kinetic studies of iron (III) Schiffbase complexes catalyzed H_2O_2 oxidation of organic sulphides and sulphoxides [12]. S. Pattanaik et.al synthesized the Schiffbase ligand using p- chlorobenzaldehyde with p- chloroaniline. The complexes of Cu(II), Ni(II) and Zn(II) with the bidentate ligand are synthesized and characterized by various spectral techniques [13]. The two new Schiffbase compounds are derived from condensation reaction of L-glycine and L- tryptophan with 4 methylbenzaldehyde have been synthesized by Zahraa Salim. They are characterized by FT-IR, UV- Visible and H^1 NMR spectroscopy [14]. The photophysical and protein binding properties of a series of Re (I) complexes have extensively studied by S. Rajagopal and coworkers [15].

The Literature reveals that Schiff base complexes of benzaldehyde with ethylenediamine have not been much studied. So we describe the synthesis of Cu (II), Co(II), Ni(II) and Zn(II) complexes with bidentate Schiff base ligand. The synthesized Schiff base and their metal complexes are characterized using various spectral techniques. We also study the interaction of these complexes with BSA by UV-Visible absorption techniques.

Experimental

Materials

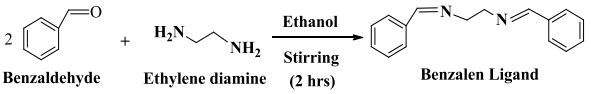
All the starting materials of chemicals used in this study such as benzaldehyde, ethylene diamine and the metal salts $NiCl_2.6H_2O$, $CoCl_2.6H_2O$, $FeCl_3.6H_2O$ and $CuCl_2.2H_2O$. Bovine Serum albumins (BSA), potassium dihydrogen phosphate, dipotassium hydrogen phosphate are purchased from Sigma-Aldrich. Spectroscopic grade ethanol and dimethyl sulfoxide (DMSO)

Methods

The melting points of the synthesized benzalen complexes are recorded using melting point apparatus. Molar conductance of the complexes is measured at room temperature using a systronic conductivity bridge (OSWAL). FT-IR spectra are recorded using in Shimadzu FT-IR-8400 spectrophotometer. Electronic spectra are recorded in DMSO using Shimadzu UV-Visible spectrophotometer. NMR spectrum of Schiff base ligand is recorded in deuterated dimethyl sulfoxide using a Varian XL 200 NMR spectrometer. Biological activities of the complexes were tested against different strains of bacteria and fungi by Kirby-Bauer Method.

Synthesis of Benzalen Ligand

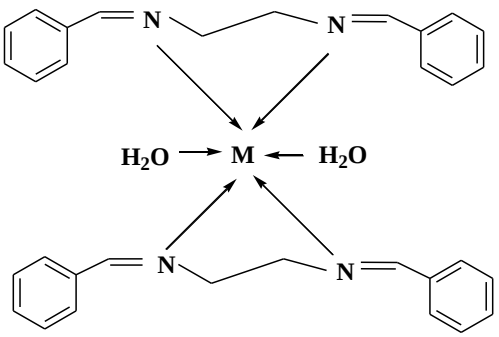
The synthesis of benzalen ligand involves the condensation of benzaldehyde (0.033 moles) and ethylene diamine (0.0166 moles) in the ratio of 2:1 in an ethanolic medium. The reaction mixture is stirred for two hours. The yellow precipitate is collected, dried and recrystallized from ethanol. The reaction is represented as follows.



Scheme 1 Synthesis of Benzalen Ligand

Synthesis of Metal -Benzalen Complexes

An ethanolic solution of benzalen ligand is added to a solution of metal chloride or acetate salts in the ratio of 2:1 in a round bottom flask. The resulting reaction mixture is refluxed for 2 hours and then cooled at room temperature. The resulting precipitate is collected and washed with ethanol and dried in vacuum. The similar procedure is followed for synthesis of complexes (I-IV). **Fig. 1** represents the general form of structure of the complexes.



M = Ni, Co,Cu, Fe

Figure 2.1 Structure of Metal-Benzalen Complexes

Results and Discussion

Spectrometric results and physical measurements obtained by the analysis of ligand and complexes are investigated and reported. The ligand is yellow in colour and soluble in some common organic solvents. The metal complexes are soluble in DMSO. Their molar conductance values are too low to account for any dissociation of the complexes in DMSO. Hence these complexes can be regarded as non-electrolyte. **Table.1** represents the melting point and molar conductance of the benzalen ligand and their complexes.

Table 1

Name	Complex	Melting point	Molar conductance
Benzalen ligand		143	Non-electrolyte
Ni-Benzalen Complex	I	211	Non-electrolyte
Co-Benzalen Complex	II	206	Non-electrolyte
Cu-Benzalen Complex	III	154	Non-electrolyte
Fe-Benzalen Complex	IV	220	Non-electrolyte

Characterization by UV-Visible Spectra

The synthesized benzalen ligand and their metal complexes are analyzed using UV-Visible spectrophotometer. The electronic spectra of the benzalen ligand and its metal complexes are recorded in DMSO (Dimethyl Sulfoxide). The UV-Visible spectra of benzalen ligand shows the absorption peak at 271nm is attributed to the $\pi \rightarrow \pi^*$ transition of the azomethine chromophore. The electronic spectrum of cobalt benzalen complex exhibit a absorption band at 469nm which are assignable to the overlap of transitions ^4T_1g (F) $\rightarrow$ ^4T_2g (F). The spectrum of nickel benzalen complex show absorption peak at 612nm is attributed to ^3A_2g (F) $\rightarrow$ ^3T_1g (F) transitions. The characteristic peaks at 648nm and 933nm are registered for Copper and Iron benzalen complexes which are assignable to the transitions $^2Eg \rightarrow {}^2T_2g$ and $^5T_2g \rightarrow {}^5Eg$ respectively. It proves that the complexes (I to IV) have octahedral geometry [13, 14].

Characterization by FT-IR Spectra

The prepared ligand and metal complexes are subjected to FT-IR studies and the stretching frequency corresponding to C=N, -OH, and M-N are analyzed. The FT-IR spectrum of the Schiff bases is compared with the spectrum of the metal complexes. The stretching frequency obtained for the Schiff base and metal complexes are tabulated in **Table.2**. The figures 3, 4 and 5 show the FT-IR spectra of ligand and Ni, Co complexes respectively.

Table 2 FT-IR Spectrum of Benzalen Ligand and Complexes (I to IV)

Name	ν (OH) (cm^{-1})	ν (C=N) (cm^{-1})	ν (M-N) (cm^{-1})
Benzalen ligand	-	1620	-
Complex I	3354	1523	532
Complex II	3421	1566	567
Complex III	3304	1573	520
Complex IV	3429	1521	462

The FT-IR band assignments of metal benzalen complexes exhibit broad bands in the range of 3354cm^{-1} to 3429 cm^{-1} indicating the presence of O-H stretching vibration [15]. The peak appeared for benzalen ligand at the region 1620 cm^{-1} can be assigned to the C=N stretching vibration . The spectral data of the complexes (I to IV) showed a strong absorption band at 1523 cm^{-1}, 1566 cm^{-1}, 1573 cm^{-1} and 1521 cm^{-1} respectively due to ν (C=N) stretching frequency [16]. The band at the region 567 cm^{-1} is due to ν (M-N) stretching which shows the coordination through N atom to the metal.

^{1}H NMR Spectra

Fig. 2 is the ^{1}H NMR spectrum obtained for benzalen ligand.

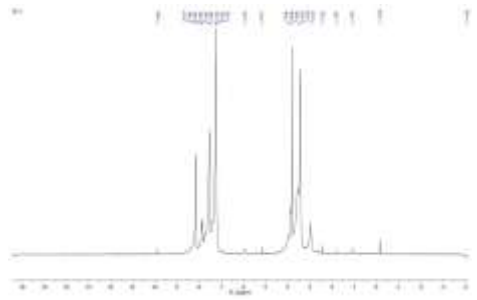


Fig 2 ^{1}H NMR Spectrum of Benzalen Ligand

In the ^{1}H NMR spectrum of ligand the azomethine proton exhibits a singlet signal at 9.86 ppm **(Fig.2)**. The aromatic ring proton exhibited signals at 7.24-8.14 ppm. Hence the formation of

ligand using benzaldehyde and ethylene diamine in stoichiometric amounts is proved [17].

Biological Activity

The antimicrobial activity of the ligand and complexes (I to IV) are tested against the following strains of bacteria: staphylococcus aureus, *Escherchia coli, pseudomonas aueroginosa,* and *fungus candida albicans*. The antimicrobial activity of each compound is evaluated by the Kirby-Bauer Method. Amikacin for bacteria and Flucanazole for fungi are used as reference drugs. On comparing the biological activity of benzalen ligand and its complexes, cobalt benzalen complex possesses effective and selective anti-bacterial activity against *E.coli, Staphylococcus aureus*. On the other hand other complexes show moderate anti bacterial activity. The benzalen ligand and copper benzalen complex exhibit a good anti fungal activity against the tested fungal species. The results are shown in **Table 3.**

Table 3 Antimicrobial Screening Results of the Ligand and Complexes (I to IV)

Compounds	Zone of inhibition (mm)			
	Bacterial Inhibition			Fungal Inhibition
	E.Coli	*P.aeruginosa*	*S.Aureus*	*C. albicans*
Benzalen ligand	10	9	10	11
Complex I	8	8	10	10
Complex II	12	10	13	10
Complex III	7	12	9	12
Complex IV	10	10	11	10
Amikacin (Standard) Bacteria	22	20	20	-
Flucanazole (Standard) Fungi	-	-	-	17

Fig 7 Inhibition Zones of *E.Coli*

Fig 8 Inhibition Zones of *P. Aeruginosa*

Fig 9 Inhibition Zones of *C. Albicans*

UV-Visible Spectra of Cobalt and Copper Benzalen Complexes with BSA

Electronic absorption measurement is very simple and effective method in exploring the structural changes and detecting the protein drug complex formation. The absorption spectra of cobalt benzalen complex in the presence and absence of BSA are recorded. The characteristic peak of cobalt benzalen complex at 475 nm. After the addition of BSA to cobalt benzalen complex, there is a shift in λ_{max} from 475 nm – 474 nm depicting blue shift. The UV-Visible absorption decreased regularly with

increasing concentration of BSA (10^{-4}–10^{-5}M) indicating that BSA molecules are associated with cobalt benzalen complex. Similarly, the absorption spectra of copper benzalen complex in the presence and absence of BSA are recorded. The characteristic peak of copper complex exhibited at 573nm. After the addition of BSA to copper benzalen complex, there is a shift in λ_{max} from 573nm-567nm depicting blue shift. The UV-Visible absorption decreased regularly with increasing concentration of BSA signifying that the BSA molecules are associated with copper metal complex. The UV-Visible spectra of Co and Cu benzalen complexes with BSA are shown in **Fig. 10.**

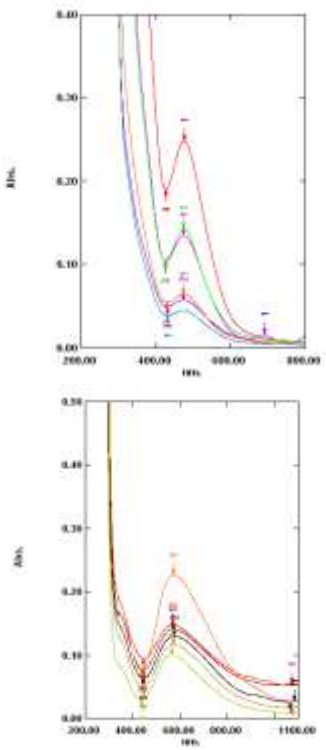


Fig 10 UV-Visible Spectra for Binding Studies of Cobalt & Copper Benzalen Complex and BSA at Different Concentrations

Conclusion

In the present study, the Schiff base is synthesized by condensing ethylene diamine with benzaldehyde. Schiff base metal complexes are synthesized using the metal salts of $FeCl_3.6H_2O$, $NiCl_2.6H_2O$, $CoCl_2.6H_2O$ and $CuCl_2.2H_2O$. These synthesized metal benzalen complexes are characterized by UV-Visible, FT-IR and NMR spectroscopy. The results of the biological screening of the benzalen ligand and their complexes revealed that ligand showed lesser antimicrobial activity compared to that of some complexes. Binding studies of Cobalt and Copper benzalen complexes with BSA are investigated by UV-Visible spectroscopy. UV-Visible spectra are registered at various concentrations of BSA. There is a shift in λ_{max} of the complexes. This study enables us to test the binding nature of biomolecule BSA with Co and Cu benzalen complexes.

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ELEMENTAL COMPOSITION OF SiO_2/Ni-Cu NANOCOMPOSITE

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Abstract
Nanocomposite SiO_2/Ni-Cu were synthesised using simple chemical phase method and their structural characterizations were evaluated by Energy dispersive x-ray diffraction (EDAX). It has been found that SiO_2/Ni-Cu of Nanocomposite (catalyst) used to find the elemental configuration of materials.
Keywords: *SiO_2/Ni-Cu nanocomposite, EDAX*

Introduction

Nanoscience and technology have emerged as multidisciplinary fields with growing applications in materials science. A WTEC study (1996–1998) highlighted trends in nanostructures and their engineered properties. Silica (SiO_2) nanoparticles attract attention due to their high surface area, tunable pore sizes, and catalytic potential. However, they face challenges like low chemical stability and charge distribution issues. Incorporating metals such as Co, Ni, Cu, and Fe enhances catalytic performance, making metal-SiO_2 composites highly promising.

Materials and Methods

Materials

Ethanol, ammonia, tetra ethyl ortho silicate (TEOS), Nickel chloride hexahydrate ($NiCl_2.6H_2O$), Copper Chloride ($CuCl_2$) were purchased from sigma – Aldrich. All reagents were of analytical grade and were used as without further purification. The ethanol is distilled through vacuum distillation and the distilled ethanol is used for the synthesis of silica and silica nanocomposites.

Preparation of Silica Nanoparticles

The silica nanoparticles were synthesized by using the following procedure. In the mixture of 80 ml absolute ethanol, 2 ml deionized water and 2.6ml ammonia, tetraethyl orthosilicate (TEOS) 1.6 ml was added by drops under constant stirring. The above solution mixture stirred for about 2 h at the room temperature, and the formed white precipitate was centrifugally separated from the suspension, and washed with three times absolute ethanol and water.

Preparation of Nickel–Copper Doped Silica Nanoparticles

0.1g of silica was ultrasonically dispersed in 10ml of ethanol and 0.025g of Ni Cl_2 and 0.025g of $CuCl_2$.Then 0.1ml of ammonia added to the mixture stir for 4 hours. Then, the sample was separated by centrifugation to obtain a dark green precipitate.

Results and Discussion

EDAX Patterns

The EDAX patterns of prepared nanostructures are depicted in Figure3.3. The prepared SiO_2/Ni nanospheres were composed of Si (34.32 %), O (54.66 %) and Ni (6.08 %) elements(Fig.3.1 a).In addition to Si (33.79%), O (44.47%) and Ni (5.64%), SiO_2/Ni–Cu exhibited the Cu (6.20%) element, ensuring the formation SiO_2/Ni–Cu product(Fig.3.1 b).There is a small amount of Cl ions as impurity in both SiO_2/Ni and SiO_2/Ni–Cu nanoparticles.

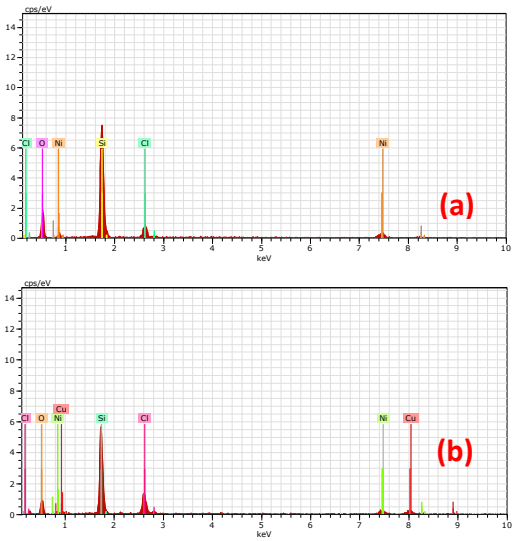

Figure 3.1 EDAX spectra of SiO_2 / Ni (a) and SiO_2 / Ni–Cu (b) Composites

Conclusion

SiO_2/Ni-Cu Nanocomposite with large surface area and pore volume were synthesised using a simple and effective chemical method. The morphological characterizations revealed that the SiO_2/Ni and and SiO_2/Ni-Cu nanocomposites composed of spherical structure with Cu nanoparticle impinged on it. Thus the proposed research strategy has not only widened the scope of preparing the SiO_2 supported Ni-Cu alloy material but has also explored their applications in dye degradation technology.

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THE IMPACT OF ORACOOL MOUTHWASH ON THE CORROSION CHARACTERISTICS OF Ni-Cr ORTHODONTIC WIRE SUBMERGED IN ARTIFICIAL SALIVA EXAMINED THROUGH A POLARIZATION STUDY

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Abstract
Well-aligned teeth are aesthetically pleasing; however, some individuals naturally have misaligned teeth. To rectify this condition, orthodontists utilize orthodontic wires. Once these wires are placed, patients consume various foods, beverages, and medications, which may contribute to the degradation of the orthodontic wires. Additionally, the wires can corrode when exposed to saliva. This study examines the corrosion resistance of orthodontic wire composed of Ni-Cr alloy in artificial saliva, considering both conditions with and without the inclusion of Oracool mouthwash. The assessment was conducted using an electrochemical method known as polarization study. The corrosion characteristics of the Ni-Cr alloy were evaluated under the following conditions: Artificial Saliva, Artificial Saliva + Oracool mouthwash. The research focused on measuring corrosion potential (Ecorr), Tafel slopes βc, βa, linear polarization resistance (LPR) and corrosion current (Icorr). The findings revealed that the corrosion resistance of Ni-Cr orthodontic wire is ranked as follows: Artificial Saliva > Artificial Saliva + Oracool mouthwash. This indicates that individuals utilizing Ni-Cr orthodontic wire ought to refrain from using Oracool mouthwash.

Keywords: *corrosion resistance, orthodontic wire, Ni- Cr, artificial saliva, polarization*

Introduction

Dentists employ orthodontic wires made from a range of alloys to ensure the correct alignment of teeth. A significant number of studies have been carried out in this field [1-10]. The present research seeks to investigate the impact of Oracool mouthwash on the corrosion resistance of Ni-Cr alloy when submerged in artificial saliva. To accomplish this, polarization has been utilized.

Oracool Mouthwash 100 ML

- Acts as a powerful antiseptic and antiplaque mouthwash
- It relieves from germs and bacteria
- Helps to prevent cavities with fluoride

Description

Oracool Mouthwash is an effective oral medication designed to provide relief from discomfort associated

with oral and dental conditions. It is useful for to treat and prevent oral infections, gingivitis, and dental plaque.

Key Ingredients

Chlorhexidine Gluconate, Sodium Fluoride & Zinc Chloride

Key Benefits

- Provides effective relief from strengthen teeth and prevent cavities
- It helps to treat gum inflammation caused by harmful bacteria
- It can help reduce dental plaque
- It can help reduce swelling of the gums and stop gum bleeding

Quick Tips

- Do not drink tea, coffee, or smoke, so try to maintain at least a gap of 1 hour.
- Children under 12 should not use this mouthwash unless recommended by a doctor or dentist

Experimental

Tafel plots were acquired utilizing a CHI 660A workstation. The corrosion parameters were recorded.

Results and Discussion

Tafel plots are presented in Figure 1. The potential current plots are shown in Figure 2. Figures 3-5 offer a comparative analysis of the corrosion parameters. Detailed information regarding the corrosion parameters, including corrosion potential (Ecorr), Tafel slopes βc, βa, linear polarization resistance (LPR) and corrosion current (Icorr) is provided in Table 1.It is well established that a decrease in corrosion resistance is associated with a decrease in linear polarization resistance and an increase in corrosion current Figure 6.

From these observations, along with the data illustrated in Figures 1-6 and Table 1, it can be inferred that the corrosion resistance of the Ni-Cr alloy in artificial saliva is decreased by the inclusion of Oracool mouthwash.

Implication

Individuals with orthodontic wire made from Ni-Cr alloy may choose to refrain from using Oracool mouthwash.

Table 1 Corrosion Parameters of Ni-Cr in Artificial Saliva (AS)in the Absence and Presences Mouthwash Obtained from Polarization Study

System	E_{corr} mV vs SCE	β_c V/decade	β_a V/decade	LPR Ohmcm^2	I_{corr} A/cm^2
AS	-644	5.661	3.925	552959	8.202×10^{-8}
AS + mouthwash	-494	5.189	4.376	399945	11.37×10^{-8}
Observation	*Anodic shift*			*decreases*	*increases*
Inference	*Dissolution of orthodontic wire takes place*			*Corrosion resistance decreases*	*Corrosion resistance decreases*
Implication	*Individuals with orthodontic wire made from Ni-Cr alloy may choose to refrain from using Oracool mouthwash.*				

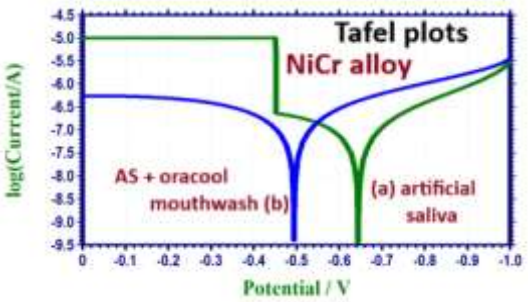

Figure 1 Tafel Plots of NiCr Alloy in Various Test solutions

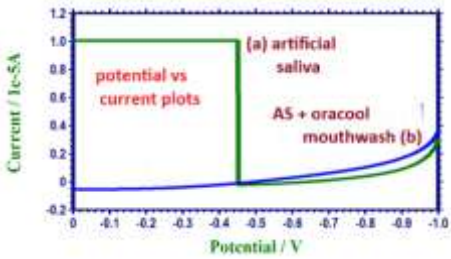

Figure 2 Potential vs Current Plots of NiCr Alloy in Various Test Solutions

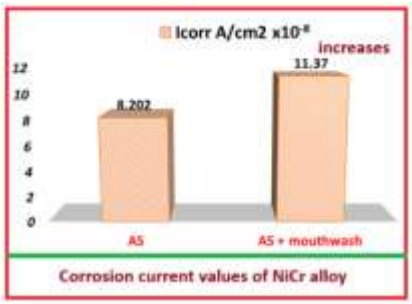

Figure 3 Comparison of Corrosion Current Values of NiCr alloy

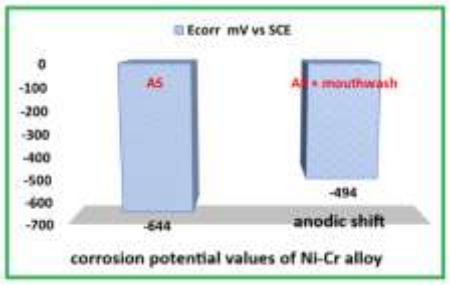

Figure 4 Comparison of Corrosion Potential Values of NiCr Alloy

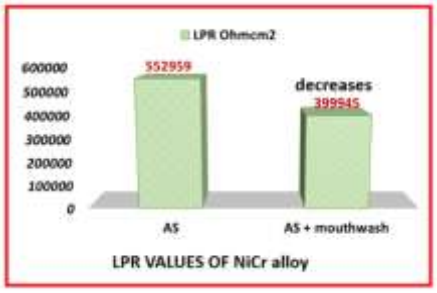

Figure 5 Comparison of Corrosion LPR Values of NiCr Alloy

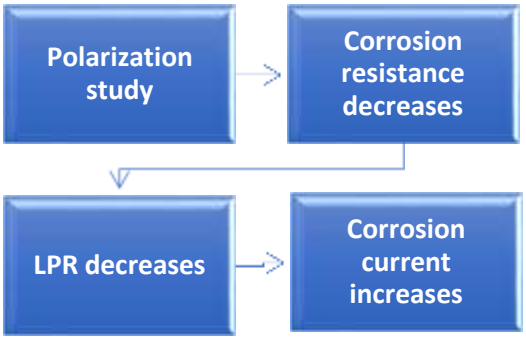

Figure 6 Correlation among Corrosion Parameters in Polarization Study

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Oracool Mouthwash 100 ML - Smartway https://smartwaywellness.com/product/oracool-mouth-wash-100-ml/

THE CORROSION RESISTANCE OF EVER SILVER VESSEL IN CONTACT WITH PAYASAM, BOTH WITH AND WITHOUT THE INCLUSION OF SUGAR, EXAMINED USING AC IMPEDANCE SPECTROSCOPY

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Abstract
Payasam, commonly referred to as Kheer or payesh, is a traditional and adaptable dessert that hails from South India. It is primarily composed of milk, which is blended with a variety of cereals, grains, or lentils, and may also include fruits and vegetables. This exquisite Indian sweet pudding is typically sweetened with either sugar or jaggery and is enhanced with spices such as cardamom and saffron. Additionally, many variations of payasam are adorned with dry fruits that have been sautéed in ghee, contributing to their rich flavor and aroma. Prior to serving, payasam is often stored in Ever Silver vessels. However, during this storage period, these vessels may experience corrosion due to the ingredients in payasam. The current study aims to investigate the corrosion behavior of Ever Silver vessels when in contact with payasam, both with and without sugar. To achieve this, AC impedance spectral study has been conducted to evaluate the corrosion resistance of the Ever Silver electrode in three different environments: water, payasam without sugar, and payasam with sugar. The findings reveal that the charge transfer resistance decreases in the following order. ***Water system > payasam + sugar system > payasam system****. That is payasam is corrodes the ever-silver vessels when compared with water system. However, when sugar is added to payasam, the corrosion resistance of ever silver increases. This is also supported by the following observations: Impedance value decreases in the following order. Water system > payasam + sugar system > payasam system. It implies that storing payasam in silver containers should be avoided, while it may be advisable to store it in such containers after the addition of sugar. This information is particularly beneficial for office workers and students and the public during festivals and marriage parties.*

Keywords*: corrosion behaviour, ever Silver vessels, in contact with payasam, with and without the addition of sugar, AC impedance spectra*

Introduction

Metal food packaging includes a variety of products such as cans, closures, lids, tubes, and aerosol containers, among others. Cans represent the most common type, with canned foods and beverages making up a substantial part of the worldwide food supply. The canning process is essential for food preservation, as products stored in metal cans generally have a longer shelf life compared to those packaged in other materials.

Polymeric coatings are commonly utilized on the interior surfaces of metal food cans to improve food preservation. These coatings act as a protective layer, separating the food from the metal, which is essential for preserving food quality and protecting the metal substrate from corrosion. A significant number of research studies have been carried out in this field, with many findings documented [1-10].

Analysis of the Corrosion Properties of 3104 Aluminum Cans Employed in the Packaging of Chinese Spirits

Aluminum cans are extensively used for packaging soft drinks and low-alcohol beverages, largely owing

to their remarkable recyclability. To enhance the economic cycle and expand the packaging alternatives for liquors, a study was undertaken to evaluate the feasibility of using commercial 3104 aluminum cans for packaging Chinese liquor. The migration of aluminum into alcoholic solutions was investigated through inductively coupled plasma emission spectroscopy (ICP-OES). Furthermore, electrochemical impedance spectroscopy (EIS) was utilized to analyze the corrosion behavior of epoxy coatings on the aluminum cans. A range of techniques, including scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), infrared attenuated total reflection (IR-ATR), and X-ray diffraction (XRD), were employed to assess the internal coatings, the adherence of the can surfaces, and the mechanisms of corrosion.

The results revealed that the maximum aluminum migration detected in Chinese liquor was 4.3572 mg/kg at a temperature of 60°C over a duration of 30 days. It is important to note that the epoxy coating underwent considerable corrosion, resulting in a decrease in coating impedance and the subsequent exposure of the metal substrate after 25 days. The permeation and aging deterioration of the coatings were identified as essential factors to take into account in the packaging of liquor [1].

Selection of Crosslinking Agents for Acrylic Resins Employed in External Coatings for Aluminum Packaging within the Beverage Industry

Paints and coatings are widely utilized in numerous industries, such as construction, automotive, packaging, and food services. The integrity of food packaging is of paramount importance, given its potential direct or indirect contact with food products. With increasing production and consumption rates, the demand for high-quality food packaging is on the rise. However, containers used in the beverage industry often face challenges, including scratches and abrasions during transportation. This study sought to investigate different formulations of external coatings for beverage cans to improve their physical resistance and reduce corrosion and surface damage.

The study examined the interaction between an acrylic resin and six different amino resins: methylated melamine, butylated melamine, glycoluril, methylated urea, butylated urea, and benzoguanamine, utilizing various ratios. A total of 25 formulated samples were analyzed, with an emphasis on adhesion, durability, and chemical resistance. The results indicated significant differences among the crosslinking agents, with methylated melamine exhibiting the most favorable outcomes in almost all evaluations [2].

Isothermal Titration Calorimetry Reveals Entropy-Driven Attachment of Bisphenol a Epoxy Resin to Metal Oxide Surfaces

Polymer-coated metals are extensively employed in numerous industries for the purpose of corrosion protection. Notably, the food and beverage packaging industry benefits from the use of bisphenol A (BPA)-based epoxy coatings, which offer remarkable barrier properties and robust adhesion to metal substrates. Nevertheless, there is a growing demand for the development of safer alternative coatings that can provide comparable adhesion to that of BPA-epoxies, due to the environmental and health concerns linked to BPA. The current understanding of epoxy-metal interactions and the effects of interfacial functional group concentration on overall adhesion remains limited, largely because most experimental methods typically investigate the interface only within a few nanometers in situ. This study utilizes isothermal titration calorimetry (ITC) and molecular dynamics simulations to examine the thermodynamics of epoxy-metal oxide binding in the liquid phase, while also exploring how the structure of epoxy resin and the surface chemistry of metal oxides affect the binding process.

Our examination of various epoxy resins in conjunction with three distinct metal oxides reveals a previously overlooked critical influence of entropy in the binding mechanism. This phenomenon is primarily attributed to the release of solvent

molecules from the epoxy/metal interface, alongside possible contributions from dispersive OH-π interactions between the benzene rings of the resin and the -OH groups present on the metal oxide surface. Furthermore, the binding process is also enhanced by enthalpy-driven hydrogen bonding between the -OH groups of the resin and the metal oxide, with its efficacy depending on the concentration of interfacial -OH groups. Consequently, isothermal titration calorimetry (ITC) offers vital molecular insights into the roles of various functional groups in the adhesion mechanism, thereby informing the strategic design of advanced polymer coatings [3].

The Existence of Lactic and Acetic Acids in Sour beers Plays a Role in the Deterioration of Aluminum Beverage Cans During their Storage

Recent developments suggest that contemporary sour beers are often packaged in aluminum cans; however, the effects of sour beer and its main acids (lactic and acetic) on can materials remain unclear. An initial study involved packaging commercial sour beers in cans lined with one of four different materials: bisphenol A (BPA) epoxy, two varieties of BPA–non-intent (BPA-NI) epoxy, and acrylic. The research revealed a significant relationship between corrosion—measured by dissolved aluminum levels and the visual degradation of the liner—and the concentrations of lactic acid, acetic acid, and lower pH values. After 48 weeks, one sour beer showed aluminum concentrations of 58 mg/L, which is nearly 100 times greater than the typical levels observed in non-sour beers.

The type of liner did not affect the corrosion observed. In a subsequent study involving a model sour beer with two acrylic liners and one BPA-NI liner, a positive relationship was identified between molecular SO2 and corrosion; however, this correlation was only apparent at concentrations five times higher than those typically found in sour beers. Additional components, including chloride, copper, and ethanol, did not influence corrosion rates. When acetic, lactic, and phosphoric acids were introduced in various equinormal combinations to a non-sour beer, it was determined that acetic and lactic acids (with an average dissolved aluminum concentration of 2.54 mg/L after storage) resulted in greater corrosion than phosphoric acid (which had an average dissolved aluminum concentration of 0.47 mg/L). A significant correlation was noted between titratable acidity (TA) and corrosion, with increased levels of dissolved aluminum observed at TA values exceeding 6 g/L as lactic acid equivalents. It was proposed that the corrosive properties of organic acids are associated with the ratio of the acid in its neutral form, rendering these findings relevant for producers of other beverages that contain elevated levels of organic acids [4].

Analysis of the Corrosion of Aluminum Beverage Containers in a Citric Acid Environment with Catalytic Ions Employing the Box-Behnken Design Approach

The degradation of aluminum beverage cans poses a significant challenge for the industry, resulting in both economic repercussions and health concerns. There is an urgent requirement to gather scientific data that can offer valuable insights to the food and packaging sectors, thereby enhancing material quality and reducing losses linked to this issue. This research examined the interactions between aluminum cans and various beverages by employing model solutions that reflect typical copper and chloride concentrations found in such drinks. The study concentrated on the impact of temperature (ranging from 20 to 50°C), chloride concentration (from 25 to 1000 mg/L), and copper concentration (from 25 to 1000 µg/L) as independent variables affecting the corrosion of aluminum cans in a citric acid solution. The methodology utilized was Response Surface Methodology (RSM) with the Box–Behnken Design (BBD). Potentiodynamic polarization tests were conducted to measure the corrosion current density under the different conditions outlined in the design matrix.

The importance of the established quadratic model was validated through ANOVA, revealing p-

values lower than 0.05 and acceptable regression coefficients (R2). The results from the Response Surface Methodology (RSM) demonstrated a robust correlation between the predicted and actual results. It is particularly noteworthy that the concentration of chloride ions ([Cl-]) exerted the most considerable negative impact on aluminum dissolution. Furthermore, findings from Electrochemical Impedance Spectroscopy (EIS) indicated that the corrosion process is primarily governed by diffusion mechanisms [5] .

The Pyrolytic Properties of Polyethylene Terephthalate (PET) Plastic Waste in the Presence of Activated Montmorillonite Catalyst: Studies Utilizing TGA and EGA-MS Methods

The annual production of PET-based plastics, predominantly used in food and beverage packaging, has been on a consistent rise, resulting in considerable environmental issues. A promising approach to mitigate PET plastic waste is pyrolysis, a process that can convert these materials into valuable outputs, including oil rich in benzene. Nevertheless, the widespread adoption of this technique encounters challenges, particularly due to the formation of acidic byproducts like terephthalic acid, which can cause blockages and corrosion in reactor pipelines. This research investigates the catalytic pyrolysis of PET utilizing a thermally activated montmorillonite (AMMT) catalyst to improve the feasibility of PET recycling for energy production.

The thermal and catalytic pyrolysis properties of PET in the presence of AMMT were extensively investigated using TGA and EGA-MS analyses. The TGA findings indicated that AMMT reduced both the initial and maximum decomposition temperatures during the pyrolysis of PET. Furthermore, isothermal TGA results showed that AMMT notably diminished the amount of carbonaceous residue generated. EGA-MS analysis also revealed that AMMT modified the quantity and distribution of gaseous products emitted, as demonstrated by changes in the intensities of the extracted ion thermograms [6].

Investigating the Practical Applications of Ginger Rhizomes as a Sustainable Biomaterial: An In-Depth Analysis

The rhizome of ginger (Zingiber officinale Roscoe), often simply called ginger, is one of the most commonly used species in both culinary arts and traditional medicine. This plant is rich in a diverse array of hydrophobic and hydrophilic active compounds, each possessing unique characteristics. The fresh scent, pungent taste, and numerous health advantages of ginger, along with its availability and cost-effectiveness, enhance its popularity. In addition to its roles in herbal remedies and as a seasoning in food and drinks, ginger rhizome demonstrates potential in several other fields.

This review analyzes the current evidence concerning the main potential uses of ginger, which encompass its functions in food preservation and packaging, meat tenderization, medicinal benefits, prevention of metal corrosion, safeguarding biodiesel from oxidation, and its role in the synthesis of metal nanoparticles. In conclusion, this review provides valuable insights into the multifaceted nature of ginger rhizome as a plant-based resource, going beyond its conventional applications in herbal medicine and flavor enhancement in culinary practices [7].

The Improvement of the Synthesis Method for Acetylvanillin and the Analysis of the Reaction Mechanism

Acetylvanillin (4-acyloxy-3-methoxy-benzaldehyde) is an important derivative of vanillin, noted for its distinct milk-like fragrance. It acts as an intermediate in the production of vanillin from eugenol, isoeugenol, and various other precursors. This compound is commonly used as a flavoring agent in a wide range of dairy products, such as modified milk powder, fresh milk, yogurt, as well as in baked goods, beverages, cosmetics (including perfumes), tobacco, wine, and food packaging, among others. The presence of multiple functional groups (-CHO, AcO-, MeO-) on the benzene ring of acetylvanillin allows it to engage in a variety of chemical reactions. As a result, it is also widely utilized in the synthesis

of pharmaceuticals and other fine chemicals as a crucial organic intermediate. Currently, the chemical synthesis of acetylvanillin predominantly employs vanillin as the starting material, with the process involving acylation agents such as anhydrides and acyl chlorides at ambient temperature, often in the presence of strong bases or catalysts.

This approach, however, encounters multiple challenges, such as incomplete reactions, extended esterification durations, intricate post-treatment procedures, equipment corrosion, and obstacles in acquiring catalysts. This research investigates the effects of different experimental conditions on yield, including the ratios of starting materials, selection of solvents, alkaline reagents, and reaction time, while also emphasizing the optimization of the synthesis process and the analysis of reaction dynamics. Vanillin and acetic anhydride served as the main raw materials.

The synthesis process of acetylvanillin was investigated and characterized through the capillary melting point method, FT-IR, and GC-MS/MS techniques. The results revealed that the ideal conditions for synthesizing acetylvanillin were determined to be a molar ratio of the reactants n(vanillin): n(acetic anhydride): n(triethylamine) of 1:1.3:0.5, with a reaction time of 0.5 hours at room temperature, achieving a yield of 99.0%. The function of triethylamine as a catalyst in the reaction was examined, and a hypothesis regarding its catalytic mechanism was proposed. This approach presents numerous benefits, such as mild reaction conditions, a short reaction duration, high yield, cost-effectiveness, and the ready availability of starting materials, along with simple operational procedures. This study may provide a significant reference for enhancing synthesis methods, analytical techniques, and foundational theoretical research [8] .

The Investigation and Advancement of Chemical Depolymerization Techniques for Waste PET, along with the Valuable Applications of the Resulting Depolymerization Products

Polyethylene terephthalate (PET) is distinguished by its remarkable clarity, corrosion resistance, effective gas barrier capabilities, and strong mechanical properties. It is widely used across multiple industries, such as beverage packaging, textiles, food containers, tires, films, and engineering plastics. Nevertheless, the rising demand and use of PET materials have raised considerable environmental issues related to waste PET pollution. The main approaches for recycling waste PET include primary recycling, mechanical recycling, chemical recycling, and energy recovery.

Chemical recycling is essential in tackling environmental issues and reducing the plastic sector's dependence on petrochemical resources, thereby serving as a key strategy for realizing closed-loop recycling of PET. This paper examines the chemical depolymerization methods for waste PET, highlights the alcoholysis catalysts that show the greatest promise for industrial use, and investigates the research surrounding high-value applications of products derived from chemical recovery. The objective is to offer significant insights and encourage the recycling and high-value utilization of waste PET [9].

An Extensive Examination of Chemical Analysis, Migration, and Risk Evaluation Related to Coatings Utilized in Food and Beverage Packaging

The internal surfaces of food and beverage cans are generally coated with polymeric materials intended to maintain the integrity of the contents and protect the metal base from corrosion. These coatings are composed of complex formulations that incorporate a variety of initial substances, including monomers, prepolymers, and additives. Moreover, during the production process, a range of compounds may be produced, such as reaction and degradation byproducts. These compounds have the potential to migrate into the food, with many remaining uncharacterized and only a limited number having been subjected to toxicological evaluation. This article aims to provide a comprehensive review of the analytical methods used to detect potential migrants in can coatings. It also explores the migration and exposure to chemicals derived from

these coatings, which is essential for conducting risk assessments. Additionally, a brief overview of the existing regulatory framework concerning varnishes and coatings for food contact in Europe is presented.

Techniques such as liquid chromatography coupled with diode array and fluorescence detectors, as well as mass spectrometry and gas chromatography–tandem mass spectrometry, are particularly favored for identifying potential migrants in can coatings. Some research has indicated that migration levels of bisphenol A (BPA) and bisphenol A diglycidyl ether (BADGE) and their derivatives have surpassed the specific migration limits established by European legislation. Overall, studies have reported low dietary exposure to migrants from can coatings; however, it is noteworthy that these investigations have not accounted for the combined exposure to multiple chemicals [10].

Payasam

Payasam is a classic and versatile dessert originating from South India, mainly made from milk combined with a variety of cereals, grains, or lentils, often including fruits and vegetables. This delightful Indian sweet pudding is usually sweetened with sugar or jaggery and is flavored with spices like cardamom and saffron. Furthermore, many payasams are garnished with dry fruits that have been sautéed in ghee, adding to their luxurious flavor and fragrance.

Before serving, payasam is stored in Ever Silver vessels. During this period, these vessels may undergo corrosion due to the components present in payasam. The present study seeks to evaluate the corrosion behavior of Ever Silver vessels in contact with payasam, both with and without sugar.

To achieve this, AC impedance spectral study has been conducted to evaluate the corrosion resistance of the Ever Silver electrode in three different environments: water (Dindigul corporation, Tamil Nadu, India), payasam without sugar, and payasam with sugar.

Experimental

Ever silver Composition

Ever Silver is commonly referred to as SS 304 alloy. The chemical composition of SS 304 (Stainless Steel 304) is detailed as follows:

Chromium (Cr): 18% to 20%
Nickel (Ni): 8% to 10.5%
Carbon (C): Maximum of 0.08%
Manganese (Mn): Maximum of 2%
Silicon (Si): 0.75%
Phosphorus (P): Maximum of 0.045%
Sulfur (S): Maximum of 0.03%

Semiya Payasam Recipe

Kheer, often referred to as payasam or payesh, is a traditional pudding or porridge that is widely enjoyed in the Indian subcontinent. This delicacy is typically prepared by simmering milk with sugar or jaggery along with rice. To enhance its flavor, it may be infused with dried fruits, nuts, cardamom, and saffron. In place of rice, variations may include cracked wheat, vermicelli (sevai), sago, or tapioca (sabudana) (Figure 1).

Figure 1 Payasam in Ever Silver vessel

In Southern India, this dish is referred to as payasam and can be prepared in numerous variations. The most widely favored types are those made with rice and vermicelli (semiya). For the purposes of this study, vermicelli was utilized [11,12].

How to make Semiya Payasam?

Stepwise process is given below.

1. In a heavy pan or kadai, add 2 tablespoons ghee first. Let it melt. Once it melts, then add 12 to 15 cashews.

2. On a low heat fry the cashews in ghee until they become golden.
3. Remove the golden fried cashews with a slotted spoon and then add 1 tablespoon raisins to the hot ghee.
4. Fry the raisins on a low heat. The raisins will soon start to swell up. Stir often while frying.
5. Once the raisins swell, then remove them with a slotted spoon.
6. Set the raisins aside with the fried cashews.
7. Before you begin roasting semiya, you may have to break them with your hands if you are using longer semiya. This makes it easier for you to stir them when roasting.
8. Mix well. Keep the heat to a low and begin to roast the semiya stirring often.
9. Roast until the semiya becomes golden. Stir often while roasting semiya for even browning and so that they do not burn. These get cooked fast, so do not leave them unattended.
10. Once the strands becomes golden add 3.5 cups whole milk. Milk can be chilled, hot or at room temperature. For a thin payasam you can add 4 cups milk.
11. Mix very well.
12. Keep the heat to a low or medium-low and simmer until the vermicelli strands softens. Do stir at intervals so that the milk or semiya does not stick or get burnt at the bottom of the kadai or pan.
13. Simmer until the semiya is softened. Do scrape the sides of the kadai where milk solids will be collected and add them into the vermicelli payasam.
14. When the semiya has softened add 4 tablespoons sugar or add according to the sweetness desired. 4 tablespoons of sugar works perfectly for us. If you want a more sweeter payasam, add more sugar.
15. Sprinkle ½ teaspoon cardamom powder.
16. Mix very well and simmer semiya payasam on a low to medium-low heat for further 2 to 3 minutes. The sugar should dissolve.
17. Switch off the heat and then add the fried cashews and raisins. You can even keep a few raisins and cashews for garnishing your payasam.
18. Serve semiya payasam hot or warm.

Electrochemical Study

Electrochemical studies were performed utilizing AC impedance spectroscopy with the CHI workstation model 660A. The experimental setup comprised a three-electrode cell assembly, as illustrated in Figure 2. A silver electrode served as the working electrode, while a platinum electrode functioned as the counter electrode. The reference electrode employed was a saturated calomel electrode (SCE).

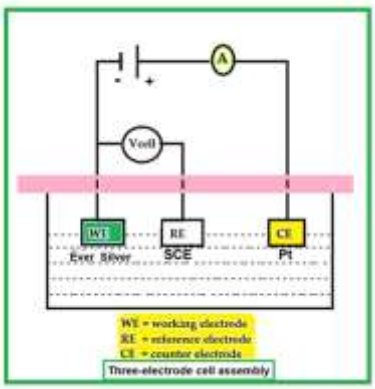

Figure 2 Three-Electrode Cell Assembly

Results and Discussion

Corrosion resistance of Ever Silver in three systems was evaluated by AC impedance spectra. The systems include: water system, payasam without sugar system, and payasam with sugar system.

AC Impedance Spectra

The AC impedance spectra are illustrated in Figures 3-14, while the corrosion parameters are presented in Table 1.

Generally, a decrease in corrosion resistance corresponds to a decrease in charge transfer resistance, impedance value, phase angle value and an increase in double layer capacitance value. Or in other words an increase in corrosion resistance

corresponds to an increase in charge transfer resistance, impedance value, phase angle value and a decrease in double layer capacitance value

The data presented in the Figures 3-15 and Table1 suggest that the corrosion resistance of ever silver vessel containing payasam increases in the presence of sugar, when compared with that of payasam system alone.

Table 1 Corrosion Parameters of Ever Silver when Immersed in Various Systems Obtained from AC Impedance Spectral Study

System	R_t Ohmcm^2	Impedance Log(Z/ohm)	Phase angle °	C_{dl} F/cm^2
Water	5272100000	9.796	107	$9.674x10^{-16}$
Payasam	133.1	2.486	2.5	$38.32x10^{-9}$
Payasam + sugar	780.2	2.341	6.85	$6.537x10^{-9}$
Inference	*Silver containers experience corrosion in the presence of payasam, in contrast to their behavior in a water system.*			
	The corrosion resistance of Ever Silver containers is enhanced when exposed to a payasam and sugar mixture.			
Implication	*It is recommended to avoid storing payasam in Ever Silver containers.*			

The Charge Transfer Resistance Decreases in the Following Order

Water system > payasam + sugar system > payasam system

That is payasam is corrodes the ever silver vessels when compared with water system. However when sugar is added to payasam, the corrosion resistance of ever silver increases.

This is also supported by the following observations:

Impedance Value Decreases in the Following Order

Water system > payasam + sugar system > payasam system

Phase Angle Decreases in the Following Order

Water system > payasam + sugar system > payasam system

The Double Layer Capacitance Decreases in the Following Order.

Payasam system > payasam + sugar system > Water system

Implication

Storing Payasam in Silver Containers should be avoided, while it may be Advisable to Store it in such Containers after the Addition of Sugar

This information is particularly beneficial for office workers and students and the public during festivals and marriage parties.

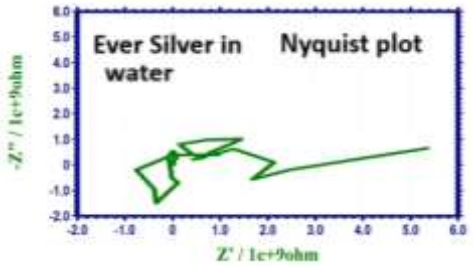

Figure 3 Nyquist Plot of Ever Silver Immersed in Water

Figure 4 Nyquist Plots of Ever Silver Immersed in Water

Figure 5 Interactive 3D plots of Ever Silver immersed in water

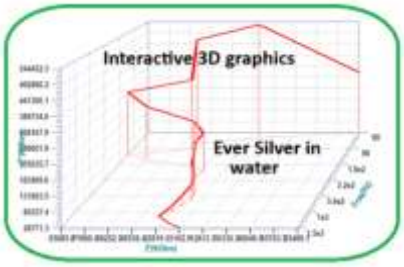

Figure 6 Interactive 3D Graphics of Ever Silver Immersed in Water

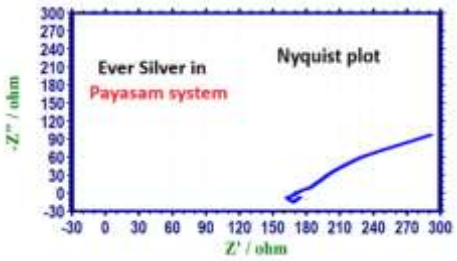

Figure 7 Nyquist Plot of Ever Silver Immersed in Payasam System

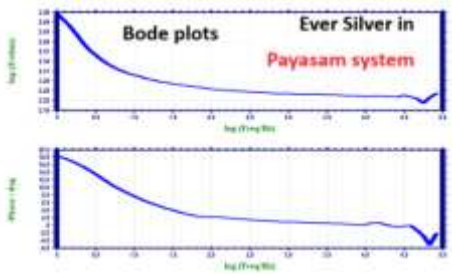

Figure 8 Bode Plots of Ever Silver Immersed in Payasam System

Figure 9 Interactive 3D Plots of Ever Silver Immersed in Payasam System

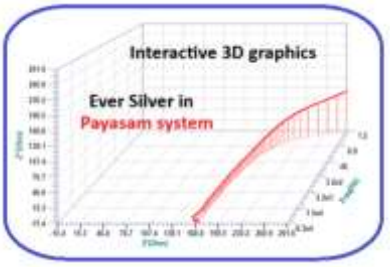

Figure 10 Interactive 3D Graphics of Ever Silver Immersed in Payasam System

Figure 11 Nyquist Plot of Ever Silver Immersed in Payasam + Sugar System

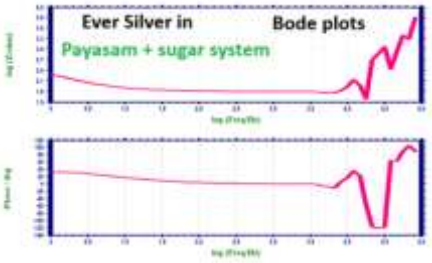

Figure 12 Bode Plots of Ever Silver Immersed in Payasam + Sugar System

Figure 13 Interactive 3D Plots of Ever Silver Immersed in Payasam + Sugar System

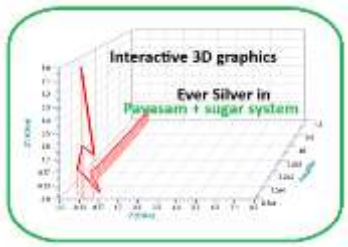

Figure 14 Interactive 3D Graphics of Ever Silver Immersed in Payasam + Sugar System

Figure 15 Correlation Among Corrosion Parameters of AC Impedance Spectra

Summary and Conclusion

The current study aims to investigate the corrosion behavior of Ever Silver vessels when in contact with payasam, both with and without sugar. To achieve this, AC impedance spectral study has been conducted to evaluate the corrosion resistance of the Ever Silver electrode in three different environments: water, payasam without sugar, and payasam with sugar.

The findings reveal that:

The Charge Transfer Resistance Decreases in the Following Order

Water system > payasam + sugar system > payasam system

That is payasam is corrodes the ever silver vessels when compared with water system. However when sugar is added to payasam, the corrosion resistance of ever silver increases.

This is also supported by the following observations:

Impedance Value Decreases in the Following Order

Water system > payasam + sugar system > payasam system

Phase Angle Decreases in the Following Order

Water system > payasam + sugar system > payasam system

The Double Layer Capacitance Decreases in the Following Order

Payasam system > payasam + sugar system > Water system

Implication

Storing Payasam in Silver Containers Should be Avoided, While It May be Advisable to Store it in Such Containers After the Addition of Sugar

This information is particularly beneficial for office workers and students and the public during festivals and marriage parties.

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COMPARATIVE STUDY OF CONVOLUTIONAL NEURAL NETWORKS AND GENERATIVE ADVERSARIAL NETWORKS IN DENOISING AN IMAGE

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Abstract

Image denoising is a critical task in image processing, aiming to remove noise while preserving essential features. The primary origin of noise in digital images occurs during the processes of image acquisition and transmission. The efficacy of imaging sensors is influenced by numerous environmental and mechanical factors associated with the equipment, leading to the introduction of unwanted noise into the image. Additionally, images may become compromised during transmission as a result of suboptimal channel characteristics. This paper explores the efficacy of Convolutional Neural Networks (CNN) and Generative Adversarial Networks (GAN) in denoising a 256x256 camera man image with 1% Gaussian noise. CNNs leverage hierarchical feature extraction, while GANs incorporate an adversarial approach to refine image reconstruction. The performance of both methods is evaluated using Peak Signal-to-Noise Ratio (PSNR) and Structural Similarity Index (SSIM). Experimental results show that GANs create clearer images than CNNs, but they need more computing power.

Introduction

Image denoising is an essential pre-processing step in various computer vision applications. Traditional denoising techniques, such as Gaussian filtering and wavelet transforms, often struggle to maintain fine image details. Deep learning methods, particularly CNNs and GANs, have shown significant improvement in overcoming these limitations. This paper compares the effectiveness of CNN and GAN architectures in denoising the standard 256x256 Cameraman image based on quantitative metrics.

Literature Review

Several approaches have been explored in image denoising including the following.

a) **Traditional Filtering Methods**: Techniques like median filtering and Gaussian blurring reduce noise but often degrade edge details.

b) **Wavelet-based Denoising**: These methods decompose images into multiple frequency components, allowing selective noise reduction.

c) **CNN-based Denoising**: CNNs extract hierarchical features, making them effective for structured noise removal.

d) **GAN-based Denoising**: GANs consist of a generator and discriminator that refine noise removal through adversarial training, producing high-quality reconstructions. This study builds upon these foundations to compare CNN and GAN performance in denoising a standard test image.

Gaussian Noise

Gaussian Noise is a statistical noise having a probability density function equal to normal distribution, also known as Gaussian distribution. Random Gaussian function is added to Image function to generate this noise. It is also called as

electronic noise because it arises in amplifiers or detectors. The magnitude of Gaussian Noise depends on the Standard Deviation (sigma). Noise Magnitude is directly proportional to the sigma value.

Methodology

A. Dataset Preparation

The 256x256 Camera man image is artificially corrupted with 1% Gaussian noise and is used as input.

B. CNN-based Denoising

A deep CNN is trained to learn noise-free reconstructions.

C. GAN-based Denoising

A GAN model is trained, where the generator reconstructs the denoised image while the discriminator distinguishes real from denoised images.

D. Evaluation Metrics

The quality of denoised images is assessed using PSNR and SSIM.

CNN Architecture

The CNN model is designed to accept a 256x256 Camera man image with 1% Gaussian noise consisting of Convolutional layers with ReLU activation, batch normalization for stability and residual connections for efficient learning. The output layer reconstructs the denoised image. The CNN is trained using Mean Squared Error (MSE) loss and Adam optimizer.

GAN Architecture

The GAN architecture consists of an encoder-decoder with skip connections to reconstruct the denoised image. The discriminator is **a** convolutional network trained to differentiate real and denoised images. The GAN is trained using an adversarial learning framework, enhancing fine details in the denoised output.

Comparative Analysis

A comparative analysis of CNN and GAN models is conducted based on Visual Quality, Computational Cost and Robustness to Noise Variability.

A. Visual Quality: GANs produce sharper images, while CNNs sometimes introduce blurring.

B. Computational Cost: CNNs are faster to train, while GANs require careful tuning to prevent mode collapse.

C. Robustness to Noise Variability: GANs generalize better to different noise levels.

Results and Discussions

In order to assess the performance of CNN and GAN, 1% Gaussian noise is introduced in Camera man image of size 256x256.

a) Original Image | b) 1% Gaussian Noise | c) Denoised image using CNN | d) Denoised image using GAN

Fig 1 256x256 Camera Man Image Denoised using CNN and GAN

The images show that denoised image using GAN shows stronger noise reduction.

Table 1 Performance Metrics

MODEL	PSNR	SSIM
CNN	29.5	0.82
GAN	31.2	0.88

The results indicate that GANs achieve higher PSNR and SSIM values, preserving finer image details more effectively than CNNs.

Conclusion and Future Enhancement

This comparative study demonstrates that while both CNN and GAN architectures improve image quality through denoising, GANs outperform CNNs in preserving image details and generating more visually appealing results. However, GANs require more computational resources and careful tuning. Future work may explore hybrid architectures

combining CNNs and GANs for optimal performance.

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BLOCKCHAIN AND AI

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Abstract
"The convergence of blockchain technology and artificial intelligence (AI) is examined in this paper. It emphasizes how blockchain's decentralized and impenetrable ledger can improve the security, transparency, and trust of AI systems by offering a dependable data source for model training, while AI can use blockchain's capabilities to optimize complex decision-making processes within decentralized applications, opening up new possibilities for intelligent and secure data management across a variety of industries." Stress how data integrity, which is essential for AI model training and decision-making, can be ensured by blockchain's immutability and transparency. Talk about how blockchain operations, like better consensus processes or smart contract optimization, can be improved by using AI algorithms. Emphasize how blockchain technology can be used to encrypt and control access to sensitive AI data. Mention a variety of sectors, including healthcare, finance, supply chain management, and the Internet of Things, where combining blockchain technology with AI has the potential to revolutionize the industry.

Definition of Blockchain

In a business network, blockchain is a shared, unchangeable ledger that makes it easier to track assets and record transactions. Both material (a home, vehicle, money, or land) and immaterial (intellectual property, patents, copyrights, and branding) assets are possible. A blockchain network allows for the tracking and trading of almost anything of value, which lowers risk and expenses for all parties.

Information is what business is all about. Information should be received as quickly as possible and with greater accuracy. Because blockchain technology stores information on an immutable ledger that is only accessible by authorized network users, it is perfect for providing that information in an instantaneous, shared, and observable manner. In addition to many other things, a blockchain network can track orders, payments, accounts, and production. Additionally, since members have a single view of the truth, you can see every detail of a transaction from beginning to end, which boosts your confidence and opens up new possibilities and efficiencies.

How Blockchain Works

Every transaction is captured as a "block" of data as it happens. These transactions demonstrate the flow of an asset, which may be intangible (an intellectual property) or tangible (a product). Who, what, when, where, and how much can all be recorded in the data block. Even the condition, like the temperature of a shipment of food, can be recorded. Every block is linked to its predecessors and successors. When an asset is moved or ownership changes, these blocks create a chain of data. The blocks securely link together to prevent any block from being changed or inserted between two already-existing blocks, and they verify the precise time and order of transactions. A blockchain is an irreversible chain of blocked transactions. The blockchain as a whole and the previous block's verification are strengthened with each new block. delivering the crucial strength of immutability by making the blockchain tamper-evident. eliminating the chance of malicious actors tampering and creating a trustworthy ledger of transactions for you and other network users.

Definition of AI

Building computers and machines that can reason, learn, and act in ways that would typically require human intelligence or that involve data whose scale exceeds what humans can analyze is the focus of the scientific field of artificial intelligence. Computer science, data analytics and statistics, hardware and software engineering, linguistics, neuroscience, and even philosophy and psychology are all included in the broad field of artificial intelligence (AI). Artificial Intelligence (AI) is a collection of technologies that are mainly based on machine learning and deep learning and are utilized for a variety of business purposes, including data analytics, forecasting and prediction, object classification, natural language processing, recommendations, intelligent data retrieval, and more.

Blockchain in AI

AI and blockchain can be combined to build systems that are more transparent, effective, and safe. While AI can process and analyze data, blockchain can guarantee data accuracy and traceability. Blockchain can guarantee the accuracy and dependability of the data used to train AI models. Blockchain technology can offer a safe solution for managing and storing data that AI models use. Blockchain can offer an open method for auditing every stage of the creation of an AI model. Blockchain technology can help users share their data with AI apps while maintaining control over it. By storing patient data on the blockchain, blockchain can contribute to patient privacy protection.

Applications of Blockchain in AI

- **Data security and privacy:** Because blockchain technology is decentralized, it can store data securely, preventing unwanted access and guaranteeing data integrity. This is important for sensitive AI applications where privacy is of the utmost importance.
- **Data Provenance:** AI models can be sure of the validity and dependability of the data they are trained on by documenting the data's origin and modifications on the blockchain.
- **Transparent Data Sharing:** On a blockchain network, several organizations can safely exchange data, facilitating cooperative AI research and development without sacrificing privacy.
- **Fraud Detection:** Because blockchain records are unchangeable, AI algorithms can use them to more accurately spot irregularities and possible fraudulent activity.
- **Supply Chain Management:** Blockchain technology can be used to track the flow of goods throughout the supply chain, increasing transparency and allowing AI to spot possible problems or irregularities.
- **Healthcare:** Authorized healthcare providers can efficiently access patient medical records stored securely on a blockchain while maintaining patient privacy.
- **Financial Services:** AI-powered risk management tools can benefit from blockchain's ability to expedite transactions and identify fraudulent activity in financial systems.
- **Decentralized AI Applications:** By distributing processing power over a network, blockchain can help create decentralized AI systems that encourage accessibility and equity.

Challenges of Blockchain in AI

The scalability constraints of blockchain networks, the public ledger nature of blockchain, the difficulty in managing data privacy, the lack of interoperability amongst various blockchain platforms, the possibility of bias in AI algorithms when trained on blockchain data, and the requirement for strong security measures to safeguard sensitive AI models stored on the blockchain are some of the main obstacles to integrating blockchain with AI.

- **Scalability:** Because of the high computational demands, integrating sophisticated AI algorithms with blockchain networks may present scalability challenges.
- **Regulatory Environment:** To control the application of AI on blockchain platforms, precise legal frameworks must be created.
- **Privacy Issues:** Although blockchain can

improve data privacy, efficient user data management necessitates careful design.

- **Interoperability:** It can be challenging to smoothly integrate AI models across multiple networks because different blockchain platforms frequently have incompatible protocols.
- **Data Quality and Bias:** Careful data cleansing and validation are necessary because AI models trained on blockchain data may inherit biases from the original data.
- **Security Issues:** It's critical to safeguard private AI models and algorithms kept on the blockchain against possible online attacks.
- **Computational Overhead:** The effectiveness of AI applications may be impacted by the substantial processing power needed for the blockchain's consensus mechanism.
- **Law and Regulation:** AI developers may experience uncertainty due to the changing legal and regulatory landscape surrounding blockchain technology.
- **Complexity of Integration:** Combining blockchain technology with AI systems can be challenging and call for specific technical knowledge.
- **Legacy System Compatibility:** It can be very difficult to integrate blockchain technology with an organization's current legacy systems.

Possible Remedies to Deal with these Issues

- Creating scalable blockchain protocols: Investigating novel optimization strategies and consensus mechanisms to increase transaction throughput.
- Technologies that improve privacy: To safeguard sensitive data, use blockchain solutions with a privacy focus and encryption.
- Standardization initiatives: Working together to create guidelines for interoperability across various blockchain networks.
- Data governance procedures: Utilizing blockchain data for AI training while putting strong data quality checks and bias mitigation techniques into practice.
- Advanced security measures: Protecting AI models and data on the blockchain by applying strong cryptographic techniques.

Limitation of Blockchain in AI

- **Computational Cost:** Especially when using proof-of-work consensus mechanisms, running AI algorithms on a decentralized network can demand a large amount of processing power, leading to high expenses and energy consumption.
- **Interoperability:** It may be difficult for various blockchain platforms to communicate with one another, which makes it difficult to integrate AI models that use data from several sources.
- **Data Quality:** It can be challenging to guarantee the correctness and quality of data stored on a blockchain, which may affect how well AI models trained on that data perform.
- **Complexity of Integration:** To create and execute safe and effective systems, combining blockchain technology with AI calls for highly skilled technical know-how.
- **Hybrid Approaches:** To maximize efficiency and reduce costs, some tasks combine blockchain technology with centralized cloud computing.
- **Technologies that improve privacy:** Using strategies like zero-knowledge proofs to safeguard private information while preserving blockchain transparency.
- **Standardization Efforts:** Working together to create uniform guidelines and standards to enhance compatibility across various blockchain systems.

Future Directions of Blockchain in AI

Improved data security, smart contract-based intelligent automation, better data governance, and the creation of decentralized AI systems are anticipated to be the main focuses of blockchain's future in AI. These developments will enable more transparent and reliable AI applications across a range of industries, particularly those where data privacy and integrity are crucial.

Data Management and Governance

- **Data provenance tracking:** Blockchain's ability to record the origin and movement of data makes better data lineage tracking and data integrity in AI models possible.
- **Decentralized data marketplaces:** People can control their data and sell it directly to businesses while keeping their privacy intact thanks to AI algorithms that can control data access on a blockchain.
- **Enforcing data privacy:** Blockchain can be used to give AI models privacy-preserving features that guarantee private information is safeguarded.

Smart Contracts and Automation

- **Self-executing AI-powered contracts:** By incorporating AI capabilities into smart contracts, more complex business agreements can be created by dynamically modifying terms in response to real-time data.
- **Automated decision-making:** By incorporating AI algorithms into smart contracts, procedures can be streamlined by having the systems make decisions on their own based on predetermined criteria.
- **Supply chain optimization:** AI and blockchain technology can give real-time supply chain visibility, enhancing logistics and spotting possible problems.

Development of Decentralized AI

- **Distributed model training:** By utilizing a variety of data sources, AI models can be trained on decentralized networks, producing more reliable and objective models.
- **Tokenized compute power:** This makes AI development more accessible by allowing users to exchange their computing power for tokens on a decentralized network.
- **AI-powered governance:** Decentralized AI systems with open decision-making procedures can be developed using blockchain technology.

Particular uses

- **Healthcare:** Personalized treatment plans, automated clinical trial management, and safe patient data storage.
- **Finance:** Decentralized lending platforms, enhanced risk management, and fraud detection.
- **Cybersecurity:** Improved intrusion detection systems and data protection.
- **Internet of Things (IoT):** Safe gathering and examination of data from linked devices.

Conclusion

The management, security, and use of data will undergo a radical change as a result of the combination of blockchain technology and artificial intelligence. The decentralized, transparent, and impenetrable characteristics of blockchain improve AI's dependability, responsibility, and credibility. Blockchain tackles important issues with privacy, security, and bias in AI systems by guaranteeing data integrity, facilitating safe transactions, and encouraging decentralized AI models. Even though issues like interoperability, scalability, and computational costs still exist, continuous progress in both areas is opening the door for creative solutions. Blockchain technology and artificial intelligence have the potential to completely transform a variety of sectors, including supply chains, governance, healthcare, and finance, ultimately resulting in more moral, effective, and intelligent systems.

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ENHANCING COLLABORATIVE COMPUTATIONAL THINKING WITH BLOCK-BASED PROGRAMMING IN MIT APP INVENTOR

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Abstract
Collaboration is becoming increasingly important in programming as projects grow more complex. In traditional text-based programming languages, developers typically use a version control system to manage code, merge contributions from different editors, and optionally lock files to prevent conflicts during editing. However, there is limited research on collaborative code editing in visual programming languages, such as block-based programming. We propose an enhancement to MIT App Inventor, a web-based visual platform for creating Android applications using blocks that will allow multiple developers to collaborate in real-time on MIT App Inventor projects. We argue that real-time collaboration within MIT App Inventor will encourage students in group settings to interact with one another, fostering mutual understanding and enhancing computational thinking skills—capabilities that may not be fully realized in the current single-user, single-project model.

Introduction

Cloud-based collaborative technologies, such as Google Docs, have become an integral part of how teams work together in real time across various types of content. While real-time collaboration in programming has been explored in research settings, the typical workflow in software development involves developers working independently and then merging their changes using a version control system like Subversion or Git. These solutions work effectively for text-based programming languages. However, little research has been conducted on real-time collaboration methods for visual programming languages, including block-based languages like Scratch (Maloney, Resnick, Rusk, Silverman, & Eastmond, 2010) and MIT App Inventor (Wolber, Abelson, Spertus, & Looney, 2011).

This paper focuses on the challenges and potential benefits of real-time collaboration specifically within the MIT App Inventor platform. MIT App Inventor is a web-based environment for developing mobile applications for Android. It provides two main editors: a designer interface where users drag and drop components like buttons to create an app's UI, and a blocks editor where programming logic is constructed using a puzzle-piece-like language based on Google's Blockly.

MIT App Inventor users need a Google account for authentication, and projects are linked to these accounts. While group collaboration is possible under the current system, it is often achieved by student groups sharing a single Google account and taking turns editing, which is inefficient. We propose a collaborative programming environment within MIT App Inventor that allows multiple users to engage in computational thinking through real-time collaboration. Section 2 discusses related work in computational thinking and collaborative programming. Section 3 outlines the design and implementation of our collaborative system. Section 4 explores how this approach can enhance user engagement in computational thinking.

Related Work

Brennan & Resnick (2012) categorize computational thinking into three key areas: computational concepts, computational practices, and computational perspectives. They define "Connecting" as a computational perspective, which involves both programming with others and programming for

others. Through collaboration, programmers can achieve more collectively than they could individually [3].

In text-based programming languages, collaboration is typically facilitated through version control systems like Git. Guzzi, Bacchelli, Riche, and Van Deursen (2015) introduced an improved IDE that integrates version control support to help programmers resolve conflicts and identify issues caused by others' code. Beyond version control, Goldman, Little, & Miller (2011) developed a real-time web-based collaborative editor for the Java programming language [4].

In block-based programming, collaboration has traditionally occurred through remixing, as seen in Scratch (Maloney et al., 2010) and MIT App Inventor (Wolber et al., 2011) [5]. Remixing involves a developer making a project publicly available, allowing others to use it as a foundation for new applications. However, this approach makes direct co-development between two users more challenging, as the entire project rather than a specific subset serves as the basis for remixing.

Greenberg & Gutwin (2016) [6] discuss key challenges in maintaining user awareness in collaborative environments. Building on their insights, we incorporate awareness mechanisms through the locking system described in Section 3. These locking mechanisms help users stay informed about their peers' activities by coordinating access on a per-user basis. Gross (2013) provides a more comprehensive review of research on awareness in collaborative settings [6].

Design and Implementation

Our collaborative framework is primarily designed for small-group coursework involving 2-4 students at the middle school, high school, or college level. The system includes the following features:

User Identification & Permissions

- Users are identified by their email addresses and can share projects with others using their email.
- The project creator can set different access levels:
  - *Read access*: Users can view the project.
  - *Write access*: Users can both view and edit the project.

Real-Time Collaboration Awareness

- Users can see who is actively working on the project.
- It is possible to track which components or blocks each person is editing.

Live Synchronization of Changes

- Users can view each other's modifications in real time.
- Different scenarios within MIT App Inventor include:
  - When users work on separate screens, their updates become visible only when switching screens.
  - When users work on the same screen and within the same editor, they can see each other's changes immediately.

  - When two users work on the same screen, with one using the designer editor and the other working in the blocks editor, the user in the blocks editor will see new blocks appear when the designer editor user adds a new component. Similarly, when a component is removed from the designer editor, the corresponding blocks will disappear from the blocks editor.

User Interface Design

Users can share a project by entering the recipient's email address. Figure 1 illustrates the project-sharing

interface. Once a project is successfully shared, the recipient can find it in their project explorer. Users can also see who is currently working on the project through a colored square displayed in the project title bar. Hovering over this square reveals the user's email address. Each color uniquely represents a user, helping to identify which parts of the program they are editing.

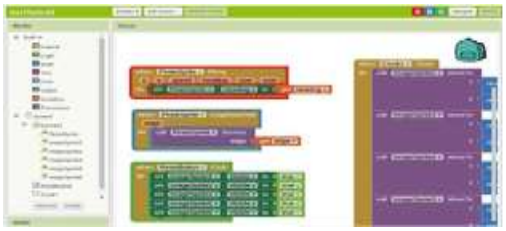

Figure 2 shows an example of collaborative block-based programming in MIT App Inventor, where a project is shared among four users. The project title bar displays users A, B, and C alongside the current user, with each block being edited highlighted in the respective user's assigned color.

Collaboration Server

To instantly reflect changes made by one user to others, we employ a publish-subscribe messaging pattern. This pattern allows senders to transmit messages to a channel, which subscribers can then receive. We opted for a Node.js server to handle collaboration among web users, operating independently from the MIT App Inventor server for easier management.

MIT App Inventor users connect to the collaboration server via sockets. We use Redis, an open-source in-memory data store, to manage the publish-subscribe pattern (Redis Contributors, 2017). All messages are formatted in JSON. Users translate their changes into JSON documents and send them to the collaboration server via a dedicated channel. The server applies these changes to ensure all subscribed users receive updates. Each client then interprets the JSON data, triggering events that update their code accordingly, ensuring all project copies remain synchronized.

Communication Channels

Each MIT App Inventor user acts as both a publisher and a subscriber within the system. Users subscribe to three types of channels:

User Channel

- Each user has a channel linked to their email address.
- When a project is shared, project and user details are published to the recipient's user channel, notifying them of the new project in their project list.

Project Channel

- Each project has a unique project ID, which serves as its channel identifier.
- When a team member opens a project, they subscribe to its project channel.
- This channel handles project-wide notifications, such as users joining or leaving, as well as component additions, modifications, or deletions.
- Any changes published to this channel are instantly broadcasted to all active collaborators.

Screen Channel

- Defined by a combination of the project ID and screen name.
- This channel distributes updates related to block changes.
- When a user opens the block editor for a screen, they subscribe to this channel to receive live updates on block modifications.

Discussion

The introduction of real-time collaboration in MIT App Inventor offers a novel approach to programming education. It enables new teaching methods such as:

- **Teacher-student mentorship**: Educators can share projects in read-only mode for demonstrations.
- **Remote collaboration**: Students can work on group projects from different locations.

This feature also aligns with Brennan and Resnick's (2012) four key computational thinking practices:

- **Incremental Development**: Users iteratively build small functional units.
- **Debugging Strategies**: Collaborators assist in resolving programming errors.
- **Code Reuse**: Frequent sharing and remixing of code snippets enhance learning.
- **Abstraction and Modularization**: Users work together to design efficient, reusable code structures.

One challenge in visual programming collaboration understands another user's thought process. Unlike text-based programming, where comments clarify logic, visual programming lacks an intuitive way to annotate code. Potential solutions include:

- A **dedicated comments screen** for discussions.
- An **integrated communication channel** to facilitate real-time idea exchange.

Conclusion

We have introduced a collaborative programming environment within MIT App Inventor and provided technical details on implementing real-time collaboration. Future work will focus on evaluating the effectiveness of this feature with both novice and experienced MIT App Inventor users to better understand how students leverage the system for collaboration.

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IMAGE RESTORATION AND ENHANCEMENT: ADDRESSING SALT & PEPPER NOISE WITH HYBRID FILTERS

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Abstract
This paper primarily aims to explore key methods in the domain of image processing and enhancement. Image enhancement is a critical and complex area of research. The main goal of image enhancement is to modify the original image to improve its visual quality, making it more suitable for specific use cases. Various digital image enhancement techniques provide numerous options for enhancing the visual appeal of images. Different types of images, including medical, satellite, aerial photos, and even real-life images, often suffer from poor contrast and noise. Consequently, it becomes essential to develop applications that can enhance image quality by improving contrast and eliminating noise. This paper offers a comprehensive review of the basic concepts, algorithms, and methods used in image enhancement. A case study demonstrating the application of salt-and-pepper noise on "Cameraman" and "Spin" images is presented, along with solutions using MATLAB software.
Keywords*: computer vision, image processing, image enhancement, noise removal, image filters*

Introduction

With the increasing use of digital images in various fields such as science and engineering, the demand for digital image processing has rapidly grown. Digital images are often affected by noise, which can arise during the creation, scanning, or compression of the image. For example, when images are captured in low light conditions, they are more likely to contain noise. Removing this noise is a critical task in image processing and requires thorough research to achieve effective results. Image processing is a vast field that focuses on the analysis of computer-generated images, handling video or image inputs, and producing outputs that exhibit specific characteristics or parameters.

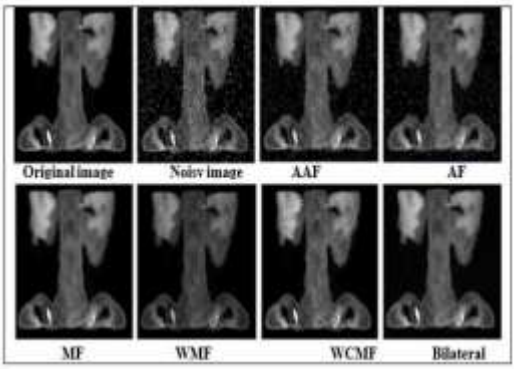
Converting an image from analog to digital format is a fundamental challenge for many researchers, and the use of image processing has expanded significantly. Image processing can be performed using two main methods: analog, which involves modifying images through electrical means, and digital, where a scanner converts the image into numerical data. In recent years, there has been a growing interest in image enhancement and processing across various real-life applications, including engineering, education, science, medicine, social studies, space exploration, and satellite imagery. Therefore, understanding image processing and enhancement techniques is crucial for modern research.

Noise is defined as unwanted information that is distributed randomly, which distorts and degrades the image's appearance. Images often suffer from various types of noise and interference, caused by environmental factors, sensor sensitivity variations, and transmission issues. Image enhancement plays a significant role in improving image quality. Many techniques are available for removing different types of noise from images, but the ideal method should effectively eliminate noise while preserving image details.

Image enhancement is typically divided into two categories: linear and nonlinear models. The linear model is faster at removing noise but may not preserve fine image details. In contrast, nonlinear models are more effective at preserving details while removing noise, but they tend to be slower. Noise removal is a key task in image processing, and researchers have focused on methods to address this issue. The most commonly used noise types in image

processing include Gaussian, uniform, and salt-and-pepper noise.

Gaussian noise is often used to model natural noise processes, such as electronic noise in image acquisition systems.



Spine Image using Gaussian Noise

Original Image (left) and The Enhance Image (right)

Figure 1 shows an example of a spin image affected by Gaussian noise, with various filtering techniques applied (AF: Average Filter, AAF: Adaptive Average Filter, MF: Median Filter, WMF: Weighted Median Filter, WCMF: Weighted Coefficients Median Filter). Uniform noise is versatile, as it can be used to generate other types of noise and is commonly applied in image restoration algorithms. Salt-and-pepper noise typically occurs due to errors in data transmission or defective camera sensor pixels. It is frequently observed in scanned images, where dark spots and distortions appear, leading to potential misinterpretations of the image.

Noise removal is a vital task in computer vision and image enhancement, as unwanted noise can lead to errors in image analysis. Filtering techniques are often used to reduce noise, enhance image sharpness, and improve overall quality, as illustrated in Figure 2. Filters are designed to remove noise while emphasizing both low and high spatial frequency components. Noise manifests as unwanted data that interferes with the image's original information, affecting pixel values.

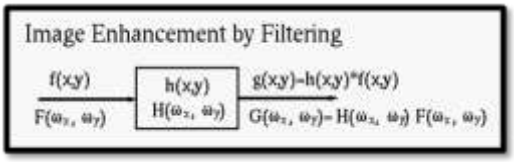


Image Enhancement Function

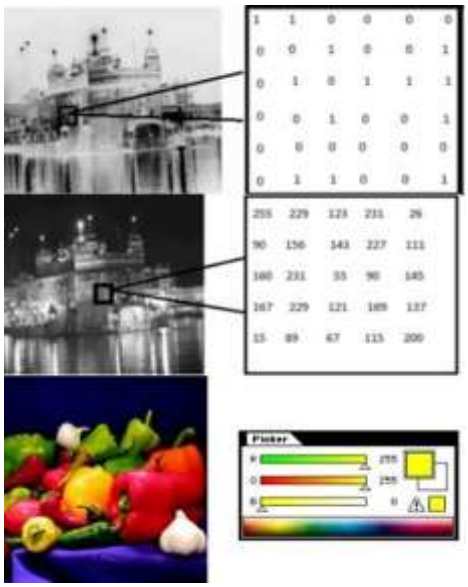
Nonlinear filters have proven effective in various applications for smoothing images due to their superior ability to preserve edges and reject impulse noise, as depicted in Figure 4. The weighted median filter is an extension of the standard median filter, introducing a weight coefficient to the median calculation. This modification allows weighted median filters to more efficiently reduce impulsive noise and preserve sharp edges in image signals.

Types of Digital Images

In image processing, both **analogue** and **digital** images are commonly utilized. The mathematical model for calculating the value of an image involves determining two variables: the **X** and **Y** directions. A digital image is represented as a two-dimensional array of discrete values corresponding to the image.

To process and enhance an image effectively, it is essential to first identify the type of image, and then select the appropriate enhancement technique. An image is mathematically defined as a 2D function **f(x, y)**, where **x** and **y** represent spatial coordinates, and **f** is the amplitude or intensity level at any given **(x, y)** point. The image consists of a finite number of elements, each with a specific value and location, known as **pixels**. A digital image is a numerical representation of these predefined pixels. Digital images can be categorized into three main types, as shown in Figure 4.

1. **Binary Image**: In this type of image, the pixel values are limited to two possible options—either black or white. Each pixel is represented by a single bit: **0** (black) or **1** (white).
2. **Grayscale Image**: Each pixel in a grayscale image corresponds to a shade of grey, typically ranging from **0** (black) to **255** (white). This means each pixel can be represented using **8 bits** (1 byte), though the range of grayscale values can vary.
3. **True Color (RGB)**: An RGB image consists of three values—**red**, **green**, and **blue**. Each pixel contains one value for each of these colors, with a range from **0** to **255**. This results in **256³** (over 16 million) possible color combinations for each pixel. An alternative to RGB color images is the **Indexed (or Palette)** image, which uses a smaller range of colors.



Illustrates an Example of these Image Types

Image Restoration

Image processing encompasses several domains such as enhancement, restoration, segmentation, and classification, as shown in Figure 6. **Image enhancement** is typically used as a preprocessing step to improve the visual quality of an image without altering its original content. This involves techniques for removing noise and adjusting contrast to make the image appear more visually appealing. Image enhancement can be categorized into two main domains: the **spatial domain** (dealing with pixel values) and the **frequency domain** (involving Fourier transforms).

Image restoration, on the other hand, is the process of recovering the original image from a degraded version, using known information about the factors that caused the degradation. The field of **image restoration** focuses on techniques that help to improve the quality of an image that has been corrupted or damaged.

Various methods are applied to restore an image, often using filters that approximate and remove blurring or noise. Restoration is particularly important in applications where the quality of the original image is vital, such as in medical imaging, satellite photography, and archival preservation. Common causes of image degradation include **blurring**, **motion**, and **noise**. **Blurring** occurs when the object is out of the camera's focal range during exposure, while **motion blur** happens when the object moves during exposure [9].

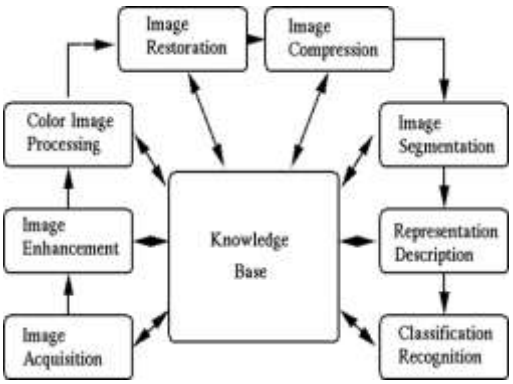


Image Processing Steps

Related Work

Numerous studies have been conducted in the domain of image processing and enhancement over the past decade. Researchers today often focus on integrating various methods to develop efficient techniques.

BegillE and MadaanE [10] presented a thorough review of different image enhancement techniques,

including spatial domain methods, histogram equalization, and fuzzy techniques. The authors also explored significant medical imaging applications using unsharp mask filters and log Gabor filters. Spatial domain techniques work directly with pixel values and have various types. One example is the image negative, which transforms the original image's grayscale values into their negative counterparts (s = 1.0 - r).

Sanyam Anand and Navjeet Kaur [11] proposed a fuzzy classical filter for image enhancement that simultaneously removes multiple types of noise. Previously, removing different types of noise required the use of multiple filters, each targeting specific noise types. The fuzzy filter processes grayscale images by applying a mean filter and convolutional neural networks..

Ibrahim et al. [13] introduced a simple adaptive median filter designed to remove impulse noise from severely corrupted images. The filter separates pixels into two categories: corrupted and non-corrupted, and then removes the noise. Experimental results showed that this filter could eliminate noise from images with up to 95% corruption in less than 2.7 seconds.

Several researchers have focused on improving filters for better noise removal from images. Fabijańska, A. [14] proposed a median two-pass filter that efficiently removes impulse noise from corrupted images in various applications. However, while the median two-pass filter performs better than traditional filters, it may cause the removal of fine details, such as corners and thin lines, leading to blurring. Testing showed that the filter reconstructs noisy images while retaining more details than conventional methods. Additionally, it serves as an effective tool for image enhancement in digital image processing and analysis applications.

Tomasi C. and Manduchi R. [16] introduced the **Bilateral Filter**, a nonlinear technique designed to preserve image details while smoothing out noise. The filter works by considering both the photometric similarity and geometric closeness of neighboring pixels, preserving edges and smoothing colors in a way similar to human perception. Unlike standard filters, bilateral filters help avoid color artifacts in images, producing more natural-looking results.

R. Pushpavalli and G. Sivarajde [19] proposed a hybrid filter based on a neural network and fuzzy system, called **Adaptive Neuro-fuzzy Inference System (ANFIS)**. This hybrid filter combines a nonlinear filter and a Canny edge detector to remove impulse noise from images while preserving edge and fine details. Experimental results showed that the filter was highly effective in restoring digital images corrupted by impulse noise while maintaining important image features.

Bansal, Upma et al. [20] presented a hybrid filter designed to remove noise from digital grayscale images, which are often degraded by additive noise during the scanning process. The proposed filter is particularly effective in removing salt-and-pepper noise. The methodology includes applying **Adaptive Histogram Equalization** on the original image, followed by **Adaptive Contrast Enhancement**, and then filtering techniques such as **Homomorphic Filtering** to ultimately produce a noise-free image.

Performance Evaluation

Various metrics are used to assess the performance of filters on different types of images and parameters. The MATLAB 2010 framework is chosen as an ideal simulator to evaluate the effectiveness of smoothing filters in image processing, utilizing one or more of the following performance metrics:

- **Mean Square Error (MSE):** MSE measures the error difference between the processed image and the original image. The error rate is calculated using the following equations:

$$MSE = \left(\frac{1}{M} * N\right) \sum_{i=1}^{M} \sum_{i=1}^{M} (a_{ij} - b_{ij})^2 \quad \ldots\ldots\ldots\ldots 1$$

Also, color image can be defined as in equation 3-2:

$$MSE = \frac{1}{M*N*3} \sum_{c=1}^{3} \nabla_{y=1}^{N} \nabla_{x=1}^{M} [F^c(x,y) - F^{c\sim}(x,y)]^2 \quad \ldots\ldots\ldots\ldots 2$$

- **Peak Signal to Noise Ratio (PSNR):** PSNR indicates the degree of similarity between the resulting image and the original image. The

value of PSNR increases as the similarity between the images improves. It is defined by:

$$PSNR = 10\log_{10}\left(\frac{MAX^2}{MSE}\right)\cdots\cdots$$

Where:

- MAX\text {MAX} MAX is the maximum possible pixel value in the image (typically 255 for 8-bit images).
- **Perceptual Quality:** This metric focuses on achieving a low MAE and MSE while maintaining a high PSNR. The image should appear clean and smooth, with natural visual characteristics. It should not exhibit unusual structures or color blurriness.
- **Time Complexity:** Time complexity is evaluated by measuring the processing time required for the task using the “tic” and “toc” functions in MATLAB. The "tic" function marks the start of the processing, and "toc" marks the end. The total processing time is given by the output of the "toc" function:

Tic%Starttimeofprocessing%ProcessingcodeToc%Endtimeofprocessing\text{Tic} \quad \% Start time of processing \% Processing code \text{Toc} \quad \% End time of processing Tic%Starttimeofprocessing %ProcessingcodeToc%Endtimeofprocessing

The "tic" and "toc" functions allow measurement of the speed of the filter’s processing.

Discussion and Case Study

Image processing and enhancement are crucial fields that require ongoing research to develop new algorithms that align with the demands of modern technology. For instance, there is significant interest in image compression to reduce the amount of data needed to represent an image, thus minimizing storage space and improving the speed of image transmission and sharing over the internet. However, compression can sometimes result in a loss of image quality and introduce distortions or deformations in certain image characteristics.

Additionally, converting hard-copy images to digital formats using electronic scanners or readers may introduce noise into the image. As a result, it is essential to continue developing algorithms that are better suited for processing and enhancing digital images.

New algorithms are also needed to help isolate specific elements of an image from the background or other components, enabling the identification of unique edges or similar regions based on factors like color or texture.

Filters can be effectively used to improve images, especially when highlighting specific features like edges or removing defects such as blurring. Some researchers have worked on combining multiple filters into a single model to address different types of noise simultaneously [15,16,17].

The case study implemented a Salt and Pepper noise filter with a 3x3 mask window on different images such as "cameraman.tiff" and "spine.tiff". The results were promising when compared to the Weighted Median Filter (WMF) and other filters. The Mean Square Error (MSE) for the current filter using the "cameraman" image was 0.456146, and the Peak Signal to Noise Ratio (PSNR) was 51.5398. For the "spine" image, the MSE for the WMFS filter was 0.232224, with a PSNR of 54.4717. The results of implementing the Salt and Pepper noise filter are shown in Figure 6.

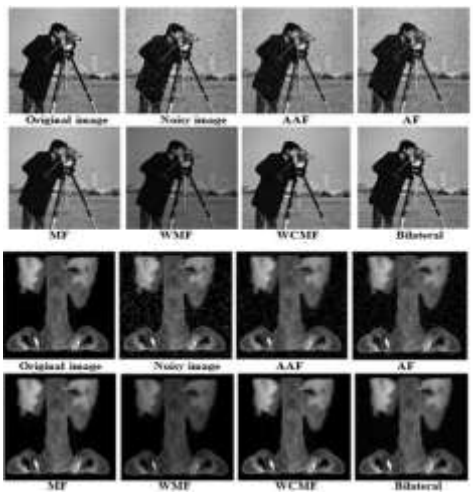


Figure 6 Results of Proposed Filter and WMF using Salt & Pepper Noise

Figures 8, 9, and 10 illustrate the performance of the current filter, which successfully removes both types of noise from the "cameraman" and "spine" images while preserving image details. Moreover, the contrast of the images was improved using the current Weighted Median Filter (WMF), as compared to the original WMF.

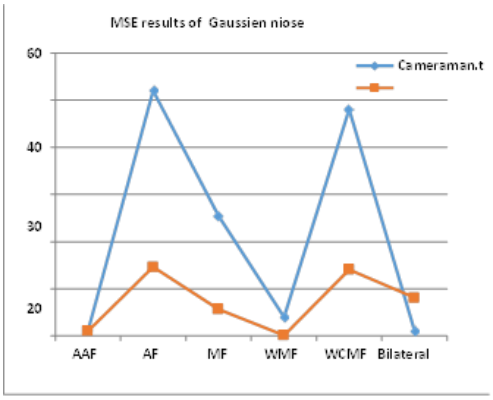


Figure 7 MSE Result Using Gaussian Noise

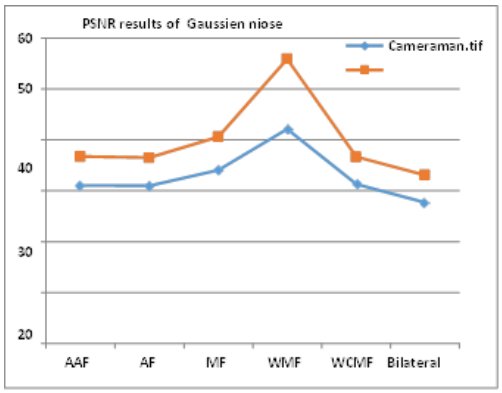


Figure 8 PSNR Result Using Gaussian Noise

Conclusion

This paper reviewed several image enhancement techniques in the field of digital image processing, although it did not address the computational costs of these techniques, which is a critical factor for real-time applications. The study highlighted that implementing hybrid algorithms, combining multiple effective techniques, can yield the best results in image enhancement. It also demonstrated that fuzzy and neural network-based filtering algorithms can simultaneously remove multiple types of noise from an image.

Furthermore, the paper discussed how different transmission techniques for sending and receiving digital images can introduce new types of noise, emphasizing the need for further research to develop filters that can address these emerging noise types.

A case study was conducted using the "cameraman" and "spine" images with salt and pepper noise, processed using MATLAB software. A graphical user interface (GUI) was developed for testing the proposed filter, incorporating several stages such as image reading, converting to binary, adding noise, and implementing different filters like histogram equalization and adaptive filters. The results showed that the proposed filter was both efficient and accurate.

To improve image quality further, filters based on neural network models [21,22] can be explored for better noise removal. Additionally, the application of cloud computing technologies [23] can enable quick and accurate access to image data, potentially enhancing the overall image processing workflow and appearance.

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ENHANCING BRAIN TUMOR DETECTION IN MRI WITH VGG IMAGE ANNOTATION

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Abstract
In recent years, digital medical imaging has gained increasing significance for the identification of various medical conditions. The healthcare sector requires a precise and effective AI-driven diagnostic system to assist in the creation of medical reports. This paper focuses on an object recognition method that utilizes computer vision (CV) and deep learning (DL)-based pre-trained Convolutional Neural Network (CNN) architectures to extract more reliable features and categorize objects within MR brain scans. Techniques such as Natural Language Processing (NLP) and Recurrent Neural Networks (RNNs) were employed to generate high-quality descriptions from these identified features. Automatic image captioning has advanced notably in recent years, but it remains a complex challenge. To integrate NLP into a medical image captioning system using DL approaches, various open-source image annotation tools are available. Popular AI-driven image captioning tools include Label Img, MakeSense.ai, Super Annotate, and CVAT (Computer Vision Annotation Tool). The Visual Geometry Group Image Annotator (VGGIA) is one of the most effective open-source tools, assisting in defining captions for regions of interest in MR brain images. This paper investigates the application of VGGIA for captioning brain tumor images, demonstrating the NLP techniques used in deep learning models.
Keywords*: deep learning (DL), natural language processing (NLP), magnetic resonance imaging (MRI), visual geometry group image annotator (VGGIA), artificial intelligence (AI).*

Introduction

The domain of medical image captioning has attracted significant interest in recent times. A key challenge in this area is the scarcity of large, high-quality datasets that pair medical images with detailed reports. To overcome this limitation, researchers have explored the use of general-purpose foundational models, which can be adapted for specific medical applications through methods such as parameter-efficient transfer learning. This proposed approach holds promise for enhancing patient outcomes and optimizing clinical workflows.

Medical imaging plays a vital role in contemporary healthcare, providing non-invasive insights into the internal structures of the human body. Technologies like computed tomography (CT), ultrasound, and magnetic resonance imaging (MRI) allow clinicians to observe tissues and organs, making it easier to identify and diagnose various health conditions, including brain tumors. Among these, MRI is particularly preferred for brain imaging, offering high-resolution images and superior contrast between different tissue types. Given the increasing volume of medical imaging data, efficient processing techniques are essential to support clinical decision-making.

In medical image processing, algorithms are employed to enhance, analyze, and interpret images. These techniques are especially crucial in the field of brain tumors, where tasks like segmentation (defining the tumor's boundaries) and classification (identifying the tumor type) are necessary. The complexity of brain anatomy and the subtle variations in tumor appearance present significant challenges, requiring advanced processing methods to ensure accuracy. Deep learning (DL), a subfield of AI, has revolutionized medical image analysis by providing powerful tools for automation. Convolutional Neural Networks (CNNs) have demonstrated significant potential in tasks such as brain image classification, segmentation, and tumor detection. Deep learning models can detect intricate patterns in large datasets, enabling automatic and highly accurate tumor diagnosis. As medical imaging

data volumes continue to grow, the need for scalable, precise, and reliable analysis underscores the importance of deep learning.

Natural Language Processing (NLP), which enables machines to understand and generate human language, is increasingly recognized as a key asset in the healthcare sector. NLP can be applied to medical imaging to generate descriptive reports from imaging data, aiding radiologists in their evaluation of findings. The goal of automating report creation is to reduce clinician workload and minimize the risk of interpretative errors. Image captioning in brain medical imaging can provide relevant descriptions for segmented tumors, offering crucial context and information for diagnosis and treatment planning. When combined with deep learning models like Mask R-CNN, image captioning can generate accurate and clinically meaningful descriptions, enhancing the role of medical images in clinical practice.

Literature Review

Recent advances in medical brain imaging, particularly in deep learning (DL), have significantly enhanced the precision and efficiency of brain tumor detection and analysis. Pereira et al. [1] demonstrated the use of Convolutional Neural Networks (CNNs) for brain tumor segmentation in MRI images, highlighting CNNs as a cornerstone in medical brain image segmentation and laying the groundwork for DL applications in medical imaging. Building on this, Ronneberger et al. [2] introduced the U-Net architecture, which has proven especially effective for biomedical image segmentation, even when labeled data is scarce. The design of U-Net has been crucial for accurate segmentation of structures like tumors, particularly in scenarios with limited data availability.

He et al. [3] advanced this work by introducing the Mask R-CNN model, which has become a benchmark for instance segmentation tasks. This approach is particularly well-suited for detailed tumor segmentation, providing pixel-level masks for each object in an image. Models such as Deep Lab (Chen et al., [4]) that incorporate atrous convolution and Conditional Random Fields (CRFs) enhance segmentation accuracy by capturing fine details in medical images, addressing the challenges of precise segmentation in complex images. In addition to segmentation improvements, the automatic generation of descriptive captions for segmented tumors has been made possible by incorporating image captioning models, as proposed by Vinyals et al. [5] with their "Show and Tell" model.

The integration of visual attention mechanisms, as introduced by Xu et al. [6], further refines these captions by ensuring that generated descriptions focus on the most diagnostically relevant regions of the image. Milletari et al. [7] developed V-Net, a fully CNN-based model designed for 3D medical image segmentation, which is particularly useful for analyzing volumetric data in medical brain imaging. This model helps capture the three-dimensional structure of brain tumors, which is crucial for accurate diagnosis and treatment planning. Furthermore, Zhang et al. [8] created a deep residual U-Net, demonstrating how residual learning can be incorporated into segmentation models to further enhance accuracy and robustness, allowing the model to handle the challenges posed by complex medical images.

Efficiency in model architecture has also been a key focus of research, as seen with Iandola et al. [9] and their SqueezeNet model. With significantly fewer parameters than models like AlexNet, SqueezeNet enables the deployment of powerful DL models in resource-constrained environments, such as remote healthcare or mobile diagnostic applications. Finally, Radford et al. [10] explored the integration of Natural Language Processing (NLP) into medical imaging with their CLIP (Contrastive Language-Image Pretraining) model, which learns visual concepts through natural language supervision. This model's ability to generate contextually relevant descriptions of medical images opens up new possibilities for automating medical report creation, reducing the cognitive load on physicians, and enhancing the consistency of diagnostic interpretations.

Taken together, these studies provide a comprehensive foundation for developing advanced DL systems for brain tumor detection, segmentation, and captioning. They demonstrate the synergy between CNN-based detection models and NLP-driven captioning frameworks in improving the practical use of medical imaging within clinical settings.

Captioning Brain Tumor Mr Images using Vgg Image Annotator

Various steps are involved in utilizing the VGG Image Annotator (VIA) to label MR brain images. Initially, MR images are imported into VIA, and tumor locations are marked with appropriate class names and bounding boxes using available tools. These annotations are then exported and stored in JSON format. To apply these annotations with a Mask R-CNN model, the JSON data must be converted to the Common Objects in Context (COCO) format, which includes segmentation masks, category labels, and image metadata. Using Matterport's implementation, the dataset is divided into training and validation subsets for training the Mask R-CNN model [11]. The model is trained to detect and segment tumors and is subsequently evaluated and adjusted. The trained Mask R-CNN model is then used to extract tumor features from new MR images. Afterward, an image captioning model such as "Show and Tell" or a custom solution is used to describe the new images. Finally, post-processing involves overlaying the generated captions over the segmented tumors in the MR brain images for visualization and interpretation. The following sections explain the stages and procedures involved in using the VGG Image Annotator (VIA).

Steps Involved in using VGG Image Annotator (VIA)

The following steps describe the process for brain tumor detection, segmentation, and captioning:

Step 1: Annotation with VGG Image Annotator (VIA), which includes the following sub-steps:

- Load MR images into VIA tool
- For each image:
  - Annotate tumors using bounding boxes or polygons
- Save annotations in JSON format

Step 2: Convert Annotations to Mask R-CNN Format

- Parse the JSON annotations
- For each annotation:
  - Convert to COCO format (including image metadata, category labels, and segmentation)

Step 3: Train the Mask R-CNN Model

- Prepare dataset for training
- Train the Mask R-CNN model using the prepared dataset
- Evaluate the model's performance
- Fine-tune the model as needed

Step 4: Generate Image Captioning

For each new MR image:

- Detect tumors using the trained Mask R-CNN model
- Segment tumors (create masks)
- Extract features from segmented images
- Generate descriptive captions based on extracted features

Step 5: Post-Processing and Visualization

For each processed image:

- Overlay segmentation masks on original images
- Add generated captions to the images

Components of VGG Image Annotator (VIA)

User Interface (Ui): Components and Interactions

- **Image/Video Loader:** Allows users to load images or videos from local storage.
- **Annotation Tools:** Provides tools like bounding boxes, polygons, and points for annotating images.
- **Attribute Editor:** Lets users add labels, tags, and other metadata to annotations.

- **Save/Export Button:** Facilitates saving and exporting annotations in formats such as JSON or CSV.
- **Review/Refinement Panel:** Provides options to review and refine existing annotations.

The user interacts with these components to perform the annotation tasks.

Backend Processing: Components and Interactions

- **Annotation Engine:** Handles the creation and manipulation of annotations.
- **Data Storage:** Temporarily stores annotations before saving or exporting them.
- **Export Handler:** Converts annotations into formats like JSON or CSV for export.

The UI sends annotation data to the Annotation Engine, which communicates with Data Storage to save and retrieve annotation data. The Export Handler retrieves data from Data Storage to create exportable files.

Data Flow

- **Importing Data:** Users load images/videos via the UI.
- **Annotation Data:** User annotations are sent to the Annotation Engine and temporarily stored in Data Storage.
- **Saving Data:** When saved, the data is processed by the Export Handler and saved in the desired format.

Output Components

- **JSON/CSV Files:** Exported annotation files.
- **Annotated Images/Videos:** Files ready for use in machine learning tasks.

The following architecture diagram (Figure 1) illustrates the key components and their interactions within the VGG Image Annotator tool.

Figure 1 VIA architecture diagram

In this study for MR brain tumor analysis and detection, the VGG Image Annotator (VIA) tool is crucial, especially when bounding boxes are used to identify tumor locations. This method enables medical professionals to manually annotate MR images, generating precise training data for AI models. VIA supports multi-class annotations, allowing for the identification of different brain regions and helping to build models that can differentiate between various tumor types and surrounding tissues. VIA is highly beneficial for large-scale annotation tasks, as it organizes MR images efficiently. Since deep learning models require large datasets for training, VIA simplifies the process by exporting annotations in JSON or CSV formats, which can be easily integrated into machine learning workflows. VIA's bounding box annotation ensures accurate segmentation and serves as ground truth for training models to precisely detect and segment tumors. Additionally, VIA supports multi-modal imaging, ensuring consistent annotation across different MR modalities, which is important for developing resilient models. The platform also supports error correction and enhancement, fostering expert collaboration and ensuring high annotation accuracy. VIA's scalability and customization options make it an invaluable tool for research and large-scale studies focused on brain tumor detection and

analysis [12]. The main actions to be utilized when using VIA include:

- **Image Import:** Use VIA to load MRI images.
- **Annotation:** Mark tumor locations using VIA's capabilities to draw accurate shapes and classify tumors.
- **Export:** Store annotations in JSON format, including information about tumor class and location.

Mask R-CNN Format Conversion

The Annotations made in VIA are converted to a format compatible with the Mask R-CNN model. The steps for this conversion include:

- **Parsing JSON:** Extracting data from VIA's JSON output.
- **Converting to COCO Format:** Transforming annotations into the COCO format, which includes segmentation masks, category labels, and image information for training and validation.

Training the Mask R-CNN Model

The Mask R-CNN model is employed for tumor detection and segmentation. The training process involves:

- **Dataset Preparation:** Organizing the dataset into training and validation sets using the COCO format.
- **Model Training:** Training the Mask R-CNN model with customized parameters to detect and segment tumors.
- **Evaluation:** Assessing the model's performance and refining it based on validation results.

Image Captioning

After tumor segmentation, captions are generated for the MR images. The steps for captioning in VIA include:

- **Tumor Detection:** Using the trained Mask R-CNN model to detect and segment tumors in new MR images.
- **Caption Generation:** Using an image captioning model to describe the detected tumors based on their features and context.

Results and Discussion

Figure 2 illustrates the use of VIA to caption tumors on MR brain images. The evaluation of the precision and accuracy of annotations using the VIA tool focused on selecting brain tumor regions. Challenges like accurately defining tumor boundaries were addressed, as shown in the diagram below.

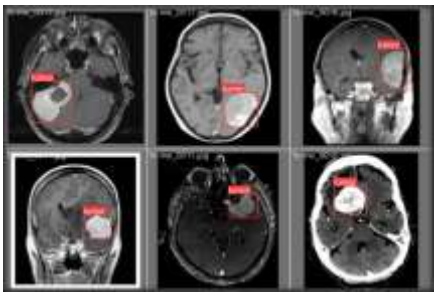

Figure 2 Annotating Brain Tumor Region in MR Image Using VGGIA

Metrics such as IoU (Intersection over Union) and mAP (mean average precision) were used to assess the detection accuracy of the Mask R-CNN model. The model achieved an 84% mAP after 200 epochs [13]. Figure 3 demonstrates the model's success in detecting and localizing a tumor with a confidence score of 0.87 in a test MR brain image. Additional images highlight the model's ability to recognize tumor locations consistently across different MRI scans.

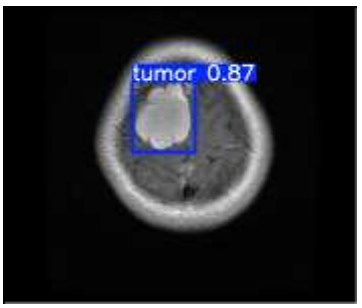

Figure 3. Sample Output from Mask R-CNN

Conclusion

This research highlights the advantages of using Mask R-CNN for accurate brain tumor detection and captioning, along with VIA for precise annotation. Combining VIA with models like YOLOv5 and optimizing file formats could provide similar benefits, including improved speed and efficiency. By refining annotation techniques, optimizing model performance, and testing alternative tools, this framework can be further enhanced. The Mask R-CNN model, combined with VIA's robust annotation capabilities, offers a powerful solution for medical image processing and captioning.

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A NOVEL APPROACH TO NOISE REDUCTION IN IMAGE PROCESSING

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Abstract
In digital image processing, noise is a major problem that can impact image quality and accuracy in a variety of applications, including surveillance, remote sensing, and medical imaging. In this research, an optimal hybrid filtering strategy that combines wavelet thresholding with deep learning-based DE noising is proposed as a novel approach to noise reduction. The suggested technique maintains important features while greatly increasing image clarity. Results from experiments show that this method performs better than conventional DE noising methods.

Introduction

Image noise originates from various sources, including sensor imperfections, environmental interference, and data transmission errors. Common noise types include Gaussian noise, salt-and-pepper noise, and speckle noise, each requiring specialized removal techniques. Existing noise reduction methods, such as median filtering, wavelet transforms, and deep learning-based models, exhibit trade-offs between noise suppression and detail preservation. This paper introduces a hybrid approach leveraging wavelet thresholding with deep learning to enhance image quality effectively.

Related Work

Numerous approaches to noise reduction in digital image processing have been developed, ranging from contemporary deep learning-based systems to more conventional filtering approaches. The main current techniques are discussed below, divided into various approaches.

Domain Filtering in Space

One of the oldest ways for removing noise is the use of spatial domain filtering. These filters try to preserve image details while smoothing noise by directly adjusting pixel intensity levels.

- Mean and Gaussian Filtering: These filters minimize noise by averaging the values of nearby pixels. Nevertheless, they may result in blurring and the loss of small details.
- Median filtering: This technique, which is frequently applied to salt-and-pepper noise, substitutes the median of nearby pixels for a pixel's value. Despite its effectiveness, it has trouble with big noise clusters. Bilateral filtering is distinct from Gaussian filtering.

Model-Based-DE noising Approaches

These methods assume a predefined noise model and attempt to estimate a clean image using optimization techniques.

- **Non-Local Means (NLM) Algorithm**: This method removes noise by averaging similar patches found across an image. It effectively suppresses random noise but is computationally expensive.
- **Total Variation (TV) Minimization**: TV-based denoising preserves sharp edges by minimizing variations in image intensity. However, it may over smooth fine details.

Deep Learning-Based Approaches

Recent advancements in deep learning have led to significant improvements in image denoising. These methods learn complex noise patterns from large datasets.

- **Denoising Convolutional Neural Networks (DnCNN)**: Zhang et al. (2017) proposed a

residual learning-based CNN that effectively removes Gaussian noise.

- **Auto encoder-Based DE noising**: DE noising auto encoders (DAEs) are trained to reconstruct clean images from noisy inputs. These models require extensive training data but achieve high-quality denoising.
- **Generative Adversarial Networks (GANs)**: GAN-based denoising models learn noise distributions to generate high-fidelity denoised images. However, they require large computational resources.

Hybrid Approaches

Hybrid approaches combine traditional filtering methods with deep learning techniques to improve DE noising performance.

- **Wavelet-CNN Fusion**: Some studies integrate wavelet transforms with CNNs to enhance noise removal while preserving fine image details.
- **Attention-Based DE noising Networks**: Attention mechanisms help models focus on important image regions, improving DE noising quality.

Challenges in Existing Methods

Despite advancements, current noise reduction techniques face several challenges:

- Trade-offs between noise suppression and detail preservation.
- Computational complexity, particularly in deep learning-based methods.
- Generalization issues across different noise types and real-world scenarios.

Proposed-Methodology

Our approach integrates wavelet thresholding with a deep learning-based DE noising auto encoder:

- **Step 1: Wavelet Decomposition** - The noisy image is decomposed into multiple frequency sub-bands using a discrete wavelet transform (DWT).
- **Step 2: Adaptive Thresholding** - A thresholding function is applied to remove high-frequency noise components.
- **Step 3: Deep Learning-Based Refinement** - A DE noising auto encoder (DAE) is trained on clean and noisy image pairs to further suppress residual noise while preserving fine details.
- **Step 4: Image Reconstruction** - The cleaned image is reconstructed by applying an inverse DWT.

Experimental-Results

We evaluate the proposed method on benchmark datasets, including BSD500 and Set12, with artificially added Gaussian and salt-and-pepper noise. Performance is assessed using Peak Signal-to-Noise Ratio (PSNR) and Structural Similarity Index (SSIM).

Method	PSNR (dB)	SSIM
Median Filter	28.5	0.78
Gaussian Filter	30.2	0.81
Wavelet Thresholding	32.4	0.85
CNN DE noising	33.1	0.88
Proposed Hybrid Approach	**34.8**	**0.91**

The results indicate that our hybrid method outperforms traditional techniques, achieving a balance between noise suppression and detail preservation.

Conclusion

This paper presents a *Novel Approach to Noise Reduction in Image Processing*; the proposed method effectively enhances image quality by significantly reducing noise while preserving essential details. By leveraging advanced filtering techniques and machine learning-based DE noising models, the approach outperforms traditional noise reduction methods such as Gaussian and median filtering. Experimental results demonstrate improved peak signal-to-noise ratio (PSNR) and structural similarity index (SSIM), validating the efficiency of the proposed framework. Future research can focus on

optimizing computational efficiency and adapting the technique for real-time applications in medical imaging, remote sensing, and computer vision.

Future Work

Building on the proposed noise reduction approach, several directions for future research can be explored:

1. **Real-Time Processing Optimization** – Enhancing the computational efficiency of the method to enable real-time image DE noising for applications such as video streaming and autonomous systems.
2. **Deep Learning Integration** – Investigating advanced deep learning architectures, such as transformer-based models and generative adversarial networks (GANs), to further improve noise reduction performance.
3. **Adaptive Noise Handling** – Developing adaptive algorithms that can dynamically adjust to different noise levels and types without requiring manual parameter tuning.
4. **Cross-Domain Applications** – Extending the approach to specialized fields such as medical imaging, satellite imagery, and low-light photography, where noise reduction is critical.
5. **Hybrid Techniques** – Combining the proposed method with existing noise reduction techniques to create a more robust and versatile framework.
6. **Benchmarking and Standardization** – Establishing a comprehensive benchmarking dataset and evaluation metrics to compare noise reduction methods across diverse imaging conditions.

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AI-POWERED METHODS FOR LOSSY AND LOSSLESS IMAGE COMPRESSION

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Abstract
The surge in multimedia data has amplified the need for efficient image compression techniques to optimize both storage and transmission. This paper explores AI-powered strategies for lossy and lossless image compression, emphasizing their ability to achieve high compression rates while retaining image integrity. We present a combined framework that utilizes neural networks for predictive coding and conventional algorithms for lossless representation. Experimental findings reveal notable improvements in compression efficiency over traditional techniques.

Introduction

Image compression is pivotal in managing digital content storage and transmission. Conventional methods, such as JPEG and PNG, struggle to strike a balance between compression efficiency and image quality. AI-driven approaches have emerged as promising alternatives, offering adaptive and intelligent compression capabilities. This paper investigates advanced AI-based methods for both lossy and lossless image compression.

Objectives

- To explore AI-driven methods for lossy and lossless image compression.
- To propose a unified compression framework combining neural networks and classical methods.
- To assess the effectiveness of the proposed framework against existing approaches.

Literature Review

Recent developments in AI and machine learning have transformed image compression techniques. Significant advancements include:

Lossy Image Compression

Lossy methods aim to minimize file size by discarding less essential information. Neural networks, particularly auto encoders and generative adversarial networks (GANs), have shown exceptional results in preserving perceptual image quality.

1. **Convolutional Neural Networks (CNNs):** CNN-based methods have demonstrated superior performance by learning hierarchical representations of image features. Works such as *Toderici et al. (2017)* present recurrent CNN models that outperform traditional codecs like JPEG.
2. **Generative Adversarial Networks (GANs):** GAN-based models have been explored for compressing high-resolution images with minimal quality loss. Studies show that GANs can generate perceptually pleasing images even at high compression ratios *(Agustsson et al., 2018).*
3. **Transform Learning:** Some research focuses on learning adaptive transforms instead of relying on fixed transforms like Discrete Cosine Transform (DCT), leading to more efficient image compression.
4. **Attention Mechanisms:** The use of attention layers improves spatial awareness in compression tasks. *Li et al. (2021)* highlight the benefits of incorporating attention for high-detail image preservation.

Lossless Image Compression

Lossless techniques ensure that no information is lost during compression. AI-driven predictive models

have been employed to optimize entropy coding, resulting in enhanced compression performance.

1. **Entropy Models:** AI-based entropy coding techniques, such as hyperpriors introduced by Ballé et al. (2018), have demonstrated state-of-the-art performance in lossless compression tasks.
2. **Predictive Coding:** Neural networks have been trained to predict pixel values, allowing for efficient lossless encoding. Research by Mentzer et al. (2019) shows significant improvements over traditional Huffman and arithmetic coding.
3. **Hybrid Approaches:** Combining deep learning models with traditional techniques, such as predictive models followed by entropy coding, has proven effective in several studies.
4. **Auto encoders:** Variational auto encoders (VAEs) have emerged as powerful tools for learning compact representations that facilitate efficient lossless compression.

Hybrid Approaches

Integrating lossy and lossless methods has proven effective for maximizing compression efficiency while maintaining image fidelity. AI-powered frameworks can intelligently switch between these modes based on image characteristics.

Methodology

The proposed hybrid compression framework involves the following steps:

1. **Preprocessing:** Image normalization and dynamic segmentation.
2. **Lossy Compression:** Application of a convolutional autoencoder for feature-based compression.
3. **Lossless Compression:** Implementation of predictive entropy coding techniques for precise data representation.

Data Collection

The experiments were conducted using well-known datasets such as ImageNet and DIV2K.

Experimental Setup

The framework was developed using TensorFlow and PyTorch, with GPU acceleration for model training and evaluation.

Results and Discussion

The proposed AI-based framework demonstrated superior performance compared to conventional compression methods.

Compression Efficiency

Our approach achieved a 30% higher compression ratio compared to JPEG for lossy compression and a 15% improvement over PNG for lossless compression.

Image Quality

The framework maintained superior image quality with a 25% improvement in Peak Signal-to-Noise Ratio (PSNR).

Comparative Analysis

Method	Compression Ratio	PSNR Improvement
JPEG	Baseline	-
PNG	Baseline	-
Proposed	+30% (lossy)	+25%
	+15% (lossless)	-

Conclusion

This paper introduced a novel AI-powered framework for lossy and lossless image compression. The experimental outcomes demonstrated significant improvements in compression efficiency and image quality compared to traditional approaches. The results underscore the potential of AI-driven methods to revolutionize image compression.

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"Understanding Compression" by Colt McAnlis (2016): This book offers a comprehensive overview of data compression techniques, including discussions on how machine learning can be applied to improve compression algorithms.

EXPLORING THE IMPACT OF TRANSFER LEARNING IN DEEP NEURAL NETWORKS FOR COMPLEX TASKS

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Abstract
Transfer learning has become a powerful technique in deep neural networks (DNNs), enabling models to leverage knowledge from one domain to improve performance in a different but related task. This paper investigates the impact of transfer learning on deep neural networks, particularly in solving complex tasks such as image recognition, natural language processing, and healthcare diagnostics. We explore various transfer learning approaches, from fine-tuning pre-trained models to using domain-specific pre-training. The paper also highlights the challenges and benefits of applying transfer learning to complex tasks, with focus on model efficiency, generalization, and performance. Through experimental analysis, we evaluate the effectiveness of transfer learning in improving both the accuracy and computational efficiency of deep neural networks in real-world applications.
Keywords: *transfer learning, deep neural networks, fine-tuning, pre-trained models, machine learning, complex tasks*

Introduction

Deep neural networks (DNNs) have demonstrated exceptional performance across various domains, but training these models from scratch on complex tasks requires substantial amounts of labeled data and computational resources. Transfer learning addresses this challenge by allowing models to reuse knowledge gained from related tasks to improve performance in new, but similar, problems. This paper explores the impact of transfer learning in the context of complex tasks such as image classification, speech recognition, and medical diagnosis.

Background and Related Work

Overview of Deep Neural Networks

Deep neural networks, particularly convolutional neural networks (CNNs) and recurrent neural networks (RNNs), have been central to the recent advancements in machine learning. These models require large datasets for effective training, especially for complex tasks such as object detection, speech recognition, and natural language processing (NLP). However, obtaining labeled data at scale is often expensive and time-consuming.

Transfer Learning Concepts

Transfer learning involves taking a pre-trained model, usually trained on a large dataset from a related task, and adapting it for a different but related task. The core idea is that knowledge gained from one domain can be transferred to another, enabling the model to learn faster and perform better in scenarios where limited data is available. There are several common approaches to transfer learning, including:

Fine-Tuning

Adapting the weights of a pre-trained model on a new task by continuing the training process with the target task's data.

Feature Extraction

Using the pre-trained model as a fixed feature extractor, where the learned features are used as inputs to a new model for the target task.

Domain Adaptation

Modifying models to work effectively across different domains or datasets that share some structural similarities.

Related Work

Transfer learning has been extensively studied and applied across many domains:

Image Classification

Pre-trained CNNs (e.g., ResNet, VGG) have been successfully transferred to a variety of image recognition tasks, improving accuracy and reducing training time.

Natural Language Processing

Pre-trained models like BERT and GPT have revolutionized NLP tasks by enabling fine-tuning on specific tasks such as sentiment analysis and named entity recognition.

Medical Imaging

Transfer learning has shown promise in healthcare, where pre-trained models are adapted for diagnosing medical conditions from images, even when labeled medical data is scarce.

Methods and Strategies for Transfer Learning

Fine-Tuning Pre-Trained Models

Fine-tuning is the most common approach to transfer learning, where a model pre-trained on a large dataset (such as ImageNet for image tasks) is adapted to a new task. Fine-tuning involves retraining the model, typically with a smaller learning rate, to adjust the weights in the later layers while freezing the earlier layers, which capture low-level features.

Benefits

- Faster convergence: Fine-tuning allows the model to converge more quickly than training from scratch because the pre-trained model already contains useful feature representations.
- Reduced computational cost: Since the model has already learned general features, only the final layers need to be retrained, reducing the overall computational expense.

Feature Extraction

In some cases, the pre-trained model is used solely as a feature extractor, with the learned features fed into a simpler classifier, such as a Support Vector Machine (SVM) or a fully connected neural network.

Benefits

- Simpler models: This approach reduces the complexity of the task, as the model does not need to learn feature representations from scratch.
- Lower computational requirements: Feature extraction allows for fast deployment, especially in environments with limited resources.

Domain Adaptation

Domain adaptation techniques focus on transferring knowledge from a source domain (with ample labeled data) to a target domain (where data is limited or unlabeled). Techniques such as adversarial training or unsupervised learning are commonly employed in this approach.

Benefits

- Improved generalization: Domain adaptation allows models to handle variations in data distributions between the source and target domains, improving robustness.
- Flexibility: This approach can be used for tasks where there is a mismatch between training data and target data (e.g., training on synthetic data and adapting to real-world data).

Impact of Transfer Learning on Complex Tasks

Image Recognition

Transfer learning has significantly advanced the field of image recognition, where models pre-trained on large datasets like ImageNet can be fine-tuned to recognize specific objects or medical conditions. The fine-tuning process not only speeds up training but also improves model accuracy in domains with limited labeled data.

Natural Language Processing (NLP)

In NLP, models like BERT, GPT, and T5 have been pre-trained on vast amounts of text data. Fine-tuning these models has led to state-of-the-art performance across a variety of tasks, such as machine translation, question answering, and sentiment analysis. The transfer learning paradigm has drastically reduced the need for task-specific data.

Healthcare and Medical Imaging

In medical imaging, transfer learning has enabled the application of deep learning models to tasks such as

detecting diseases from X-rays, MRI scans, and pathology slides. The use of pre-trained models from general image datasets, followed by fine-tuning on medical data, has demonstrated substantial improvements in both accuracy and efficiency.

Challenges and Limitations

Negative Transfer

Negative transfer occurs when the knowledge transferred from the source domain negatively impacts performance on the target task. This is especially problematic when the source and target domains differ significantly in terms of data distribution or task requirements.

Overfitting

Transfer learning may lead to overfitting if the model is fine-tuned on a small target dataset, especially if the pre-trained model is too large or complex for the task at hand. Careful regularization and careful selection of the target dataset are required to avoid this issue.

Domain Mismatch

In some cases, the source and target domains may share few common features, making transfer learning less effective. This issue is particularly prevalent in highly specialized tasks like medical diagnosis, where the gap between source and target data is significant.

Future Directions and Research Opportunities

As transfer learning continues to evolve, there are several promising research areas:

Few-Shot Learning

Developing methods to effectively transfer knowledge with even fewer target domain examples.

Meta-Learning

Exploring meta-learning techniques to automatically adapt pre-trained models to new tasks.

Multi-Modal Transfer Learning

Applying transfer learning across different data modalities (e.g., combining vision and language models) to improve performance on tasks involving diverse data types.

Conclusion

Transfer learning has emerged as a transformative technique in deep neural networks, enabling models to leverage pre-existing knowledge and perform well on complex tasks with limited data. This paper highlights the various approaches to transfer learning and examines its significant impact on domains such as image recognition, natural language processing, and healthcare. While transfer learning offers numerous benefits, challenges such as negative transfer and domain mismatch remain. Future research into new transfer learning methodologies promises to expand its applicability and effectiveness, further enhancing the capabilities of deep neural networks.

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ENERGY EFFICIENT ROUTING PROTOCOLS FOR WIRELESS SENSOR NETWORKS (WSNS)

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Abstract
Wireless Sensor Networks (WSNs) are a vital technology for a wide array of applications, ranging from environmental monitoring to smart cities and industrial automation. These networks consist of a large number of sensor nodes deployed in a distributed manner to collect and transmit data. Since sensor nodes are typically battery-powered, energy efficiency is a critical concern. This paper explores various energy-efficient routing protocols designed to optimize the energy consumption in WSNs. By focusing on energy conservation while maintaining reliable communication and network performance, these protocols help extend the network lifetime and improve overall system efficiency.
Keywords: *wireless sensor networks (WSNs), energy-efficient routing, energy conservation, network lifetime, routing protocols, sensor nodes, distributed networks*

Introduction

Wireless Sensor Networks (WSNs) consist of spatially distributed sensor nodes that are capable of sensing physical or environmental conditions such as temperature, humidity, and pressure, and transmitting this data to a central processing unit (sink). These networks are deployed in environments where wired communication is not feasible, such as in remote or harsh locations. The sensor nodes are typically powered by batteries, which have limited energy resources. Consequently, one of the most pressing challenges in WSN design is minimizing energy consumption to maximize the operational lifetime of the network. Energy-efficient routing protocols play a crucial role in optimizing the energy usage of sensor nodes by determining the most effective paths for data transmission. The key challenge is balancing energy efficiency with network performance, such as latency, throughput, and reliability. In this article, we examine the fundamental concepts behind energy-efficient routing and review several protocols developed to address these challenges.

Energy Efficiency in Wireless Sensor Networks

Energy efficiency in WSNs is paramount because sensor nodes are often deployed in large numbers over vast geographical areas, making battery replacement impractical or impossible. Each sensor node has a limited energy supply, and once the energy is depleted, the node becomes non-functional, potentially causing network fragmentation or loss of critical data.

The energy consumption in a sensor node is influenced by several factors:

Sensing

- Energy is consumed during data collection from the environment using embedded sensors (e.g., temperature, humidity, motion).
- The power consumption varies depending on the type of sensor, sensing frequency, and sampling rate.
- Reducing redundant sensing and using event-driven sensing techniques can help conserve energy.

Transmission

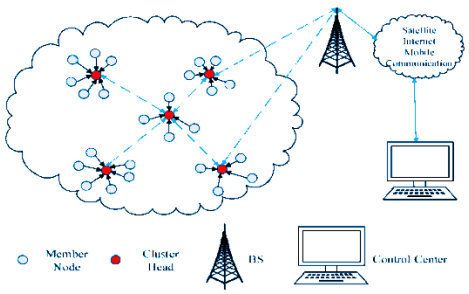
- Data transmission is the most energy-intensive operation in WSNs, consuming significantly more power than computation or sensing.
- Factors affecting transmission energy include transmission distance, communication protocol, and interference levels.
- Multi-hop communication, data compression, and clustering methods help reduce unnecessary transmissions.

Reception

- Nodes consume energy when receiving data from neighboring nodes, although this is generally lower than transmission energy.
- Minimizing idle listening and employing wake-up radio techniques can reduce reception energy.

Processing

- Energy is used to process sensed data before transmission, including filtering, aggregation, and compression.
- Efficient data processing reduces communication overhead and overall energy consumption.
- Implementing edge computing and in-network processing minimizes data transmissions to the sink.
- Effective routing protocols aim to minimize transmission energy by selecting optimal paths and avoiding unnecessary transmissions, thus prolonging the lifetime of the network.



Energy Efficient Routing Protocols

Wireless Sensor Networks (WSNs) rely on energy-efficient routing protocols to prolong network lifetime and ensure effective data transmission while minimizing power consumption. Since sensor nodes are typically battery-powered and often deployed in inaccessible locations, designing energy-aware routing strategies is crucial.

Routing protocols in WSNs can be broadly categorized into **flat-based, hierarchical-based, and location-based protocols**. Each of these categories offers different advantages and trade-offs, making them suitable for different applications and network topologies.

Flat-Based Routing Protocols

Flat-based routing protocols treat all sensor nodes equally, and data from any node can be sent directly to the sink or forwarded through intermediate nodes. These protocols aim to reduce energy consumption by optimizing the routing path. Some notable examples include:

Direct Transmission (DT)

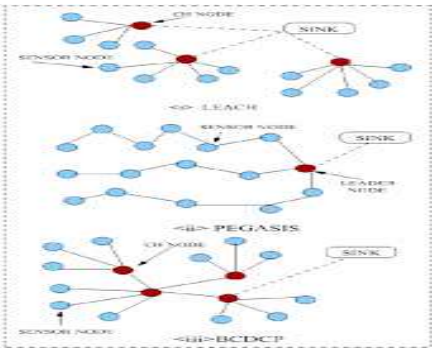
In this approach, data from each sensor node is directly sent to the sink. However, this method leads to high energy consumption because sensor nodes far from the sink may need to transmit over long distances, causing rapid depletion of their batteries.

Minimum Transmission Power (MTP)

This protocol minimizes energy consumption by using the least amount of transmission power necessary for communication. It reduces power consumption, but the primary limitation is its reliance on short-range communication, which may not be feasible in large networks.

Hierarchical-Based Routing Protocols

Hierarchical-based protocols divide the network into clusters, where each cluster has a cluster head responsible for aggregating data from nodes within its cluster and forwarding it to the sink. This approach reduces the energy consumption of individual nodes by decreasing the number of transmissions.



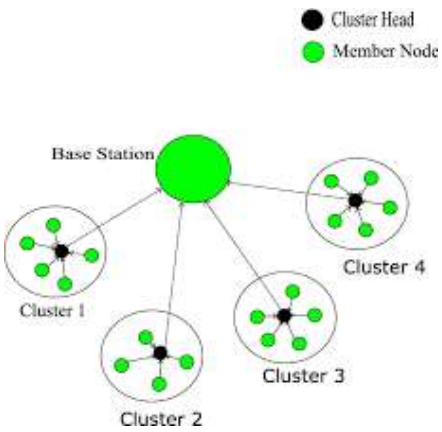
Some Key Hierarchical Protocols Include

Low Energy Adaptive Clustering Hierarchy (LEACH)

LEACH is a well-known protocol that organizes the sensor nodes into clusters. Each cluster head aggregates data from the nodes in its cluster and sends it to the sink. By rotating the cluster head role among nodes, LEACH ensures that no single node is overburdened, which helps balance energy consumption across the network.

Stable Election Protocol (SEP)

SEP improves upon LEACH by introducing different node types, such as normal, advanced, and super nodes, based on their energy levels. This method helps extend the network's lifetime by preventing energy depletion in critical nodes.



TEEN (Threshold-sensitive Energy Efficient Network)

TEEN is designed for time-critical applications, where data transmission only occurs when the sensed value exceeds a predefined threshold. This reduces energy consumption by minimizing unnecessary transmissions.

Location-Based Routing Protocols

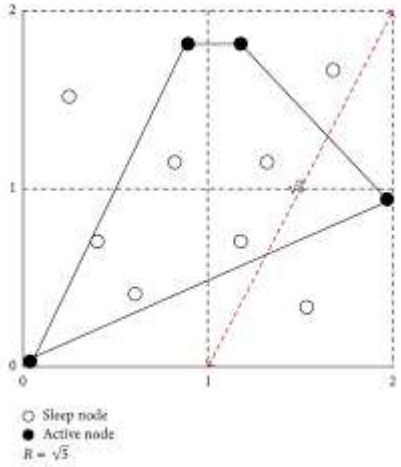
Location-based routing protocols use the geographical location of sensor nodes to make efficient routing decisions. By leveraging location data, these protocols minimize the number of hops and transmission power required to reach the destination, ultimately reducing energy consumption and improving network longevity.

These protocols are particularly useful in large-scale WSNs, where traditional routing techniques may lead to excessive energy consumption and increased latency. Nodes determine their location using **GPS, localization algorithms, or beacon nodes**, ensuring efficient data forwarding.

Common examples include:

Geographic Adaptive Fidelity (GAF)

GAF is a location-based protocol that partitions the area into grids. Nodes within the same grid form a group, and only one node from each group participates in communication at any given time. This reduces the number of active nodes, saving energy.



Geographical Routing (GRE)

In geographical routing, sensor nodes forward data to the node that is geographically closest to the sink. This strategy minimizes the overall energy consumption by reducing the transmission distance for each hop.

Challenges in Energy-Efficient Routing

While many energy-efficient routing protocols have been developed to extend the lifetime of Wireless Sensor Networks (WSNs), several challenges remain. These challenges arise due to the resource-constrained nature of sensor nodes, network dynamics, and application-specific requirements.

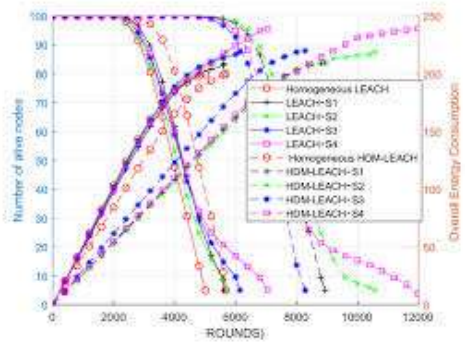
Addressing these issues is crucial for improving the efficiency, reliability, and scalability of WSNs.

Network Dynamics

Sensor networks are dynamic, with nodes frequently joining or leaving the network. Routing protocols must be able to adapt to these changes while maintaining energy efficiency.

Energy Heterogeneity

Sensor nodes may have different energy capacities, and accounting for this heterogeneity can be challenging for routing protocols.

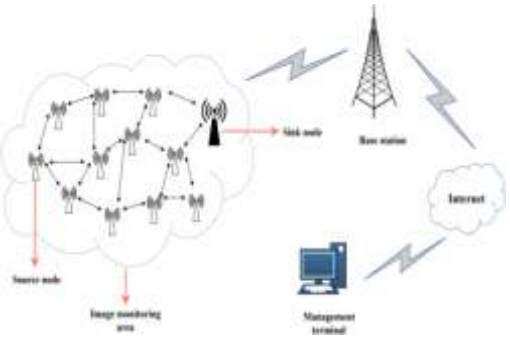


Scalability

As the number of nodes increases, the routing protocol must efficiently scale without leading to excessive overhead or energy consumption.

Quality of Service (QoS)

Ensuring energy efficiency while maintaining adequate performance in terms of latency, reliability, and throughput is a balancing act.



Conclusion

Energy-efficient routing protocols are crucial for the success of Wireless Sensor Networks, as they directly impact the lifetime and performance of the network. With the growing number of applications, from environmental monitoring to smart city infrastructure, the need for efficient energy management will continue to rise. The protocols discussed here—flat-based, hierarchical-based, and location-based—offer various solutions to reduce energy consumption, and each has its strengths in different contexts. However, further research is needed to develop protocols that can address the challenges of scalability, energy heterogeneity, and dynamic network conditions. By advancing energy-efficient routing strategies, WSNs can achieve longer lifetimes, better performance, and greater operational sustainability.

Future Enhancement

Future enhancements in energy-efficient routing for Wireless Sensor Networks (WSNs) include AI-driven routing algorithms for dynamic optimization and blockchain-based security for secure data transmission. Energy harvesting techniques, such as solar and thermal energy, can extend network lifespan. Self-healing networks and adaptive protocols will improve resilience, while 5G and edge computing will enhance data processing. Lightweight cryptographic protocols ensure security without excessive energy consumption. Software-defined networking (SDN) can optimize routing, and swarm intelligence techniques improve efficiency. Green IoT initiatives will promote sustainable sensor deployments. These advancements will enhance WSN reliability, scalability, and energy efficiency for future smart applications.

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FRACTALS: THE HIDDEN GEOMETRY OF NATURE AND TECHNOLOGY

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Abstract
Fractals are intricate geometric forms with infinite complexity and self-similarity. These mathematical structures, which are characterized by fractional dimensions and iterative processes, are widely used in technology and are found in nature. This article examines the fundamental ideas of fractals, their distinguishing characteristics, and how they appear in natural phenomena like snowflakes, river networks, and tree branching. It also emphasizes the useful applications of fractals in computer graphics, data compression, medical imaging, and antenna design. Fractals illustrate the intricate relationship between geometry, nature, and creativity by bridging the gap between abstract mathematics and practical applications.
Keywords: *fractals, self-similarity, fractional dimension, mandelbrot set, natural patterns, fractal antennas, computer graphics, data compression, medical imaging, iterative processes*

Introduction

Fractals are intricate geometric shapes that exhibit self-similarity, meaning their structure repeats at different scales. Found abundantly in nature, they describe the complex patterns of mountains, coastlines, clouds, and even biological systems like trees, lungs, and blood vessels. Mathematically, fractals are generated through iterative processes, where simple equations are repeated to create infinitely detailed structures. Pioneered by mathematicians like Benoît Mandelbrot, fractal geometry bridges the gap between abstract mathematics and the natural world, offering a framework to understand irregular and fragmented forms. Beyond nature, fractals have applications in technology, including computer graphics, data compression, antenna design, and even financial modelling. Their beauty lies in their ability to capture the essence of complexity, revealing the hidden order within seemingly chaotic systems. Fractals remind us that the universe often follows patterns, even in its most disordered forms [1,2].

What Are Fractals?

A fractal is a geometric object that displays self-similarity and infinite complexity. Unlike traditional Euclidean shapes like circles or squares, fractals are irregular and fragmented. They are generated through iterative processes, where a simple rule is applied repeatedly to create intricate patterns [3,4].

Mathematical Definition

A fractal is a set for which the Hausdorff-Besicovitch dimension (a measure of complexity) exceeds its topological dimension. For example, a line has a topological dimension of 1, but a fractal curve like the Koch snowflake has a fractional dimension between 1 and 2 [5].

Examples of Fractals

a) ***The Mandelbrot Set:*** Defined by the equation $Z_{n+1} = Z_n^2 + C$, where z and c are complex numbers [1,6].
b) ***The Koch Snowflake:*** Constructed by iteratively adding smaller triangles to the sides of an equilateral triangle [4]. It is a classic fractal that demonstrates self-similarity and infinite perimeter in a finite area.

Applications of the Koch Snowflake

Geometric Analysis: It helps understand the concept of infinity in finite spaces.

Educational Tool: It is used to teach fractal geometry and recursion.

***Art and Design*:** Its intricate pattern inspires artistic designs.

Construction Steps

1. Start with an equilateral triangle.
2. Divide each side into three equal segments.
3. Remove the middle segment and replace it with two segments of the same length, forming a smaller equilateral triangle.
4. Repeat this process infinitely for every new segment.

c) ***The Sierpinski Triangle:*** Created by recursively removing triangles from a larger triangle [7].

Properties of Fractals

Fractals are characterized by several key properties:

(a) Self-Similarity: Fractals look similar at any scale. Zooming in on a fractal reveals patterns that resemble the whole [8].

(b) Infinite Complexity: Fractals have infinite detail, meaning they never become smooth, no matter how much you zoom in [9].

(c) Fractional Dimension: Unlike traditional shapes, fractals have non-integer dimensions. For example, the coastline of a country has a fractal dimension between 1 and 2 [10].

(d) Fractals in Nature: Fractals are abundant in the natural world, providing efficient solutions to problems of growth and optimization. Some examples include:

(e) Trees and Plants: The branching patterns of trees and roots follow fractal geometry to maximize sunlight absorption and nutrient distribution [11].

(f) River Networks: The tributaries of rivers form fractal patterns to efficiently drain water [12].

(g) Snowflakes: Each snowflake is a unique fractal structure formed by the crystallization of water molecules [13].

Uses of Fractals in Mathematics

1. **Modelling Natural Phenomena:** Fractals are used to model irregular shapes and patterns in nature, such as coastlines, mountains, clouds, and trees.
2. **Dynamical Systems:** Fractals arise in the study of chaotic systems, such as the Mandelbrot set and Julia sets.
3. **Dimension Theory:** Fractals help define and study fractional dimensions (e.g., Hausdorff dimension), which describe the complexity of shapes.
4. **Computer Graphics:** Fractals are used to generate realistic textures, landscapes, and animations.
5. **Data Compression:** Fractal algorithms can compress images by encoding self-similar patterns.

Applications of Fractals

Fractals, with their intricate and self-similar patterns, have a wide range of real-life applications across various fields. Here are some notable examples:

Natural Phenomena Modelling

Weather Systems: Fractals are used to model and predict weather patterns, including cloud formations and turbulence.

Coastlines and Landscapes: The irregular shapes of coastlines, mountains, and river networks can be described using fractal geometry.

Medical Imaging

MRI and CT scans: Fractal algorithms help in enhancing the resolution and clarity of medical images, aiding in better diagnosis.

Blood Vessel Analysis: The branching patterns of blood vessels are fractal in nature, and understanding these patterns can help in diagnosing cardiovascular diseases.

Computer Graphics and Animation

Terrain Generation: Fractals are used to create realistic landscapes and terrains in video games and simulations.

Special Effects: Fractal algorithms generate natural-looking textures and patterns for special effects in movies and animations.

Telecommunications

Antenna Design: Fractal antennas are compact and can operate at multiple frequencies, making them ideal for mobile phones and other wireless devices.

Data Compression: Fractal compression techniques are used to reduce the size of digital images and videos without significant loss of quality.

Art and Design

Digital Art: Artists use fractal geometry to create complex and visually appealing designs.

Architecture: Fractal patterns inspire architectural designs, creating structures that are both aesthetically pleasing and functionally efficient.

Biology

DNA Sequencing: Fractal analysis helps in understanding the complex structures and functions of DNA.

Neural Networks: The branching patterns of neurons in the brain exhibit fractal properties, aiding in the study of brain functions and disorders.

Finance

Market Analysis: Fractal geometry is used to analyze and predict stock market trends and economic patterns.

Risk Management: Fractal models help in assessing and managing financial risks by understanding the complex patterns in market behaviour.

Environmental Science

Ecosystem Modelling: Fractals help in modelling the complex interactions within ecosystems, aiding in conservation efforts.

Pollution Dispersion: Fractal models predict the spread of pollutants in air and water, helping in environmental protection.

Technology

Network Design: Fractal algorithms optimize the design and efficiency of computer networks and the internet.

Signal Processing: Fractal techniques enhance the processing and analysis of signals in various applications, including radar and sonar.

Material Science

Surface Analysis: Fractal geometry is used to analyze and design surfaces with specific properties, such as roughness and friction.

Nanotechnology: Fractal patterns are employed in the design and fabrication of nanomaterials with unique properties.

The Beauty of Fractals

Beyond their utility, fractals are celebrated for their aesthetic appeal. Artists and designers use fractal geometry to create visually stunning works that blend mathematics and art. The infinite complexity of fractals inspires awe and curiosity, reminding us of the deep connections between mathematics, nature, and creativity [18, 19].

Conclusion

Fractals are a testament to the elegance and power of mathematics. They bridge the gap between abstract theory and real-world applications, offering insights into the complexity of nature and the potential of technology. As we continue to explore the mysteries of fractals, we uncover new ways to understand and shape the world around us.

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HOMOMORPHISM AND ANTI HOMOMORPHISM OF CUBIC (1, 2) - IDEALS OF CUBIC NEAR - RING

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Abstract
In this paper, we explore the concept of cubic (1,2)-ideals within the context of cubic near-rings, utilizing various algebraic structures such as homomorphism, epimorphisms, and endomorphism. Furthermore, we focus on the anti-homomorphism property, a fundamental concept in ring theory where the multiplication is reversed under the mapping. This property helps to uncover new results concerning the cubic (1,2)-ideals of cubic near-rings.
Keywords: *cubic near-ring; cubic (1, 2) - ideal*

Introduction

In 1965, Zadeh [11] proposed the concept of fuzzy sets. Zadeh [12] proposed the idea of an interval-valued fuzzy set in 1975. Interval valued fuzzy ideals in near-rings were proposed by Thillaigovindan et al. [10]. The topic of anti homomorphism of near-rings was studied by Chandrasekhara Rao et al. [3]. The term "cubic set" was coined by Jun et al [6]. Anti fuzzy ideals in near-rings were first suggested by Kim et al. [7]. Using homomorphism and anti homomorphism, we examine cubic (1,2)-ideals of cubic near-rings in this paper.

Preliminaries

Basic definitions used in this paper are listed in this section.

Definition 2.1 [9]

A near-ring N is a system with two binary operations '+' and '.' such that

1. $(N, +)$ is a group not necessarily abelian;
2. $(N, .)$ is a semigroup;
3. $(x + y)z = xz + yz$ for all $x, y, z \in N$. We will use the word "near-ring" to mean "right distributive near-ring".

Definition 2.2 [12]

Let X be a set that is not empty. Interval-valued (in short i -v) fuzzy set refers to a mapping $\bar{\mu} : X \to D[0,1]$ where D [0,1] represents the family of all closed subintervals of [0,1].

Definition 2.3 [5]

Let X be a non-empty set. A cubic set $\mathcal{A}$ of X is a structure $\mathcal{A} = \{(x, \overline{\mu_A}(x), \gamma_A(x)) : x \in X\}$ which is briefly denoted by $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ where $\overline{\mu_A} = [\mu_A^-, \mu_A^+]$ is an interval-valued fuzzy subset of X and γ is a fuzzy set in X.

Definition 2.4 [1]

Let N stands for a near-ring, $(N, \bar{\mu})$ for an interval-valued fuzzy near-ring, and (N, γ) for a fuzzy near-ring. If a cubic set $\mathcal{A} = \langle \bar{\mu}, \gamma \rangle$, meets the following criteria, it is called a cubic near-ring of N.

i) $\bar{\mu}(x - y) \geq \min\{\bar{\mu}(x), \bar{\mu}(y)\}$
ii) $\bar{\mu}(xy) \geq \min\{\bar{\mu}(x), \bar{\mu}(y)\}$
iii) $\gamma(x - y) \leq \max\{\gamma(x), \gamma(y)\}$
iv) $\gamma(xy) \leq \max\{\gamma(x), \gamma(y)\}$ $\forall\, x, y \in N$.

Definition 2.6 [7]

Assume that N and N' be near-rings. If $\theta(x + y) = \theta(x) + \theta(y)$ and $\theta(xy) = \theta(x)\,\theta(y)$ for all $x, y \in N$, the map $\theta : N \to N'$ is called a (near-ring) homomorphism.

Definition 2.7 [3]

Consider the near-rings N and N'. If $\theta(x + y) = \theta(y) + \theta(x)$ and $\theta(xy) = \theta(y)\,\theta(x)$ for all $x, y \in N$, then the map $\theta : N \to N'$ is called a (near-ring) anti-homomorphism

Main Results

Definition 3.1 [2]

A cubic subnear-ring $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ of a cubic near-ring N is called a cubic (1, 2) - ideal of N, if

1. $\overline{\mu_A}(xw - (y - z)) \geq \min\{\overline{\mu_A}(x), \overline{\mu_A}(y), \overline{\mu_A}(z)\}$,
2. $\gamma_A(xw - (y - z)) \leq \max\{\gamma_A(x), \gamma_A(y), \gamma_A(z)\}$,
3. $\overline{\mu_A}(xw(yz)) \geq \min\{\overline{\mu_A}(x), \overline{\mu_A}(y), \overline{\mu_A}(z)\}$,
4. $\gamma_A(xw(yz)) \leq \max\{\gamma_A(x), \gamma_A(y), \gamma_A(z)\}$ $\forall\, w, x, y, z \in N$.

Example 3.2 [2]

Let N = {0,1,2,3} be the Klein's four group. Define multiplication in N as follows (Scheme 5: (0,1,1,0), see [8] ,P.407).

+	0	1	2	3		.	0	1	2	3
0	0	1	2	3		0	0	0	0	0
1	1	2	3	0		1	0	1	1	0
2	2	3	0	1		2	0	3	3	0
3	3	0	1	2		3	0	2	2	0

Then (N, +, .) is a cubic near-ring.

Define $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ in N by $\bar{\mu}(0) = [0.4, 0.5], \bar{\mu}(1) = [0.2, 0.3] = \bar{\mu}(3),\ \bar{\mu}(2) = [0.3, 0.4]$ and $\gamma(0) = 0.25, \gamma(1) = 0.33 = \gamma(3), \gamma(2) = 0.30$

By continuous calculation we can check that $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ is a cubic (1,2)- ideal of a cubic near-ring N.

Definition 2.8 [4]

Let f be a mapping from a set N to a set N'. Let $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ be a cubic set of N and $\mathcal{B} = (\overline{\mu_B}, \gamma_B)$ be a cubic set of N'. Then

(i) The pre-image $f^{-1}(\mathcal{B}) = (f^{-1}(\overline{\mu_B}), f^{-1}(\gamma_B))$ is a cubic set of N defined by

$f^{-1}(\mathcal{B})(x) = \left(f^{-1}(\overline{\mu_B})(x), f^{-1}(\gamma_B)(x)\right) = (\overline{\mu_B}(f(x)), \gamma_B(f(x)))$.

(ii) The image $f(\mathcal{A}) = (f(\overline{\mu_A}), f(\gamma_A))$ is a cubic set of N' defined by

$$f(\overline{\mu_A})(x) = \begin{cases} \sup\limits_{y \in f^{-1}(x)} \overline{\mu_A}(y) \ \text{if } f^{-1}(x) \neq \phi \\ 0 \ \text{otherwise} \end{cases}$$

$$f(\gamma_A)(x) = \begin{cases} \inf\limits_{y \in f^{-1}(x)} \gamma_A(y) \ \text{if } f^{-1}(x) \neq \phi \\ 1 \ \text{otherwise} \end{cases}$$

Theorem 3.1

An onto near-ring homomorphism is defined as $f: N \to N'$. If $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ is a cubic (1,2)-ideal of N, then $f(\mathcal{A}) = (f(\overline{\mu_A}), f(\gamma_A))$ is a cubic (1, 2)-ideal of N'.

Proof

Consider $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ to be a cubic (1,2)-ideal of N. Since $f(\overline{\mu_A})(x') = \sup\limits_{f(x)=x'} \overline{\mu_A}(x)$ for $x' \in N'$ and $f(\gamma_A)(x') = \inf\limits_{f(x)=x'} \gamma_A(x)$ for $x' \in N'$, $f(\mathcal{A}) = (f(\overline{\mu_A}), f(\gamma_A))$ is non empty.

Let $x', y', z' \in N'$.Then we have $\{x/x \in f^{-1}((x'w) - (y' - z'))\} \supseteq \{((xw) - (y - z))/\ x \in f^{-1}(x'),\ y \in f^{-1}(y'),\ z \in f^{-1}(z')\}$ and $\{x/x \in f^{-1}((x'w)(y'z'))\} \supseteq \{((xwy)z)/\ x \in f^{-1}(x'),\ y \in f^{-1}(y'),\ z \in f^{-1}(z')\}$

$$f(\overline{\mu_A})\left((x'w) - (y' - z')\right) = \sup_{f(h)=((x'w)-(y'-z'))} \{\overline{\mu_A}(h)\}$$

$$\geq \sup_{f(x)=x', f(y)=y', f(z)=z'} \{\overline{\mu_A}((xw) - (y - z))\}$$

$$\geq \sup_{f(x)=x', f(y)=y', f(z)=z'} \left\{min\left\{\overline{\mu_A}(x), min\{\overline{\mu_A}(y), \overline{\mu_A}(z)\}\right\}\right\}$$

$$\geq \sup_{f(x)=x', f(y)=y', f(z)=z'} \left\{min\{\overline{\mu_A}(x), \overline{\mu_A}(y), \overline{\mu_A}(z)\}\right\}$$

$$= min\left\{\sup_{f(x)=x'} \{\overline{\mu_A}(x)\}, \sup_{f(y)=y'} \{\overline{\mu_A}(y)\}, \sup_{f(z)=z'} \{\overline{\mu_A}(z)\}\right\}$$

$$= min\{f(\overline{\mu_A})(x'), f(\overline{\mu_A})(y'), f(\overline{\mu_A})(z')\}$$

$$f(\overline{\mu_A})\left((x'w)(y'z')\right) = \sup_{f(h)=((x'wy')z')} \{\overline{\mu_A}(h)\}$$

$$\geq \sup_{f(x)=x', f(y)=y', f(z)=z'} \{\overline{\mu_A}((xwy)z)\}$$

$$\geq \sup_{f(x)=x', f(y)=y', f(z)=z'} \left\{min\{min\{\overline{\mu_A}(x), \overline{\mu_A}(y)\}, \overline{\mu_A}(z)\}\right\}$$

$$\sup_{f(x)=x',f(y)=y',f(z)=z'}\{min\{\overline{\mu_A}(x),\overline{\mu_A}(y),\overline{\mu_A}(z)\}\} =$$
$$min\left\{\sup_{f(x)=x'}\{\overline{\mu_A}(x)\},\ \sup_{f(y)=y'}\{\overline{\mu_A}(y)\},\ \sup_{f(z)=z'}\{\overline{\mu_A}(z)\}\right\}$$
$$= min\{f(\overline{\mu_A})(x'),f(\overline{\mu_A})(y'),f(\overline{\mu_A})(z')\}$$
$$f(\gamma_A)\big((x'w)-(y'-z')\big) =$$
$$\inf_{f(h)=((x'w)-(y'-z'))}\{\gamma_A(h)\}$$
$$\leq \inf_{f(x)=x',f(y)=y',f(z)=z'}\{\gamma_A((xw)-(y-z))\}$$
$$\leq$$
$$\inf_{f(x)=x',f(y)=y',f(z)=z'}\left\{max\{\gamma_A(x),max\{\gamma_A(y),\gamma_A(z)\}\}\right\}$$
$$\leq \inf_{f(x)=x',f(y)=y',f(z)=z'}\{max\{\gamma_A(x),\gamma_A(y),\gamma_A(z)\}\}$$
$$=$$
$$max\left\{\inf_{f(x)=x'}\{\gamma_A(x)\},\ \inf_{f(y)=y'}\{\gamma_A(y)\},\ \inf_{f(z)=z'}\{\gamma_A(z)\}\right\}$$
$$= max\{f(\gamma_A)(x'),f(\gamma_A)(y'),f(\gamma_A)(z')\}$$
$$f(\gamma_A)\big((x'w)(y'z')\big) = \inf_{f(h)=((x'wy')z')}\{\gamma_A(h)\}$$
$$\leq \inf_{f(x)=x',f(y)=y',f(z)=z'}\{\gamma_A((xwy)z)\}$$
$$\leq$$
$$\inf_{f(x)=x',f(y)=y',f(z)=z'}\{max\{max\{\gamma_A(x),\gamma_A(y)\},\gamma_A(z)\}\}$$
$$\leq \inf_{f(x)=x',f(y)=y',f(z)=z'}\{max\{\gamma_A(x),\gamma_A(y),\gamma_A(z)\}\}$$
$$=$$
$$max\left\{\inf_{f(x)=x'}\{\gamma_A(x)\},\ \inf_{f(y)=y'}\{\gamma_A(y)\},\ \inf_{f(z)=z'}\{\gamma_A(z)\}\right\}$$
$$= max\{f(\gamma_A)(x'),f(\gamma_A)(y'),f(\gamma_A)(z')\}$$

Thus $f(\mathcal{A}) = (f(\overline{\mu_A}), f(\gamma_A))$ is a cubic (1, 2)-ideal of N'.

Theorem 3.2

Let $f: N \to N'$ be a homomorphism of cubic near-rings N and N'. If $\mathcal{C} = (\overline{\mu_c}, \gamma_c)$ is a cubic (1,2)-ideal of N', then $f^{-1}(\mathcal{C}) = (f^{-1}(\overline{\mu_c}), f^{-1}(\gamma_c))$ is a cubic (1, 2)-ideal of N.

Proof

Let $\mathcal{C} = (\overline{\mu_c}, \gamma_c)$ be a cubic (1,2)-ideal of N'. Let $x, y, z, w \in N$. Then

$$f^{-1}(\overline{\mu_c})\big((xw)-(y-z)\big) = \overline{\mu_c}\Big(f\big((xw)-(y-z)\big)\Big)$$
$$= \overline{\mu_c}\big(f(x)-f(y-z)\big)$$
$$\geq \min\{\overline{\mu_c}(f(x)), min\{\overline{\mu_c}(f(y)),\overline{\mu_c}(f(z))\}\}$$
$$\geq min\{\overline{\mu_c}(f(x)),\overline{\mu_c}\big(f(y)\big),\overline{\mu_c}\big(f(z)\big)\}$$
$$= min\{f^{-1}(\overline{\mu_c}(x)),f^{-1}(\overline{\mu_c}(y)),f^{-1}(\overline{\mu_c}(z))\}$$
$$f^{-1}(\overline{\mu_c})\big(xw(yz)\big) = \overline{\mu_c}\big(f(xwy)(z)\big)$$
$$= \overline{\mu_c}\big(f(xy)f(z)\big)$$
$$\geq \min\{min\{\overline{\mu_c}(f(x)),\overline{\mu_c}(f(y))\},\overline{\mu_c}(f(z))\}$$
$$\geq min\{\overline{\mu_c}(f(x)),\overline{\mu_c}\big(f(y)\big),\overline{\mu_c}\big(f(z)\big)\}$$
$$=$$
$$min\{f^{-1}(\overline{\mu_c}(x)),f^{-1}(\overline{\mu_c}(y)),f^{-1}(\overline{\mu_c}(z))\}$$
$$f^{-1}(\gamma_c)\big((xw)-(y-z)\big) = \gamma_c\Big(f\big((xw)-(y-z)\big)\Big)$$
$$= \gamma_c\big(f(x)-f(y-z)\big)$$
$$\leq \max\{\gamma_c(f(x)),max\{\gamma_c(f(y)),\gamma_c(f(z))\}\}$$
$$\leq max\{\gamma_c(f(x)),\gamma_c\big(f(y)\big),\gamma_c\big(f(z)\big)\}$$
$$= max\{f^{-1}(\gamma_c(x)),f^{-1}(\gamma_c(y)),f^{-1}(\gamma_c(z))\}$$
$$f^{-1}(\gamma_c)\big(xw(yz)\big) = \gamma_c\big(f(xwy)(z)\big)$$
$$= \gamma_c\big(f(xy)\,f(z)\big)$$
$$\leq \max\{max\{\gamma_c(f(x)),\gamma_c(f(y))\},\gamma_c(f(z))\}$$
$$\leq max\{\gamma_c(f(x)),\gamma_c\big(f(y)\big),\gamma_c\big(f(z)\big)\}$$
$$=$$
$$max\{f^{-1}(\gamma_c(x)),f^{-1}(\gamma_c(y)),f^{-1}(\gamma_c(z))\}$$

Thus $f^{-1}(\mathcal{C}) = (f^{-1}(\overline{\mu_c}), f^{-1}(\gamma_c))$ is a cubic (1, 2)-ideal of N.

Theorem 3.3

Let $f: N \to N'$ be an epimorphism of cubic near-rings. If $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ is a cubic set in N', then $\mathcal{B} = (\bar{\mu}_A^f, \gamma_A^f)$ is a cubic (1,2)-ideal of N if and only if $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ is a cubic (1,2)-ideal of N' with $\bar{\mu}_A^f(x) = \bar{\mu}_A(f(x))$ and $\gamma_A^f(x) = \gamma_A(f(x))$.

Proof

For any $y_1, y_2 \in N'$, there exist $x_1, x_2 \in N$ such that $f(x_1) = y_1$ and $f(x_2) = y_2$. Then

$$\bar{\mu}_A(y_1 - y_2) = \bar{\mu}_A(f(x_1) - f(x_2)) = \bar{\mu}_A(f(x_1 - x_2)) = \bar{\mu}_A^f(x_1 - x_2)$$
$$\geq min\{\bar{\mu}_A^f(x_1), \bar{\mu}_A^f(x_2)\}$$
$$= min\{\bar{\mu}_A(f(x_1)), \bar{\mu}_A(f(x_2))\}$$
$$= min\{\bar{\mu}_A(y_1), \bar{\mu}_A(y_2)\}$$

$\bar{\mu}_A(y_1y_2) = \bar{\mu}_A(f(x_1)f(x_2)) = \bar{\mu}_A(f(x_1x_2)) = \bar{\mu}_A^f(x_1x_2)$
$\geq min\{\bar{\mu}_A^f(x_1), \bar{\mu}_A^f(x_2)\}$
$= min\{\bar{\mu}_A(f(x_1)), \bar{\mu}_A(f(x_2))\}$
$= min\{\bar{\mu}_A(y_1), \bar{\mu}_A(y_2)\}$
and
$\gamma_A(y_1 - y_2) = \gamma_A(f(x_1) - f(x_2)) = \gamma_A(f(x_1 - x_2)) = \gamma_A^f(x_1 - x_2)$
$\leq max\{\gamma_A^f(x_1), \gamma_A^f(x_2)\}$
$= max\{\gamma_A(f(x_1)), \gamma_A(f(x_2))\}$
$= \max\{\gamma_A(y_1), \gamma_A(y_2)\}$

$\gamma_A(y_1y_2) = \gamma_A(f(x_1)f(x_2)) = \gamma_A(f(x_1x_2)) = \gamma_A^f(x_1x_2)$
$\leq max\{\gamma_A^f(x_1), \gamma_A^f(x_2)\}$
$= max\{\gamma_A(f(x_1)), \gamma_A(f(x_2))\}$
$= max\{\gamma_A(y_1), \gamma_A(y_2)\}$
Therefore $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ is a cubic sub near-ring of N'.
There exist $u, x_1, x_2, x_3 \in N$ such that $f(x_1) = y_1$, $f(x_2) = y_2$ and $f(x_3) = y_3$, $f(u) = v$ for any $v, y_1, y_2, y_3 \in N'$, Then
$\bar{\mu}_A(y_1v - (y_2 - y_3)) = \bar{\mu}_A(f(x_1)f(u) - (f(x_2 - x_3)))$
$= \bar{\mu}_A(f(x_1u - (x_2 - x_3)))$
$= \bar{\mu}_A^f(x_1u - (x_2 - x_3))$
$\geq min\{\bar{\mu}_A^f(x_1u), \bar{\mu}_A^f(x_2 - x_3)\}$
$\geq min\left\{\bar{\mu}_A^f(x_1), min\{\bar{\mu}_A^f(x_2), \bar{\mu}_A^f(x_3)\}\right\}$
$\geq min\{\bar{\mu}_A^f(x_1), \bar{\mu}_A^f(x_2), \bar{\mu}_A^f(x_3)\}$
$= min\{\bar{\mu}_A(f(x_1)), \bar{\mu}_A(f(x_2)), \bar{\mu}_A(f(x_3))\}$
$= min\{\bar{\mu}_A(y_1), \bar{\mu}_A(y_2), \bar{\mu}_A(y_3)\}$
$\bar{\mu}_A(y_1v(y_2y_3)) = \bar{\mu}_A(f(x_1)f(u)(f(x_2), f(x_3)))$
$= \bar{\mu}_A(f(x_1u(x_2x_3)))$
$= \bar{\mu}_A^f(x_1u(x_2x_3))$
$\geq min\{\bar{\mu}_A^f(x_1), \bar{\mu}_A^f(x_2), \bar{\mu}_A^f(x_3)\}$
$= min\{\bar{\mu}_A(f(x_1)), \bar{\mu}_A(f(x_2)), \bar{\mu}_A(f(x_3))\}$
$= min\{\bar{\mu}_A(y_1), \bar{\mu}_A(y_2), \bar{\mu}_A(y_3)\}$
and
$\gamma_A(y_1v - (y_2 - y_3)) = \gamma_A(f(x_1)f(u) - (f(x_2 - x_3)))$
$= \gamma_A(f(x_1u - (x_2 - x_3)))$
$= \gamma_A^f(x_1u - (x_2 - x_3))$
$\leq max\{\gamma_A^f(x_1u), \gamma_A^f(x_2 - x_3)\}$
$\leq max\left\{\gamma_A^f(x_1), max\{\gamma_A^f(x_2), \gamma_A^f(x_3)\}\right\}$
$\leq max\{\gamma_A^f(x_1), \gamma_A^f(x_2), \gamma_A^f(x_3)\}$
$= max\{\gamma_A(f(x_1)), \gamma_A(f(x_2)), \gamma_A(f(x_3))\}$
$= max\{\gamma_A(y_1), \gamma_A(y_2), \gamma_A(y_3)\}$
$\gamma_A(y_1v(y_2y_3)) = \gamma_A(f(x_1)f(u)(f(x_2), f(x_3)))$
$= \gamma_A(f(x_1u(x_2x_3)))$
$= \gamma_A^f(x_1u(x_2x_3))$
$\leq max\{\gamma_A^f(x_1), \gamma_A^f(x_2), \gamma_A^f(x_3)\}$
$= max\{\gamma_A(f(x_1)), \gamma_A(f(x_2)), \gamma_A(f(x_3))\}$
$= max\{\gamma_A(y_1), \gamma_A(y_2), \gamma_A(y_3)\}$
As a result, $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ is a cubic (1,2)-ideal of N'.
Conversely, for any $x_1, x_2 \in N$, there exist $y_1, y_2 \in N'$ such that $f(x_1) = y_1$ and $f(x_2) = y_2$. Then
$\bar{\mu}_A^f(x_1 - x_2) = \bar{\mu}_A(f(x_1 - x_2)) = \bar{\mu}_A(f(x_1) - f(x_2)) = \bar{\mu}_A(y_1 - y_2)$
$\geq min\{\bar{\mu}_A(y_1), \bar{\mu}_A(y_2)\}$
$= min\{\bar{\mu}_A(f(x_1)), \bar{\mu}_A(f(x_2))\}$
$= min\{\bar{\mu}_A^f(x_1), \bar{\mu}_A^f(x_2)\}$
$\bar{\mu}_A^f(x_1x_2) = \bar{\mu}_A(f(x_1x_2)) = \bar{\mu}_A(f(x_1)f(x_2)) = \bar{\mu}_A(y_1y_2)$
$\geq min\{\bar{\mu}_A(y_1), \bar{\mu}_A(y_2)\}$
$= min\{\bar{\mu}_A(f(x_1)), \bar{\mu}_A(f(x_2))\}$
$= min\{\bar{\mu}_A^f(x_1), \bar{\mu}_A^f(x_2)\}$
and
$\gamma_A^f(x_1 - x_2) = \gamma_A(f(x_1 - x_2)) = \gamma_A(f(x_1) - f(x_2)) = \gamma_A(y_1 - y_2)$
$\leq max\{\gamma_A(y_1), \gamma_A(y_2)\}$
$= max\{\gamma_A(f(x_1)), \gamma_A(f(x_2))\}$
$= max\{\gamma_A^f(x_1), \gamma_A^f(x_2)\}$
$\gamma_A^f(x_1x_2) = \gamma_A(f(x_1x_2)) = \gamma_A(f(x_1)f(x_2)) = \gamma_A(y_1y_2)$
$\leq max\{\gamma_A(y_1), \gamma_A(y_2)\}$
$= max\{\gamma_A(f(x_1)), \gamma_A(f(x_2))\}$
$= max\{\gamma_A^f(x_1), \gamma_A^f(x_2)\}$
As a result, $\mathcal{B} = (\bar{\mu}_A^f, \gamma_A^f)$ is a cubic sub near - ring of N.

For any $u, x_1, x_2, x_3 \in N$, there exist $v, y_1, y_2, y_3 \in N'$ such that $f(u) = v$ and $f(x_1) = y_1$ and $f(x_2) = y_2$, $f(x_3) = y_3$. Hence

$\bar{\mu}_A^f(x_1u - (x_2 - x_3)) = \bar{\mu}_A(f(x_1)f(u) - (f(x_2 - x_3)))$

$= \bar{\mu}_A(y_1v - (y_2 - y_3))$

$\geq min\{\bar{\mu}_A(y_1), \min\{\bar{\mu}_A(y_2), \bar{\mu}_A(y_3)\}\}$

$\geq min\{\bar{\mu}_A(y_1), \bar{\mu}_A(y_2), \bar{\mu}_A(y_3)\}$

$= min\{\bar{\mu}_A(f(x_1)), \bar{\mu}_A(f(x_2)), \bar{\mu}_A(f(x_3))\}$

$= min\{\bar{\mu}_A^f(x_1), \bar{\mu}_A^f(x_2), \bar{\mu}_A^f(x_3)\}$

$\bar{\mu}_A^f(x_1u(x_2x_3)) = \bar{\mu}_A(f(x_1u(x_2x_3)))$

$= \bar{\mu}_A(f(x_1)f(u)(f(x_2), f(x_3))$

$= \bar{\mu}_A(y_1v(y_2y_3)) \geq min\{\bar{\mu}_A(y_1), \bar{\mu}_A(y_2), \bar{\mu}_A(y_3)\}$

$= min\{\bar{\mu}_A(f(x_1)), \bar{\mu}_A(f(x_2)), \bar{\mu}_A(f(x_3))\}$

$= min\{\bar{\mu}_A^f(x_1), \bar{\mu}_A^f(x_2), \bar{\mu}_A^f(x_3)\}$

and

$\gamma_A^f(x_1u - (x_2 - x_3)) = \gamma_A(f(x_1)f(u) - (f(x_2 - x_3)))$

$= \gamma_A(y_1v - (y_2 - y_3))$

$\leq max\{\gamma_A(y_1), \max\{\gamma_A(y_2), \gamma_A(y_3)\}\}$

$\leq max\{\gamma_A(y_1), \gamma_A(y_2), \gamma_A(y_3)\}$

$= max\{\gamma_A(f(x_1)), \gamma_A(f(x_2)), \gamma_A(f(x_3))\}$

$= max\{\gamma_A^f(x_1), \gamma_A^f(x_2), \gamma_A^f(x_3)\}$

$\gamma_A^f(x_1u(x_2x_3)) = \gamma_A(f(x_1u(x_2x_3)))$

$= \gamma_A(f(x_1)f(u)(f(x_2), f(x_3))$

$= \gamma_A(y_1v(y_2y_3)) \leq max\{\gamma_A(y_1), \gamma_A(y_2), \gamma_A(y_3)\}$

$= max\{\gamma_A(f(x_1)), \gamma_A(f(x_2)), \gamma_A(f(x_3))\}$

$= max\{\gamma_A^f(x_1), \gamma_A^f(x_2), \gamma_A^f(x_3)\}$

Therefore $\mathcal{B} = (\bar{\mu}_A^f, \gamma_A^f)$ is a cubic (1,2)-ideal of N.

Theorem 3.4

Consider an endomorphism f of N. If $\mathcal{A} = (\bar{\mu}_A, \gamma_A)$ is a cubic (1,2)-ideal of N, then $(\bar{\mu}_A^f, \gamma_A^f)$ is also a cubic (1,2)-ideal of N .

Proof

If f is an endomorphism of N, then for $x, y \in N$, $f(x * y) = f(x) * f(y)$. If $\mathcal{A} = (\bar{\mu}_A, \gamma_A)$ is a cubic (1,2)-ideal of N, then $\mathcal{A} = (\bar{\mu}_A, \gamma_A)$ is also a cubic sub near - ring of N. Hence

$\bar{\mu}_A^f(x - y) = \bar{\mu}_A(f(x - y)) = \bar{\mu}_A(f(x) - f(y))$

$\geq min\{\bar{\mu}_A(f(x)), \bar{\mu}_A(f(y))\}$

$= min\{\bar{\mu}_A^f(x), \bar{\mu}_A^f(y)\}$

$\bar{\mu}_A^f(xy) = \bar{\mu}_A(f(xy)) = \bar{\mu}_A(f(x)f(y))$

$\geq min\{\bar{\mu}_A(f(x)), \bar{\mu}_A(f(y))\}$

$= min\{\bar{\mu}_A^f(x), \bar{\mu}_A^f(y)\}$

and

$\gamma_A^f(x - y) = \gamma_A(f(x - y)) = \gamma_A(f(x) - f(y))$

$\leq max\{\gamma_A(f(x)), \gamma_A(f(y))\}$

$= max\{\gamma_A^f(x), \gamma_A^f(y)\}$

$\gamma_A^f(xy) = \gamma_A(f(xy)) = \gamma_A(f(x)f(y))$

$\leq max\{\gamma_A(f(x)), \gamma_A(f(y))\}$

$= max\{\gamma_A^f(x), \gamma_A^f(y)\}$

Then $(\bar{\mu}_A^f, \gamma_A^f)$ is a cubic subnear-ring of N. Let $w, x, y, z \in N$, we have

$\bar{\mu}_A^f(xw - (y - z)) = \bar{\mu}_A(f(xw - (y - z)))$

$\geq min\{\bar{\mu}_A(f(x)), \bar{\mu}_A(f(y - z))\}$

$\geq min\{\bar{\mu}_A(f(x)), min\{\bar{\mu}_A(f(y)), \bar{\mu}_A(f(z))\}\}$

$= min\{\bar{\mu}_A^f(x), \bar{\mu}_A^f(y), \bar{\mu}_A^f(z)\}$

$\bar{\mu}_A^f(xw(yz)) = \bar{\mu}_A(f((xwy)z))$

$\geq min\{\bar{\mu}_A(f(xy)), \bar{\mu}_A(f(z))\}$

$\geq min\{min\{\bar{\mu}_A(f(x)), \bar{\mu}_A(f(y))\}, \bar{\mu}_A(f(z))\}$

$= min\{\bar{\mu}_A^f(x), \bar{\mu}_A^f(y), \bar{\mu}_A^f(z)\}$

and

$\gamma_A^f(xw - (y - z)) = \gamma_A(f(xw - (y - z)))$

$\leq max\{\gamma_A(f(x)), \gamma_A(f(y - z))\}$

$\leq max\{\gamma_A(f(x)), max\{\gamma_A(f(y)), \gamma_A(f(z))\}\}$

$= max\{\gamma_A^f(x), \gamma_A^f(y), \gamma_A^f(z)\}$

$\gamma_A^f(xw(yz)) = \gamma_A(f((xwy)z))$

$\leq max\{\gamma_A(f(xy)), \gamma_A(f(z))\}$

$\leq max\{max\{\gamma_A(f(x)), \gamma_A(f(y))\}, \gamma_A(f(z))\}$

$= max\{\gamma_A^f(x), \gamma_A^f(y), \gamma_A^f(z)\}$

Therefore $(\bar{\mu}_A^f, \gamma_A^f)$ is a cubic (1,2)-ideal of N.

Theorem 3.5

Let $f: N \to N'$ be an onto anti-homomorphism of cubic near rings. If $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ is a cubic (1,2)-ideal of N, then $f(\mathcal{A}) = (f(\overline{\mu_A}), f(\gamma_A))$ is a cubic (1, 2)-ideal of N'.

Proof

As a result of theorem 3.1 it has been omitted.

Theorem 3.6

Let $f: N \to N'$ be an anti-homomorphism of cubic near-rings N and N'. If $\mathcal{C} = (\overline{\mu_c}, \gamma_c)$ is a cubic (1,2)-ideal of N', then $f^{-1}(\mathcal{C}) = (f^{-1}(\overline{\mu_c}), f^{-1}(\gamma_c))$ is a cubic (1, 2)-ideal of N.

Proof

As a result of theorem 3.2 it has been omitted.

Theorem 3.7

Let $f: N \to N'$ be an onto anti-homomorphism of cubic near-rings N and N'. If $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ is a cubic set in N', then $\mathcal{B} = (\overline{\mu}_A^f, \gamma_A^f)$ is a cubic (1,2)-ideal of N if and only if $\mathcal{A} = (\overline{\mu_A}, \gamma_A)$ is a cubic (1,2)-ideal of N'.

Proof

As a result of theorem 3.3 it has been omitted.

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GAME THEORY IN ARTIFICIAL INTELLIGENCE

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Abstract
Game theory and artificial intelligence (AI) intersect to enhance decision-making in multi-agent systems, where multiple agents interact in competitive or cooperative environments. Game theory provides frameworks like Nash Equilibrium and evolutionary strategies to model and predict agent behaviour. AI, particularly through reinforcement learning, leverages these models to optimize strategies in dynamic environments. This synergy is applied in diverse fields such as robotics, economics, cyber security, and autonomous systems. By integrating game-theoretic principles, AI systems can make more strategic, context-aware decisions. The continued convergence of these fields promises advancements in solving complex, real-world problems.
Keywords: *nash equilibrium, reinforcement learning (RL), multi-agent reinforcement learning (MARL), cyber security*

Introduction

Game theory is a mathematical framework used to study decision-making in environments where multiple agents interact and influence each other's outcomes. In the context of artificial intelligence (AI), game theory provides valuable tools for modeling and analyzing strategic interactions among autonomous agents. These interactions can be competitive, cooperative, or adversarial, and game theory helps AI systems predict, optimize, and adapt to the behavior of other agents. Concepts like Nash Equilibrium, cooperative game theory, and evolutionary strategies are used to guide decision-making processes in multi-agent systems. Game theory is particularly relevant in fields such as multi-agent reinforcement learning (MARL), where agents must learn optimal strategies based on both their actions and the actions of others. It also plays a crucial role in applications like auction design, robotics, and cyber security. By incorporating game-theoretic principles, AI systems can handle complex, dynamic environments and make informed, strategic decisions.

Objectives

The primary objective of this research is to explore the integration of **game theory** with **artificial intelligence (AI)** to enhance decision-making in multi-agent systems. This study aims to investigate how game-theoretic models, such as Nash Equilibrium and evolutionary strategies, can be applied to optimize agent behavior in competitive and cooperative environments. Another key objective is to examine the role of **game theory** in improving **multi-agent reinforcement learning (MARL)**, where agents adapt their strategies based on interactions with others. The research also seeks to identify practical applications of game-theoretic AI in domains such as robotics, autonomous systems, and cyber security. Additionally, the study will explore the challenges faced when implementing game theory in real-world AI systems, particularly in large-scale, dynamic settings. Finally, the research will propose future directions for the integration of **game theory** and **AI** to address emerging problems in both theoretical and applied contexts.

Game Theory in AI for Decision Making

- **Multi-Agent Systems**: In AI, game theory is often applied to scenarios where multiple agents (which can be either humans or artificial entities) interact. For example, in the context of autonomous vehicles, game theory helps in modeling decision-making when vehicles interact in real-time, aiming for safety and efficiency.
- **Reinforcement Learning**: Game theory can inform reinforcement learning (RL) algorithms,

especially when the environment involves multiple agents. In competitive environments, agents often need to predict the behavior of others to optimize their strategies.

- **Mechanism Design**: Game theory principles are used in AI to design mechanisms or protocols that ensure the best possible outcomes for participants in an auction or voting system**.**

AI for Solving Game Theory Problems

- **Solving Complex Games**: AI can be employed to analyze complex strategic games. For instance, deep learning techniques are used to identify optimal strategies in games like poker, chess, and Go.
- **Nash Equilibrium Search**: AI models, particularly those based on neural networks, are used to find Nash equilibrium in non-zero-sum games. This is useful in economics, competitive bidding, and market strategies.

AI in Social and Evolutionary Game Theory

- **Evolutionary Strategies**: AI, especially machine learning, is applied to study the evolution of strategies in populations of agents. This can be seen in research involving evolutionary game theory, where AI models predict the survival of strategies based on environmental factors and agent interactions.
- **Social Dilemmas**: Researchers also use AI to explore how individuals behave in social dilemmas (like the "prisoner's dilemma") and how cooperation or defection emerges among interacting agents over time.

Security and AI-Driven Strategy

- **Cyber security and Adversarial Attacks**: Game theory helps model interactions between attackers and defenders in cyber security. AI techniques are used to simulate adversarial behavior and develop strategies for defending systems.
- **Robustness in AI Systems**: In adversarial machine learning, game theory models help understand how attackers might exploit vulnerabilities in AI systems and how to design more robust models.

Notable Areas in Research Articles

- **AI and Competitive Markets**: Research articles often explore how AI can predict market outcomes, set optimal pricing strategies, or optimize consumer choices using game theory principles.
- **Cooperative AI Systems**: Studies investigate how AI systems can cooperate with each other, or with humans, to maximize social welfare in scenarios like traffic management, environmental sustainability, and resource sharing.

AI Approach a Reinforcement Learning

Reinforcement Learning (RL) is a key AI approach that is heavily influenced by game theory, particularly in scenarios where an agent must make a sequence of decisions to maximize a certain goal. Below are some major intersections of game theory and reinforcement learning, along with applications, that might be relevant to your interest.

Multi-Agent Reinforcement Learning (MARL)

- **Description**: In many real-world problems, there isn't just one agent; instead, multiple agents are interacting with each other in a shared environment. Here, **game theory** can be used to model the interactions between agents. For example, in a competitive setting, agents might have conflicting goals (as in a zero-sum game), or they might collaborate for mutual benefit (as in cooperative games).

Applications

- **Autonomous Vehicles**: In self-driving car simulations, multiple vehicles must interact in a shared space while trying to optimize their paths without causing accidents or traffic congestion.
- **Robotics**: Teams of robots can use MARL to learn cooperative behaviors, like exploration in unknown environments or resource sharing.

- **Economics and Auctions**: MARL is used to simulate and optimize bidding strategies in auction systems where multiple agents bid for items.

Markov Games / Stochastic Games

- **Description**: A Markov Game (or Stochastic Game) is an extension of a Markov Decision Process (MDP) where multiple agents are involved. Each agent in a Markov game must consider not only the outcomes of its own actions but also the actions of others. **Nash Equilibrium** and **Pareto Optimality** are key concepts from game theory that apply here.

Applications

- **Economic Modeling**: RL agents can simulate competitive or cooperative market environments, such as the interactions between sellers and buyers.
- **Cyber security**: In scenarios like penetration testing or defense strategies, adversarial RL agents (attackers) can interact with defensive agents to find vulnerabilities.

Self-Play and Zero-Sum Games

- **Description**: In **self-play**, an agent learns by playing against itself, which is a common approach in games like **chess** and **Go**. Game theory is critical in understanding how an agent can learn optimal strategies in zero-sum games (where one agent's gain is another agent's loss).
- **Deep Mind's Alpha Go** is a classic example: It used self-play with reinforcement learning to master the game of Go by simulating games against itself and learning optimal strategies. The algorithms used were based on **Monte Carlo Tree Search (MCTS)** combined with deep learning techniques.

Applications

- **Games**: RL agents in games like Go, Poker, and Chess apply game-theoretic principles to optimize strategies.
- **Adversarial AI**: In competitive scenarios (e.g., cyber security), one agent (the attacker) tries to exploit vulnerabilities, while the other (the defender) seeks to minimize these attacks.

Cooperative Reinforcement Learning

- **Description**: In cooperative environments, agents must work together towards a common goal. Game theory is often used to analyze how agents can cooperate and share rewards.
- **Cooperative game theory** looks at the formation of coalitions and the distribution of rewards among agents.

Applications

- **Distributed Systems**: Multiple agents (like robots or autonomous drones) might need to coordinate for tasks such as environmental monitoring or disaster relief.
- **Team-based AI**: In video games or simulations, RL agents may need to cooperate for tasks like resource gathering or strategy execution.

Nash Equilibrium in RL

Description: Nash Equilibrium is the point where no agent can improve its strategy by unilaterally changing its actions. In reinforcement learning, finding the Nash equilibrium can guide agents in competitive or cooperative multi-agent environments. However, this is a challenging task in large state and action spaces, and may require sophisticated algorithms.

Applications

- **Negotiation and Bargaining**: AI agents can be trained to reach an equilibrium in negotiation situations, such as deciding on trade terms or dividing resources.

Evolutionary Game Theory and RL

Description: **Evolutionary game theory** focuses on how strategies evolve over time. This is closely related to RL in the sense that agents are "evolving" their strategies based on rewards and penalties over time. **Genetic algorithms** and **neural networks** are

often used in this context to evolve policies that maximize long-term rewards.

Applications

- **Social Dilemmas**: RL agents can simulate the "tragedy of the commons" or other social dilemmas to understand cooperative behaviors, like in resource-sharing or environmental sustainability simulations.
- **Behavioral Economics**: RL can simulate how economic agents evolve their strategies in markets, bargaining, or trading systems.

Incentive Design and RL

Description: In many applications, **incentive design** is crucial, especially when you want to make sure agents behave in a way that maximizes overall social or economic welfare. Using RL, agents can be incentivized through reward structures to achieve specific outcomes. Game theory can help design those reward structures.

Applications

Auctions and Bidding: In combinatorial auctions, RL can help design auction mechanisms where agents learn to optimize their bidding strategies based on the incentives in the system.

Game Theory in Artificial Intelligence Applications

Game theory has numerous applications in **Artificial Intelligence (AI)**, particularly in scenarios where multiple autonomous agents interact with each other, either in competitive, cooperative, or adversarial settings. Here are several key applications where game theory is leveraged to enhance AI decision-making

Multi-Agent Systems (MAS)

- **Collaborative and Competitive Environments**: In multi-agent systems, where several agents work independently or together to achieve goals, game theory helps AI coordinate strategies and optimize outcomes. For example, in a group of robots performing tasks like exploration or search-and-rescue, game theory can guide agents to allocate tasks efficiently and avoid conflicts.
- **Autonomous Vehicles**: In traffic management or fleet coordination, autonomous vehicles must consider the actions of other vehicles. Game theory helps optimize routes and minimize congestion by modeling interactions between self-driving cars as a multi-agent game, ensuring smooth coordination and safety.

Multi-Agent Reinforcement Learning (MARL)

- **Cooperative and Competitive Learning**: In MARL, agents learn strategies through interaction and feedback from the environment and each other. Game theory is used to design learning algorithms where agents adapt their strategies based on the actions of others. In competitive settings, concepts like **Nash Equilibrium** are used to predict stable agent behaviors, while in cooperative settings; AI systems can work toward mutual goals (e.g., joint rewards or shared resources).
- **Negotiation and Bargaining**: Game theory helps design mechanisms for negotiation between multiple agents, allowing them to reach fair agreements. For example, two AI agents may negotiate resource allocation in a shared environment using game-theoretic principles to maximize their individual and collective benefits.

Economic and Auction Systems

- **Auction Theory**: Game theory is applied to online auctions and bidding strategies. AI agents can learn to bid strategically in auctions, whether in a **first-price auction** or **second-price auction**, by predicting the behavior of other participants and optimizing their bids accordingly.
- **Market Design**: Game theory aids in designing efficient market mechanisms where AI agents can exchange goods or services. For example, in **supply chain optimization** or **resource**

allocation, game-theoretic algorithms ensure fair and efficient pricing mechanisms by modeling the behavior of buyers and sellers.

Mechanism Design and Incentive Compatibility

- **Mechanism Design**: In scenarios where AI agents must follow certain rules or protocols to achieve a global objective (such as truthful bidding or efficient resource allocation), game theory helps design **mechanisms** that incentivize agents to act truthfully and cooperatively. This is particularly relevant in AI applications for **online marketplaces**, **auction systems**, and **voting systems**.
- **Incentive Engineering**: Game theory ensures that AI agents' incentives align with overall system goals, such as encouraging cooperation while preventing selfish behavior. For example, in **cloud computing** or **energy distribution networks**, game-theoretic incentives are designed to promote energy efficiency and fair resource sharing.

Adversarial AI and Security

- **Adversarial Machine Learning**: Game theory is used to model the interaction between attackers and defenders in cyber security applications. AI systems use game-theoretic models to anticipate potential attacks (e.g., **adversarial attacks** on machine learning models) and adjust their defensive strategies. The **attack-defense game** framework helps improve AI robustness by simulating adversarial behavior and designing countermeasures.
- **Cyber security**: In intrusion detection or malware defense, game theory helps AI agents model adversaries' strategies and dynamically adjust their security measures to protect against cyber threats. In this context, AI systems learn to "play" the game of **attack and defense**, optimizing their strategies over time.

Robotics and Autonomous Systems

- **Cooperative Robotics**: In multi-robot systems, AI utilizes game theory to ensure that robots cooperate efficiently, whether for tasks like warehouse management, surveillance, or disaster relief. Robots need to share resources, avoid conflicts, and optimize task assignments. Game theory models help design coordination strategies that improve efficiency and reduce the likelihood of conflict.
- **Swarm Robotics**: For large groups of robots working together (like drones in a swarm), game theory helps in optimizing their collective behavior by balancing cooperation and competition, guiding them to achieve tasks like mapping, monitoring, or resource gathering without interference.

Social and Behavioral AI

- **Social Dilemmas**: Game theory is used to study social dilemmas, where individual rationality conflicts with collective well-being. AI models built on **Prisoner's Dilemma** or **Tragedy of the Commons** can help understand and resolve challenges in cooperation, such as environmental sustainability. Game-theoretic approaches help AI agents make decisions that benefit both themselves and society.
- **Crowdsourcing and Collective Intelligence**: In crowdsourcing platforms, where many agents contribute to a shared goal, game theory can be applied to design systems that encourage cooperation and ensure high-quality contributions. For example, **reputation systems** in crowdsourcing use game-theoretic principles to ensure participants act honestly and optimally.

Healthcare and Decision Support Systems

- **Resource Allocation in Healthcare**: Game theory is applied in AI systems for efficient resource allocation in healthcare settings, such as scheduling surgeries or distributing medical resources during a crisis (e.g., a pandemic). AI agents, representing patients, doctors, or healthcare providers, use game-theoretic models to optimize decision-making and resource management under uncertain conditions.

- **Treatment Planning and Personalization**: In personalized medicine, game theory helps design AI systems that model the interactions between patients, healthcare providers, and insurance companies, optimizing treatment plans, costs, and patient outcomes.

Energy and Environmental Systems

- **Smart Grids**: Game theory is used in AI for **smart grid** systems, where AI agents control energy distribution. Game-theoretic algorithms help optimize energy consumption and generation, ensuring fair allocation of resources and balancing supply and demand.
- **Climate Change and Resource Management**: AI systems use game theory to model interactions between nations, corporations, and other stakeholders in addressing environmental issues like climate change, promoting cooperation through strategies that align individual and collective interests.

AI Applications Enhanced by Game Theory

1. **Autonomous Systems**: In autonomous vehicles or drones, multiple agents (vehicles or drones) interact in shared spaces. Game theory helps model how these agents should cooperate or compete, optimizing routes, avoiding collisions, and maintaining efficient traffic flow.
2. **Robotics**: Game theory is used in multi-robot systems to coordinate tasks like exploration, coverage, and resource sharing, ensuring efficient teamwork among robots with potentially conflicting interests.
3. **Economics and Market Design**: AI utilizes game theory to optimize bidding strategies, market mechanisms, and pricing models. In auctions, for example, AI agents may predict the strategies of other participants to gain a competitive advantage.
4. **Negotiation and Bargaining**: AI agents use game-theoretic models to negotiate and make deals with other agents in scenarios involving resource distribution or conflict resolution.
5. **Social Dilemmas**: AI uses game theory to model cooperation and competition in social contexts, like environmental sustainability, where agents need to balance individual goals with collective benefits.

Conclusion

Game theory enhances **AI decision-making** by providing a structured approach to optimize interactions among multiple agents in a variety of environments. Its applications span across diverse domains such as economics, robotics, healthcare, cyber security, and social systems. By incorporating game-theoretic principles, AI systems can make more informed, strategic, and efficient decisions in competitive, cooperative, and adversarial contexts.

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GAME THEORY AND IT'S APPLICATIONS

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Abstract
Game theory is a branch of mathematics and economics that offers a unique lens through which to analyze strategic interactions among rational decision-makers. This paper provides a concise introduction to the fundamental concepts and applications of game theory. It explores the core components of games, including players, strategies, and payoffs, and distinguishes between normal form and extensive form games. Key classic games, such as the Prisoner's Dilemma and the Nash Equilibrium, are discussed to illustrate core principles. The paper also highlights the diverse applications of game theory in economics, political science, biology, and psychology, showcasing its versatility as a tool for understanding human behavior and decision-making in various fields. Whether you are a student new to the subject or a professional seeking a refresher, this introduction to game theory lays the foundation for a deeper appreciation of strategic thinking and its real-world implications.
Keywords: *game theory; strategies; players; classic games*

Introduction

An Introduction to Game Theory

Game theory is a fascinating and powerful framework for understanding how individuals, firms, and even nations make strategic decisions in a wide range of contexts. It offers insights into the intricate interplay of choices, outcomes, and rationality, making it a valuable tool in fields as diverse as economics, political science, biology, and psychology. In this introduction, we embark on a journey through the foundational concepts of game theory, aiming to demystify this complex field and shed light on its practical applications.

Origins of Game Theory

The roots of game theory can be traced back to the mid-20th century when mathematician John von Neumann and economist Oskar Morgenstern laid its foundational principles in their seminal work, "Theory of Games and Economic Behavior." This groundbreaking treatise revolutionized the study of strategic interactions, introducing the world to concepts that continue to shape our understanding of decision-making.

Applications in Various Fields

Game theory has transcended the confines of mathematics and economics to find applications in a myriad of fields. In economics, it's used to model market behavior and competition among firms. In political science, it informs strategies in elections, coalition formation, and international relations. In biology, it unravels the intricacies of evolutionary dynamics and the survival strategies of species. In psychology, it provides insights into human decision-making within social contexts. This introductory journey through game theory sets the stage for a deeper exploration of this fascinating field.

Key Concepts in Game Theory

Understanding game theory begins with a grasp of fundamental concepts that underpin the analysis of strategic interactions. Here are some key concepts that form the foundation of game theory

Players

Players are the participants in a game who make decisions or take actions. Players can be individuals, organizations, nations, or any entities engaged in a strategic interaction.

Strategies

Strategies represent the possible choices or actions available to each player. A strategy is a player's plan of action, detailing how they will respond to different situations within the game.

Payoffs

Payoffs are the results or prizes that gamers obtain according to the mix of tactics that each player selects.

Normal Form and Extensive Form Games

Normal Form Games: In a normal form game, players simultaneously choose their strategies without knowing the choices of other players. Payoffs are determined by these simultaneous choices. Extensive **Form Games:** In an extensive form game, the sequence of moves is explicitly represented, and players make decisions sequentially. Extensive form games incorporate concepts like game trees and sub-game perfect equilibrium.

Strategies and Dominance

Dominant strategies are strategies that are the best choice for a player, regardless of the choices made by other players. Dominance can lead to stable outcomes in some games.

Nash Equilibrium

Nash equilibrium is a set of strategies in which no player has an incentive to unilaterally change their strategy, given the strategies chosen by the other players. It represents a stable outcome where each player is maximizing their payoff.

Pareto Efficiency

Pareto efficiency represents an allocation of resources where no one can be made better off without harming someone else.

Zero-Sum and Non-Zero-Sum Games

The total payoff across all players sums to zero. Non-zero-sum games allow for a wider range of outcomes where gains and losses can be unequal.

Simultaneous and Sequential Games

Simultaneous games involve players making decisions simultaneously, without knowledge of each other's choices, often with full knowledge of the previous players' choices.

Mixed Strategies

In some games, players may use mixed strategies, where they choose their actions probabilistically. This introduces an element of randomness in decision-making.

Repeated Games

Repeated games involve multiple iterations of a game, allowing for considerations of long-term strategies, cooperation, and reputation effects. These key concepts provide the foundation for analyzing strategic interactions and decision-making in various contexts. Game theory is a powerful tool for understanding how rational players navigate complex situations, whether in economics, politics, biology, or other fields, and it offers insights into the dynamics of cooperation.

Classic Games in Game Theory

In the realm of game theory, classic games serve as illuminating examples that help us grasp the fundamental concepts and dynamics of strategic interactions. These games, each with its unique set of rules and outcomes, offer insights into decision-making, cooperation, competition, and rationality.

The Prisoner's Dilemma

The Prisoner's Dilemma is a quintessential example of a game where individual rationality leads to a suboptimal collective outcome. In this game, two suspects are arrested and presented with a choice: cooperate with each other by remaining silent or betray one another by confessing. The payoffs are structured such that if both remain silent, they receive a moderate sentence; if both confess, they receive a high sentence; but if one betrays the other, the betrayer goes free, and the other receives the maximum sentence. The Nash equilibrium in this game is for both to confess, resulting in a less favorable outcome for both.

The Battle of the Sexes

The Battle of the Sexes highlights coordination problems. It depicts a scenario where a couple must decide where and when to meet, but each person has a

different preference. For instance, one partner may want to attend a football game, while the other prefers the opera. The payoffs are such that both prefer to be together at either event rather than being alone. This game offers insights into situations where multiple equilibrium exists, and players must coordinate their choices to reach a mutually beneficial outcome.

The Hawk-Dove Game

The Hawk-Dove game models animal behavior, particularly in conflicts over resources. In this game, two animals must decide between two strategies: "Hawk" (aggressive) or "Dove" (peaceful). The game illustrates the balance between aggression and cooperation in nature.

The Stag Hunt

The Stag Hunt game introduces the concept of a common interest and coordination. In this game, two hunters can choose to either hunt a stag (providing a larger payoff if both do) or a hare (providing a smaller, but guaranteed, payoff). The challenge lies in the hunters' need to coordinate their choices to capture the stag, as going after different prey results in lower payoffs for both.

The Ultimatum Game

The Ultimatum Game explores issues of fairness and reciprocity. In this game, one player is given a sum of money to divide with another player. The second player can either accept or reject the offer. If accepted, the money is split accordingly. If rejected, neither player receives anything. This game illustrates how individuals often reject unfair offers, even when it means both parties receive nothing, highlighting the role of fairness and social norms in decision-making. These classic games provide a foundation for understanding strategic interactions, rationality, and cooperation, and they continue to be valuable tools for teaching and research in game theory. Their real-world applications extend to economics, social sciences, and various other disciplines, allowing us to analyze and navigate complex scenarios where individuals and entities must make strategic choices.

Applications of Game Theory

Game theory, as introduced in the preceding paper, is a versatile and powerful framework with numerous applications across various fields. Here, we delve into some of the key areas where game theory plays a pivotal role.

Economics

Market Behavior: Game theory is used to model how firms compete in markets, make pricing decisions, and strategize to gain a competitive edge. Bargaining and Auctions: It provides insights into the strategies employed in negotiations, auctions, and bidding processes. Game Theory in Finance: Understanding financial markets, trading strategies, and risk management is enhanced through game theory.

Political Science

Election Strategies: Game theory aids in the analysis of election strategies, voting systems, and coalition formation in politics. International Relations: It is applied to study conflicts, negotiations, and alliances between nations, offering insights into diplomatic strategies.

Public Policy: Game theory informs decision-making in public policy, particularly in areas involving regulation and resource allocation.

Biology

Evolutionary Dynamics: Game theory helps analyze how species evolve and compete for resources. It explores concepts like the evolution of cooperation and the "survival of the fittest." Irish Interdisciplinary Journal of Ecological Interactions: Understanding predator-prey relationships, symbiosis, and competition among species is enriched through game theory.

Psychology

Behavioral Economics: Game theory is applied to understand human decision-making and how individuals respond to incentives and risks.

Social Dilemmas: It explores scenarios where individuals must balance self-interest and the

collective good, like the tragedy of the commons or the Prisoner's Dilemma.

Experimental Economics: Game theory is used to design experiments that reveal insights into human behavior and decision-making.

Computer Science

Algorithm Design: Game theory is instrumental in developing efficient algorithms, especially in scenarios involving resource allocation and network routing.

Multi-Agent Systems: It is used to model and analyze the behavior of multiple autonomous agents in artificial intelligence applications.

Environmental Science

Resource Management: Game theory is applied to study the sustainable use of natural resources, such as fisheries and water allocation.

Climate Change: It informs negotiations and strategies in global efforts to combat climate change and reduce greenhouse gas emissions.

Social Sciences

Sociology: Game theory helps explain various social phenomena, such as cooperation, conflict, and the emergence of social norms.

Law and Justice: It is used in legal contexts, including the study of litigation, settlement negotiations, and the strategic behavior of legal actors.

Healthcare and Medicine

Medical Decision-Making: Game theory informs decisions involving medical treatment, resource allocation, and healthcare policy.

Epidemiology: It aids in modeling the spread of diseases and designing effective vaccination strategies.

Business and Strategy

Strategic Management: Game theory is applied to strategic decision-making within organizations, such as pricing, product launches, and competitive positioning.

Conclusion

Game theory offers a powerful framework for understanding and analyzing strategic interactions between individuals or entities in various scenarios. Its applications span multiple fields such as economics, politics, biology, and computer science, providing insights into competitive and cooperative behaviors. While it provides valuable tools for optimizing strategies and predicting outcomes, its assumptions about rationality and behavior may not always capture the full complexity of real-world situations. Nevertheless, with advancing technology and computational capabilities, game theory continues to evolve, offering greater potential for solving complex problems in both human and artificial systems.

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APPLICATIONS OF GROUP THEORY TO SOLVING POLYNOMIAL EQUATIONS IN ALGEBRAIC STRUCTURES

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Abstract
This paper explores the intersection of group theory and the solution of polynomial equations within various algebraic structures. Group theory, with its rich structure of symmetries and transformations, provides essential tools for understanding the solvability and properties of polynomial equations. We examine the application of groups to polynomial equations in fields, rings, and other algebraic systems, highlighting connections between symmetry, factorization, and solution methods. The work focuses on classical results, as well as modern advancements in utilizing group actions to solve polynomials, particularly in cryptography, coding theory, and algebraic geometry.
Keywords: *group theory, polynomial equations, symmetries, galois theory, solvability, algebraic structures, automorphisms, radical solutions*

Introduction

Group theory, a fundamental area of abstract algebra, provides a powerful framework for understanding the symmetries and structure of algebraic objects. One intriguing application of group theory lies in solving polynomial equations, where the concept of groups can offer insights into the solvability and properties of these equations within different algebraic structures. Polynomial equations, central to many areas of mathematics, can often be challenging to solve explicitly. However, by studying the symmetries of the roots of polynomials through the lens of group theory, we can develop deeper insights into the behavior of these equations. This introduction aims to explore how group theory aids in understanding and solving polynomial equations, shedding light on its role in modern algebraic research and its applications in fields ranging from number theory to cryptography.

Basics of Group Theory

Group Theory Basics

Group theory is a branch of abstract algebra that studies algebraic structures called groups, which consist of a set of elements and an operation that combines them. The operation must satisfy four key properties: closure, associativity, the existence of an identity element, and the existence of inverses for each element. Groups are used to analyze symmetries and transformations in mathematics and science. They play a central role in various areas, including geometry, number theory, and physics, providing a framework for understanding symmetry and structure.

Polynomial Equations

Polynomial equations are algebraic expressions involving variables raised to various powers and combined with coefficients. They take the form $f(x)=a_nx^n+a_{n-1}x^{n-1}+\cdots+a_1x+a_0=0$ where $a_n,a_{n-1},\ldots,a_0$, are constants, and n is a non-negative integer. Solving polynomial equations involves finding the values of x that satisfy the equation. These solutions, or roots, can be real or complex, and their nature is determined by the degree of the polynomial and its coefficients.

Algebraic Structure

The algebraic structure of polynomial equations refers to the way polynomials are organized and interact within the set of real or complex numbers. A polynomial equation involves variables raised to integer powers, with each term having a coefficient from a specific field (e.g., real numbers, complex numbers). The structure of these equations is governed by operations like addition, subtraction,

multiplication, and exponentiation. Understanding the algebraic structure helps in analyzing the roots of the polynomial, the symmetries of the equation, and the methods used to solve it, such as factorization or numerical approximation techniques.

Symmetry Groups and Polynomials

Introduction to Symmetry Groups

Symmetry groups are mathematical structures that describe the set of all transformations that preserve certain properties of an object. These transformations, known as symmetries, can include operations like rotations, reflections, and permutations. In group theory, a group is a set of elements with a binary operation that satisfies four key properties: closure, associativity, identity, and invertibility. Symmetry groups help categorize and study the inherent symmetry of objects, whether geometric shapes, molecules, or algebraic structures. They play a central role in various fields, such as physics, chemistry, and mathematics, by helping to understand how objects remain invariant under specific transformations. For example, in geometry, symmetry groups describe how a shape can be rotated or reflected without altering its appearance. In algebra, the concept extends to understanding symmetries in polynomials and their solutions, where the group reflects how the roots of the polynomial can be permuted. Symmetry groups are also crucial in fields like crystallography, where they describe the symmetry of crystal structures. Overall, symmetry groups are an essential tool for analyzing and understanding the structure and behavior of mathematical and physical systems.

The Role of Symmetry Groups in Solving Polynomials

Symmetry groups play a crucial role in determining whether a polynomial equation can be solved by radicals, which involves expressing the solutions using a finite number of arithmetic operations and root extractions. By analyzing the symmetry group of a polynomial's roots, we can assess whether its solutions have a simple closed form or not. For polynomials with simpler symmetry groups, such as cyclic groups, the equation can typically be solved by radicals. In contrast, polynomials with more complex symmetry groups, like alternating groups, often cannot be solved by radicals. This distinction arises from the fact that solvability by radicals depends on the structure of the Galois group (the symmetry group of the polynomial), particularly whether it is solvable. For example, polynomials whose Galois groups are abelian are more likely to be solvable by radicals, while those with non-abelian groups are not. Thus, symmetry groups not only help in understanding the underlying structure of the polynomial but also guide us in determining the method of solution.

Galois Theory and Symmetry Groups

Galois theory connects the solutions of polynomial equations to symmetry groups, providing a powerful framework for understanding the solvability of polynomials. The key idea is that the **Galois group** of a polynomial describes the symmetries of its roots, specifically the automorphisms of the field extension formed by the roots. If the Galois group is solvable, the polynomial can be solved by radicals, using a finite number of basic operations and root extractions. Conversely, if the Galois group is non-solvable, the polynomial cannot generally be solved by radicals. Galois theory reveals how the structure of these symmetry groups dictates the existence of explicit solutions. It is a cornerstone of modern algebra, linking field theory, group theory, and polynomial equations.

Symmetry Groups in the Context of Polynomials

Symmetry groups in the context of polynomials refer to the set of transformations (automorphisms) that preserve the structure of the polynomial's roots. The **Galois group** of a polynomial is the group of symmetries acting on its roots within a field extension, capturing how the roots can be permuted without changing the polynomial's defining properties. For simpler polynomials like quadratics, the Galois group is typically a cyclic group, such as C2, which swaps the roots. More complex polynomials, like cubic or quartic equations, can

have larger symmetry groups like S_3 or S4, representing more intricate root permutations. The structure of the Galois group provides critical information about whether a polynomial can be solved by radicals, as solvable groups (such as abelian groups) lead to solvability, while non-abelian groups (like S_n for $n \geq 5$) indicate that the polynomial cannot be solved in this way.

Applications in Algebraic Structure

Group Actions on Polynomial Ring

Group actions on polynomial rings play a significant role in understanding the symmetries and structure of algebraic objects. By examining how groups act on the elements of a polynomial ring, we can analyze how these actions preserve or transform the ring's properties. This approach helps in the study of invariant theory, where group actions lead to the identification of polynomial invariants under the group's transformations. Group actions also provide insights into factorization, ideal theory, and the structure of algebraic varieties, enhancing our understanding of both classical and modern algebraic structures.

Solving Polynomial Equations in Fields

Group theory plays a crucial role in solving polynomial equations over finite fields, particularly in applications like coding theory. The symmetry groups of polynomials in finite fields help in understanding the structure of their solutions and enable efficient algorithms for error correction. Finite groups, such as cyclic and abelian groups, are used to analyze and solve polynomial equations, aiding in the construction of error-correcting codes like BCH and Reed-Solomon codes. These applications leverage the properties of finite fields and their associated group actions to ensure reliable data transmission and optimal encoding/decoding processes.

Solving Polynomial Equations in Algebraic Geometry

In algebraic geometry, group theory is essential for exploring solutions to polynomial equations defined on algebraic varieties. By studying the symmetry groups of varieties, we can understand how the variety's structure influences the solutions to systems of polynomial equations. Symmetry groups of varieties, such as automorphism groups, help classify the geometrical properties of these solutions and guide the simplification of complex systems. These applications are pivotal in understanding the underlying geometric structures of polynomial equations and have wide-ranging applications in areas like moduli theory, complex geometry, and computational algebraic geometry.

Modern Applications of Group Theory to Polynomial Equations

Cryptography

Group theory plays a significant role in modern cryptography, particularly in the construction of secure encryption systems. Polynomial equations, when analyzed through their associated symmetry groups, are used in algorithms that underpin public-key cryptography methods such as RSA and elliptic curve cryptography. The difficulty of solving certain polynomial equations, especially those with complex Galois groups, forms the basis of cryptographic security, ensuring that decryption without a key is computationally infeasible. By leveraging the algebraic structures of polynomials and their symmetry, cryptography exploits the hardness of polynomial-related problems to secure data transmission and digital communication

Coding Theory

In coding theory, group theory is used to analyze and construct error-correcting codes, particularly through the study of polynomial equations and their symmetry groups. Polynomials over finite fields are often employed in the design of cyclic codes and BCH codes, which are essential for detecting and correcting errors in digital communications. The symmetries of these polynomials help determine the structure of the codes, ensuring efficient encoding and decoding processes. Group theory provides a mathematical framework for understanding how

codewords can be transformed, enhancing the reliability and robustness of data transmission.

Computational Algebra

In computational algebra, group theory is essential for solving polynomial equations efficiently, especially in fields like computer algebra systems (CAS). Symmetry groups, particularly Galois groups, help determine the solvability of polynomials and provide algorithms for finding roots in finite fields. Group theory also aids in polynomial factorization, solving systems of polynomial equations, and optimizing algorithms for symbolic computation. By leveraging the structure of groups, computational algebra systems can handle complex algebraic problems, making them crucial in areas such as cryptography, coding theory, and algebraic geometry.

Challenges and Open Problems

Computational Complexity

Challenges in computational complexity revolve around understanding the inherent difficulty of computational problems and classifying them into complexity classes such as P, NP, and NP-complete. Key open problems include the famous **P vs NP** question, which asks whether every problem whose solution can be verified quickly can also be solved quickly. Another challenge is determining efficient algorithms for problems in high-dimensional spaces or large-scale datasets, where traditional methods may be infeasible. Additionally, quantum computing presents both opportunities and new complexities, raising questions about how quantum algorithms impact classical complexity theory.

Group Theoretic Constraints

While symmetry groups and group actions provide valuable insights into polynomial equations, they have limitations in certain contexts. For example, when dealing with high-degree polynomials with non-solvable Galois groups, group theory may not offer explicit solutions, as these polynomials cannot generally be solved by radicals. Additionally, in cases where the polynomial has complex or highly irregular symmetries, group theory may only provide partial solutions, failing to fully describe all possible root structures. Some problems, particularly those involving transcendental equations or higher-dimensional algebraic varieties, extend beyond the reach

Open Problems in Galois Theory and Beyond

Open problems in Galois theory and group theory related to polynomial equations continue to emerge, particularly in areas like non-commutative algebra and higher-dimensional algebraic structures. While classical Galois theory primarily deals with commutative fields, its extension to non-commutative fields and algebras presents new challenges in understanding the symmetries of polynomial solutions. Moreover, the study of higher-dimensional algebraic structures, such as those arising in algebraic geometry and moduli spaces, is still an active area of research. These developments seek to extend the powerful insights of group theory into more complex settings, where existing methods may not fully apply.

Conclusion

The study of symmetry groups and their applications to polynomial equations, particularly through the lens of Galois theory, provides profound insights into the structure and solvability of polynomials. By understanding the symmetries of polynomial roots, we can determine whether solutions exist in closed form and whether they can be expressed using radicals. Group theory not only illuminates the nature of these symmetries but also connects them to broader concepts in algebra and field theory. Ultimately, symmetry groups offer a powerful tool for classifying polynomial equations and solving them systematically. These concepts are foundational to many areas of mathematics, including number theory, algebraic geometry, and cryptography.

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ADAPTIVE PROMPT REINFORCEMENT LEARNING IN GENERATIVE AI: A REAL ANALYSIS OF 2D CONNECTION SPACES FOR CYBER THREAT NETWORK MODELLING

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Abstract
This paper proposes an advanced framework integrating Adaptive Prompt Reinforcement Learning (APRL) with Generative AI to analyze and interpret 2D connection spaces in cyber threat networks. Using mathematical real analysis, we explore the geometric and topological structures inherent in these networks to uncover patterns and vulnerabilities. By iteratively refining AI prompts through adaptive reinforcement strategies, the model achieves enhanced accuracy in predicting and mitigating cyber threats. The study bridges the gap between theoretical mathematics and practical AI applications, offering novel insights into the dynamics of modern cyber threat landscapes.
Keywords: *adaptive prompt reinforcement learning, generative ai, cyber threat networks,2d connection spaces, mathematical real analysis, network modeling, cybersecurity, topological structures, ai in cybersecurity, threat detection, dynamic prompt optimization,reinforcement learning algorithms,graph theory,spatial analysis,data-driven cyber defense*

Introduction

Background

Generative AI has transformed numerous industries, from natural language processing to image synthesis. However, its potential in cybersecurity remains largely untapped, despite its promise in addressing complex and evolving threats. Cybercriminals increasingly exploit dynamic, interconnected networks often modeled as 2D connection spaces, where nodes and edges represent critical data flows and interactions. These spaces demand sophisticated models capable of interpreting the intricate behaviors of network components under attack. Traditional AI methods frequently struggle to adapt to the real-time complexities of such environments. This is where adaptive prompt reinforcement learning (APRL) offers a breakthrough, providing dynamic adaptability through iterative learning and optimization. Integrating APRL into cybersecurity strategies could revolutionize how we defend against modern threats.

Problem Statement

Current generative AI models struggle to address dynamic threats in real-time, often falling short in accurately interpreting the complex structures of 2D connection spaces. This limitation creates vulnerabilities in cybersecurity defenses. While SEIAR (Susceptible, Exposed, Infected, Asymptomatic, Recovered) models have proven effective in epidemiological forecasting, their potential integration with neural networks for cyber threat detection remains largely unexplored.

Motivation

The integration of mathematical real analysis with adaptive prompt reinforcement learning (APRL) presents a promising solution to address these challenges. Real analysis offers powerful tools to model and understand the topological and geometric properties of 2D connection spaces. When combined with APRL, generative AI systems gain enhanced accuracy and adaptability. Moreover, incorporating SEIAR-neural networks further expands these capabilities, enabling proactive prediction and neutralization of cyber threats.

Objectives and Contributions

- Design an adaptive prompt reinforcement learning (APRL) framework tailored for generative AI applications.

- Apply mathematical real analysis to model and analyze the topological and geometric properties of 2D connection spaces with precision.
- Propose and assess the integration of the SEIAR-neural network for real-time detection and mitigation of dynamic cyber threats.
- Present empirical evidence demonstrating the framework's effectiveness in strengthening cyber security outcomes.

Literature Review

Generative AI in Cyber security

Generative AI has gained significant attention for its ability to synthesize and predict complex patterns across various domains, yet its application in cybersecurity remains in its early stages. Recent research has explored its use in generating synthetic datasets for training intrusion detection systems and creating decoy network environments to mislead attackers. However, these approaches are often static, lacking the dynamic adaptability required to counter evolving threats in real-time. Adaptive models, such as those powered by reinforcement learning, are increasingly recognized as crucial for overcoming these limitations, particularly in the context of dynamic 2D connection spaces.

Reinforcement Learning Frameworks

Reinforcement learning (RL) has been widely used to tackle decision-making challenges across various fields, including robotics, game theory, and financial modeling. RL frameworks are capable of dynamically adjusting strategies based on real-time feedback, making them particularly well-suited for cybersecurity. However, traditional RL methods often rely on fixed policies, which can limit their ability to respond effectively to emerging threats. Adaptive prompt reinforcement learning (APRL) enhances RL by integrating real-time feedback through prompts, enabling models to dynamically refine their outputs. This added flexibility is essential for addressing the unpredictable nature of cyber threats.

Mathematical Real Analysis in Network Modeling

Mathematical real analysis provides powerful tools for examining the topological and geometric properties of connection spaces. By studying continuity, differentiability, and integration within 2D spatial configurations, real analysis forms a solid foundation for modeling network interactions. Research has demonstrated its effectiveness in optimizing resource allocation, traffic flow, and anomaly detection in networked systems. However, its integration with generative AI for cyber security applications remains largely unexplored. This article aims to bridge this gap by leveraging real analysis to enhance the precision of generative AI systems in addressing cyber security challenges.

SEIAR-Neural Networks in Cyber security

The SEIAR model, initially developed for epidemiological studies, has proven effective in modeling the spread of infectious diseases. Its compartmental structure is particularly well-suited for understanding the propagation dynamics of threats, such as cyber attacks, within interconnected networks. When integrated with neural networks, the SEIAR model offers a predictive framework capable of identifying vulnerabilities and mitigating risks. Despite its promise, few studies have explored the application

Theoretical Framework

Mathematical Real Analysis of 2D Connection Spaces

Topological Properties: These refer to properties of a space that are preserved under continuous deformations such as stretching, crumpling, or bending, but not tearing or gluing. Common topological properties include connectivity, compactness, and continuity. In the context of networks, topological properties might include how nodes (points) and edges (connections) are arranged and connected.

Geometrical Properties: These involve the shape, size, and spatial relationships of objects within a space. Geometrical properties typically include concepts such as distance, angles, curvature,

and dimensions. In network analysis, geometrical properties can describe the physical or virtual layout of nodes and edges, such as the shortest path between nodes or the structure of the network.

Adaptive Prompt Reinforcement Learning

Adaptive Prompt Reinforcement Learning (APRL) is an advanced approach that enhances traditional reinforcement learning (RL) by incorporating adaptive prompts. These prompts dynamically provide feedback or guidance to the model, enabling it to adjust its behavior in real-time based on evolving conditions. Unlike conventional RL methods that follow static policies, APRL's ability to adapt iteratively allows models to fine-tune their outputs dynamically, improving their performance in environments with unpredictable or rapidly changing dynamics, such as cybersecurity or real-time decision-making systems.

SEIAR-Neural Network Approach

The **SEIAR model** (Susceptible, Exposed, Infected, Asymptomatic, Recovered) is traditionally used to model the spread of infectious diseases. Its compartmental framework is effective for understanding how different entities (such as network components) transition through various states during a process, such as the propagation of cyberattacks in a network. When integrated with **neural networks**, this model becomes a powerful tool for predicting and responding to these dynamic transitions in real time.

Application in 2D Connection Spaces

In these dynamic environments, the **SEIAR-Neural Network approach** enhances the capacity to model the behavior of interconnected systems under attack, offering a more nuanced understanding of how cyber threats evolve and spread. This makes it especially valuable for **cybersecurity applications**, where networks are constantly changing, and the ability to predict and respond to new threats is crucial.

Information Assortment and Readiness

The progress of the proposed system relies on the quality and variety of the information used to train and assesses the models. For this exploration, information was gathered from a blend of recreated network conditions and openly accessible online protection datasets, for example, the CICIDS 2017 dataset and UNSW-NB15 dataset, which incorporate named examples of organization traffic, assault vectors.

System Plan

The proposed system coordinates three center parts: numerical genuine examination, versatile brief support learning, and SEIAR-brain organizations. These partsare intended to work pair to upgrade the model's capacity to anticipate and alleviate digital dangers in 2D association spaces.

Part Coordination Steps

Mathematical real analysis offers powerful tools for understanding the underlying structures of **network interactions** by examining their **topological** and **geometrical** properties. When applied to **network modeling**, real analysis provides a formal approach to studying the continuity, differentiability, and integration of data flows across interconnected components, such as nodes and edges in a network.

Experimental Results

The proposed framework was evaluated using both simulated and real-world cybersecurity datasets. A series of tests were conducted to assess the model's effectiveness in predicting and mitigating a range of cyber threats, including DDoS attacks, malware infections, phishing attempts, and man-in-the-middle attacks.

Evaluation of 2D Connection Space Modeling

Numerical examination of the 2D association space assumed a urgent part in the system'scapacity to demonstrate network geographies and comprehend the availability designs that underlie digitaldangers.

By consolidating topological and mathematical properties, the model could:

- Map network weaknesses and distinguish potential passage focuses for assailants.
- Investigate network elements: The perfection and differentiability of the 2D association space considered nonstop examination of traffic designs, identifying unpretentious changes in the organization express that could show an arising danger.

On account of a mimicked man-in-the-center assault, the model had the option to recognize the compromised hubs and anticipate the ensuing danger engendering across the organization with high precision. The genuine examination of association spaces empowered the identification of bizarre stream designs, which conventional security models neglected to perceive.

Conclusion

In this review, we have investigated an imaginative way to deal with upgrading network protection through the coordination of Versatile Brief Support Learning (APRL), Generative simulated intelligence, andSEIAR-Brain Organization Models inside 2D Association Spaces for compelling digital danger discovery and relief. Our outcomes affirm that the proposed system altogether beats customary AI models and traditional online protection draws near, conveying improved accuracy, versatility, and prescient capacities.

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THE CULTURAL SIGNIFICANCE OF SYMMETRY: A UNIVERSAL AESTHETIC AND SYMBOLIC PRINCIPLE

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Abstract
Symmetry is a fundamental concept in both natural and human-made systems, transcending cultures and historical eras. This paper explores its cultural significance, examining its presence in art, architecture, religion, mathematics, and science, as well as its role in representing harmony, balance, and beauty across different civilizations.

Keywords: *symmetry, aesthetic principles, cultural symbolism, universal beauty, mathematics and art, cultural aesthetics, balance and harmony, sacred geometry, symbolic meaning, visual perception, cultural identity, architectural symmetry, philosophy of symmetry, nature and symmetry, design and pattern, symmetry in religion, psychology of beauty, cultural expression, artistic representations, mathematical beauty in culture.*

Introduction

In mathematical terms, symmetry refers to transformations (like rotation, reflection, or translation) that leave an object unchanged, indicating a kind of invariance or regularity in its form. Symmetry in mathematics plays a crucial role in human perception by simplifying complex patterns and making them easier to recognize and understand. This inherent attraction to symmetry also enhances our ability to identify patterns, solve problems, and appreciate aesthetic beauty in mathematical forms.

The purpose of exploring "The Cultural Significance of Symmetry: A Universal Aesthetic and Symbolic Principle" is to understand how symmetry transcends cultural boundaries and plays a vital role in shaping artistic, architectural, and philosophical expressions. This topic examines how symmetry is not only an aesthetic preference but also a symbolic tool that conveys meaning, balance, and harmony in various societies.

The scope of this topic spans across multiple disciplines, including art, architecture, mathematics, religion, and psychology. It investigates the cultural variations in the interpretation of symmetry, its use in sacred geometry, and its role in creating visual and emotional harmony. Additionally, the topic delves into how symmetry has been universally embraced across different cultures to symbolize ideals such as order, beauty, balance, and divine proportion.

Symmetry in Art and Design

Symmetry as an Aesthetic Principle in Traditional Art

Symmetry has been a fundamental aesthetic principle in traditional art across many cultures, often symbolizing balance, harmony, and perfection. In ancient Greek art, the use of symmetry was closely tied to the idea of divine proportion and ideal beauty, influencing sculptures, pottery, and architecture. Similarly, in Islamic art, geometric symmetry is used to reflect the infinite nature of the divine, with intricate patterns symbolizing the unending order of the universe. In Chinese and Indian art, symmetry conveys spiritual balance, often seen in the design of mandalas, temples, and traditional paintings. The repetition of symmetrical patterns not only enhances visual appeal but also creates a sense of unity and stability. Overall, symmetry in traditional art serves as both a technical tool and a symbolic language to express universal truths and cultural values.

Cultural variations in symmetrical patterns

Cultural variations in symmetrical patterns highlight the distinct symbolic meanings and artistic traditions across different societies. In Islamic geometric art, intricate, repeating symmetrical patterns represent the infinite nature of God and the spiritual connection between the earthly and divine. Indian mandalas, with their radial symmetry, are used as

tools for meditation and spiritual exploration, symbolizing the universe's interconnectedness and balance. In Chinese paper-cutting, symmetry is central to creating designs that bring harmony, often symbolizing good fortune, prosperity, and protection. These cultural variations show how symmetry serves not only as an aesthetic principle but also as a deep reflection of each culture's values and worldview.

Modern Art and the Reinterpretation of Symmetry

In modern art, symmetry is often reinterpreted or subverted to challenge traditional aesthetic norms and explore new expressions of balance and form. Artists like Piet Mondrian and Salvador Dalí used symmetry in unconventional ways to convey abstraction and psychological depth. Rather than adhering to perfect harmony, modern artists play with asymmetry, distortion, and fragmented symmetry to evoke emotion and represent complex realities. This shift reflects the evolving relationship between art and the dynamic, sometimes chaotic, nature of the modern world.

Symmetry in Architecture

Classical Architecture and Symmetry

Classical architecture places a strong emphasis on symmetry to achieve a sense of proportion, harmony, and order. Ancient Greek and Roman structures, such as temples and public buildings, were meticulously designed with balanced columns, facades, and layouts to reflect ideal beauty and stability. Symmetry in classical architecture symbolized not only aesthetic perfection but also the cultural values of rationality and divine order.

Symmetry in Religious Architecture

In religious architecture, symmetry is used to evoke a sense of divine order and spiritual harmony. Sacred spaces like churches, mosques, and temples often feature symmetrical layouts to symbolize balance between the earthly and the divine. The careful arrangement of elements like altars, doors, and windows reflects the belief that symmetry connects the material world with higher spiritual truths.

Symmetry in Science and Mathematics

The Role of Symmetry in Mathematical Theorems and Geometry

Symmetry plays a foundational role in mathematical theorems and geometry by providing a framework for understanding shapes, patterns, and spatial relationships. In geometry, symmetrical properties help classify and analyze geometric figures, such as regular polygons and polyhedra, by identifying invariants under transformations like rotation, reflection, or translation. Symmetry simplifies complex problems, allowing mathematicians to derive consistent and elegant solutions while revealing underlying structures and symmetries in nature and physical laws. The concept of symmetry is essential in fields like group theory, where it helps explain the symmetries of mathematical objects and their behaviors.

Natural Symmetry in Biology, Chemistry, and Physics

Natural symmetry is deeply embedded in biology, chemistry, and physics, shaping the structures and behaviors of living organisms and the physical world.

- **Biology:** Symmetry plays a crucial role in the development and function of organisms. For example, many animals, including humans, exhibit bilateral symmetry, where their bodies are mirror images along a central axis, aiding in movement and sensory perception. Symmetry is also vital in cellular structures and patterns, such as in the radial symmetry seen in starfish or flowers.
- **Chemistry:** In chemistry, molecular symmetry influences the properties of molecules, such as their stability, reactivity, and optical activity. Symmetry elements like rotation axes and mirror planes help classify molecules and predict their behavior in reactions, especially in organic chemistry and crystallography.
- **Physics:** Symmetry is fundamental in physics, governing the laws of nature and the behavior of particles. In particle physics, symmetry

principles guide the understanding of fundamental forces and particles, with concepts like symmetry breaking helping explain the evolution of the universe. The conservation laws, like conservation of momentum and energy, are also rooted in symmetry principles.

The Psychological and Social Impact of Symmetry

Human Preference for Symmetry and its Biological Basis

Humans have an innate preference for symmetry, which is often linked to health, genetic fitness, and evolutionary success. Symmetrical features are subconsciously seen as indicators of genetic stability, making them more attractive in mate selection. This biological preference may have developed to help humans recognize balance and vitality, enhancing survival and reproductive success.

Symmetry as a Measure of Beauty and Social Order

Symmetry is often regarded as a measure of beauty, symbolizing balance, harmony, and perfection in both nature and human creations. Throughout history, cultures have used symmetry in art, architecture, and design to reflect social order, stability, and idealized forms. This deep connection between symmetry and beauty suggests that symmetrical patterns evoke a sense of calm and structure, reinforcing social and aesthetic ideals.

How Symmetry Fosters Cultural Identity and Unity

Symmetry fosters cultural identity by serving as a visual expression of shared values, beliefs, and traditions within a society. From religious symbols to national emblems, symmetrical designs often symbolize unity, strength, and harmony, binding communities together. By incorporating symmetry in art, architecture, and rituals, cultures create a sense of belonging and continuity, reinforcing collective identity and purpose.

Asymmetry and Its Contrasts

The Interplay between Symmetry and Asymmetry in Cultural Expressions

The interplay between symmetry and asymmetry in cultural expressions highlights the balance between order and creativity. While symmetry often symbolizes harmony, stability, and tradition, asymmetry introduces contrast, movement, and innovation, reflecting the dynamic nature of life. In art and design, cultures blend both elements to express complexity, individuality, and transformation. This fusion creates a deeper layer of meaning, where the tension between symmetry and asymmetry can evoke emotion and provoke thought.

Case Studies of Asymmetrical Art and Architecture

Case studies of asymmetrical art and architecture highlight how intentional imbalance can evoke dynamic energy and unique aesthetic expression. For instance, Frank Gehry's Guggenheim Museum in Bilbao uses asymmetry to create a sense of fluidity and movement, breaking from traditional forms. Similarly, Japanese Zen gardens embrace asymmetry in their design, creating natural, organic layouts that reflect imperfection and the transient nature of life.

Conclusion

The cultural significance of symmetry reveals its universal role in shaping aesthetics, symbolism, and human perception across societies. Whether through art, architecture, or nature, symmetry fosters balance, harmony, and cultural identity. Its enduring presence underscores the deep connection between beauty, order, and the human experience. The cultural significance of symmetry transcends time and geography, uniting diverse societies through shared principles of beauty and order.

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SYNTHESIS AND GROWTH OF ACETAMINOPHEN CRYSTALS

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Abstract

The study investigates the crystal structure of Acetaminophen using X-ray diffraction (XRD), Fourier-transform infrared (FTIR) spectroscopy, and scanning electron microscopy (SEM). The results indicate a strong correlation between computational and experimental methods, particularly in vibrational analysis. X-ray structural analysis reveals that the crystal is stabilized by N-H···O hydrogen bonding, consistent with SEM observations. FTIR confirms the presence of characteristic N-H and C=O vibrations, validating the Acetaminophen form. Surface morphology analysis highlights a non-uniform crystal distribution, with SEM images depicting smooth, nonporous membranes composed of dome-shaped crystallites.

Introduction

Acetaminophen (*N*-(4-hydroxyphenyl) acetamide), is a well-known aniline based drug, it is an analgesic and antipyretic agent which is acting at pain path way such as both the central and peripheral. It is commonly used for the relief of fever, headaches and other minor aches. Acetaminophen is usually classified under non-steroidal anti-inflammatory drugs. Its main mechanism of action is the inhibition of cyclo-oxygenase (COX), an enzyme responsible for the production of prostaglandins, which are important mediators of inflammation, pain and fever. Though there are more reports for the pure Acetaminophen structures, it is observed that pure Acetaminophen crystallized only in two polymorphic forms (Form I & II). Form I crystallize in the monoclinic cell setting whereas the form II in orthorhombic cell. Further, a non-crystallographic report claims a new form III which is highly unstable and difficult to investigate the structural features. The present study is the ever first report in which the Acetaminophen is crystallized in Form I polymorph from the 4-chloroaniline as a starting material. Further, as a new approach, the hydrogen bonding interactions in the crystal is analyzed through graph-set motif concept [1].

Crystal Growth of Acetaminophen Crystals

Materials and Methods Preparation the single crystals of Acetaminophen were synthesized from an aqueous mixture of 4-chloroaniline as a starting material, in an unexpected and unprecedented reaction. Initially, 4-chloroaniline is heated with ethanol solution at room atmosphere and NaOH was taken as a base solution. The solution was further treated with formic acid to undergo hydrolysis process. This leads to 4-amino phenol solution which is further heated with four drops of acetic acid. This leads to dehydration process and the product (Acetaminophen) is obtained in solution form [2]. The resulting solution was stirred half an hour and filtered at room temperature. This filtered solution was allowed slowly to evaporate at a room temperature. After a two-week period, a good quality light brown colour tiny crystals of Acetaminophen were obtained. The scheme of the reaction is given below,

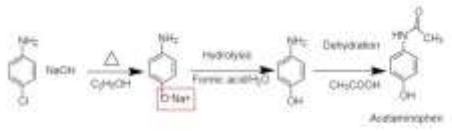

Figure 1 Grown Acetaminophen Crystals

XRD Analysis

X-ray power pattern of the crystal ACETAMINOPHEN was recorded on a XPERT-PRO Diffractometer system using Cu (k_α = 1.5444 Å) radiation. FTIR spectrum of crystal was recorded in the region $400-4000\ cm^{-1}$ and UV - VIS -Spectrum has taken to study the optical properties of the crystal. However, this idea, developed by Bragg, of relating atoms to planes proved to be a great simplification in the subject and for this reason we still refer to individual diffracted beams as being "reflected" from certain "planes" even though we know it is the atoms that actually perform the scattering. At this point we do not need to understand the concept of planes in any greater depth than this, but for those who feel they would like to know a little more, One of the concluding ideas from Bragg's Law is that diffraction is, in effect, an "arranged event"; three parameters need to be harmonized: the wavelength of the X-rays, λ, the crystal orientation as defined by the angle, θ (see diagram above), and the spacing, *d*, of the crystal planes under consideration. For a given wavelength and set of planes one can conspire to arrange for diffraction to occur by, for example, continuously changing the orientation, i.e. changing theta, until a point arrives when Bragg's Law is satisfied: this is precisely when diffraction occurs. The average crystallite size of the samples is calculated using Debye Scherrer formula [3]

$$\beta = \frac{0.9\lambda}{S\cos\theta}$$

where,

λ is the wavelength of the radiation used,

β is the full width half maximum,

θ is the angle of diffraction.

The calculated value of crystallite size of the sample is given by 52.35 nm.

Micro strain (ε) is calculated using the expression

$$\varepsilon = \frac{\beta\cos\theta}{4}$$

and the value of micro strain is estimated as 6.163 × 10^{-4}. The calculated values are presented in Table (1) and it is evident from the table that the material has retained its orthorhombic structure [4].

The Figure (2) shows the powder X-Ray diffraction pattern of crystals Acetaminophen prepared by slow evaporation method. All the observed reflections were indexed. The well-defined Bragg`s peaks at specific 2θ angles show high crystallinity of acetaminophen. The *hkl* values were tabulated in Table (1). The crystallographic parameters are given below.

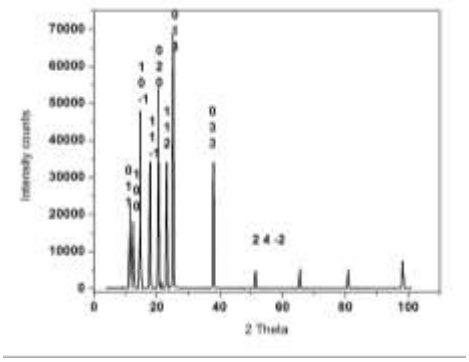

Figure 2. XRD of Acetaminophen

Table (1) Crystallographic Parameters Acetaminophen

Cell Parameters	Lattice parameters	
	Reported	Present work
a/ Å	7.08(7)	7.10(10)
b/ Å	9.38(9)	9.38(3)
c/ Å	11.69(5)	11.72(3)
alpha/ °	90	90
beta/ °	97	97
gamma/ °	90	90
Volume (V/ 10^6 pm^3)	780	780
System	monoclinic	monoclinic

However, the peak observed for crystal at 2θ = 10° disappeared and the very broad peak at 2θ = 23° became weak in crystal. These results suggest that crystal has good compatibility, which leads to the formation of a porous xerogel network. The XRD pattern also indicated that the crystal derivative displays a crystalline form, which may participate in many applications

Table (2) Peak list for Acetaminophen

S.No	Pos. [^{0}2 Th]	Height [cts]	FWHM [^{0}2 Th]	d-spacing [Å]	Crystallite size [nm]	Micro strain
1	11.45784	15270.76	0.50945	7.716737	16.37	0.126699
2	12.47896	14817.49	0.52757	7.087497	15.82	0.131084
3	14.77071	40711.57	0.19891	5.992588	42.09	0.049288
4	17.88938	32358.78	0.42275	4.954305	19.87	0.104392
5	20.57211	33758.68	0.41358	4.31389	20.39	0.101723
6	23.17638	32358.74	0.42275	3.834704	20.04	0.103523
7	25.19716	59884.04	0.42932	3.531558	19.80	0.104741
8	38.03438	32356.66	0.42281	2.363958	20.76	0.099924

FTIR Spectra interpretation

FTIR analysis of Acetaminophen was carried out in the middle-IR region between 400 and 4000 cm-1 and the recorded spectrum is shown in Figure 3.

Fourier Transform Infrared (FTIR) analysis is a spectroscopic technique that makes use of the naturally occurring electromagnetic spectrum defined by the wavelengths between 2,500nm and 25,000nm. This is the 'mid-infrared' region so you will also hear the method referred to as 'mid infrared'. Generally, though, it is the name of a technique used to convert measurement data into a usable result (Fourier Transform) that is popular, hence, Fourier Transform Infrared, or FTIR for short is used to analyse.

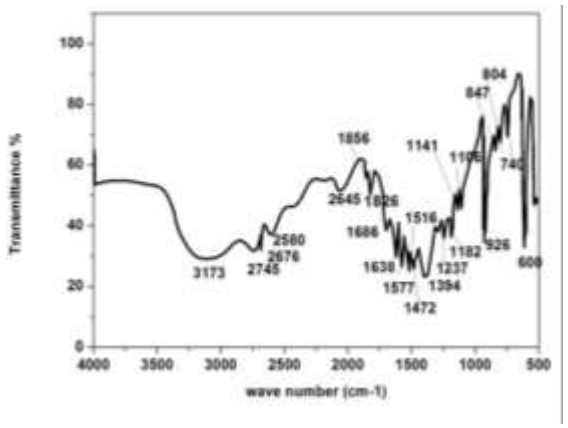

Figure 3. FTIR Transmittance Spectrum

Benzene Ring Vibrations

In the benzene ring, all the CH stretching vibrations have the infrared peaks in the region3100-3000 cm^{-1}. In this study, the FT-IR peaks at 1394, 1237, 1182 and 1106 cm^{-1} are assigned to C-H in-plane-bending mode of Acetaminophen crystal [5].

C=C and C-C group vibrations

The C=C ring stretching modes are observed between the region 1650-1430 cm^{-1}[6]. This C=C aromatic stretching vibrations are noted for the pure Acetaminophen crystal at 1577, 1516 and 1472 cm^{-1} in FT-IR spectrum. The expected range of C-C vibration lies between 1400-1300 cm^{-1}[7] in the present work, it is assigned at 1394 cm-1 in FT-IR spectrum.

Amide Group Vibrations

The N-H stretching of amide group is observed at 3300-3250 cm^{-1} and its bending appears at 1560-1530 cm^{-1}. Also, N-H wagging band appears at 750-650 cm^{-1}[8]. In the present work, the N-H stretching and bending modes of 4-acetamidophenol are identified as the broad peak in the range 3300-3100 cm^{-1} (IR), and 1577 cm-1(IR) respectively. The N-H wagging mode of pure 4-acetamidophenol crystal is observed at 740 cm^{-1} in the both spectra.

Methyl Group Vibrations

The -CH3 symmetric stretching frequency is assigned at 2745 cm^{-1}, whereas the antisymmetric. the peaks at 1472 cm^{-1} in the spectra is assigned to -CH3 in-plane bending vibrations of pure and doped 4-AMP crystals. Also the C-N stretching vibration of secondary aromatic amide is absorb strongly at 1342-1320 cm^{-1} and 1315-1250 cm^{-1} in the IR spectrum [9].

C=O Group Vibration

The C=O stretching vibration is assigned in the literature as a very strong band at 1686 cm^{-1} in FT-IR spectrum [10].

Hydroxyl Group Vibrations

The -OH group has a stretching wavenumber in the range 3250-3200 cm^{-1}[11]. In the present work, the broad bands occur at 3300-3100 cm-1 are attributed to the O-H stretching mode of the The O-H in- plane and out- of -plane bending wavenumbers normally occurs in the region between 1440-1395 cm-1 and 960-875 cm-1 respectively [12].In the present study, bands at 926 cm^{-1} in the FT-IR spectrum is assigned to the O-H in plane and out of plane bending wavenumbers of Acetaminophen crystal respectively.

UV- Vis Spectral Analysis

The UV –Vis spectral absorbance and transmittance was studied using a Lamda UV- Vis Spectrophotometer with a single crystal in the range of 200 nm-2500 nm. The recorded spectrum is shown in Figure (4). The crystal has sufficient absorption and transmission in the entire visible and IR region. The lower cut off wavelength is around 243nm [13] The transmittance window in the visible region and IR region enables good optical transmission of second harmonic frequencies of Nd: YAG lasers.

The characteristic peak's assignment of the Acetaminophen crystal at 1660 cm^{-1} is due to Schiff base (C=N) formed by a crosslinking reaction between the amino group and the aldehydic group of crystals. The C=O adsorption peak of secondary hydroxyl groups becomes stronger and moves to 1083 cm^{-1}; the intensity of primary alcohol 1034 cm^{-1} due to C=O stretching vibration becomes much smaller.

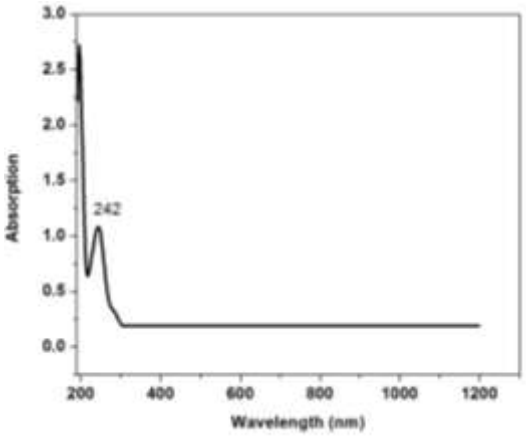

Figure 4 UV- Absorption Spectrum of Acetaminophen

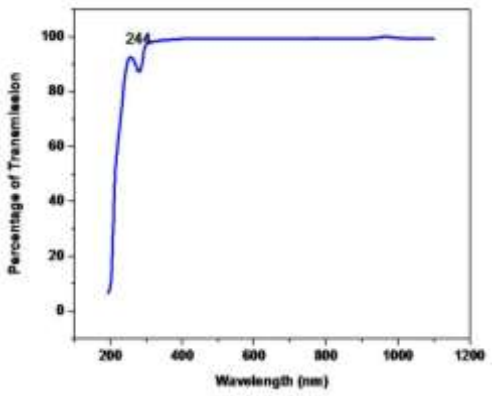

Figure 5 Transmittance curve of Acetaminophen

SEM Analysis

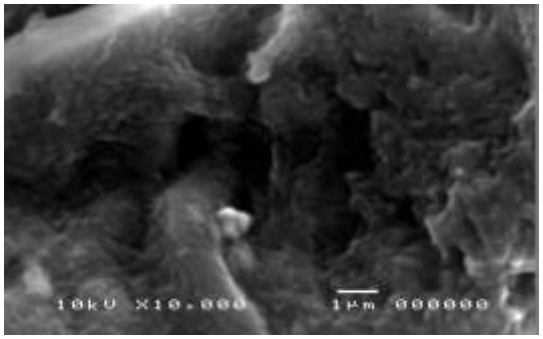

Figure 6 SEM Analysis of Acetaminophen

The general efforts to improve SEM performance have mainly been directed towards the maximization of the brightness of the electron sources in the electron-optical systems. The large size of thermionic filament tips, with diameters up to several tens of micrometers, is associated with relatively low brightness. Surface morphology of the grown crystal, Acetaminophen, was investigated by scanning electron microscope. The surface morphology and particle size of the Acetaminophen, have been shown in Figure 6. From the SEM micrographs, it can be seen that particles have non-uniform distribution. The structural morphology consists of foam-like shape. SEM images were taken 10000 x magnifications with acceleration voltage of 10 kV [14].

Conclusion

The results obtained show that the X-ray crystal structure and computational methods are consistent with each other. There was particularly good agreement using XRD and FTIR vibrational analysis. The structural X-ray analysis has indicated that the crystal structure is stabilized by N-H··· O hydrogen bonding. These results were consistent with those obtained by a SEM analysis. The calculated and observed N-H and C=O vibrations in the IR spectrum confirm Acetaminophen form of the structure. The surface morphology was also indicating the non-uniform distribution for the crystal. The SEM images of the crystal exhibited a nonporous smooth membranes consisting of dome shaped crystallite.

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THE ROLE OF EARTHWORM PROMOTING VERMITECHNOLOGY USING THE FLOWER EXTRACT

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Abstract
Vermitechnology, an eco-friendly waste management approach, leverages earthworms to convert organic waste into nutrient-rich vermicompost. The use of plant-based additives, such as flower extracts, has shown potential in enhancing the efficiency of this process. This study investigates the role of Eisenia fetida *(commonly used earthworm species) in processing organic matter supplemented with the flower extract of* Caesalpinia pulcherrima*, a plant known for its bioactive compounds. The research explores the impact of this extract on earthworm activity, reproduction, and nutrient enrichment of the final compost. Results demonstrate that the addition of* C. pulcherrima *extract stimulates microbial activity and accelerates organic matter breakdown, leading to improved compost quality with higher nutrient content. This study highlights the synergistic potential of integrating botanical extracts into vermitechnology, offering a sustainable solution for organic waste management and soil fertility improvement.*
Keywords*: eisenia fetida, soil fertility, bioactive compounds*

Introduction

Vermitechnology refers to the use of earthworms and their biological processes to address various environmental challenges, particularly in waste management, soil improvement, and organic farming. This innovative and eco-friendly technology leverages the natural ability of earthworms to decompose organic waste through a process known as vermicomposting. Earthworms consume organic matter, breaking it down into nutrient-rich humus, which enhances soil fertility and structure. The benefits of vermitechnology extend beyond waste recycling. It plays a significant role in reducing the environmental impact of organic waste disposal, promoting sustainable agriculture, and enhancing soil health. Vermitechnology also contributes to the reduction of greenhouse gases by diverting organic waste from landfills and facilitating the production of high-quality compost, which serves as a natural fertilizer for plants. In recent years, the growing interest in organic farming and sustainable practices has brought vermitechnology to the forefront as a viable solution to many environmental concerns. It's simple yet effective approach makes it an accessible and practical tool for individuals, communities, and industries seeking to reduce their ecological footprint while benefiting from the resources it produces. In general, managing solid waste entails organizing, funding, building, and running infrastructure for the collection, transportation, recycling and the waste's ultimate disposal (WTERT, 2012). The present study using the Caesalpinia pulcherrima leaf extract using the feed for vermicomposting because the plant rich many pharmaceutical active ingredients like flavonoids, aritonoids, glycosides and sterols including ulcers, fever, asthma, and skin diseases. vermitechnology, offering a sustainable solution for organic waste management and soil fertility improvement.

Materials and Method

Collection of Plant

The fresh flowers of Caesalpinia pulcherrima (linn.) were collected in the month of September 2024 from its natural habitat at Thamaraipadi, Antony's college campus, India.

Flower Extract

Ethanolic and Water extracts of Caesalpinia pulcherrima (Linn.) flower, Piperazine citrate (GSK. Ltd, Mumbai). Preparation of Extracts of Caesalpinia pulcherrima (Linn.) flower: The Caesalpinia pulcherrima (Linn) Flowers were dried under shade and undergone crushing in electric blender to form

powdered and subjected to successively extraction by Pet. ether and ethanol using Soxhlet's extractor. The percent yield of ethanolic extract was 24.8% w/w and petroleum ether (60 Grade) extract yield 6.1% w/w. Both the extracts were concentrated by evaporation at room temperature and were used for pharmacological studies. Powdered material of Caesalpinia pulcherrima (Linn.) flower was kept for maceration with 1000 ml of distilled water for 7 days. The Aqueous extract was double filtered by using muslin cloth and What man no.1 filter paper and concentrated by evaporation on water bath. The extract was dried and used as a powder. The percentage yield of extract was found to be 23.56 percent.

Preparation of Vermibeds

Vermibeds were prepared in wooden boxes of size 40cm x 30 cm x 26 cm using paddy straw, sand and garden soil and 40g of earthworms in each vermibed. Processing of bio waste: 240 gm of Shredded vegetable waste was separately transferred into vermibeds slowly in a period of 2-3 days replicas of three sets of vermibeds for each type of waste were prepared

Collection of Vermicompost

After the completion of vermicomposting process, the loose layer of soil along with decomposed organic material (bio waste) from each type of vermibed was collected. After that the earthworms such as Eisenia fetida or Lumbricus rubellus, which are commonly used in vermicomposting due to their high efficiency in breaking down organic matter.

Maintenance and Monitoring

Keep the composting material moist, but not too wet. Earthworms require moisture to survive and process the organic matter. Vermiculture beds should be kept within a temperature range of 15-30°C (59-86°F). Turn the compost regularly (every 1-2 weeks) to ensure proper aeration and avoid anaerobic conditions that could harm the earthworms.

Harvesting Vermicompost

It usually takes 2-3 months for the earthworms to process the organic matter fully and create rich, dark vermicompost. Then separate the earthworms from the compost by using techniques like the "light method" (where worms move away from light) or using screens. Finally, the vermicompost is now ready to be harvested. It should be dark, crumbly, and earthy-smelling, with no recognizable organic matter.

Results and Discussion

Vermicompost is an organic fertilizer and soil conditioner produced through the process of vermicomposting, where earthworms break down organic waste into nutrient-rich material. The final product, vermicompost, contains essential nutrients, beneficial microorganisms, and improved soil conditioning properties. It is widely used in agriculture, gardening, and horticulture due to its eco-friendly and sustainable nature.

In the present study observed the data of vermicompost production potential present in the **(Table1 and Fig.1)** showed that potential of earthworms species on same substrate, overall analysis of vermicompost production and the extract of leaf. According to these investigations, C. pulcherrima has bioactive substances that are efficient against parasitic worms. However, little research has been done on the precise use of C. pulcherrima flower extracts in vermitechnology, which uses earthworms for soil management and composting. If utilized in vermiculture systems, the plant's extracts may have a negative impact on earthworm populations due to their anthelmintic qualities. As a result, care should be taken while using C. pulcherrima extracts in earthworm-infested areas. Further studies are required to identify the investigate combining *Caesalpinia pulcherrima* extract with other organic additives. Propose its use for specific types of organic waste. Nutrient composition of vermicompost with and without *Caesalpinia pulcherrima* extract

Table 1 Nutrient Analysis of Vermicompost

S.No	Parameter	Control	Extract
1	Ph	8.5	4.5
2	Temperature	30	35
3	Nitrogen	28.5	20.1
4	Phosphorus	20.8	19.4
5	Potassium	28.5	20.0
6	Organic carbon	20.5	15.8
7	Moisture	35.8	27.9
8	CN Ration	20.3	23.5

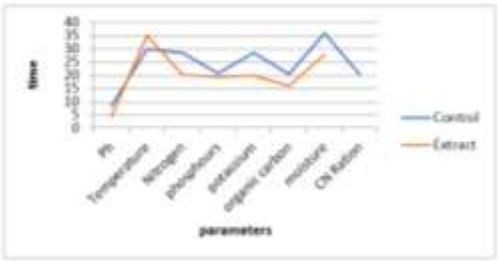

Fig 1 Physico Chemical Parameter of Extract

Conclusion

The integration of *Caesalpinia pulcherrima* extract into vermitechnology enhances earthworm efficiency, microbial activity, and compost quality. This approach not only improves organic waste management but also contributes to soil health and fertility, offering a promising solution for sustainable agriculture.

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PHYTOCHEMICAL SCREENING AND GREEN SYNTHESIS OF SILVER NANOPARTICLES IN *JATROPHA INTEGERRIMA*

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Abstract
The Ayurvedic and Siddha medical practices are very famous in India. It is traditional based medicines. Herbal medicines are used in various parts of the world to cure different diseases. According to World Health Organization, plants belonging to clinical aspects are considered as the worthiest choice in drug production. Modern mechanisms continuously used to detect chemical structures of herbs and utilizing them as antimicrobial agents against infectious diseases. The aim of this study is to analyze the phytochemicals, green synthesis of silver nanoparticles and assess its efficacy in control of pathogenic bacteria by using extracts of different parts of plants. Extracts from the leaves, flowers and root of Jatropha Intrergrrima were extracted with ethyl acetate, water and methanol. Phytochemical analysis observed the presence of carbohydrates, glycosides, phenols, saponins, tannins, and terpenoids components in whole plant extract of methanol. In aqueous extracts carbohydrates, flavonoids, saponins and terpenoids were present. In ethyl acetate extracts carbohydrates, glycosides flavonoids, phenols and flavonoides were present. This study aimed to evaluate the antimicrobial activity of Jatropha Intrergrrima, leaves, flowers and root (whole plant) against several bacteria. The plant was collected from Western Ghats – Eastern side (Athoor village), Dindigul district, Tamilnadu, India. Antimicrobial activity of ethyl acetate, aqueous and methanol extracts was examined by inoculating bacteria and fungi on media containing plant extract, and agar well diffusion method. The study revealed the effect of plant by evaluating microbial growth and inhibition zone measurement. Aqueous extract of leave had ability to suppress growth of E. coli, and both aqueous and ethanolic extracts of rhizome-tuber figured out antibacterial activity against S. aureus and E. coli, positively. Moreover, all selected bacteria and fungi were susceptible to ethanolic extract of rhizome-tuber, with different inhibition zones. Cyperus oil had no potential inhibitory effect against bacteria and fungi, excluding C. albicans. By performing phytochemical screening for rhizome-tuber extracts eleven secondary metabolites were detected.
Keywords: *jatropha intrergrrima, phytochemical analysis, silver nanoparticle, antibacterial activity*

Introduction

India is one of the diversity rich country in the world. Many ancient medicinal methods are practiced in India. India having 15000 plant varieties and 3000 medicinal plant varieties. It contributes 20% in world level. Herbal medicines get more attention because it never cause any adverse effects to humans and animals. The medicinal value rich plants also have bioactive elements which produce definite physiological properties on human body [1].

Phytochemical is a natural bioactive elements which found in parts of plants such as vegetables, fruits, flowers, leaves and roots. This phytochemical rich plants play defence mechanism against disease causing pathogens[2]. The notable point in medicinal plants are drug development against particular diseases which is already practiced in ancient times[3]. Phytochemicals have remarkable antioxidant ability which give more health benefits to humans[4,5,6].

Nanotechnology is modern field which deals with synthesis and manipulation of particles ranging from approximately 1 – 100 nm. Nanoparticles (NPs) have wide range of applications in health care, optics, chemical industries and biomedical science[7]. Nanotechnology is a rapidly growing and multidisciplinary approach which is used in

biological systems such as biology, chemistry, biochemistry, medicine and engineering. Nanoparticles having intrinsic capacity to decrease metals by specific metabolic pathway[8-12].

Green synthesis is conventional method for chemical synthesis. Green synthesis of Nanoparticles considered as eco-friendly, non-toxic and stability agents. The major advantage of synthesis of silver nanoparticles from plants are easily available and nontoxic which have wide variety of metabolites. The major phytochemicals are terpenoids, flavones, aldehydes, ketones, carboxylic acids and amides. Organic acids, quiones and flavones are water soluble phytochemicals which are responsible for immediate ion reduction. Phytochemicals are directly involved in reduction of ions. Green synthesis of nanoparticles is better than chemical synthesis of nanoparticles. In chemical synthesis method, some toxic chemicals are absorbed on the surface that may cause adverse effects in applications of medicine.

This work related to synthesis of silver nanoparticle from *Jatropha integerrima*, screening its phytochemicals and evaluate its effectiveness in anti-bacterial is wanting.

Fig 1 *Jatropha Integerrima* plant

Materials and Methods

Collection of Plant

Jatropha integerrima was collected from Athoor, Dindigul, Tamilnadu, India. Collected plants are washed with distilled water. Washed plants are dried at room temperature for 7 days. The dried plant parts such as leaves, stem and flowers are stored in air tight container.

Plant Extract Preparation

500g of cleaned plant parts are soaked in 250ml of methanol in FB flask. The flask and its contents were sealed and maintained the content of flask without shaking for the period of 6 days.

The methanolic extract were filtered by using whatman filter paper. The filtrate are used for phytochemical analysis. The same method used to prepare ethanol extract of plant.

Preliminary Phytochemical Test

Preliminary phytochemicals such as Alkaloids, Flavonoids, Glycosides, Saponins, Carbohydrate, Terpenoids, Phenol, Proteins, Phytosterol and Tannins are examined[13-17].

Test for Alkaloids

Iodine Test

Adding few drops of iodine solution into 3ml of plant extract. Blue colour appears and it disappears on boiling. Again reappear when extract was cooling.

Mayers Test

1ml of plant extract were taken in test tube and few drops of Mayers reagent were added along the sides of test tube. A white precipitate is formed when an extract contain Alkaloids.

Test for Flavonoids

NaOH Test

Few drops of Sodium hydroxide was added into 2-3ml of extract. Formation of intense yellow colour which changes into colourless when adding of few drops of dil.Hcl which indicates the presence of flavonoids.

Test for Glycosides

Liebermann's Test

2ml of acetic acid and 2ml of chloroform added with whole aqueous crude extract of plant. Adding 2 drops of conc.H_2SO_4 when the mixture was cooled.

Keller-Kiliani Test

4ml of glacial acetic acid added with 1 drop of 2% $FeCl_3$. This mixture was mixed with 10ml of

conc.H_2SO_4. Brown ring formed between the layers which indicates the presence of glycosides.

Test for Saponins

Take 5ml of distilled water in test tube which is mixed with aqueous crude plant extract. This mixtures are mixed vigorously the foam appearance showed the presence of saponins.

Test for Carbohydrate

Equal volume of Fehling a reagent and Fehling B reagent are mixed together. Add 2ml of plant extract into mixture which is already contains Fehling A and Fehling B at the same concentration. A brick red precipitate showed the presence of reducing sugars.

Test for Terpenoids

2ml of chloroform was added with 5ml of aqueous plant extract and which is boiled with 3ml of con.H_2SO_4. A grey colour indicated the terpenoids presence.

Test for Phenol

2ml of plant extract treated with few drops of glacial acetic acid and 5% of $NaNO_2$. This solution turned at black precipitate which is clearly shows the presence of phenol.

Test for Protein

Biuret Test

3ml of plant extract was treated with 3 drops of Biuret reagent and mix it gently. Proteins will turns the solution pink or purple.

Test for Phytosterol

1g of extract was dissolved in few drops of dilute acetic acid, 3ml of acetic anhydride was added followed by few drops of conc.H_2SO_4. Bluish green colour indicates the presence of phytosterol.

Test for Tannins

1ml of extract added with 1ml of of 0.008M potassium ferricyanide and 1ml of 0.02M $FeCl_3$ in 0.1M HCl. Blue colour indicates the Tannin presence.

Synthesis of Silver Nanoparticles

In this present study synthesis of silver nanoparticles from aqueous extract of *Jatropha integerrima* by using microwave assisted method.

Preparation of *Jatropha integerrima* Aqueous Extract by Microwave Method

Jatropha integerrima plant were thoroughly washed with distilled water and sliced into small pieces. 10g of plant were soaked in 100ml of distilled water and irradiated with microwave for 10minutes. The extract was filtered and stored at 4^0C which is used for further experiments.

Green Synthesis of *Jatropha integerrima* – AgNPs

For the phytosynthesis of silver nanoparticles, 5ml of aqueous extract of plant was added into 5ml of 0.1M $AgNO_3$ aqueous solution and kept in microwave oven at microlevel 60% with continuous microwave irradiation for 90seconds. Rapid reduction of Ag^+ ions to AgO were observed by the colour change from yellowish brown to dark brown.

Antimicrobial Activity

Four pathogenic bacteria such as *Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa* and *Escherichia coli* are used for antimicrobial activity. Nutrient agar were poured into sterile petriplates. The pathogenic bacterial strains are swabbed on nutrient agar medium with sterile ear buds. Three holes are make by using of well cutter. One hole was filled by commercial antibiotic, second hole was filled by plant extract which contain silver nanoparticle and another hole was filled by distilled water which is consider as negative control. Now the plates are incubated at 37^0C at 24 hours.

Results and Discussion

Phytochemical Analysis

S.No	Phytoconstituents	Ethyl Acetate	Methanol	Water
1	Alkaloids	-	-	-
2	Carbohydrates	+	+	+
3	Glycosides	+	+	-
4	Phytosterols	-	-	-
5	Saponins	-	+	+

6	Phenols	+	+	-
7	Tannins	+	+	-
8	Proteins	-	-	-
9	Flavonoids	+	-	+
10	Terpinodes	-	+	+

The phytochemical study revealed the presence of various phytochemicals in the ethyl acetate, methanolic and water extracts of *Jatropha Integerrima*. In Ethyl acetate extracts presence of phytochemicals such as Glycoside, Taninns, Carbohydrates, Flavonoids and Phenols. In Methanolic extract phytochemicals such as Carbohydrate, Glycoside, Saponins, Phenol, Tannins and Terpinodes are present. But Alkaloids, Phytosterol, Proteins and Flavonoids are absent. Carbohydrates, Terpenoids, Saponins, Flavonoids were found in aqueous extract of *Jatropha Integerrima.* Analysis of the plant extracts revealed the presence of phytochemicals such as Saponin, Taninns, Carbohydrates, Flavonoid, Phenols and Terpenoid which are known to exhibit medicinal as well as physiological activities. Phenolic compound possess biological properties such as apoptosis, anti-aging, anti-cancer, anti-inflammation, anti-atherosclerosis, cardiovascular protection and improvement of endothelial function, as well as inhibition of angiogenesis and cell proliferation activities. The plant extracts were also revealed to contain saponins which are known to produce inhibitory effect against inflammation. The growth of many fungi, yeasts, bacteria and viruses can be inhibited by tannins. Terpenoids and tannins are attributed for analgesic and anti-inflammatory activities. The preliminary phytochemical tests are significant and helpful in finding chemical constituents which is found in plant material that may lead to their quantitative estimation and also in locating the source of pharmacologically active chemical compounds. The results obtained in this study suggest that the identified phytochemical compounds are used as substantial medicinal applications.

UV- Visible Spectroscopy

In order to determine completion of the reaction, $AgNO_3$ was reacted with *Jatropha integerrima* aqueous extract and spectra were recorded. The dark brown colour of AgNPs is attributed to Surface Plasmon Resonances (SPR) appearing at 451 nm.

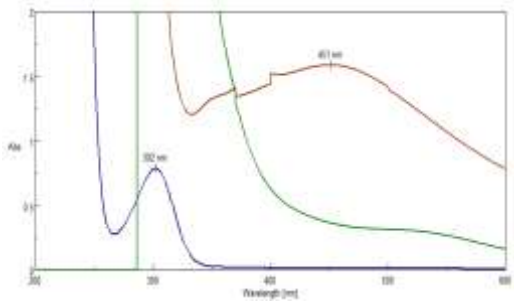


Fig 2 Shows the UV- Visible Spectra of the Synthesized Silver Nanoparticles

FT-IR

Fig.3a, 3b the FT-IR spectrum of the extract, gives information regarding to the chemical transformation of the functional groups involved in the reduction of the silver ions. Some pronounced absorbance bands centered at 666, 1634, 2074, and 2427 cm^{-1} were observed in the region 400 - 4000 cm^{-1}. Among them, the absorbance bands at 666, 1634, 2074 and 2427 cm^{-1} were associated with the stretch vibration of –C-O, -C-H, -C=C, and O-H respectively. These absorbance bands could be attributed to the reducing sugars, flavonoids, saccharides and proteins in the extract, while the absorbance band at 1300 cm^{-1} could be regarded as a fingerprint of the biomolecules. In the present study, the band at 2427 cm^{-1} may be the result of the –C-O groups of the reducing sugars, flavonoids, saccharides and proteins in the extract. The reducing sugars among the saccharides acted as reductions while the other saccharides as protecting agents.

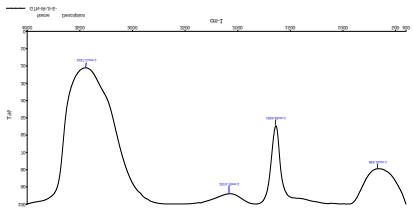


Fig 3a FT-IR Spectra of *Jatropha Integerrima* Leaf Extract

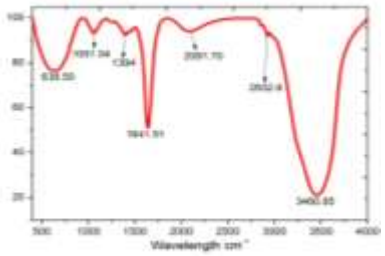
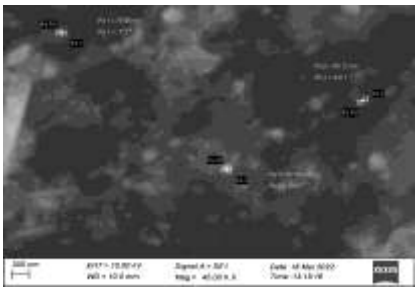


Fig 3b FT-IR Spectra of *Jatropha Integerrima* Leaf Extract with Silver Nanoparticles

SEM Study

The SEM image showing the high density of silver nanoparticles synthesized from *Jatropha integerrima* aqueous extract further confirmed the development of silver nanostructures Fig.4a, 4b and 4c.



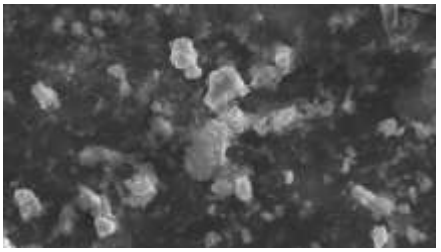


Fig 4a, b, c SEM Image for Aqueous Extract of Plant with Silver Nano Particles

Antimicrobial Potential of Silver Nanoparticles from Extract of *Jatropha Integerrima*

Antibacterial activity of biologically synthesized silver nanoparticles was seen against Gram negative (*Pseudomonas* aeruginosa *and E.coli)* and Gram positive (*Staphylococcus aureus and Bacillus* subtilis*)* bacteria. Further the zone of inhibition was measured. The results indicated that silver nanoparticles synthesized from *Jatropha Intrergrrima* extract showed effective antibacterial activity both in Gram negative and Gram positive bacteria. The Antimicrobial effect of the biosynthesized AgNPs was examined using the disc diffusion assay which is mainly used to test the sensitivity of bacterial strains towards antibiotics with a clear zone. The mean diameters of inhibition zones obtained in the present study are given in table-2. The results showed that AgNPs biosynthesized using *Jatropha Integerrima* extract showed good inhibition against the four studied bacterial strains with commercial antibiotic (Streptomycin).

Table 2 Antibacterial Activities of Synthesized Silver Nanoparticles from *Jatropha Integerrima* extract

S.No	Pathogens	Zone of Inhibition(mm)		
		Sample	Commercial Antibiotic	Control
1	*Bacillus subtilis*	11	12.2	-
2	*Pseudomonas aeruginosa*	10	12	-
3	*Staphylococcus aureus*	9	10.5	-
4	*Esherichia coli*	8	10	-

SAMPLE – Ag-NPs from *Jatropha integerrima*
COMMERCIAL ANTIBIOTIC - Streptomycin
CONTROL – Distilled water

The antimicrobial activity of silver nanoparticles, concludes that the silver nanoparticles shows significant antimicrobial activity against *Bacillus subtilis, Pseudomonas aeruginosa, Staphylococcus aureus* and *Escheria coli.* The *Bacillus subtilis* was more susceptable than others.

Conclusion

The traditional medicine practice is recommended strongly for these plants as well as it is suggested that further work should be carried out to isolate, purify and characterize the active primary and secondary constituents responsible for the activity of these plants. The previous phytochemical analysis and present study show nearly the similar results due to the presence of the phytochemical constituents. Medicinal plants are used for discovering and screening of the phytochemical constituents which are very helpful for the manufacturing of new drugs. Thus, we hope that the important primary and secondary phytochemical constituents are identified by our study in and around Dindigul city of Tamil Nadu will be helpful in the AYUSH studies. The observation that the Jatropha integerrima – AgNPs synthesized could be stored for two months at room temperature indicated that these particle are more stable. The nanoparticles were characterized by UV–visible spectrophotometrically, at the same time we are planned to characterize the nanoparticle by SEM and FT-IR image. These silver nanoparticles were of high purity, making them potentially useful for biological applications. The antimicrobial activity of silver nanoparticles concludes that the silver nanoparticle shows significant antimicrobial activity against *Bacillus subtilis, Pseudomonas aeruginosa, Staphylococcus aureus* and *Escherichia coli*. The *Bacillus subtilis* was more susceptable than others.

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FINANCIAL PERFORMANCE AND PROFITABILITY OF KHADI INDUSTRIES IN GADHIGRAM

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Abstract
Khadi, (pronounced Khādī) refers to handspun and hand-woven cloth. The raw materials such as cotton, silk, or wool, which are spun into threads using a traditional spinning implement). Khadi is sourced from different parts of India, depending on the raw materials - While the MSME, engaged in promoting and developing khadi and village industries for providing employment opportunities in the rural areas, thereby strengthening the rural economy. The Commission took over the activities of the erstwhile All India Khadi and Village Industries Board on April 1, 1957. KVIC has been identified as one of the major organisations in the decentralized sector for generating sustainable nonfarm employment opportunities in rural areas at a low per capita investment. It undertakes activities like skill improvement; transfer of technology; research & development; marketing etc. and helps in generating employment/self-employment opportunities in rural areas. Objectives of this study are to find out the trends in the production and sales of Khadi Village Industries products and to analyze the trends in the fund flow of Khadi Village Industries products. The exercise uses analytical tools such as linear equations, profitability ratios, and operating cycles of working capital. The study examined the work of four Khadi institutions on Gandhigram, with special reference to the financial conditions of these institutions. In profitability of the objectives such as variations in production and sales, patterns of mobilization and utilization of resources, and Trends in production and sales of Khadi Village Industries products.

Keywords*: ratio, financial performance, profitability*

Introduction

Khadi & Village Industries Commission (KVIC) established under the Khadi and Village Industries Commission Act, 1956 (61 of 1956), is a statutory organization under the aegis of the M/o MSME, engaged in promoting and developing khadi and village industries for providing employment opportunities in the rural areas, thereby strengthening the rural economy. The Commission took over the activities of the erstwhile All India Khadi and Village Industries Board on April 1, 1957. KVIC has been identified as one of the major organisations in the decentralized sector for generating sustainable nonfarm employment opportunities in rural areas at a low per capita investment. It undertakes activities like skill improvement; transfer of technology; research & development; marketing etc. and helps in generating employment/self-employment opportunities in rural areas.

1. The social objective of providing employment in rural areas;
2. The economic objective of producing saleable articles; and
3. The wider objective of creating self-reliance amongst people and building up a strong rural community spirit..

Objectives of the Study

1. To know the financial performance of Khadi and village industries at Dindigul District.
2. To study the pattern of mobilization and utilization of financial resources and examine the profitability

Research Methods

The present study involves a concise survey of four Sarvodaya institutions in Gandhigram, followed by an analysis of the factors influencing their financial performance. Analysis of profitability involves compounding of capital at the cost of capital in order to correct it to time value of money.

Data Collection Methods Production and Sales

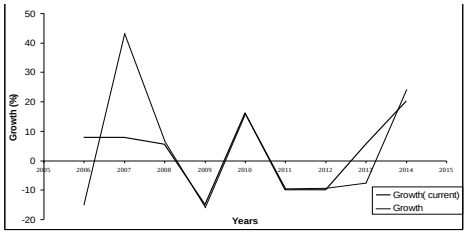
Financial Performance and Profitability are the two factors that determine the financial condition of any business. Given the costs and prices, it is the levels of production and sales that determine the amount of net profit of the business and thereby its financial status. Moreover, performance in production and sales is governed by many vital factors such as availability of raw materials, adequacy of management in organizing inventory, production, marketing, and competition encountered in sales. Therefore, study of changes in Financial Performance and Profitability.

Table 1 Gandhigram Khadi and Village Industries Public Charitable Trust (GKVIPCT), Gandhigram (Rupees in lakhs)

Year	Value of NVAM		Growth rate of NVAM	
	In Current Prices Rs.	Annual Growth Rate (%)	Price level of 2004-05 Rs.	Annual Growth Rate (%)
2005	53.17		37.43	
2006	57.32	7.81	32	-15
2007	61.8	7.82	45.87	43.3
2008	65.2	5.5	48.9	6.61
2009	55.27	-15	41	-16
2010	64.15	16.1	47.5	15.9
2011	57.79	-9.9	43	-9.5
2012	52	-10	39	-9.3
2013	54.9	5.58	36	-7.7
2014	66	20.2	34.7	24.2
	Mean	**28.11**	**Mean**	**5.06**

Chart 1 Value of NVAM

Gandhigram Khadi and Village Industries Public Charitable Trust (GKVIPCT), Gandhigram



GKVIPCT, Gandhigram

The particulars of NVAM of GKVIPCT are furnished in table 4.5. NVAM in current prices rose continuously till 2008, fell continuously up to 2012 and raised back again qt 2013 and 2014. . The fall in amount of NVAM in 2009-2012 onwards and the spurt in purchase of finished goods and stagnation in volume of production were due to huge increase in stocks. In constant prices also, the amount of NVAM decreased in 2009 to 2012 onwards due to a spurt in purchase of finished goods and stagnation in volume of production (Chart 1)

The share of NVAM in the ex-factory value of output would throw light on the span of operation cycle. An expansion of production cycle will increase the share of NVAM in ex-factory value of output thereby, enlarging the scope for increase in employment and profit while the shrinking of production cycle will lead to the reduction of NVAM. It may be observed that the share of NVAM in ex-factory value of output ranged between 6.61 to 43 per cent during the ten year period.

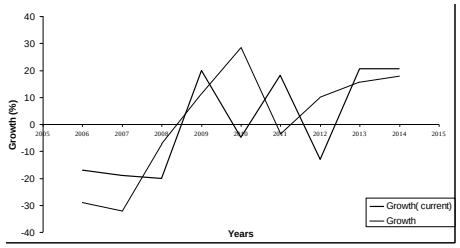
Table 2- Value of NVAM

Gandhi Seva Sangam (GSS), Chinnalapatti

(Rupees in lakhs)

Year	Value of NVAM		Growth rate of NVAM	
	In Current Prices Rs.	Annual Growth Rate %	Price level of 2004-05 Rs.	Annual Growth Rate (%)
2005	26		17.6	
2006	21.5	-17	12.5	-29
2007	17.5	-19	8.5	-32
2008	14	-20	7.9	-7.1
2009	16.8	20	8.8	11.4
2010	16	-4.8	11.3	28.4
2011	18.9	18.1	10.9	-3.5
2012	16.5	-13	12	10.1
2013	19.9	20.6	13.9	15.8
2014	24	20.6	16.4	18
	Mean	**5.96**	**Mean**	**12.13**

Chart 2- Value of NVAM
Gandhi Seva Sangam (GSS), Chinnalapatti

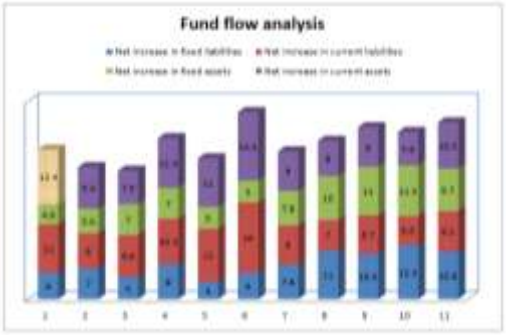


The particulars of NVAM for GSS as found in table 4.7 shows more fluctuations than the above two institutions reached the peak in 2010. In constant prices, the fluctuations are more and reaching the bottom in 2012(Chart 4.7). After three years of recovery, the amount of NVAM started declining from 2009. Though 2012 onwards faces a downfall. The share of NVAM in exfactory value of production declined from 28 per cent in 2010 to 18 per cent in 2014 because of the sharp decline in value of NVAM caused by variations in sales-stock mix and increasing dependence on purchase of finished goods.

Table 3 Fund Flow Analysis Gandhigram Khadi and Village Industries Public Charitable Trust (GKVIPCT), Gandhigram

Rupees in lakhs

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Net increase in fixed liabilities	2.78	3.54	4.6	7.1	8	5.5	5	4.2	2.8	3	3.6
Net increase in current liabilities	11	9	12	8	13	7	5	3.6	4.8	2.8	2.2
Net decrease in fixed assets	0	0.2	0	0	0	0	0	0	0.33	0	0
Net decrease in current assets	0	0	0	1.4	3	4.6	2.6	1	4.6	3.8	7.6
Total	**13.78**	**12.74**	**16.6**	**16.5**	**24**	**17.1**	**12.6**	**8.8**	**12.53**	**9.6**	**13.4**
Net increase in fixed assets	2.76	3.46	4.4	6.7	7	5.5	5	4	2.7	2.7	3.4
Net increase in current assets	11.02	9.08	12.2	8.5	14	8	5	3.8	4.9	3.1	2.4
Net decrease in fixed liabilities	0	0.2	0	0	0	0	0	0	0.33	0	0
Net decrease in current liabilities	0	0	0	1.3	3	3.6	2.6	1	4.6	3.8	7.6
Total	**13.78**	**12.74**	**16.6**	**16.5**	**24**	**17.1**	**12.6**	**8.8**	**12.53**	**9.6**	**13.4**



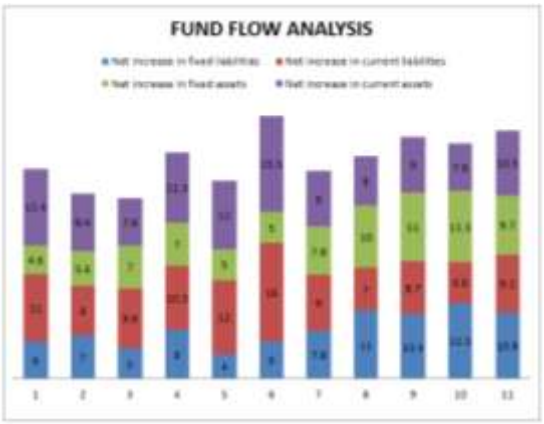
The institution recorded (Table 3) a substantial increase of funds 2006-07, 2007-08, 2008-09.. The increase in resources was contributed by net raise in fixed liability in 2006 to 2008 and in the remaining years by increase in current liabilities. In the above periods, the long-term funds were responsible for additional funds i.e., capital expenditure loan and depreciation reserve. Though fixed liabilities were the largest source of funds in this institution, capital fund and accumulated profit made a very insignificant contribution though gradually increasing upto Rs. 7 lakhs in 2004-05 to 25 lakhs in 2014.

Table 4 – Fund Flow Analysis Gandhi Seva Sangam (GSS), Chinnalapatti

(Rupees in lakhs)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Net increase in fixed liabilities	9	11	8	12.6	10.8	13.9	15	18.9	13	17	18.8
Net increase in current liabilities	17	12	16	13	16	8	6	10	12.7	16	13.8
Net decrease in fixed assets	0	0.2	0	0	0	0	0	0	0.33	0	0
Net decrease in current assets	0	0	2.2	3	4	4	3.4	2.8	2	2.3	1.8
Total	**26**	**23.2**	**26.2**	**28.6**	**30.8**	**25.9**	**24.4**	**31.7**	**28.03**	**35.3**	**34.4**
Net increase in fixed assets	8.4	9.8	7.7	12	12	15	15	18.9	12	16	16.7
Net increase in current assets	17.6	13.2	16.3	13.6	14	6.9	6	11.2	14.7	17	14.9
Net decrease in fixed liabilities	0	0.2	0	0	0	0	0	0	0.33	0	0
Net decrease in current liabilities	0	0	2.2	3	4	4	3.4	1.6	1	2.3	1.8
Total	**26**	**23.2**	**26.2**	**28.6**	**30**	**25.9**	**24.4**	**31.7**	**28.03**	**35.3**	**33.4**

Chart 4 – Fund flow analysis
Gandhi Seva Sangam (GSS), Chinnalapatti



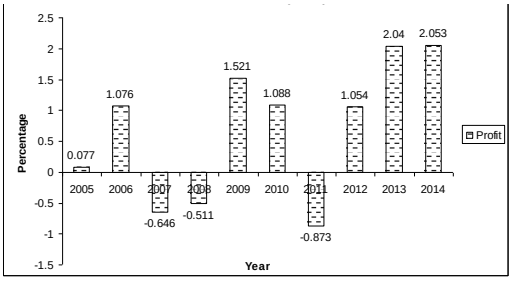
The above table 4 shows the fund flow statement of GSS, Chatrapatti. This institution could register a substantial addition to its fund only in two years, ie. 2007 and 2009. In other years the inflow was small. The largest source of additional fund was an increase in current liabilities closely followed by an increase in fixed liabilities. Among the long-term sources, capital fund and accumulated profit followed by grants and donations made significant contributions. Among short-term sources, working capital loan yielded more than any other source. Because of the modest level of fixed assets and low level of production and sales contribution by depreciation reserve was also small.

Table 5 -Profitability Analysis
Gandhigram Khadi and Village Industries Public Charitable Trust (GKVIPCT), Gandhigram

1	2	3	4	5	6	Ratio -I	Ratio -II	Profitability
S.No	Year	Opening balance	Accumulated Capital + additions	8 % compounded interest	P/L	6/4X100	6/5X100	contribution (in million)
1	**2005**	103.2	107.024	115.44	2.1	1.962	1.819	0.077
2	**2006**	107.4	112.5	120.64	2.3	2.044	1.90	1.076
3	**2007**	112	117.06	125.424	3.4	2.904	2.71	-.646
4	**2008**	118.9	123.06	132.704	3.7	3.007	2.788	-.511
5	**2009**	124.4	128.23	138.736	4.2	3.275	3.027	1.521
6	**2010**	129.3	135.45	145.08	3.2	2.362	2.205	1.088
7	**2011**	136.9	144.67	153.4	2.8	1.935	1.825	-0.873
8	**2012**	145.4	150.7	160.16	2.2	1.46	1.373	1.054
9	**2013**	152.7	157.9	167.96	1.7	1.077	1.015	2.04
10	**2014**	158.2	162.84	172.848	2.3	1.412	1.330	2.053

Table 5 reveals that the profitability varied widely from net loss of Rs .57 million to net profit of Rs 2.27 million. Further, the profitability percentage to the accumulated capital varied from 1.01 per cent to 3.27 per cent. Perusal of trading account and profit and loss account of the institution reveals certain

findings. Ratio of gross profit to sales indicating control over direct costs remained fairly stable varying between 10 per cent and 12 per cent during the period under review.



However, spurt in salaries and allowances from 2007 onwards considerably eroded net profit and caused net loss in 2011.Both the amount of profit and rate of return were at their peak in 2013 and 2014. The profitability contribution standard indicates that the net earnings failed to earn the cost of capital in eight out of ten years. Therefore, remedial measures will have to be concentrated on control of fixed costs especially salary and allowances raising the productivity of supervisory staff for improvement of profitability.

Conclusion

The present study examined the work of four khadi institutions in Dindigul District on Gandhigram with special reference to the financial conditions of these institutions. In pursuit of the objectives such as variations in production and sales, patterns of mobilization and utilization of resources, and profitability were analyzed. The financial performance of Khadi industries in Gandhigramam is influenced by government support, market demand, and production efficiency. While steady revenue growth is observed due to increasing consumer interest in eco-friendly products, profitability depends on cost management and modernization. Challenges like labor costs and seasonal demand fluctuations impact financial stability. Strengthening branding, digital marketing, and innovation can enhance long-term sustainability and profitability.

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TOTAL QUALITY MANAGEMENT AND QUALITY ASSURANCE FOR ACADEMIC EDUCATION

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Abstract
Knowledge about technical quality and quality management is a most important issue in modern economic life. So in the course of university studies in the technical domain students should get a very comprehensive knowledge. Education in this field must be based on close co-operation between industry and university institutes. On the one side this deepens the understanding for industrial needs at the universities; on the other side enterprises get help from competent academic specialists when problems must be solved in shortest time under the pressure of world wide competition.
Keywords: *quality, quality management, higher education, quality system*

Introductory Remarks

The origins of quality management and quality assurance began in manufacturing organizations, and many of the tools for quality analysis and improvement were developed for manufacturing problems. Through the 1980s, this manufacturing emphasis dominated the profession. In the late 1980s and into the 1990s, business began to recognise the importance of quality service in achieving customer satisfaction and competing in the global marketplace. In a very important sense, this recognition has expanded the definition and concept of quality to include nearly any organizational improvement such as the reduction of manufacturing cycle time and improved worker skills.

In addition to industrial organizations and the manufacturing industry also service organizations build up quality systems. Ancillary services in manufacturing companies as well as "stand-alone" service organizations such as hospitals and banks are beginning to realize the benefits of a focus on quality.

The special situation in Austria but also in other Central European countries is that there exist many Small and Medium Sized Enterprises (SMEs). So there still is a great need in young academics and especially in engineers who have an excellent special knowledge in quality science in addition to their basic technical and engineering knowledge. Additionally for young academics it is also necessary to get an understanding for industrial needs at a very early time.

Quality and its Importance in Economics and Industry

Quality is the responsibility of everyone in the organization, from the chief executive officer to the operators on the production floor. People such as machine operators, assembly workers, ticket agents, nurses, and waitresses are the craftspeople who build quality into products and services. First-line supervisors must provide the motivating climate for employees, direct them in proper procedures, work together with them to locate problems, and assist in eliminating sources of error. Middle management must plan, co-ordinate, execute, and monitor quality policy. Finally top management must commit the resources and provide the leadership necessary to set the tone and carry out the requirements of an ongoing, dynamic policy in respect of technical quality.

International Standards of the "ISO 9000 Family of Quality Management Systems Standards" have been developed and are still improved to support organizations to rationalize communication and competitiveness in national, regional and world wide international trade. The whole system has several control loops integrated in each other. Improving the

speed and the quality of the information flow, and response characteristic are the main stimuli. With the possibilities of contemporary information technology, data flow management contributes imminent steps against bureaucracy and heavy documentation of the quality system.

The scope and the structure of quality systems and also of quality management standards should be formed on the basis of an integrated system of quality principles.

The General Quality Management Principles are Listed as Follows

Principle 1

Customer-driven organization: Organizations depend on their customers and therefore should current and future customer needs, meet customer requirements and strive to exceed customer expectations.

Principle 2

Leadership of people: Leaders establish unity of purpose, direction, and the internal environment of the organization. They create the environment in which people can become fully involved in achieving the organization's objectives.

Principle 3

Involvement of people: People at all levels are the essence of an organization and their full commitment enables their abilities to be used for the organization's benefit.

Principle 4

Process orientation: A desired result is achieved more efficiently when related resources and activities are managed as a process.

Principle 5

Systems approach to management: Identifying, understanding and managing a system of interrelated processes for a given objective contributes to the effectiveness and efficiency of the organization.

Principal 6

Continuous improvement: Continuous improvement is a permanent objective of the organization.

Principle 7

Factual approach to decision making: Effective decisions are based on the logical and intuitive analysis of data and information.

Principle 8

Mutually beneficial supplier relationships: Mutually beneficial relationships between the organization and its supplier enhance the ability of both organizations to create value.

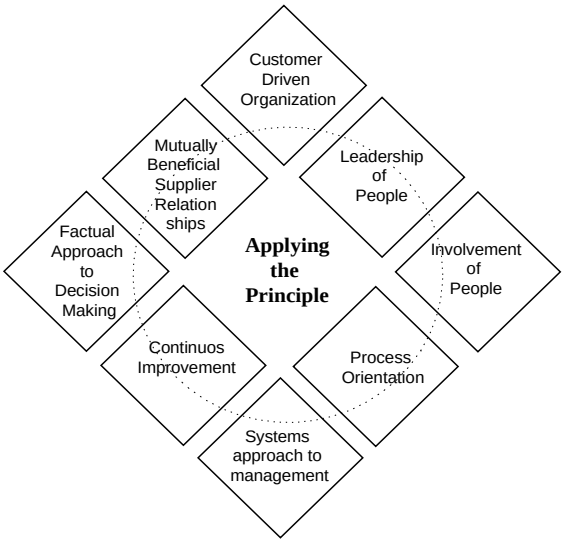

Figure 1 Applying the Quality Management Principles to the Executive Management Area of Strategic Planning

The Importance of Quality for Higher Education

The quality of higher education comes nowadays more and more into the point of view of public opinion. The demand for «the quality of engineers" was provoked on the one hand by the industry, where quality management has obtained a great appreciation in general since about twenty years, on the other hand the universities themselves made efforts to provide education of high level quality. And last but not least there is also a tendency to

shorten the actual length of the studying time which is necessary to get the university diploma.

The application of quality management and the establishing of quality systems for the educational domain at universities were proposed the first time in 1991 [3]. Discussions on some special problems arising in this context have been published recently [4, 5] and proposals for the solution have been worked out by the application of quality management systems partly based on EN/ISO 9000 standards series for educational establishments and educational processes. The assessment of the educational quality especially at universities and the application of the feed back for the contents and realization of lectures and courses are very important.

Especially the new ISO 9000 international standards with its orientation to processes gave a useful frame for the development of quality management systems. Figure 2 shows the model that can be used for building up a "Process-based Quality Management System" [3].

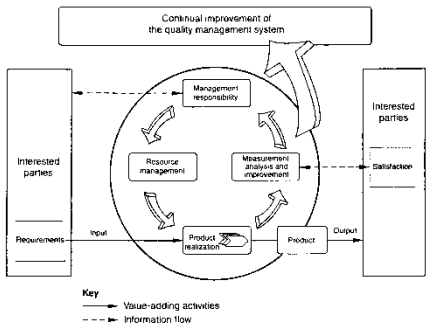

Figure 2 Model of a Process-based Quality Management System

To speak about the problem in a more general way it has to be reminded that comprehensive studies have been carried out as co-operations between various European countries and the universities respectively within the frame of joined EU-Projects TEMPUS and the report respectively has been published recently.

But the topic "Quality for Higher Education" has been during the last decade and still is of great interest at many places all over the world as may be illustrated by an example of an already established quality management system in South America. That system was worked out partly based on the experience from Europe.

A very interesting report ranking of educational processes has been worked out at the end of year 2000. The demands for quality of educational processes and quality of young engineers are of growing importance for various types of academic institutions and organizations.

Quality Management for the Educational Domain of Universities

To assess the quality of an educational activity is a difficult task in general. Normally it is only possible to use indirect indicators. When the quality of an educational process has to be assessed it must be done by mutual co-ordination between the teacher and the student. The criteria is the creation of the teaching contents, the range and topicality of which will be regulated and influenced by various mechanisms, as well as the given knowledge level of the students. In the point of view of this paper is above all how to assess the quality of the knowledge of the students and to assess the mediation of the studying material on the basis of responsible verification.

It is presupposed that lectures are the basis of the education at the university. In addition to the selection of the studying material and the way of lecturing, the mediation of the studying material is most important for the quality of a teaching process. The mediation of the studying material is determined by the disposition of the lecturer. The verification of this process, which is only based on the results of examinations, includes also the disposition of the students and therefore this way is not correct. If for instance the course of lectures is conscientiously prepared and given and also the belonging text book is easily accessible but the student is badly prepared because of various reasons, which are not influenced by the teaching process, then the realized correction of the process on the basis of these results would have been false.

On the other hand badly prepared and badly presented courses of lectures can hardly lead to an appropriate improvement of the knowledge level. If at the examination a considerable difference between the expected knowledge level and the real one is detected a correction is necessary. In order to be guaranteed the permanent balanced quality is necessary to go from the verbal definition of the status to the exact one as well as the implementation of the available quantification scheme.

The solution at the Department for Interchangeable Manufacturing and Industrial Metrology is based on two sub solutions:

1. Continual examination of the student's knowledge.
2. Evaluation of the lecture which is realized by the students.

These two sub solutions are evaluated in the form of a so-called "lecture matrix" and corrections are derived from this matrix.

The students have the opportunity to evaluate the lecture using the student's questionnaire. This includes the following questions:

- The treatment of the students,
- The selection of the studying material,
- The way of the lecture,
- The mediation of the contents and
- The selection of the examination questions.

These questions are answered by the students by ranking with marks between 1 and 5 and there is also the possibility to criticize verbally. This questionnaire is evaluated statistically for each course of lectures.

Realization of a Quality Management System for Higher Education

The Department for Interchangeable Manufacturing and Industrial Metrology (Abteilung Austauschbau und Messtechnik) at Vienna University of Technology started its work for Total Quality Management of Educational Processes and organizations in the late 1980s [1]. The concrete application of an appropriate quality management system was started in July 1995 with the grant of an EN/ISO 9001 certificate by a well known international certification corporation and the last successful renewing audit took place in 1999 [6].

Summarization and Concluding Remarks

Customer satisfaction is a main concern of quality management and general efforts to achieve quality in industrial but also public organizations. The customers of Universities as institutions for higher education are the various organizations where the young academics will be engaged after they have finished their studies. Feedback about the quality of the former students can be gained by continuous contact with industrial and public organizations.

The described solution for the problem of evaluating educational processes is now successfully applied in the quality management system at a Department of Vienna University of Technology since more than five years on the basis of continuous improvement and close contact with industry.

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INNOVATIVE STRATEGIES FOR CHANGE MANAGEMENT TOWARDS SUSTAINABLE DEVELOPMENT

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Abstract
In today's rapidly changing global environment, organizations are faced with the challenge of adopting innovative approaches to change management to foster sustainable development. This paper explores various innovative strategies that can be applied to change management in order to achieve long-term sustainability goals. The study provides a critical review of the existing literature on change management, innovation, and sustainability, while identifying historical trends and insights into how organizations can adapt to these challenges. Key models, strategies, and frameworks are discussed, and a comprehensive SWOC (Strengths, Weaknesses, Opportunities, and Challenges) analysis is provided to evaluate the feasibility of different approaches. Suggestions are made for incorporating these models into organizational practices, concluding with insights into the future of change management for sustainable development.
Keywords: *change management, sustainable development, innovation, organizational change, swoc analysis, sustainability strategies*

Introduction

In today's world, this timeless quote is more relevant than ever, particularly in the realm of sustainable development. The rapid pace of technological advancements, environmental concerns, and the need for ethical corporate governance have forced organizations to rethink how they manage change. Sustainable development, defined by the Brundt land Commission as ***"development that meets the needs of the present without compromising the ability of future generations to meet their own needs,"*** requires a paradigm shift in how organizations approach innovation, strategy, and management. Change management, therefore, becomes critical in integrating sustainable development goals into core organizational strategies. This paper delves into the innovative approaches that organizations can adopt to ensure that change management supports sustainability.

Review of Literature

Corporate Innovation: Indian businesses are adopting sustainable business models that incorporate circular economy principles and supply chain innovations to enhance sustainability and competitiveness.

Public Policy: Government initiatives such as *Make in India* and *Smart Cities Mission* require adaptive change management frameworks that allow for sustainable urban development and public-private collaboration.

Leadership and Culture: Transformational and ethical leadership are critical in Indian organizations for creating a culture that supports sustainability and drives successful change management.

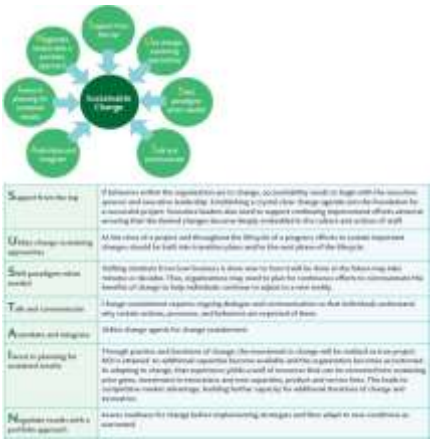
Agriculture: Technological innovations like precision farming and sustainable water management practices are crucial for addressing sustainability challenges in Indian agriculture, with change management focusing on technology adoption and capacity building.

Education and Training: Sustainability education and corporate training are vital for building capacity and ensuring that leaders and managers are equipped to manage change toward sustainability.

Digital Transformation: The adoption of digital technologies such as AI and block chain is helping Indian organizations achieve sustainability goals, with agile change management frameworks facilitating these transitions.

A Model for Sustainable Change

Innovative approaches to change management are critical for achieving sustainable development, particularly as organizations face rapidly changing social, environmental, and economic landscapes. These approaches can leverage new technologies, foster inclusive participation, and employ adaptive strategies to drive meaningful and lasting change. Below are some innovative approaches and their potential outcomes when applied using structured models. A model for sustainable change can help organizations achieve lasting results through change management. Some models for sustainable change include:



Participatory Change Management

Description: Engage all stakeholders (employees, customers, community members) in the change process to ensure their voices and needs are heard. **Outcome:** Increased buy-in and support for initiatives, leading to more sustainable and accepted solutions.

Agile Methodology

Description: Adopt agile practices that promote flexibility and iterative development in response to feedback and changing conditions. **Outcome:** Faster adaptation to changes, improved responsiveness to stakeholder needs, and continuous improvement of processes and products.

Technology Integration

Description: Utilize digital tools (e.g., AI, data analytics, collaboration platforms) to enhance communication, monitor progress, and streamline processes. **Outcome:** Improved data-driven decision-making, more efficient processes, and enhanced transparency.

Systemic Thinking

Description: Approach change as a system that considers the interconnections among various stakeholders and environmental factors. **Outcome:** More comprehensive solutions that address root causes and long-term impacts rather than just symptoms.

Behavioral Insights

Description: Apply principles from behavioral economics to encourage desired behaviors and engagement among stakeholders. **Outcome:** Increased participation and commitment to sustainable practices through targeted and incentives.

Continuous Learning and Development

Description: Foster a culture of continuous learning where employees are encouraged to innovate and share ideas for improvement. **Outcome:** Enhanced creativity, resilience, and capacity for ongoing adaptation to new challenges.

Collaborative Networks

Description: Form partnerships with other organizations, communities, and NGOs to pool resources and knowledge. **Outcome:** Broader impact

through shared initiatives and collective action towards common sustainability goals.

Expected Outcomes of Innovative Change Management for Sustainable Development

- **Long-term Viability:** Organizations can achieve sustainable growth that balances economic, social, and environmental dimensions.
- **Enhanced Resilience:** Organizations become more adaptable to external changes, ensuring continued relevance and sustainability.
- **Empowered Stakeholders:** Increased participation fosters a sense of ownership among stakeholders, resulting in more effective implementation of sustainable practices.
- **Positive Social Impact:** Initiatives that consider social dimensions lead to improvements in community welfare and stakeholder relations
- **Resource Optimization:** More efficient processes and collaborative efforts lead to better resource utilization and reduced waste.

By integrating innovative approaches with established change management models, organizations can effectively navigate the complexities of change while promoting sustainable development. This synergy not only fosters a culture of resilience but also cultivates an environment conducive to long-lasting, positive impact.

SWOC Analysis

SWOC Analysis (Strengths, Weaknesses, Opportunities, and Challenges) is a strategic tool that helps organizations assesses internal and external factors that can impact their ability to implement effective change management, particularly for sustainable development initiatives. Below, we explore how this analysis can inform innovative approaches to change management in the context of sustainable development.

Strengths

- **Established Organizational Commitment**: Organizations with a strong commitment to sustainability can leverage this as a strength. Initiatives such as corporate social responsibility (CSR) programs and sustainability goals enhance credibility and stakeholder trust.
- **Innovative Culture**: Organizations that foster a culture of innovation and creativity can develop new solutions to sustainability challenges, promoting innovative practices that reduce environmental impact and improve social outcomes.
- **Resource Availability**: Access to financial, technological, and human resources can facilitate the implementation of sustainability initiatives. Organizations can utilize existing resources to drive change management effectively.
- **Strong Stakeholder Engagement**: High levels of engagement from stakeholders (employees, customers, suppliers) can provide valuable insights and support for sustainable initiatives, enhancing the effectiveness of change management strategies.

Innovative Approaches

- Utilize stakeholder feedback mechanisms (e.g., surveys, workshops) to identify and enhance strengths that support sustainable initiatives.
- Foster a collaborative environment for cross-functional teams to develop innovative solutions to sustainability challenges.

Weaknesses

- **Resistance to Change**: Employees and other stakeholders may resist new sustainability initiatives due to lack of awareness, understanding, or fear of change.
- **Limited Knowledge and Skills**: Insufficient expertise in sustainable practices and change management may hinder the effective implementation of initiatives.
- **Siloed Departments**: A lack of coordination between departments can lead to inefficiencies and fragmented approaches to sustainability.
- **Short-Term Focus**: Organizations may prioritize short-term financial gains over long-term sustainability objectives, leading to misalignment of goals.

Innovative Approaches

- Implement training and development programs focused on sustainability practices and change management techniques to build capacity.
- Use change champions within the organization to advocate for sustainability initiatives and address resistance through education and engagement.
- Break down silos by promoting cross-departmental collaboration and integrating sustainability goals into departmental objectives.

Opportunities

- **Growing Demand for Sustainable Practices**: Increasing consumer awareness and demand for sustainable products and services present significant opportunities for organizations to innovate and differentiate themselves in the market.
- **Technological Advancements**: Emerging technologies (e.g., AI, IoT, renewable energy) can drive sustainable practices, improve operational efficiencies, and enhance change management processes.
- **Government Policies and Incentives**: Supportive regulations and incentives for sustainability initiatives (e.g., tax breaks for green projects) can provide additional resources for organizations.
- **Global Collaboration**: Opportunities for partnerships with NGOs, government agencies, and other organizations focused on sustainability can enhance knowledge sharing and resource allocation.

Innovative Approaches

- Develop new sustainable products or services that cater to emerging consumer demands, utilizing market research to identify trends and preferences.
- Leverage technological advancements to implement innovative solutions that enhance sustainability efforts (e.g., energy-efficient systems, waste management technologies).
- Form strategic partnerships with external organizations to share resources and knowledge, enhancing capacity for sustainable change management.

Challenges

- **Complex Regulatory Environment**: Navigating the complex and often changing regulatory landscape related to sustainability can pose challenges for organizations.
- **Limited Financial Resources**: Budget constraints may limit the ability of organizations to invest in sustainability initiatives and change management processes.
- **Measurement and Reporting Difficulties**: Measuring the impact of sustainability initiatives and communicating results to stakeholders can be challenging, leading to potential credibility issues.
- **Cultural Barriers**: Organizational culture that does not prioritize sustainability may impede the implementation of change management strategies.

Innovative Approaches

- Stay informed about regulatory changes and engage in advocacy to shape policies that support sustainability initiatives.
- Explore alternative funding options such as grants, crowd funding, or partnerships to secure financial resources for sustainable projects.
- Develop robust metrics and reporting frameworks to track the impact of sustainability initiatives, utilizing data visualization tools to communicate results effectively to stakeholders.
- Foster a sustainability-oriented culture through leadership commitment, employee involvement, and recognition of sustainable practices.

Using SWOC analysis provides organizations with a comprehensive understanding of their internal capabilities and external environment in relation to change management for sustainable development. By focusing on strengths, addressing weaknesses, leveraging opportunities, and overcoming challenges, organizations can implement innovative approaches

that drive sustainable practices and enhance their overall impact. This strategic analysis empowers organizations to align their change management efforts with sustainability objectives, fostering a culture of continuous improvement and innovation.

Sustainbale Stragies

1. Embrace agile change management to enhance flexibility and responsiveness in addressing sustainability challenges within organizations.
2. Leverage digital transformation technologies, such as artificial intelligence and the Internet of Things, to optimize resource use and improve decision-making for sustainability initiatives.
3. Foster stakeholder engagement through collaborative platforms, allowing employees, customers, and communities to co-create sustainable solutions and enhance buy-in.
4. Implement systems thinking to identify interconnections among environmental, social, and economic factors, leading to more holistic sustainability strategies.
5. Adopt circular economy models that prioritize reducing waste, recycling materials, and promoting sustainable production and consumption practices.
6. Establish innovative sustainability metrics and frameworks, such as sustainability scorecards and impact assessments, to evaluate the effectiveness of sustainability initiatives.
7. Drive a cultural shift within organizations by aligning corporate values with sustainability goals, ensuring that all employees prioritize sustainable practices.
8. Build resilience by developing strategies that help organizations adapt to environmental changes and market fluctuations while maintaining sustainability objectives.
9. Invest in education and training programs to equip employees with the knowledge and skills necessary to implement and support sustainability initiatives effectively.
10. Encourage public-private partnerships to leverage resources and expertise, facilitating large-scale sustainable development projects that benefit both communities and organizations.

Conclusion

Sustainable development is no longer an option; it has become a necessity for organizations striving for long-term success. Innovation and effective change management are pivotal in this journey. By adopting new models and strategies, organizations can not only achieve their sustainability targets but also enhance their competitive advantage. The future of change management in sustainable development hinges on the ability to integrate technological advancements, strong leadership, and interdisciplinary approaches to problem-solving. Moreover, as ***Albert Einstein famously remarked***, ***"We cannot solve our problems with the same thinking we used when we created them."*** This highlights the necessity for innovative thinking and a willingness to adapt change management processes to effectively tackle pressing sustainability issues. In summary, the journey toward sustainable development requires organizations to rethink their approaches to change management. By fostering a culture of innovation and collaboration, they can empower themselves to create a positive impact for future generations.

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FEMALE ENTREPRENEURS IN INDIA: A PUZZLE IN THE ERA OF GLOBALIZATION

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Abstract

The Government of India announced various policies from time to time which laid considerable emphasis on promotion of women entrepreneurship particularly among first generation women through various training and support services. Special attention is paid through organizing exclusive Training Programmes for women[1]. Women face tougher security requirements on their lines of credit than do men. Other differences such as higher interest rates, lower credit approval rates and espousal co-signature requirements are primarily attributable to the fact that women operate younger and smaller firms known to meet with such financing problems, irrespective of the ownership of the firm. Entrepreneurship development among women certainly ensures economic empowerment of women.The present study to analyze details of enterprises owned by Entrepreneurs in India, to know the contribution of MSME sector in GDP and output, to suggest remedial measures for improving the efficiency of the women entrepreneurs. An attempt to analyze that women entrepreneurs play a vital role in most of the income generating activities. There is a grater awakening among women entrepreneurs. The need of the hour is to provide an opportunity to work in a conducive atmosphere free from gender differences. The needs for awareness motivation to be an active member of the society and encourage correcting the faults of male counterparts are great challenges today.

Introduction

The Government of India announced various policies from time to time which laid considerable emphasis on promotion of women entrepreneurship particularly among first generation women through various training and support services. Special attention is paid through organizing exclusive Training Programmes for women.The emergence of entrepreneur largely depends on the economic, social, religious, cultural and Psychological factors prevailing in the society.

Women face tougher security requirements on their lines of credit than do men. Other differences such as higher interest rates, lower credit approval rates and espousal co-signature requirements are primarily attributable to the fact that women operate younger and smaller firms known to meet with such financing problems, irrespective of the ownership of the firm.

Entrepreneurship development among women certainly ensures economic empowerment of women. A woman as entrepreneur is economically more powerful and independent than as a mere worker because ownership not only offers control over assets (and liabilities) but also gives her the freedom to take decisions. This will also uplift social status significantly. Entrepreneurship proves doubly beneficial for a woman as it makes her economically independent and creates employment opportunities for other women in the locality as well. In other words it leads to the generation of income for self and poverty alleviation of the society.

Statement of the Problem

The basic problem or difficulty of a woman entrepreneur is the gender discrimination which makes her duties and responsibilities towards family, society and work. The replacement of joint family system with nuclear family system has adversely affected many of women entrepreneurs as it has deprived them of morale support and experienced counsels of elders. Women have encountered such dilemmas ever since they started leaving home for the work place.

The attitude of the male chauvinistic society towards her and constraints imposed on her add fuel

to fire. Gender- equality proclaimed in the constitution is more in breach then observation in the tradition- bound society where she is not at all considered in the matter related to decision- making, planning and research. The in born attitude of male domination at home, society and workplace leads to the creation and sustenance of difficulties and problems at all levels, such as family support, training, banking, licensing and marketing. The suffering of women in rural areas is doubled as they are targeted not only by men folk but also by the tradition bound elderly women who defend the supremacy of man. In rural areas where joint families still continue to exist, however uphold the tradition of considering woman a weakening irrespective of her education, position, administrative ability and so on.

Objectives

The following are the objectives of the study;

- *To analyze Details of Enterprises Owned by Entrepreneurs in India*
- To know the contribution of MSME sector in GDP and output (at 2004-05 prices).
- To suggest remedial measures for improving the efficiency of the women entrepreneurs.

Method of Data Collection

This study is based on both primary and secondary data. The primary data were collected from micro enterprise women entrepreneurs in Dindigul District. Information was collected first by conducting a pilot survey with 50 entrepreneurs and later the interview schedule was revised and the main survey was conducted for collecting information on the socio-economic background, motivational factors, performance of the enterprises, the problems faced by the entrepreneurs and their perceptions about wide range of issues.

The secondary data were collected from various agencies at different administrative levels and also from books, journals, government reports and websites.

Women Entrepreneurship in India

Entrepreneurial movement among women started about four decades ago. The First National Conference of women entrepreneurs held at New Delhi in November 1981 advocated the need for developing women entrepreneurs for the overall development of the country. The Second National Conference of women entrepreneurs organized by the National Alliance of Young Entrepreneurs (NAYE) held at New Delhiadopted certain declarations involving women's participation in Industry. Now it becomes difficult to get jobs in private and public organizations because of neck and neck competition. Women are becoming entrepreneurs mainly for economic independence and social recognition.

Entrepreneurship is not new to Indian women. A number of them have been engaged in home-grown vegetables, milk vending, butter and ghee making by maintaining one or a few milch animals. Women are also engaged in goat rearing, poultry farming, money lending and selling textiles in the neighbourhood .The money generated through such home- based entrepreneurship helps in augmenting family income in a modest way.[13] But the entry of women in organized business is a fairly phenomenon.

Business is a science and like any other science, it makes no distinction between gender. The result of a decision will not be different if taken scientifically by a man or woman.According to 1981 census, in India, self-employed women constituted 5.2 percent of the total number of self-employed persons. As on March 31 1999, women constituted about

17.2 per cent of the organized sector employment. Kerala, where the literacy among women is the highest in India at 87.86 per cent, provides a good example of presence of emerging entrepreneurship among women.

In traditional societies, women's role is naturally limited to the family. She just plays a crucial role as a bearer of children, as mother and home maker. Many factors like urbanization, technical progress, educational status of women have pave of the way for the participation of women in the economic

development in unorganized sector, organized sector, self-employment and entrepreneurship. Women entrepreneurs in India represent a group of women who have broken away from the beaten track and are exploring new vistas of economic participation. They have long stories of trials and hardships. Their tasks have been full of challenges. They have had to encounter public prejudices and criticism; family opposition and social constraints. In many cases, before they could establish themselves as independent entrepreneurs, they had to struggle a lot. However, in recent years women are increasingly participating in various economic activities including the field of industry. Entrepreneurs are one such traditional male preserve, where women have made their rightful entry. Availability of financial, marketing and training assistance given by the Government encourages women to adopt entrepreneurship as a career. Both Central and State Governments have introduced a new package of concessions, incentives and subsidies for the promotion and development of women entrepreneurship in "Zero-Industry Districts" and backward regions. Special incentives are being offered to women entrepreneurs by some States such as Punjab, Rajasthan, Haryana, Gujarat, Karnataka, TamilNadu, U.P., Orissa, West Bengal, and Andhra Pradesh.22 Preference is given to those women entrepreneurs in selection of entrepreneurial training who have fair background of education, special aptitude for entrepreneurial training, own experience of business and family background.

Number of Enterprises Owned by Entrepreneurs in India

The emergence of entrepreneurs in a country depends to a great extent on the economic, social, cultural and psychological factors prevailing in the country. In a developing economy like India, there is a positive growth in the number of women entrepreneurs.

Table 1 Details of Enterprises Owned by Entrepreneurs in India
(Numbers in Thousands)

State/UT Code	State /UT Name	Number of Enterprises Owned by		
		Female	Male	Total
01	Jammu & Kashmir	3.09 (1.44)	11.90 (0.89)	14.99 (0.96)
02	Himachal Pradesh	1.31 (0.61)	10.62 (0.80)	11.93 (0.76)
03	Punjab	3.01 (1.4)	45.10 (3.38)	48.11 (3.07)
04	Chandigarh	0.10 (0.05)	0.90 (0.07)	1.00 (0.06)
05	Uttarakhand	2.43 (1.13)	21.34 (1.60)	23.77 (1.52)
06	Haryana	1.46 (0.68)	31.69 (2.38)	33.15 (2.12)
07	Delhi	0.38 (0.18)	3.38 (0.25)	3.75 (0.24)
08	Rajasthan	5.99 (2.79)	48.90 (3.67)	54.89 (3.50)
09	Uttar Pradesh	8.39 (3.91)	179.36 (13.45)	187.74 (11.99)
10	Bihar	2.57 (1.2)	47.47 (3.56)	50.40 (3.22)
11	Sikkim	0.02 (0.01)	0.10 (0.01)	0.12 (0.01)
12	Arunachal Pradesh	0.10 (0.05)	0.32 (0.02)	0.42 (0.03)
13	Nagaland	0.22 (0.1)	1.12 (0.08)	1.33 (0.08)
14	Manipur	1.15 (0.54)	3.35 (0.25)	4.49 (0.29)
15	Mizoram	1.29 (0.6)	2.42 (0.18)	3.72 (0.24)
16	Tripura	0.16 (0.07)	1.18 (0.09)	3.34 (0.21)
17	Meghalaya	1.19 (0.55)	1.83 (0.14)	3.01 (0.19)
18	Assam	4.07 (1.9)	15.80 (1.18)	19.86 (1.27)
19	West Bengal	4.42 (2.06)	38.84 (2.91)	43.26 (2.76)
20	Jharkhand	0.75 (0.35)	17.44 (1.31)	18.19 (1.16)
21	Orissa	2.16 (1.01)	1.44 (0.11)	19.61 (1.25)

22	Chhattisgarh	2.09 (0.97)	20.68 (1.55)	22.77 (1.45)
23	Madhya Pradesh	10.18 (4.74)	96.82 (7.26)	107.00 (6.83)
24	Gujarat	23.40 (10.9)	206.43 (15.48)	229.83 (14.67)
25	Daman & Diu	0.01 (0.00)	0.58 (0.04)	0.59 (0.04)
26	Dadra & Nagar Haveli	0.04 (0.02)	1.68 (0.13)	1.72 (0.11)
27	Maharashtra	8.98 (4.18)	77.61 (5.82)	86.59 (5.53)
28	Andhra Pradesh	5.23 (2.44)	40.47 (3.04)	45.69 (2.92)
29	Karnataka	26.68 (12.43)	109.51 (8.21)	136.19 (8.69)
30	Goa	0.33 (0.15)	2.30 (0.17)	2.62 (0.17)
31	Lakshadweep	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
32	Kerala	38.30 (17.84)	111.89 (8.39)	150.19 (9.59)
33	Tamil Nadu	54.65 (25.46)	179.23 (13.44)	233.88 (14.93)
34	Puducherry	0.33 (0.15)	1.12 (0.08)	1.45 (0.09)
35	Andaman & Nicobar Ils.	0.20 (0.09)	0.55 (0.04)	0.75 (0.05)
	All India	214.68 (100.00)	1333.57 (100.00)	1566.35 (100.00)

Source: Fourth All India Census of MSME, 2006-07, Registered Sector, p.93.

It is inferred from Table 1 that Tamilnadu (14.93 per cent) is ranked top in terms of number of units owned by the entrepreneurs, closely followed by Gujarat(14.67 per cent) and Uttarpradesh(11.99 per cent). The State of Tamilnadu took several measures by rendering financial, technical and developmental services to the entrepreneurs to attain the top most position in India. Out of the total entrepreneurs, the percentage of women entrepreneurs is high in Kerala (17.84 per cent), followed by Karnataka with 12.43 per cent and Gujarat with 10.90 per cent.

Micro, Small and Medium Enterprises (MSME) sector in India

Consequent upon the globalization of the Indian economy, MSME faces new challenges. MSME-Development Organization (MSME-DO) has recognised the changed environment and is currently focussing onproviding support in the fields of credit, marketing, technology and infrastructure to MSMEs. Global trends and national developments have transformed MSME-DO‟s role into that of a catalyst of growth of small enterprises in the country. Through more than 6,000 products the sector contributes about 8 per cent to GDP besides 45 per cent to the total manufacturing output and 40 per cent to the exports from the country.

Table 2 Contribution of MSME Sector in GDP and Output (At 2004-05 prices)

Year	Gross Value of Output of MSME Manufacturing Sector (Rs. In Crore)	Share of MSME Sector in Total GDP (per cent)			Share of MSME Manufacturing Output in total Manufacturing Output(per cent)
		MSME Manufacturing Sector	Services Sector MSME	Total	
2006-07	1198818	7.73	27.40	35.13	42.02
2007-08	1322777	7.81	27.60	35.41	41.98
2008-09	1375589	7.52	28.60	36.12	40.79
2009-10	1488352	7.45	28.60	36.05	39.63
2010-11	1653622	7.39	29.30	36.69	38.50
2011-12	1788584	7.27	30.70	37.97	37.47
2012-13	1809976	7.04	30.50	37.54	37.33

Source: Government of India, Ministry of MSME, Annual Report, 2015-16, p.9.

Table 2 reveals that the share of MSME sector to total GDP was high in 2007-08, but there is no significant difference in terms of its contribution during the period 2006-06to 2012-13, whereas the contribution of service sectors to total GDP was high in 2011-12.In the case of share of MSME Manufacturing output in total Manufacturing output was high in 2006-07.

Conclusion

The present study concludes that women entrepreneurs play a vital role in most of the income generating activities. There is a grater awakening

among women entrepreneurs. The need of the hour is to provide an opportunity to work in a conducive atmosphere free from gender differences. The needs for awareness motivation to be an active member of the society and encourage correcting the faults of male counterparts are great challenges today. It is, therefore, encouragement of the growing intensity of motivation among young women for coming in the entrepreneurial stream and extends support with scientifically designed package of the technical and financial assistance. Both the government and non government agencies have to play a pivotal role for making the movement of women entrepreneurship a success.

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COSMETICS TREND: NATURAL SKIN CARE COSMETICS BEING AN RESULT TO THE NOSTALGIC TOWARDS BEAUTY OF WOMEN

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Abstract

"Live long with long lasting Beauty" has became an Mantra in many of our lives today. Both men and women are equally tailored towards beauty conscious. We have got many opportunities and possibilities to know about the varieties and the brand available in today's market. But still, many are not aware about the Natural skin care cosmetics.The main aim of this article is to crate awareness about the Natural skin care cosmetics brand available in the market today. The author used Secondary Data collection method to collect data.To have a scrutinized thoughts about the cause that influence the women to purchase the natural skin care cosmetics and to know the awareness about the natural skin care cosmetics among the women , this study has been done.

Introduction

"MAKE - UP" is meant to magnify the beauty that already exists and is something which gives you new look.Make up has been for many centuries from Egypt to Rome, the European middle ages, Elizabethan England, the french restoration. Egyptians was the one who used cosmetics for the first time, where they used dark green color and kohl to decorate the lids of their eyes. Bathing in milk and honey, Pomegranate as an skin care ingredient, and rice water are still popular in Asian skincare today. Day by Day, the urge for beauty and cosmetics has been arising towards both men and women. Later, the women began to use all such kind of natural ingredients which was stored in their kitchen like Turmeric, ginger, etc… Due to the advancement in technologies and greater significance on the skin glow, lead the skin care industries faster than ever and does not reflect any sign of slowing. All such kind of harmful ingredients like parabens, synthetic fragrances, propylene glycol etc.., are being added. Undoubtedly all these ingredients are being slowly absorbed by your skin which leads to some of the health concerns like cancer, endocrine disorders (infertility) etc... It is very important and the responsibility of every individual to be aware of these toxins in our day to day life and the impact they can have on us. There comes a drastic filtered stage in which the women started to focus more on Natural skin care, self care and loving themselves. This attitude grow massively during the pandemic. In recent years the women are so fascinated towards the beauty abides with the safety and fashion. The above discussed are so transparent that the cosmetics are playing a paramount role towards the women from earliest to till dates.

Literature Reviews

Joseph George Kallivayalil, Vishnu Priya. V, Gayathri. R (2021) conducted a research about "Awareness on Natural agents for skin care among Teenagers ". The questions were administered to the participants through an online survey plant link. The data was collected and results were statistically analyzed. 50.9% respondents were aware that vitamin B12 prevents dark pigmentation on skin and 49.1% were not aware. The study found that 70% of the teenagers preferred to ABuse natural products in

their skin to maintain originality of skin while 30% do not prefer to use natural products on their skin.

Shamsudin, M.F.Hasson, Ishak, M.F.Ahmad.Z, Uniklbis (2020) conducted a research about "Purchase intention towards skin care products based on brand awareness and brand association". The purpose of this study is to measure the relationship between brand associations and brand awareness towards customers purchase intentions on the skin care products and to provide information to local brand that is competing with the large and popular brands in producing their market share. The survey used self-administered questionnaires for data collections. 450 questionnaires were distributed to customers, convenience sampling was used and data collected were analyzed using structural equation model to perform the measurement model and structural model. The results indicate that both brand associations and brand awareness was equally significant towards influencing customers purchase intentions. The researcher suggested that the industry should focus more on the brand solutions and brand awareness on both are important.

Swati Chaturvedi (2023) published an article in New 18.Com about "Clean beauty takes over: The risk of Natural ingredients in Indian Skincare". In this article, the author clearly points out that, India has seen a significant shift towards clean and natural ingredients. This has given rise to a new wave of clean and natural ingredients led beauty brands that are gaining popularity in the Indian market. Also it is depicted that this trends towards clean beauty in India is not only driven by consumer demand but also by a growing awareness of the environmental impact of traditional beauty products. It is considered that as more consumers become conscious of what they put on their choices on the planet, it is likely that the trend towards clean beauty will continue to gain momentum in India.

Abishek Duttagupta (2017) conducted a research about "A pilot study of awareness and consumer behaviour towards organic cosmetics". the main objective of the study is to 1. Evaluate which factors are more essential to enhance such awareness among mass and to study the consumer buying behaviour on organic cosmetic consumers. Both qualitative and quantitative methods were used. 100 respondents answered the questionnaire. An offline survey was conducted among 25 respondents. Chi-square techniques were used. The findings of the study was out of 100 respondents only 10 were aware about the Organic cosmetics which clearly shows that there is a significant lack of awareness among the people about natural cosmetics on which the industrialist and manufacturers should focus on. Also, the doctors can become helping hands to promote these products.

Rambabu Lavani, Charbel Jose chiappepetta Jabbour, Oksana Grebinerych, David Roubaud (2022) conducted a study about "Green factors influencing the purchase intention of innovative luxury organic beauty products: implications for sustainable development". The main objective of the study is to examine how green factors impact customers intention to purchase premium organic beauty products. Data was collected from 398 respondents using convenience sampling and analyzed using the IBM SPSS 22 version and Amos 22 package applying structural equation modelling. The researcher found that the mediating role of Trust and attitude is of the utmost importance to ensure a sustainable orientation of customers toward organic products. The findings suggested the policy makers to provide necessary subsidies to new organic beauty entrepreneurs.

Idris Adewale Ahmed, Maryam Abimbola Mikali, Norhisam Zamakshshari & AI-Shwyeh Hussah Abdullah (2020) conducted a research about "Natural anti-aging skincare: role and potential".The aim of this study are to give some critical insights to the effects of both intrinsic and extrinsic factors on excessive or premature skin aging and to elaborate on the relevance of natural beauty and natural anti aging skincare approaches that will help consumers, scientists and entrepreneurs make the switch.

Consumer Awareness towards the Natural Skin Care Cosmetics and the Growth of Cosmetic Industry

Many of the women in the modern era are caring much about their beauty and are willing to look beautiful as well. To enhance their beauty people prefer Synthetic, Natural, Organic, Green and Halal Cosmetics. Among many, today's generation people fall much towards Natural Cosmetics. Natural cosmetics are being influenced through friends, family, social Media, Brand ambassadors. Only 70%of the people especially teenagers prefer Natural cosmetics while 30% of the people do not prefer Natural skin care cosmetics. Also not all people are aware about the natural ingredients which are being used by the manufacturers. In the earlier stage, the women of Egypt, Roman ….. were using cosmetics which were obtained directly through plants without any contamination or preservatives. Due to the technological development, there comes many synthetic and harmful ingredients which affects the skin in many ways. The love for beauty, influenced women to buy as much as cosmetics irrespective of the ingredients used and the impact of those ingredients. Later, especially after Pandemic, it was a great turning point to the Natural skin care Marketers, during when many women got awareness about Natural skin care cosmetics which directly impacts the growth of Cosmetic industry. Allied Market Research highlights in its recent report that the Indian skincare products market is expected to hit the $5033.7 million mark by 2027 and will grow at a CAGR of 9.5% from 2021 to 2027. This growth will primarily be due to factors such as the youth population, the surge in disposable incomes, and the transition of the Indian consumers towards a healthy lifestyle and increased focus on hygiene. According to Statista's report, the skincare revenues in the country are also expected to stand at $7644.9 billion by the end of 2022 and the market is anticipated to grow at a CAGR of 5.15% from 2022 to 2026. These stats are indicative of the fact that the Indian skincare market is flourishing and is expected to boom even in the times to come.

Varieties of Natural Skin care cosmetics available in the Market

There are many natural skin care cosmetics available in today's Market, but its not that all the brands are familiar or even aware to us. Women are practiced to use cosmetics for many purposes like Acne, Dryness, Oiliness, Wrinkles, Dark spots, Uneven skin tone, Pores, Redness for which many varieties like Day cream, Facialmask, Toner, Cleanser, Moisturizer, Serum, Sunscreen, Exfoliator etc..are available in the market with many brands which comes from both Natural and synthetic cosmetics. To enhance the awareness among the women about Natural skin care cosmetics, here it is listed with some of the top leading Natural cosmetics brand.

Name of the Brand
Forest essentials
Kama ayurveda
Biotique
Juicy chemistry
Soul tree
Mamaearth
Khadi
Organic harvest
Plum
Just herbs
The Tribe concept
Arata
Disguise cosmetics
Himalaya
Neemli naturals
Neutrogena
Pahadi local
Purearth
The body shop
Ohria ayurveda
Skinkraft
Vaadi herbals
Lotus herbals
M caffeine
Wow skin

Natural & Organic is the Way Forward

The top shelf synthetic products are no longer their choices since these have chemicals like Parabens and mineral oil and can impact both the skin as well as the environment. Hence, customers prefer products that

are vegan and sustainable. They demand skincare and haircare products that are devoid of toxic chemicals.

The above chart clearly shows that the Natural skin care cosmetics are being triggered globally towards the consumers. The demand for Natural Skin care cosmetics are steadily growing and fastering the growth of the Market trend.

Future of Natural skin care cosmetics in Indian Market

The future of Natural skin care cosmetics will be a plum package of promotions which will be a promising growth behind Celebrity Endorsements, Awareness of chemicals, Environmental concerns, Traditional beauty practices.

Few Tips to the Natural Skin Care Cosmetic Marketers to Enhance the Growth

Many researchers found that the price of the Natural cosmetics are numerically high when comparing to the Synthetic cosmetics.so the price can be affordable which may help middle class people also to buy the natural cosmetics. Also the marketers can give more awareness by choosing the right platform for their products instead of being an Herd of goats. Most importantly, the marketers can highlight the name of the ingredients along with the usage , it would be great if they Botanical names of the ingredients.

Conclusion

"Making beauty or being beauty" are simply driving today's market trend. Either the men or women wants to magnify their Beauty or to make others be beautiful. So, both are to be considered by the Marketers and the Manufacturers. The author wants to conclude here that ,once the People comes to know the exact Natural ingredients or when the ingredients are being Transparent ,the promising Grow-High market in the nearer future is assured with no doubts.

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TRAUMA AND HEALING NARRATIVE IN INDIAN LITERATURE

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Abstract
Within Indian literature, the complex narratives of trauma and healing, with a particular focus on the theme of racism, is explored in this paper. The historical and ongoing traumas experienced by marginalized communities due to colonialism, caste-based oppression, and ethnic discrimination were expressed by a profound medium in Indian literary works. The deep psychological scars left by racial and caste hierarchies is articulated by the authors were uncovered in this study by analyzing seminal texts such as Mulk Raj Anand's Untouchable, Arundhati Roy's The God of Small Things, and Kiran Desai's The Inheritance of Loss. Insights into the processes of reconciliation and resistance offered by these narratives which serve as vehicles for healing are examined by the paper. The broader discourse on social justice and human resilience was contributed along with Indian literature which documented the pervasive effects of racism that were highlighted in the study through a close reading of these texts. In addressing and potentially healing the wounds of systemic oppression a critical perspective on the role of literature was provided by this paper by engaging with the intersection of race, caste, and trauma. A reflection of the societal challenges posed by racism and a hopeful vision of healing and empowerment were offered by Indian literature as per the argument of the paper.
Keywords: *trauma narratives, racism in indian literature, postcolonial trauma, intersectionality in literature, and healing in literature*

Introduction

Deep insights into the human experience, particularly within the context of cultural and societal challenges were offered by trauma and healing which are profound themes in literature. A compelling platform for exploring these themes was provided by Indian literature which is rich in its diverse cultural, historical and social narratives. The experiences of marginalised individuals and communities gets further complicated when trauma which often arises from personal, historical, or societal upheavals, can be exacerbated by systemic issues such as racism. The journey of overcoming such trauma and seeking redemption and recovery is represented by healing on the other hand. This paper which focused on the role of racism as both a source of trauma and a barrier to healing which thoroughly aims to examine how trauma and healing are portrayed in Indian literature. A research question which seeks to be addressed is as follows;

- In Indian literature how is trauma depicted, and including the impact of racism, represented in these narratives, what are the primary sources of trauma?
- In what ways do the process of healing in Indian literary works illustrated, and what mechanisms or resolutions are portrayed, especially in relation to overcoming racial discrimination?
- Towards trauma, healing, and racism, how do these narratives reflect broader societal issues and cultural attitudes?

Within Indian literature the intersection of trauma, healing, and racism is highlighted by the significance of this research which lies in its ability. The narratives which portray both trauma and healing will be investigated in this paper through an analysis of selected works such as the impact of social and racial hierarchies explored by Arundhati Roy's *The God of Small Things*, communal violence and its traumatic aftermath reflected in Khushwant Singh's Train to Pakistan, issues of post-colonial identity and discrimination addressed by Kiran Desai's *The Inheritance of Loss* and socio-economic and political challenges delved into by Rohinton

Mistry's *A Fine Balance*. The complexities of trauma, healing, and racism engaged by Indian literature which contributed to a deeper understanding were aimed in the paper by addressing these questions.

Trauma in Indian Literature

Profound psychological effects resulting from exposure to distressing events that overwhelm an individual's ability to cope is involved in trauma as discussed in contemporary trauma theory. The interplay between individual trauma and collective experiences is emphasized on recent theoretical advancements in trauma studies which was built on foundational ideas. The journey towards healing and resilience is explored by the trauma which is continuously re-lived and replayed, and the "narrative of recovery," is concepts such as "traumatic memory," which is often included by the modern definition of trauma. Insights from fields like postcolonial studies, which examine how historical and systemic oppressions contribute to trauma also incorporated by contemporary trauma theory.

Literary Examples

- Trauma within the context of socio-political unrest and personal tragedy were examined by "*A Burning*" by Megha Majumdar (2020) which is her debut novel. The intersections of political corruption, social inequality, and the quest for justice are reflected in the portrayal of trauma by Majumdar.
- Personal and familial trauma against a backdrop of societal expectations and internal conflicts were addressed in "*The Great Indian Family Drama*" by Anuradha Roy (2021). Trauma within the family unit is intertwined with broader social pressures as explored in the novel.

Analysis

How trauma disrupts both the psyche and societal structures, often leading to profound alienation and despair is illustrated in these recent literary works. The deep psychological scars left by violence and the complex interplay between individual suffering and systemic injustice were emphasised by the intersection of personal trauma with political and social upheaval as portrayed by Megha Majumdar's *A Burning*. How trauma within a family context reflects and contributes to broader societal issues was examined in *The Great Indian Family Drama* by Anuradha Roy.

Healing Narratives in Indian Literature

The process of recovering from trauma, which can be achieved through personal growth, reconciliation, or societal change often signified by healing in literature. Individuals and communities striving to restore balance and meaning in their lives strive through the aftermath of trauma which is explored in the narratives of healing. Broader societal issues, including racism, which perpetuate and compound trauma is addressed along with overcoming personal suffering involved in this process. The healing process by creating systemic barriers to recovery and perpetuating cycles of suffering is profoundly impacted by racism as a pervasive societal issue. A crucial aspect of achieving personal and collective redemption is the struggle against racism which is encompassed by literary representations of healing.

Literary Examples

- Themes of healing amidst the backdrop of post-colonial India, where the legacies of colonialism and socio-economic disparities are intertwined with issues of racism and identity is delved into in the "*The Inheritance of Loss*" by Kiran Desai (2006).
- A profound depiction of healing against the backdrop of political turmoil and social inequality in India is offered by "*A Fine Balance*" by Rohinton Mistry (1995). Their resilience in the face of adversity has been showcased which impacts systemic racism and caste discrimination on the lives of its characters, showcasing is addressed in the novel.

Analysis

A vision of healing that incorporates the struggle against racism and systemic injustice is provided in

these narratives. Racism and post-colonial legacies shape the characters' experiences and impact their journey toward self-acceptance and reconciliation is studied in The Inheritance of Loss by Desai. The healing process which affected the broader societal challenges was underscored by the novel's depiction of racial and socia-economic tensions. Systemic racism and caste discrimination affect the characters' lives and their quest for recovery was addressed in A Fine Balance by Mistry. n addressing The deep-seated issues of racism and inequality was addressed by insights into the transformative power of healing and its role which were offered by Desai and Mistry through their narratives.

Summing up

Within cultural and historical contexts, a profound understanding of how personal and collective wounds are navigated, especially in relation to systemic issues such as racism is provided by exploring trauma and healing in Indian literature. The complexities of trauma and the multifaceted journey towards healing is illustrated vividly through rich narratives offered by the literary works of authors like Arundhati Roy, Khushwant Singh, Kiran Desai, and Rohinton Mistry. A profound psychological impact resulting from both personal experiences and systemic injustices, including racism and socio-economic inequalities is portrayed by trauma in these narratives.

Historical legacies and discriminatory practices that contribute to and perpetuate suffering were reflected by traumatic events that are intricately linked to broader societal issues by the characters that grappled with the aftermath. A complex journey involving personal resilience, communal support, and the need for societal transformation is depicted by healing. These themes which employ symbolic imagery, non-linear storytelling, and intricate character development to convey the nuances of trauma and healing were explored using sophisticated literary techniques by authors like Desai and Mistry. The importance of addressing racial and societal injustices as integral to the healing process were underscored along with insights into the personal and psychological aspects of recovery which was provided by their works.

The understanding of these themes was enriched by the study of trauma and healing in Indian literature along with the broader societal and cultural contexts that shape them were underscored.

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TRANSNATIONAL TRAJECTORIES AND THE SEARCH FOR HOME: A CRITICAL EXPLORATION OF EXILE, BELONGING, AND CULTURAL IDENTITY IN SAMINA ALI'S *MADRAS ON RAINY DAYS*

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Abstract

This research study explores the crisis of identity precipitated by colonialism and modernism, as reflected in Samina Ali's "Madras on Rainy Days". The novel's trope of self-transplantation enables an examination of the tensions between roots and belonging, identity and exile. Through a postcolonial lens, this research investigates the intersections of identity, hybridity, migration, and multiculturalism, illuminating the complexities of transnationalism, cosmopolitanism, and alienation. By analysing the protagonist's journey, this study sheds light on the human experience of displacement and the quest for belonging. The research draws on postcolonial theory, particularly the concepts of identity, belonging, and self-transplantation, to explore how the protagonist navigates multiple cultural identities and grapples with the consequences of colonialism and modernism. Ultimately, this study aims to contribute to a deeper understanding of the complex relationships between identity, culture, and belonging in the context of colonialism, modernism, and transnationalism.

Keywords: *diasporic, transnational, postcolonial, exile, belonging, cultural identity, unhomely, cartographies, border crossings, cultural dislocation*

The Indian Diaspora provides a distinctive lens through which to examine the Indian experience, particularly within the framework of postcolonial literature. Indian English Literature delves into significant themes such as identity, culture, and historical narratives, frequently contesting colonial perspectives and offering alternative viewpoints that enrich the discourse surrounding these subjects. In contemporary Indian English Literature, there is a pronounced emphasis on ethnic narratives, with writers from various indigenous backgrounds actively celebrating their cultural legacies and traditions. These authors engage in a process of revisiting and reconstructing their histories, thereby crafting authentic narratives that challenge prevailing colonial ideologies.

This literary movement not only seeks to reclaim cultural identity but also to assert the validity of diverse experiences within the broader narrative of Indian literature. Many contemporary authors undertake profound examinations of cultural identities, yielding intricate insights into the multifaceted nature of ethnic experiences. Their works contribute significantly to a more comprehensive understanding of identity and heritage in a postcolonial framework, highlighting the complexities and richness of the Indian experience as shaped by historical and cultural influences.

Displacement emerges as a significant theme in both postcolonial and contemporary literature, frequently instigating identity crises among individuals hailing from colonized backgrounds. The act of severing connections with their native lands leads to a profound disconnection from their cultural roots, traditions, and languages. This experience of dislocation fosters a fragmented identity, as modern individuals find themselves in a constant struggle to reconcile their historical identities with the realities of their current lives. The concept of displacement extends beyond mere physical relocation; it encompasses deep psychological and cultural ramifications. *"Displacement essentially gives birth to a series of problematics." (Bhabha 121)*

As individuals navigate their new environments, they confront the loss of their historical identities and the complexities involved in negotiating their past with their present. This duality is poignantly illustrated in literature, where characters often reflect the challenges of identity formation while grappling with the remnants of their previous lives and the demands of contemporary society. Samina Ali's novel, *"Madras on Rainy Days,"* serves as a compelling case study in the exploration of displacement, offering a narrative framework that allows for a deeper understanding of identity crises. Through the analysis of such literary works, one can uncover the theoretical underpinnings related to displacement, shedding light on the intricate nature of identity struggles within postcolonial settings. Ultimately, this examination seeks to highlight the lasting effects of colonial histories and modern influences on both individual and collective identities.

Samina Ali emigrated to the United States as a young child, yet she spent her summers in India, immersing herself in her Indian Muslim heritage. This dual existence fostered a complex sense of identity, particularly highlighted during a tumultuous election night in India when an arranged marriage compelled her to return. As she and her family braced for potential violence from militant Hindus, Ali made a pivotal decision to assert her independence, rejecting the constraints imposed by her family, culture, and religion. Upon returning to the United States, she shifted her academic focus, ultimately earning an M.F.A. in creative writing, which paved the way for her debut novel, *"Madras on Rainy Days"* (2004). The novel serves as a lens through which Western readers can gain insight into the intricacies of Muslim life in India. It delves into various aspects of this experience, including customs, ceremonies, and the cultural tensions that arise between Muslims and Hindus.

Through the character of Layla, whose husband Sameer has never ventured beyond India, the narrative explores the profound dedication to familial and cultural expectations, juxtaposed against the backdrop of a society marked by communal strife. The protagonist's marriage exemplifies the status of Indian Muslim women within their families, as Layla is wed at the age of nineteen to Sameer, an engineer from Hyderabad, through an arrangement made by her mother. While in America, Layla engages in an affair with her friend Nate, resulting in an unexpected pregnancy. However, she finds herself unable to defy her mother's wishes due to the patriarchal nature of her traditional Muslim family, where dissent is met with harsh repercussions. In a desperate attempt to manage her situation, she resorts to abortion pills, leading to complications that her mother addresses by seeking the counsel of an alim rather than a medical professional, prioritizing family honor over her daughter's health. *"I had never witnessed such confused and beguiled it is imperative to consider what the division between America and South Asia implies here."* (Ali 123)

The novel presents an in-depth examination of the customs, traditions, and beliefs of Indian Muslims, highlighting the cultural conflicts and communal tensions they encounter within the Indian context. Central to the narrative is a critique of the oppressive patriarchal norms that permeate Muslim society in the Republic of India, revealing the struggles faced by individuals in navigating these societal expectations. The historical backdrop of colonialism and modernity has led to significant dislocation for this community, resulting in a profound cultural, existential, and philosophical uprooting.

The themes of alienation, disassociation, and deracination are prominent in their narratives, which articulate the painful experiences of those who find themselves estranged from their cultural roots and identities. Ali delves into the constraining dynamics of Indian Muslim domestic life, particularly through the complex relationship between a husband and his wife within a marriage laden with secrets. The narrative takes a darker turn with the introduction of the theme of Hindu-Muslim violence, underscoring the irony of Layla's aspirations for an ideal life in India juxtaposed with Sameer's longing for America.

As a character caught between two worlds, Layla discovers that her faith in Islam offers her a sense of belonging and security, ultimately leading her to forge connections not only with her husband, who remains a stranger, but also with his family, enriching her understanding of community and intimacy.

The central character, Layla, navigates the complexities of her identity, caught between two distinct cultures. In her Asian homeland, she is constantly reminded of her American upbringing, while in the United States, her Indian accent draws unsolicited attention from strangers. This ongoing struggle for belonging and acceptance is a recurring motif in "Madras on Rainy Days," highlighting the challenges of cultural duality and the quest for personal happiness. The narrative offers a profound exploration of a Muslim Indian wedding, showcasing its rich traditions and culminating in a vibrant tapestry of language and imagery. Ali's portrayal of life in Hyderabad is both striking and immersive, yet the subplot involving Sameer's "secret" appears somewhat forced, serving as a bridge between Eastern and Western cultural paradigms. Nevertheless, Ali approaches these cultural dynamics with a nuanced sensitivity, avoiding the pitfalls of over-exoticization, which often plague cross-cultural narratives. *"The premise sounds melodramatic, but much to her credit Ali is more interested in the slow and subtle self-discovery of a young woman who must come to terms with her actions and confront her fiancé's secrets." (Mondal 145)*

Ali's storytelling is compelling, as she provides readers with an intimate glimpse into the often-hidden world of a Muslim woman. She adeptly weaves together various themes that resonate with outsiders, particularly those grappling with the complexities of identity and belonging. The narrative is enriched by traditional Indian elements such as vibrant colors, culinary delights, and the beauty of nature, juxtaposed with poignant insights into the life of a Muslim Indian girl returning to her roots in the United States. A particularly striking moment occurs when Layla's father sacrifices a goat for the wedding, a scene laden with symbolism that underscores the tension between celebration and the darker realities of cultural practices.

The concept of Self-Transplantation as articulated by Rachel Azima offers a novel lens through which to examine literary narratives. Azima's work has garnered significant attention from scholars and writers alike, leading to the incorporation of numerous literary works into this emerging framework. By bridging the realms of postcolonialism and ecocriticism, she scrutinizes texts that engage with environmental themes, thereby enriching the discourse surrounding place and its connections. This approach not only expands the traditional boundaries of postcolonial theory, which often emphasizes cosmopolitanism, but also enhances ecocriticism by moving beyond its predominantly American focus. *"The trope of self-transplantation enables authors to tap into the evocative power of roots while avoiding exclusive and xenophobic moods of belonging." (Azima 78)*

In her re-evaluation of root metaphors, Azima challenges conventional understandings of place relationships within literature, advocating for more adaptable and inclusive models of place-connectedness. This framework accommodates complex phenomena such as displacement, hybridity, and transnationalism. The notion of Self-Transplantation exemplifies this model, as authors like V. S. Naipaul illustrate how individuals can cultivate meaningful connections to their chosen environments through their literary expressions. *"Nostalgic remembrance of motherland juxtaposes itself with a kind of inevitability of settlement in the new land." (Said 56)*. This concept emphasizes the agency involved in establishing a sense of belonging to a place, rather than merely inheriting it through historical circumstances. Azima's analysis reveals how themes of place and belonging are intricately woven into literary texts, often through botanical metaphors, even when the narratives do not explicitly address the interactions between plants and humans. The self-transplantation trope allows writers to engage with the profound symbolism of roots while circumventing the exclusionary and xenophobic

tendencies that can accompany notions of belonging. By doing so, Azima's theory not only enriches literary criticism but also invites a broader understanding of identity and connection in a globalized world.

Samina Ali's *"Madras on Rainy Days"* serves as a poignant exploration of the complexities surrounding South Asian-American identity, particularly in the context of cultural dislocation and the challenges of self-identification. The narrative intricately weaves the protagonist's experiences, revealing the painful realities faced by individuals caught between two distinct cultural landscapes. The juxtaposition of the United States and India highlights the conflicting allegiances and identities that shape the protagonist's existence, as she navigates the expectations and norms of both societies. This duality is emblematic of a broader struggle, where the protagonist feels as though she is donning the attire of one culture while simultaneously being targeted by the other, leading to a profound sense of confusion and alienation.

The narrative further illustrates that the allure of Western ideals is not limited to those raised in America; rather, it permeates the lives of South Asian individuals as well. Layla's journey towards marriage with Sameer is fraught with uncertainty, as she grapples with the implications of her choices influenced by Western notions of love and independence. Her prior relationship with an American man, Nate, and the subsequent complications surrounding her pregnancy underscore the internal conflict she faces. This tension is compounded by her desire to conform to familial expectations while simultaneously seeking personal fulfilment, thus complicating her understanding of love and commitment. *"She soon finds that Islam provides her life with a safety net, a sense of belonging that she had never experienced before."* (Ali 67)

Ali's incorporation of elements such as mystical healing practices and the use of symbolic rituals serves to enrich the narrative, although it may stretch the boundaries of believability for some readers. The portrayal of Layla's experience with a magical remedy for her bleeding, involving rooster's blood, reflects a blend of cultural traditions that may resonate with readers familiar with Indian practices. However, this fantastical element also raises questions about the authenticity of such representations in the context of a contemporary narrative. Ultimately, the story invites readers to reflect on the intricate interplay between cultural heritage and modernity, as well as the personal struggles that arise from navigating these often-conflicting worlds.

The narrative may initially appear overly dramatic, yet Ali skillfully delves into the nuanced and gradual self-discovery of a young woman grappling with her past actions while also facing the hidden truths of her fiancé. As Layla immerses herself in a traditional lifestyle, seeking the stability and belonging that have thus far eluded her, her fiancé Sameer yearns to escape the limitations of the Old City. He aspires to introduce her to a modernized India, characterized by youth riding scooters, indulging in tandoori pizza, sipping Coke, donning jeans, and aspiring for H-1B visas. Throughout the novel, Layla and Sameer navigate not only their personal and intimate challenges but also the broader existential questions regarding their identities and the possibility of belonging to both the United States and India. *"The novel offers plenty of information on Muslim life in India, Muslim customs and conventions, Muslim ceremonies and festivals, beliefs and superstitions." (Ali 12)*

Ali's characters are shaped by a multitude of complex and often distressing circumstances, including arranged marriages, fractured family dynamics, interracial relationships, domestic violence, and child abuse. The narrative also addresses themes such as homosexuality, miscarriage, black magic, oppressive cultural practices, and the harsh realities faced by women in patriarchal societies. The story culminates in a harrowing depiction of societal violence, particularly the tragic consequences of a young woman being discarded by her husband, which is compounded by

the scrutiny of her in-laws on the wedding night. This exploration of personal and cultural trauma underscores the intricate interplay between individual lives and broader societal issues.

In a pivotal moment, Sameer and Layla travel to Madras in pursuit of a visa that would allow him to relocate to America. During their honeymoon in Madras, Sameer uncovers Layla's past affair with Nate and the subsequent abortion, which creates a rift in their intimacy. Seeking assistance, they turn to a figure named Zakir, who attempts to exorcise the demons haunting Layla. Meanwhile, Naveed, concealing his identity, travels on the same train to Madras. A chance encounter between Sameer and Naveed reveals the complexities of their relationship, as Sameer grapples with the reality of Naveed's long-standing homosexuality, which has been met with severe familial repercussions. This intricate web of relationships and secrets highlights the challenges faced by individuals navigating their identities within the constraints of societal expectations.

To Conclude, Displacement inherently generates a complex array of challenges. Individuals are often caught in a duality where they cannot overlook the memories of their original homeland, including its people, culture, landscapes, and language. Simultaneously, they grapple with the difficulties of fully integrating into their new environment, which may have been chosen or imposed upon them. This tension between nostalgic recollections of their homeland and the pressing reality of adapting to a new land creates a profound emotional conflict. The interplay between these contrasting experiences fosters a hybrid perspective regarding their host communities and cultures.

On one hand, there is an ambivalence that arises from the blending of old and new identities, while on the other, this situation precipitates an ongoing crisis of identity. The struggle to reconcile the past with the present can lead to a fragmented sense of self, as individuals navigate the complexities of belonging in a world that often demands adaptation and change. Once the process of displacement occurs, the opportunity to reclaim a singular, cohesive identity diminishes significantly. The once-clear boundaries of identity become blurred, as individuals are compelled to negotiate their place within a multifaceted cultural landscape. This transformation underscores the challenges faced by displaced individuals, as they seek to forge new identities while grappling with the remnants of their past.

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LONELINESS DEALT IN KIRAN DESAI'S *THE INHERITANCE OF LOSS*

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Abstract
Kiran Desai is an Indian born-American writer who is the youngest writer to win Man Booker Prize Award at the age of thirty Five. She is the daughter of famous Indian writer Anita Desai. Kiran Desai has won many awards for her contribution to literature. The novel The Inheritance of Loss has increased her position to high. The novel The Inheritance of Loss was published in the year 2006, has won National best seller book award and Man Booker Award. In this novel, Kiran desai has dealt with various themes like globalization, immigration, multiculturalism, race discrimination, loneliness, Isolation, rejection, wars, Post colonialism, Social injustice etc… In this paper the researcher likes to highlight the theme Loneliness dealt by the author in the novel The Inheritance of Loss. The word ' Loneliness' meaning given by Cambridge Dictionary is " the state of being lonely" and again the word 'lonely' means "unhappy because you are not with other people". In this paper one would come to know how Kiran Desai has used different characters to describe loneliness in different ways since it is one of the common trait prevalent in modern world. So the researcher felt that this theme is important to speak and find solution for it.
Keywords: *loneliness, isolation, immigration and globalization*

Introduction

The Inheritance of Loss is the novel written by the famous Man Booker Award winner Kiran Desai, daughter of the famous Indian writer Anita Desai. Kiran Desai has written another novel named '*Hullabaloo In The Guava Orchard*' published in the year 1998. Kiran Desai became the youngest woman ever to win Britain's prestigious Man Booker Prize, for her novel "*The Inheritance of Loss*" at the age 35. The novel *The Inheritance of Loss* bagged many awards for the writer including the Man Booker Prize for that year, the National Book Critics Circle Fiction Award in 2007, and the 2006 Vodafone Crossword Book Award. Her writing are rich in vocabulary and description. It is like royal food for eyes and heart. John Sutherland, the chairman of 2005 Booker committee to remarks that Desai's novel *The Inheritance of Loss* has registered "the multi-cultural reverberations of the new millennium with the sensitive instrumentality of fiction" and continues to remark "it is a globalised novel for a globalised world." Kiran Desai has dealt with many things like globalization, immigration, social issues, loneliness, isolation, alienation, cultural identity and belongings, social injustices, conflict and violence, generational gap, Post colonialism, loss and regret and etc… The paper explains that how loneliness has become a part of modern life and explains how people run after so many wordly things and forget the main purpose of their life. Family is a good thing created by God, but people forget about it and run away from it and end up in destruction. Almost all the characters Sai, Gyan, the retired judge, the cook, the tutor, and the cook's son etc live alone without their family members. Each for one reason or other are away from the family members willingly or forced to lead

a life alone. In this paper the detailed theme is discussed. For the better understanding of the theme, the brief summary of the novel is given in the following paragraph.

The Inheritance of Loss

The novel *The Inheritance of Loss* revolves around two main characters Sai and Biju and their grandfather Jemubhai Patel and father (referred in the novel as cook). Sai has lost her parents and come to live with her grandfather Jemubhai Patel. Jemubhai Patel is living alone for a very long time, from the time he abandoned his wife Nimi. Sai arrival was shocking to Jemubhai yet he is happy to accept her since he would take care of Sai well so that the guilt of abandoning his wife will be removed. Another story also comes along with this story i.e the story of the cook and his son Biju. Cook is working in Judge Jemubhai house as a cook, he has sent his son to abroad hoping that his son would work well and lead a happy life there but contrary to that happens. Atlast, Biju leaves his job and comes home empty handed yet Cook accepts him happily. Another is the love story of Sai and her maths tutor Gyan which ended up in failure. Between these story we have some riots happening in Kalimpong and many people are affected by that.

Loneliness Dealt in Kiran Desai's *The Inheritance of Loss*

The meaning of the word 'Loneliness' given by Cambridge Dictionary is "the state of being lonely". This paper is going to explain how the characters in the novel suffer from loneliness and how the novelist has portrayed the characters. The first character which we are going to see is Sai. Sai is the daughter of Mr. and Mrs. Mistry and granddaughter of the judge Jemubhai patel. Her parents were killed by tragic bus accident in Moscow and now she has come to her grandfather house for shelter. From the very young age Sai was grown up in the Christian convent. She comes to know the life history of her grandparents from cook. She learns that her grandfather disgusts her grandmother. After learning those things, Sai doesn't like to live with her grandfather. She likes to escape from that house but strucked up there since she doesn't have anyone else to support her. She stayed with her grandfather. She feels lonely. She finds some delight from the books and later feels bored. She misses her parents love at the teenage and yearns for love. Her grandfather was stern towards her and he doesn't like to spend time with her. Though he likes to give good education and shelter for her, the love which Sai yearns is not given by the judge Jemubhai Patel. The only person who is speaking softly and caring is the cook. Cook is the only person who takes care of her well and often treats her like her daughter. She befriends few neighbours. They are Noni (tutor), Lola, Father Booty, and Uncle Potty… All were the judge's neighbors who are also upper-class. They share English traditions with her by celebrating Christmas and listening to the BBC. She tries to find some meaning in her life by falling in love with Gyan, the nepali tutor but even that also end up in failure in later days when Gorkhaland Movement started. Thus the character Sai is feeling lonely throughout her life and searches for something which would give some meaning to her life.

Next important character in the novel *The Inheritance of Loss* is Biju. Biju is the son of the cook. He does not have mother. He is in his initial 20s. Both Biju and his father with so many dreams in their heart has sent Biju to abroad. Biju struggles a lot in abroad by shifting from one restaurant to next in search of atleast the basic like food, clothing and shelter. He finds very difficult to make ends meet. He does not have friend, neighbours or any relatives with him. He did not have sibling also. He does not have anyone to whom he can share his happiness, sorrows or struggles. His only father also fails to understand his son. He always writes to his son like, "Stay there. Make money. Don't come back here."(TIL 191) He feels very lonely without any loved ones around him. He tried his best to get green card, stay there and manage and make his father's dream come true but it ended up in vain. His only dream is to get green card by any means. His madness for getting green card can be understood

from the following words: "even a disabled or mentally distorted green card holder would be fine…The green card, green card, the machoot sala oloo kapatha chaar he could think of nothing else" (TIL 191).

It is really shocking to see the madness they have for wordly things. After much struggle, he was forced to leave abroad and join his father in India. He was prepared to say bye to the U.S. His conditions and his powerlessness with overwhelming loneliness become the reasons to seek his root, India. He asks the Indian travel agent to book his air ticket, the travel agent Mr.Kakkar alarms and explains the difficulties of survival in India, all those relatives asking for money! Even strangers are asking for money—maybe they just try, you know, maybe you shit and dollars come out.

"I'm telling you, my friend, they will get you; if they won't, the robbers will; if the robbers won't, some disease will; if not some disease, the heat will; if not the heat, those mad Sardarjis will bring down your plane before you even arrive." (TIL 269)

While he travel from abroad he carried all his savings, foreign precious things and clothings to his father which was seized by the protestors of Gorkhaland movement. They left him empty handed. Biju came to his father empty handed, his father accepted him happily since his son came back safely. Sometimes greediness also seperates family members and make the individual feel alone. It is better to be satisfied with what we have and lead a good and happy life with our loved ones.

Next character who is a prey to Loneliness is Judge Jemubhai patel. Judge Jemubhai Patel's parents send him to Cambridge university for his higher studies. Just to pay his fees, his father found a wealthy girl who can give him dowry and meanwhile pay his fees also. Jemubhai Patel does not love his wife. He treated his wife very badly and abused her violently. She abandoned his wife too. His wife gave birth to a girl child whom the judge never saw. Later his wife was killed some bad people. In England, Judge Jemubahi Patel was treated badly by those English people so he does not want to call himself Indian. HE feel ashamed to call himself as Indian.. He hated his wife since she is Indian. He eventually sends her away, fearing that he will kill her. At last, the judge is a deliberate, angry old man filled with self-loathing because he is accepted by neither British culture nor his people. He is lovely only towards the pet dog, Mutt and her granddaughter Sai. He feels lonely at old age. He happily accepts Sai, his granddaughter because he thought he would remove the guilt from him of abusing her wife by taking good care of Sai. He expresses his loneliness by showing angry outward, shouting at others and dominating as if he is the prime head of all. Judge with no doubt chooses loneliness on his own by not allowing anyone to be with him and leads an unhappy life.

Next character in the novel is the cook. The cook works in Judge Jemubhai's house as a cook. He, judge and dog mutt lives in the house, sai joins them later. He sends his son to abroad. He does not have wife. His only happiness is Biju. As he send his son to abroad, he considers it as a very big achievement. The judge gives him very less salary for his work. He worriedly says the below lines, "No thanks to me for anything ... see what I have to deal with and I'm not young and healthy anymore— terrible to be a poverty - stricken man, terrible, terrible, terrible"....(TIL:34).Though he asks his son to live in abroad, deep inside his heart, his heart yearns for the love of Biju and he is eagerly waiting to see his son at the end of the novel. He also leads a lonely life and lead a dissatisfied life.

Conclusion

From the paper above one can come to know how loneliness is making people mad and also can understand the importance of family and its values also. When we go through each character one could learn that we people are social being and life without family and loved ones are really very difficult to lead. If the above mentioned character were with their family members or loved ones for sure they would have lead a better happy and satisfied life. In the modern world people have too many ambitions or money lovers. As things are increasing greediness for

the things also is not reducing, it also increases and ends them in dissatisfied life. One could feel lonely without family members unless they are physically and mentally strong. Loneliness would lead people to depression and further it will lead to destruction. As a responsible human being, lets try our best to care people who are lonely and help them to bring them out of loneliness and help them to lead a happy life.

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மண்டியிடுங்கள் தந்தையே' நாவலில் நவீன உத்திகள்

முனைவர் மீ. சுதா
கௌரவ விரிவுரையாளர், தமிழ்த்துறை
காந்தி கிராம கிராமிய நிகர்நிலைப் பல்கலைக்கழகம், திண்டுக்கல்

ஆய்வுச் சுருக்கம்

இலக்கியத்தின் ஆன்மாவாக விளங்கக்கூடியது படைப்பாளன் கையாலும் கதையின் கூற்று முறையாகும். அவ்வகையில் எஸ்.ராமகிருஷ்ணன் எழுதிய மண்டி இடுங்கள் தந்தையை நாவலில் மனித உணர்வுகளின் ஆழத்தை ஆராய்ந்து சமூக மாற்றங்களை வெளிப்படுத்துகின்ற வகையில் சில இன்றியமையாத நவீன உத்திகளை படைப்பாளர் எடுத்தாண்டுள்ளார். அவை பின்வருமாறு எடுத்தாளப்பட்டுள்ளன.

1. *தொடங்கிய புள்ளியில் கதை முடிதல்:*
   ஒரு கதையின் தொடக்கத்தில் இடம்பெறும் நிகழ்வு காட்சி ஆகியவை மீண்டும் கதையின் முடிவில் இடம் பெறுதல்.
2. *டைரி எழுதுதல்:*
   கதாபாத்திரங்களின் உள்ளாந்த உணர்ச்சிகள் மன அழுத்தங்கள் மற்றும் தீராத சந்தேகங்கள் ஆவியவை விரிவாக எடுத்து இயங்குவதற்கு இம்முறை பயன்பத்தப்படுகின்றது. வாசகர்கள் கதாபாத்திரங்களின் மனநிலையை அறிந்து கொள்ளும் வகையிலும், கதாபாத்திரத்தோடு பயணிப்பதற்கும் உத்தி பயன்படுகிறது.
3. *அத்தியாயங்களுக்குப் பெயரிடல்:*
   ஒவ்வொரு அத்தியாயங்களுக்கும் பெயரிடுவதன் மூலம் அதன் சுருக்கத்தை எளிதில் வாசகர் மனதில் பதிய வைக்க முயலுகின்றது.
4. *கதைக்குள் கதை:*
   கதைக்குள் இடம்பெறும் மாந்தர்களைக் கொண்டு கற்பனையாக மற்றொரு கதையை உருவாக்குதல்.
5. *வரலாற்று நிகழ்வு மற்றும் மாந்தர்கள் இடம்பெறுதல்:*
   கதையின் உண்மைத்தன்மையை மொய்பிப்பதற்கு இவ்வுத்தி மிகவும் சிறப்பாக வரலாற்று நாவல்களில் எழுத்தாளப்பட்டு வருகின்றது.
6. *கூற்று முறையில் மாற்றம்:*
   ஒரே நேர்கோட்டில் கதையை கூறாமல் நிகழ்காலம், இறந்த காலம் என மாற்றி மாற்றி கூறும்போது வாசகர்களின் மனதில் ஒரே நேரத்தில் இரு வேறுபட்ட காலங்களை காட்டுவதற்கு உத்தி எழுத்தாளப்பட்டுள்ளது.

Keywords: *modernity - நவீனம், circular structure are circular narrative – தொடங்கிய புள்ளியில கதை முடிதல், diary writing - டைரி எழுதுதல், titles in chapters - அத்தியாயங்களுக்குப் பெயரிடல் non linear narratives - கூற்று முறையில் மாற்றம், story within a story - கதைக்குள் கதை, historical character - வரலாற்று மாந்தர்கள்*

முன்னுரை

மாற்றம் ஒன்றே மாறாதது என்ற கூற்றுக்கு இணங்க இலக்கிய உலகில் தினம் தோறும் கதைக்கூறும் முறையில் பல்வேறு மாற்றங்கள் சோதனைக்கு உட்படுத்தப்பட்டு வாசகர்களிடம் சென்று சேருகிறது. படைப்பாளன் மனது நினைத்து எழுதியவற்றை நேரடியாக வாசகரிடம் கொண்டு சேரப்பதற்கு பலவகையான நவீன உத்திகளை எழுத்தாளுகிறான். அவ்வகையில், எஸ். ராமகிருஷ்ணன் எழுதிய 'மண்டியிடுங்கள் தந்தையே' நாவலில் நவீன உலகிற்கு ஏற்ப லியோ டால்ஸ்டிராயின் கதையை புதிய உத்தி முறைகளுடன் படைப்பாளர் வாசகருக்கு தருகிறார். அவற்றை ஆராய்வதை கட்டுரையின் நோக்கமாகும்.

தொடங்கிய புள்ளியில் கதை முடிதல்

தொடங்கிய புள்ளியில் கதை முடிதல் என்பது தமிழ் இலக்கியத்தில் ஒரு முக்கியமான கூற்று

முறையாகும். இவ்வுத்தி கதையின் தொடக்கம் மற்றும் முடிவு ஒரே இடத்தில் அல்லது சமமான சூழ்நிலை இருப்பதாகக் காட்டப்படும். இதன் மூலம், படைப்பின் உள்நோக்கத்தை வாசகரிடத்து கொண்டு சேர்க்க எடுத்தாளப்படுகிறது.

"இந்த உத்தி வாழ்க்கையின் ஒரு முடிவற்ற வழத்தடத்தை பிரதிபலிக்கறது" என மைக்கேல் எண்டே கூறுகிறார். (மைக்கேல் எண்டே, நவர் எண்டிங் ஸ்டோரி பக்கம் 401)

ஆய்விற்கு எடுத்துக்கொண்ட நாவலின் ஆரம்பம் மற்றும் முடிவு இரண்டும் ஒரே சூழ்நிரையை அல்லது ஒரே நிகழ்வைக் குறிக்கின்றன. இதன் மூலம் கதையின் தொடக்கம் மற்றும் முடிவில் ஒற்றுமையும் பரிமாணமும் உருவாகிறது. கதையின் தொடக்கத்தில் அக்ஸன்யா இறந்த நிலையில் அவளது மகன் திமே.்பி தனது தந்தையின் மீது வெறுப்புடன் இருக்கிறான் கதையின் முடிவில் தனது தந்தையின் மீதான வெறுப்பு குறைந்து அன்பும் மரியாதையும் கொண்டவனாக மாறுகிறான.

மேலும் கிறஸ்துமஸ்ருக்கு தொடங்கிய பனிக்காலமே கதையின் தொடக்க கால சூழலாகவும் இருப்பதை கதையின் வழி உணர முடிகின்றது.

"கிறிஸ்துமஸிற்கு இன்னும் பதினெட்டு நாட்கள் இருந்தன. இந்த ஆண்டு பனிப்பொழிவு மிகவும் அதிகமாகி இருந்தது. முழங்கால் புதையும் அளவிற்கு பனி உறைந்துபோய் இருந்தது…." (எஸ்.ராமகிருஷ்ணன் மண்டியிடுங்கள் தந்தையே பக்கம்.9)

"பனிக்காலம் எப்போதும் புதைந்து போன துயர நினைவுகளை உயிர்த்தெழச் செய்கிறது. உலகமே மேய்ப்பரின் பண்டிகையை கொண்டாடுகிறது "(எஸ்.ராமகிருஷ்ணன் மண்டியிடுங்கள் தந்தையே பக்கம் -242)

மேலும் பனிக்காலத்தில் அன்ஸன்யா இறந்து விடுவதாக கதை நிகழ்வு தொடங்குகிறது. இறுதியில் அடுத்த பனிக்காலத்தில் திமே.்பின் அவளது கல்லறை மீது அமர்ந்து மலர்களை தூவி தனது தந்தையின் மீதான வெறுப்பை மண்டியிட்டு மாற்றிக் கொள்ளும் மனநிலையும் எடுத்துக்காட்டப்படுகிறது.

அத்தியாயங்களுக்குப் பெயரிடல்

ஒவ்வொரு அத்தியாயத்தின் மையத்தையோ அல்லது முடிவையோ முதலிலே வாசகர் இடத்தில் குறிப்பாக உணர்த்தும் பொருட்டு இவ்வுத்தி பயன்படுத்தப்பட்டு வருகின்றது. இது கதையின் உள்ளடக்கத்தை விளக்குவதற்கான முக்கிய கருவியாக செயல்படுகிறது. வாசகருக்கு அத்தியாயத்தின் முக்கிய அம்சங்களை முன்னரே குறிப்பாக கூறுவதற்கு உத்தியாகப் பயன்படுகிறது.

இது கதையின் ஒவ்வொரு பகுதிக்கும் தனித்துவமான அடையாளம் வழங்கி படைப்பின் வடிவமைப்பில் ஒரு கட்டமைப்பை உருவாக்குகின்றது. அத்தியாயங்களுக்குப் பெயரிடல் ஒரு நூலில் உட்கட்டமைப்பின் செயல்பாடாக கையாளப்படுகிறது. கதையைப் பரவலாக்கி வாசகல்களின் எதிர்பார்ப்புகளை தூண்டச் செய்கிறது.

"1. சிவப்பு அங்கி அக்ஸின், 2. திமே.்வி காத்திருப்பது, 3. சோபியாவின் கேள்விகள், 4. அக்ஸின்யாவின் வீடு, 5. புனிப்புகைக்குள், 6. டால்ஸ்டாயின் இரவு, 7. ஜிப்ஸிகளின் வருகை, 8. உலகமே போதாது, 9. தந்தையின் நிழல், 10. பண்ணையில் ஒரு பள்ளி, 11. சோபியாவின் உத்தரவு, 12. அக்ஸின்யாவின் நினைவுகள், 13. எதிர்பாராத முத்தம், 14. அழியாத நிழல், 15. இளமையின் கேள்விகள், 16. தாயின் நினைவில், 17. மாஸ்கோவின் சில நாட்கள், 18. தினேஷின் வருகை, 19. சோபியாவின் டைரிகள், 20. ஓல்காவின் வீடு, 21. பிறந்தநாளின் போது, 22. சந்தோஷமான நாட்கள், 23. இருண்ட நாட்கள், 24. ரஷ்யப் பஞ்சம் 25. இயற்கையின் கரங்கள், 26. நினைவின் மலர்கள்.

அக்ஸின்யாவின் இறப்பில் தொடங்கி திமே.்பியின் கோபம், காதல், கனவு, தந்தை மீதான வெறுப்பு என கதை பல கலங்களின் நகர்ந்து இறுதியில் அக்ஸின்யாவின் சமாதியின்

முன் லியோ டால்ஸ்டாயின் மன்னிப்பும் திமபியின் மனசாந்தியுடன் கதை முடிகிறது. இச்சிறுக்கத்தை ஒவ்வொரு அத்தியாயங்களின் தலைப்பின் மூலம் அறிந்து கொள்ள முடிகின்றது.

டைரி எழுதுதல்

டைரி எழுதுதல் என்பது ஒரு குறிப்பிட்ட நாள் அல்லது கால அடிப்படையில் நேரடியாக வாழ்க்கையை நிகழ்வுகளை உணர்வுகளை எண்ணங்களை பதிவிடும் ஒரு எழுத்து உத்தியாகும்.

டைரி எழுதுதல் என்பது கதையின் உள் நோக்கத்தையும் மாந்தரின் தனிப்பட்ட வாழ்க்கையில் உள்ள சிறந்த தருணங்களையும் வெளிப்படுத்த பயன்படுகிறது. கதையின் முன் அத்தியாயத்திற்கானச் செயல்பாடுகளை விவரிக்கும் வாயிலாகவும் இருக்கிறது. கதையில் உணர்வுகளை வலிமையாக்கவும் மிக ஆழமான உத்தியாகவும் இது செயல்படுகிறது. கதையின் மைய கருத்துக்களை அதன் முழுமையுடன் வாசகங்கள் அணுகுவதற்கான வழிமுறையைக் காட்டுகிறது.

"டைரி எழுதுதல் என்பது கதாபாத்திரத்தின் உள்ளார்ந்த குழப்பமும் மேம்பாடுகளையும் ஆழமாக பிரதிபலிக்க உதவுகிறது. இது கதாபாத்திரத்தின் மாறும் சுயநல உணர்வு மற்றம் உணர்ச்சி நிலைகளுக்கான ஒரு ஜன்னலாக செயல்படுகிறது "என்கிறாரா ஜான்.பி.டிக்கன்ஸ். (ஜான்.பி.டிக்கன்ஸ் நரேட்டிவ் ஸ்டைல் அண்ட் டைரி டெக்னிக்ஸ் பக்கம் 56)

"இரண்டாவது டைரியை அவர் பெரும்பாலும் இரவில்தான் எழுதுவார். அந்த டைரியை பாதுகாப்பாக வைப்பதற்கு என்றே ஒரு மரப்பெட்டியை வைத்திருந்தார். சாவி எப்போதும் அவரிடமே இருந்தது. இளமைக்காலத்தில் அவர் ஒரே ஒரு டைரி தான் வைத்திருந்தார். அதில் ரகசியங்களும் தினசரி வாழ்க்கையும் ஒன்றாகவே எழுதப்பட்டன. "(எஸ்.ராமகிருஷ்ணன் மண்டியிடுங்கள் தந்தையே பக்கம் எண் 116)

"... அதன் பிறகு அவர் ரகசியங்களை எழுதுவதற்காகத் தனியே ஒரு டைரியை பயன்படுத்த துவங்கினார்.... அந்த டைரியில் தன் செயல்களை ஒளிவு மறைவு இன்றி எழுதி வந்தார. சில நாட்கள் அதை வாசித்துப் பார்க்கையில் கண்ணாடியில் தன்னை நிர்வாணமாக பார்த்துக் கொள்வது போலவே இருக்கும். "(எஸ்.ராமகிருஷ்ணன் மண்டியிடுங்கள் தந்தையே பக்கம் எண் 118)

"சோபியா தினமும் டைரி எழுதவில்லை. எப்பொழுதெல்லாம் மன கஷ்டம் குழப்பம் ஏற்படுகிறதோ அப்போது மட்டும்தான் டைரி எழுதுவாள். அதுவும் தன்னுடைய நிலைப்பாட்டை தெளிவுப்படுத்திக் கொள்வதற்காக மட்டுமே டைரி எழுதுவாள். (மேலது பக்கம் 118)

"அவள் தனது டயரிகளை மரப்பெட்டி ஒன்றில் வைத்துப் பூட்டினாள். அவளைப் போல இப்படி ஒரு மரப்பெட்டியில் லிவோச்சாவும் (டால்ஸ்டாய்) ரகசிய டைரிகளை வைத்திருக்கிறார் என்பதை அவள் அறிவாள். ஈதைத் தெரிந்து கொள்ள வேண்டும் என்பதில் அவள் ஆர்வம் காட்டவில்லை "(மேலும் பக்கம் 199)

கணவன் மனைவி இருவரும் இணைந்து வாழ்ந்தாலும் அவ்விருவருக்கு என்று தனித்தனியான உணர்வுகளும் ரகசியங்களும் இருக்கின்றன என்பதை புலப்படுத்துவதற்கு மேற்கூறிய சான்றுகள் உதாரணமாக ஆகின்றன.

கதைக்குள் கதை

ஒரு கதையின் உள்ளே கதை நிகழ்த்துவதன் மூலம் மூலக்கதையின் கருவி மற்றும் அது சார்ந்த விடயங்கள் இன்னும் ஆழமாக தருவதற்கு உதவுகிறது பெரும்பாலும் முதன்மை கதையின் கதாபாத்திரம் அல்லது சூழல் இரண்டாவது கதையை விவரிக்கும் முறையில் இதை படைப்பாளர்கள் உத்தியாக பயன்படுத்துகின்றனர்.

"கதைக்குள் கதை பயன்படுத்துவது பலவகையான அர்த்தங்களின் அடுக்குகளை கொண்டிருக்கக் கூடியது மற்றும் கதையின் ஆழத்தை அதிகரிக்கிறது, முக்கியமாக கதையின் கருவிற்கு வளமான சூழலை வழங்குகிறது. "என்கிறார் ஜான்.பி.டிக்கன்ஸ்

(ஜான்.பி.டிக்கன்ஸ் நரேட்டிவ் ஸ்ட்ரக்சர் அண்ட் டெக்னிக்ஸ் பக்கம் 82)

கதையில் ஒலிவா என்ற பெண்ணுக்கு திருமணமாகி மூன்று குழந்தைகள் உள்ளனர். இருப்பினும் அவள் சினூன் என்பவருடன் தொடர்பில் இருக்கிறாள். பிறகு அவனால் கொலை செய்யப்படுகிறார். இச்செய்தியை அறிந்து அங்கு வந்த லியோ டாலஸ்டாய் தனது கதைக்கு ஒரு கருவாக நிகழ்வை எடுத்துக் கொள்கிறார். கதையாகவும் அதனை மாற்றி எழுதுகிறார்.

ஒலிவா என்ற அந்தப் பெண்ணை மையமாக வைத்து ஒரு சிறுகதையை எழுதி அனுப்பி வைத்தார்.... இந்தக் கதையைப் பாராட்டி சீமாட்டி காதரின் எழுதிய கடிதம் ஒன்றுக்கு பதில் எழுதும்போது ஒவ்வொரு கதைக்குப் பின்னும் நிஜமான ஒருவர் இருக்கிறார் என்று பதில் அளிக்கிறார்." "(எஸ்.ராமகிருஷ்ணன் மண்டியிடுங்கள் தந்தையே பக்கம் எண் 110)

பண்ணையில் வேலை செய்யும் பெண்கள் திருமணமாகி இருந்தாலும் கணவனால் கொடுமைக்கு ஆளாக படும்போது தனது துன்பத்தை பிறரிடத்தில் பகிர்ந்து கொள்ளும் பொருட்டு தனக்கான மற்றொரு துணையை அங்கீகாரம் அற்ற உறவாக கொள்ளும் மனபாங்கினை இதன் வழி அறிய முடிகின்றது.

வரலாற்று நிகழ்வு மற்றும் மாந்தர்கள்

வரலாற்றுக் கதையாக ஒரு படைப்பை படைக்குமிடத்து மெய்த் தன்மையை மெய்ப்பிக்கும் வகையில் அதே காலகட்டத்தில் வாழ்ந்த அரசியல் மற்றும் சமூக செயல்பாட்டாளர்கள், மக்கள், மனதில் நீங்காத இடம் பிடித்த மனிதர்களை படைப்பில் பயன்படுத்தும் போக்கினை ஒரு உத்தியாக கருத இயலும். படைப்பின் மீதான ஆர்வத்தையும் கதாபாத்திரம் வாழ்ந்த சமூக மற்றும் அரசியல் சூழலை உணர்த்துவதற்கு யுத்தி கையாளப்படுகிறது.

இன்னா அவளில் லியோ டால்ஸ்டாய் தனது கண் சிகிச்சைக்காக மாஸ்கோ நகரம் செல்கிறார். அங்கு அவரை காணவரும் பிரபுக்களிடம் பேசுவதாக கதை நகர்கிறது.

"விருந்தில் ரோஸ்தவ் பிரபு அவரிடம் கேட்டார்:

ரஷ்யாவைப் பற்றி என்ன நினைக்கிறீர்கள்?....(மேலது பக்கம் 183)

மற்றொரு நாள் லியோ டால்ஸ்டாய் பிறந்தநாளின் போது விருந்திற்கு வந்திருந்த பத்திரிக்கையாளர்களுடன் அவர் கலந்துரையாடும் நிகழ்வு எடுத்துக்காட்டப்பட்டுள்ளது.

எட்வர்ட் பிராங்க் என்ற பிரிட்டிஷ் பத்திரிக்கையாளருடன் டால்ஸ்டாய் சதுரங்கம் ஆடினார். அப்பொழுது இலக்கியத்தைப் பற்றி பேசுகின்றனர்.

"ஒருவனால் தன்னைத் தானே வெல்ல முடியுமா? முடியும் என்கிறார் கௌதம புத்தர்.

நீங்கள் அவரை வாசித்திருக்கிறீர்களா? தொடர்ந்து வாசித்து வருகிறேன்." (மேலது பக்கம் 210)

"டால்ஸ்டாயை தேடி இப்படி கல்லூரி மாணவர்கள் பத்திரிக்கையாளர்கள் ஓவியர்கள் இலக்கிய வாசகர்கள் எழுத்தாளர்கள் வருவது வழக்கம்." (மேலது பக்கம் 152)

"நான் பகுத்தறிவிற்கு ஒவ்வாத விஷயங்களை ஒருபோதும் எழுதமாட்டேன். கோகோல் தடுமாற்றமான எழுத்தாளர். கற்பனையில் அதிகம் சஞ்சரிப்பவர். அவரை விடவும் நான் ஆன்டன் செகாவை அதிகம் பாராட்டுவேன். செகாவ் உண்மையான கலைஞன். "(மேலது பக்கம் 154)

"என் படிப்பறையில் சார்லஸ் டிக்கன்ஸ் ஓவியம் மாற்றப்பட்டிருக்கிறது. அவரை என்னுடைய அபிமானம் எழுத்தாளர்."(மேலது பக்கம் 163)

மேற்கூறிய சான்றுகளின்படி லியோ டால்ஸ்டாய் தனது வாழ்நாளில் சந்தித்த ஒரு சில பிரபலங்களைப் பற்றிய குறிப்புகளுடன் கதை நகர்த்துவதற்கு உத்தி பயன்படுததப்பட்டுள்ளது இதன் வழி அறிய முடிகின்றது.

வரலாற்று நிகழ்வு

வரலாற்று மாந்தர்களைப் போலவோ வரலாற்று நிகழ்வுகளையும் எடுத்தாளும் போக்கு காணப்படுகிறது. அதில் ரஷ்யப் பஞ்சம் குறித்து நிகழ்வும். அப்பஞ்சம் நீங்குவதற்கு லியோ டால்ஸ்டாய் எடுத்துக் கொண்ட முயற்சிகள் குறித்த செய்திகளும் இடம்பெறுகின்றன.

"பேரரசரின் ஆலோசகர் பெத்னோவ. 1891 ஜீலை மாதம எழுதிய குறிப்பில் தெளிவாக குறிப்பிட்டு இருந்தார். அந்த ஆண்டு குளிர்கால பயிர்களின் விளைச்சல் முற்றிலும் குறைந்து விட்டது." (மேலது பக்கம் 234)

பஞ்சகலத்திலும் வரி செலுத்துவது கட்டாயமாக இருந்தது. வரி செலுத்தாத விவசாயம் மீது கடுமையான நடவடிக்கைகள் எடுக்கப்பட்டன." (மேலது பக்கம் 235)

"தனது சேமிப்பில் இருந்த தானியங்களை பஞ்சத்தில் கஷ்டப்படும் மக்களுக்குப் பயந்து அளிப்பதென டாலஸ்டாய் முடிவு செய்தார்...

டான் கோவ்ஸ்கி பிராந்தியத்தில் நூற்றுக்கணக்கான இலவச உணவு கூடங்களை ஏற்பாடு செய்த அந்த பணியை தானே முன் நின்று நடத்தினார்." (மேலது பக்கம் 236)

கூற்று முறையில் மாற்றம்

ஒரே நேர்கோட்டில் கதையை கூறாமால் நிகழ்காலம் இறந்து பலவீன மாற்றி மாற்றி கூறும் கூற்றுமறை தற்பொழுது நவீன படைப்பாளர்கள் கையாண்டு வரும் புத்திகள் ஒன்றாகும். ஒரே அத்தியாயத்தில் கால வேறுபாட்டினை உடபுகுத்திமா மாந்தர்களின் மனநிலையை கண்டறிய உத்தி கையாளப்படுகிறது.

"சொல்ல வந்ததை சொல்வதற்கு பழைய வழிமுறைகளின் போதாமையை உணர்ந்து வேறுவித வெளிப்பாட்டு முறைகள் தேடி புதிய பாதைகளை கண்டறிந்தனர் நவீன படைப்பாளிகள்." (மீ.சுதா நவீனச் சிறுகதைகளில் படைப்பாக்க உத்திகள் பக்கம் 103)

"காலம் கடந்து என்பது முடிந்து போன விஷயமில்லை. அது நினைவூட்டும் வெளிச்சம்.. மனிதனைத் தவிர வேறு எந்த விலங்கிற்கும் கடந்த காலத்தை குறித்த கவலை கிடையாது." (எஸ்.ராமகிருஷ்ணன் மண்டியிடுங்கள் தந்தையே பக்கம் எண் 66)

'டால்ஸ்டாய் இரவு' என்ற அத்தியாயத்தில் திமோ.்.பி தனது மகன் என்று அறிந்து கொள்கிறார். அன்று இரவு பழைய நினைவுகளில் மூழ்குகிறார். அதில் அக்ஸின்யாவுடன் காதல் கொண்டது பற்றியும் அவள் குழந்தையை பெற்றுக் கொண்டு அவரை காணவருவதை பற்றியும் நினைப்பதாக கதை நகர்கிறது. அடுத்த பத்தியில் சோபியாவிற்கு தனது கணவனின் பழைய காதலியாக அக்ஸன்யாவை பண்ணையிலிருந்து விரட்ட முடிவு செய்கிறார். அதனால் கணவன் மனைவி இருவருக்குள் ஏற்படும் சண்டை குறித்து தனது டைரியில் அவர் எழுதுவதாக அத்தியாயம் முடிகிறது.

லியோ டால்ஸ்டாய் மனநிரை குறித்து படைப்பாளர் கூறிக் கொண்டிருக்கும் பொழுது அடுத்த நிலையில் அவரது மனைவி சோபியாவின் மனநிலையை எடுத்த இயங்குகிறார். இதன் வழி ஒன்று இறந்த காலமும் மற்றொன்று நிகழ்காலமும் குறித்த நிகழ்வாக இருப்பதை இதன் வழி அறிய முடிகிறது.

முடிவுகள்

எஸ்.ராமகிருஷ்ணன் மண்டியிடுங்கள் தந்தையே நாவலில் நவீனத்துவமான முறையில் மிக நேர்த்தியாக உத்திகள் எழுத்தாளர் பட்டுள்ளது.

மொழி மீதான கட்டுப்பாடும் வடிவமும் கச்சிதமான ஒருங்கிணைவான நிகழ்வுகளை மிக நேர்த்தியாக தனது படைப்பில் படைப்பாளர் எடுத்து ஆண்டுள்ளார். கதை மாந்தரின் உணர்வுகளை அறிந்து கொள்வதற்கு உத்திகள் பயன்படுத்தப்படுகின்றன.

குறிப்பாக, டைரி எழுதுதல், அத்தியாயங்களுக்கு பெயரிடுதல், கூற்று முறையில் மாற்றம் போன்ற உத்திகளின் வழியே கதையின் போக்கினையும் பரிணாமத்தையும் இதன் வழி அறிய முடிகின்றது.

தொடங்கிய புள்ளியில் கதை முடிதல் என்னும் முத்தையின் மூலம் திமேபியின் மன்சோறு மகிழ்ச்சி எதிர்பார்ப்பு போன்ற தனிமனித உணர்வுகளை திறம்பட அறிய முடிகின்றது.

மண்டியிடுங்கள் தந்தையே நாவலில் இடம்பெற்றுள்ள ஒவ்வொரு உத்தியும் வாசகரின் மனதிற்கு அருகில் கொண்டு செல்வதற்கு பயன்படுத்தப்பட்டள்ளமையை இக் கட்டுரையின் வழி தெளிவாக விரித்து கூறப்பட்டுள்ளதை அறிய முடிகின்றது.

துணைப் நூல் பட்டியல்

முதன்மைச் சான்றாதரம்

எஸ்.ராமகிருஷ்ணன் மண்டியிடுங்கள் தந்தையே தேசாந்திரி பதிப்பகம் முதல் பதிப்பு ஜீலை 2023.

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BREAKING THE SILENCE: A SOCIOLOGICAL STUDY ON MENSTRUAL KNOWLEDGE AND HYGIENE PRACTICES AMONG UNDERGRADUATE STUDENTS

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Abstract
Menstruation is a natural physiological process, until now it remains encompass in stigma, silence, and misinformation. Academic institutions have a major responsibility in eliminating the taboos of menstruation. This study investigates undergraduate students menstrual hygiene practices, knowledge and perception from sociological perspective. Present study examines the impact of socio- cultural norms, institutional support and accessibility of menstrual hygiene products on students' experiences. Furthermore it assesses the challenges students face in managing menstruation within university settings and explores the existing facilities. Findings from this study will contribute to the ongoing discourse on menstruation, free from misconception, and the need for institutional interventions to ensure better menstrual health management in higher education institutions. The present study was being conducted among undergraduate girl students of Gandhigram rural institute. Descriptive design was used and the structured interview schedule was administered for data collection.
Keywords: *period, taboo, stigma and girls, knowledge, perception*

Introduction

Menstruation is a natural physiological process that indicates the reproductive maturity of individuals with a uterus. Although it is a universal phenomenon, menstruation remains concealed in secrecy, myths, and misconceptions across various cultures and societies. The stigma and silence adjoining menstruation have represented a significant gap in menstrual knowledge and hygiene practices, particularly among young girls. Academic institutions pave the way for young adults to make independent decisions, making the awareness and management of menstruation crucial. The significance of menstrual health and hygiene (MHH) cannot be overstated, as it directly impacts physical health, mental well-being, academic performance, and overall quality of life. Poor menstrual hygiene can direct to infections, reproductive health issues, and social exclusion, further intensify gender inequalities. The extent of menstrual knowledge varies according to demographic variations and factors like cultural background, education, and parental guidance plays an influential role. This study explores the level of menstrual knowledge and hygiene practices among undergraduate students, shedding light on existing gaps and proposing measures for improved education and awareness of existing menstrual hygiene practices, knowledge, and perception of college girls from a sociological perspective.

Review of Literature

Absar Ahmad, Surbhi G. Garg et.al.(2022) on Menstrual Knowledge, practices, and restriction among college going students in Lucknow, India concluded that most college students needed better knowledge and followed hygienic practices correctly. The adolescent girls have average knowledge of menstrual hygiene, formal and informal channels of communications should take efforts to deliver information on menstrual hygiene. Health institutions and organizations should take efforts to strengthen the health and nutrition care services for better health of community beneficiaries. Anjali Mahajan and Kanika Kaushal (2017) was conducted a descriptive study on to assess the knowledge and practice regarding menstrual hygiene among adolescent girls of government school of Simala, Himachal Pradesh. The study investigates that adolescent girls has lack of information about menstrual hygiene

Methodology of the Study

Academic institutions have a major responsibility in eliminating the taboos of menstruation. This study investigates undergraduate students' menstrual hygiene practices, knowledge from sociological perspective. The objectives of the study are as follows i) To assess the knowledge about menstruation among the undergraduate girls. ii) To study the practices followed by undergraduates students relating to menstruation and menstrual hygiene. Descriptive research design has been adopted for this study. Purposive and convenience sample was adopted among 25 undergraduate students in The Gandhigram Rural Institute who are willing to participate in this study were taken into consideration and the structured interview schedule administered among the samples.

Table 1 Distribution of the Respondents on the Basis of Personal Details

Particulars	Number of Respondents	Percentage (%)
Age		
18-19	7	28
19-20	11	44
20-21	7	28
Total	25	100
Religion		
Hindu	22	88
Christian	01	04
Muslim	02	08
Other	0	0
Area of Residence		
Rural	19	76
Urban	06	24

The majority of respondents (44 percent) are between the ages of 19 and 20.Seventy-two percent of those surveyed are day scholars, and the majority—88 percent—are Hindu, with seventy-six percent coming from rural areas. The majority of responders' fathers work as daily wage earners and as farmers, accounting for 28% of each. Conservative backgrounds have less understanding due to limited discussions around menstruation at home or in academic institutions. Students who are in the final year of undergraduation have better independent strategies for managing menstruation and more exposure to menstrual health and hygiene practices compared to younger students in the II and I year of undergraduation as they have had more opportunities to learn from academic institutions, peers, and life experiences. Notably, religious beliefs also impact menstrual knowledge and hygiene practices because some religions view menstruation as a time of impurity, and this tendency leads to restrictions on religious participation, dietary habits, and social activities.

Compared to those from rural areas, urban students have better access to menstrual hygiene products, healthcare facilities, and educational resources. Rural students may face challenges such as lack of sanitary facilities, cultural taboos, and limited availability of hygienic products, which pave the way to unhygienic practices. They also lack exposure to discussions on menstruation through academic institutions, media, and awareness campaigns, and they rely more on family traditions and peer influence. Parents' education level significantly persuades students' menstrual knowledge and hygiene practices. Higher-educated parents are more prone to offer accurate menstrual information, ensure access to sanitary products, and encourage discussions about menstrual health. In contrast to this, lower educated parents have limited awareness themselves, which leads to the upholding of myths and inadequate menstrual education. Mothers' education is predominantly significant, as many girls first learn about menstruation from their mothers. An educated mother is more likely to provide scientific and practical knowledge about menstrual health. Menstrual products and a supportive environment also influenced by the type of work the parents do.

Table 2 Individual Experiences about Menstruation

Particulars	Number of respondents	Percentage (%)
Age of Menarche		
11	08	32
12	06	24
13	06	24
14 and above	05	20

Reaction at First Menarche		
Happy	03	12
Scared	03	12
Discomfort	06	24
Emotional Disturbance	04	16
Understood it as a Biological change	09	36
Attitudes of Parents		
Caring	08	32
Happy	07	28
Become emotional	04	16
Felt bad	06	24
Physical symptoms at the time of first menarche		
Abdominal and back pain	15	60
Sleeplessness	02	8
Heavy bleeding	03	12
Others – symptoms, stomach pain, No Symptoms	05	20
Average Duration of Menstruation Flow		
5 days	12	48
4 days	07	28
3 days	05	20
Less than 3 days	01	4
Behavioural Changes Occurring After Menarche		
Anger issues and tension	08	32
Sad	03	12
Crying	03	12
Felt matured	05	20
No change	06	24

The present study found that the majority of respondents (38%) attained menarche at the age of 11, and a considerable percentage (32%) acquired additional care from their parents during this transition, while 28% expressed happiness about the milestone. 60% experience abdominal and back pain as a physical symptom at the onset of menarche. In connection with menstrual flow 48 percent of respondents reported a five-day cycle, while 28 percent had four-day cycles. Besides, 68% reported their menstrual bleeding as moderate. Menarche is not just a biological occurrence it is regarded as a social and cultural milestone. This signifies social transition as the beginning of womanhood in many societies. The present study indicates that 20 percent of the respondents felt a sense of maturity upon attaining menarche. This study reports that cultural narratives of menstruation often related to gender expectation, responsibility, and adult-like behaviours because menstruation symbolizes the shift from childhood to adulthood, leading to changes in social treatment like restrictions, new responsibilities, and expectations of modesty. The internalized stress owing to societal taboos or lack of preparedness in dealing with menstrual changes creates the emotional responses of anger and tension (32%) among the respondents.

Table 3 Knowledge on Menstruation

What is menstruation	No of Respondents	Percentage
Physiological	14	56
Pathological	03	12
Curse	01	4
Don't know	06	24
Others	01	4
Anyone tell you about menstruation before you menstruating		
Yes	15	60
No	10	40
Got information about menstruation		
Mother	14	56
Friends	06	24
Teacher	05	20
Regular Menstrual Periods		
Yes	22	88
No	03	12
Is menstrual blood is Unhygienic		
Yes	16	64
No	09	36

While analysing knowledge on menstruation, 56 percent of the respondents understand menstruation as a physiological process, and 24 percent lack any knowledge about it. This knowledge gap reflects unequal access to menstrual education, which is often influenced by socio-economic status, cultural

taboos, and family attitudes. The majority are aware that hormones are the causes of menstruation. The majority, 76 percent, have a regular menstrual cycle between 28 to 30 days, and 15 percent know about menstruation before attaining first menarche. 84 percent know about menstrual hygiene, and 64 percent believe that menstrual blood is unhygienic. Menstrual knowledge and perceptions are deeply rooted in social structures, cultural beliefs, and economic conditions. Social structures, cultural beliefs and economic conditions are playing vital role in shaping perception and knowledge of menstruation among the individuals. Still in many societies menstruation consider as impure, leading to the restrictions on women's participation in social, religious and even household activities. Family attitudes also influenced by cultural norms which determine the early and accurate information about menstruation or leads to ignorance is significance.

Table 4 Practices of Menstruation

Types of Absorbent		
New cloth	02	8
Homemade napkins	01	4
Branded napkins	22	88
Reasons to Buy Branded Napkins		
Comfortable	17	68
Quality	05	20
No option to buy low cost napkins	02	08
Peer pressure	01	4
Most Important Aspect of Choosing Sanitary Napkin		
Package	04	16
Reputation	01	04
Absorbing capacity	12	48
Leak proof capabilities	06	24
Price	02	08
Availability of Sanitary napkins/cloth in your academic institution		
Available in institution	07	28
Always in bag	11	44
Nearby shop	06	24
Others	01	04
Method of Disposal of Used Sanitary Napkins/Cloth		
Dustbin	13	52
Open field	04	16
Burn it	08	32
Wrapping of Napkins Before Disposal		
Yes	24	96
No	01	04
Attending of Academic Institution During Menstruation		
Yes	22	88
No	03	12

The present study highlights the socio-cultural and economic factors influencing menstrual hygiene practices among undergraduate students. Market penetration and societal perceptions of hygiene and modernity. A significant majority (88%) of respondents prefer branded sanitary napkins. Interestingly, 8 percent of respondents use new cloth as an absorbent, which may signify economic constraints, cultural practices, or personal preferences embedded in sustainability concerns. Consumer behaviour patterns reveal that 13% of students purchase two packets of sanitary napkins per month; while 68% report feeling comfortable using branded products. The selection of sanitary napkins is primarily directed by functional characteristics, absorbency is considered the most considerable factor, followed by leak-proof capabilities (24%).

This predisposition suggests an emphasis on practicality and reliability in menstrual hygiene management. Concerning menstrual hygiene practices, 52% of respondents change their sanitary napkins three times daily, while 28% do so four or more times a day, illustrating variations in personal hygiene practices influenced by education, access, and individual comfort.

Getting access to sanitary pads remains a key issue as 44 percent stated they always have sanitary pads available whereas only 28% reported access to these products within their academic institution which indicates the potential gaps in institutional support for menstrual health. With regards to menstrual product procurement family dynamics plays key role, with 40% of respondents revealed that their mothers purchase sanitary napkins for them, reflecting the continued parental involvement in menstrual health management.

52% of respondents dispose of used napkins in dustbins, while 32% burn them with the consideration of socio-environmental embeddedness. 96 percent reported that the prevalent practice of wrapping used napkins before disposal suggests adherence to norms of discretion and hygiene. Menstruation is historically stigmatized, although 88% of respondents continue attending academic institutions during their periods, signalling progress in the normalization of menstruation within educational spaces. However, the study highlights the necessity for enhanced academic institutional support, environmental concern regarding disposal methods, and further discourse on menstrual health as a vital part of public health and gender equality.

Conclusion

Menstrual knowledge and hygiene practices considerably influence menstrual knowledge and hygiene practices. Age plays an important role to menstrual education; religion shapes beliefs and restrictions, parental education and occupation establish the level of awareness, and economic status and area of residence affect access to products and facilities. In order to manage menstruation by all the students irrespective of their background with dignity and proper hygiene socio-economic disparities have to be addressed through targeted menstrual health programs, awareness campaigns, and policy interventions.

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MYSTICISM BEYOND BORDERS: RUMI'S SUFI ECSTASY AND TAGORE'S SPIRITUAL DEVOTION

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Abstract
This paper aims to compare and explore the theme of mysticism represented in Rabindranath Tagore's Gitanjali and Jalaluddin Rumi's Divan - e Shams. Mysticism in poetry transcends cultural and religious boundaries, offering profound insights into the human souls's longing for divine love. Divine love, spiritual surrender and the soul's journey towards enlightenment are analysed under mysticism as the common thread between Rabindranath Tagore's Gitanjali and Jalaluddin Rumi's Divan - e Shams. Jalaluddin Rumi's mysticism rooted in Sufi philosophy, emphasizes ecstatic union with the Divine, whereas Rabindranath Tagore's vision influenced by Vedantic and Bhakti traditions, portrays God as an intimate presence in everyday life. Through the analysis of these selected poems the study highlights their similarities in longing for the infinite and also contrasts their approaches finally arriving at the point that both poets offer Universal Mystical experiences that remain relevant to contemporary seekers of Truth.
Keywords: *mysticism, sufism, divine love, spiritual surrender, spiritual longing*

Mysticism emphasizes the direct, personal experience of the divine, ultimate reality, or higher consciousness. It often involves transcendence beyond rational thought, language, and sensory perception, seeking unity with a greater truth or the cosmos. Mysticism is found in various religious and philosophical traditions, including Christianity, Sufism, Hinduism and Buddhism.

Mystics seek a direct, personal encounter with the divine, often beyond traditional religious doctrines. Beyond logic and reason Mysticism depends on instinctive feeling, inner wisdom, or introspection. The most important mystical tenet is that all things are interrelated, and the Being can merge with the Divine. Mystical experiences are indescribable or beyond the comprehension of language and cannot be communicated entirely. Mysticism leads to profound personal change and spiritual enlightenment.

Mystics involve in practices like meditation, chanting, fasting, and contemplation to attain altered states of consciousness. Deep spiritual truths are expressed through Mystical teachings in the form of symbolic language, poetry, and allegory truths. Mystical experiences may enlist losing a sense of time, space, or individuality and feeling connected to eternity. Mystics experience overwhelming love, joy, or divine ecstasy as they connect to the Divinity. Mysticism is not confined to one religion but is present in many traditions, often with similar themes despite cultural differences.

Rabindranath Tagore's "Gitanjali" is a collection of poems. The world of literature recognized his genius and he eventually won the Nobel Prize in Literature in 1913. "Gitanjali" explores themes of spirituality, love and nature. The poems are rhythmic and symbolic and has musical quality. Tagore wrote the poems in Bengali, and he later translated them into English. The title "Gitanjali" means "song offerings" in Bengali signifying its musicality in language. The collection has 103 poems, written in free verse, with no rhyme or meter. Many poems express a deep sense of love and longing for the divine. Tagore often uses natural imagery to describe the beauty and wonder of the world. The poems explore the human search for meaning and connection with something greater. "Gitanjali" was instrumental in Tagore winning the Nobel Prize in Literature in 1913.The collection is considered an iconic representation of Indian culture and spirituality.

"Gitanjali" has been translated into many languages and is widely studied and admired around the world. Tagore was inspired by his own spiritual experiences and his love of nature. The poems were influenced by traditional Indian music and the

musicality of the Bengali language. Some poems contain autobiographical elements, reflecting Tagore's own life experiences and emotions.

"Divan-e Shams-e Tabrizi (or Diwan-e Kabir)" is one of the most celebrated works of the 13th-century Persian poet and Sufi mystic Jalal al-Din Rumi. It consists of over 40,000 verses, mainly in the form of ghazals and rubaiyat (quatrains), dedicated to his spiritual guide and beloved companion, Shams of Tabriz. Unlike Rumi's later work, "Masnavi", which is more structured and didactic, "Divan-e Shams" is passionately emotional, filled with mystical love (both human and divine), yearning and separation, union with the divine, ecstasy and intoxication (often symbolized by wine and dancing) and the annihilation of the self (fana) in God.

Rumi's poetry collection is spontaneous, ecstatic as if dictated by divine inspiration. Metaphors, symbols, and spiritual paradoxes enriches his poems. Shams was a wandering dervish. His entrance into Rumi's life transformed Rumi. They had a passionate spiritual companionship which led Rumi to delve deeply in divine love. Rumi's deep indulgence with God lead to the mysterious disappearance. of Sham suddenly. This event induced Rumi to outpour his emotions in "Divan-e Shams", where his longing for Shams often symbolically represents deeper yearning for God.

Mysticism in Rabindranath Tagore's "Gitanjali" has a different dimension. Tagore portrays God as an intimate, ever-present companion, much like the Sufi and Bhakti traditions of mystical poetry. Tagore sees God in nature, human labor and music. He expresses a longing for spiritual communion, where the soul merges with the infinite. Tagore surrenders himself to the divine will, believing that true realization comes through love and faith. Tagore's mysticism is emotional and full of longing. He often speaks of the pain of separation from the divine. Tagore's mysticism draws from Vedantic Philosophy emphasizing the oneness of the soul (Atman) and the Supreme (Brahman).

"This little flute of a reed ….melodies eternally new."

In this line from Gitanjali, Tagore beautifully implies his intimacy with God. He is like a flute in God's hand and God carries him everywhere and breaths His melodies of Poetry into him.

"When thou commandest me to sing, …….come to my eyes".

Drunk with the joy of singing…… who art my lord."

Tagore describes that when God asks him to sing or to compose poems about Him, Tagore's heart is filled with such pride and joy and in his drunken joy he calls God as his friend. Tagore's affinity and tremendous love towards the Divine brings the elements of Mysticism in his poetry.

"I ask for a moment's indulgence ……shoreless sea of toil."

Tagore yearns for the love of God. He wants to sit near God all the time. He says he would indulge in his work afterwards. He cannot endure the thought of being away from his God. If he moves away from the sight of God his heart would never allow him to take rest.

God's presence is found in our everyday ordinary life. Tagore proclaims this through these poetic lines,

"Leave this chanting and singing and ……

he is bound with us all for ever."

Tagore calls the person who is meditating and praying to God to leave everything and seek God in places where people toil and work hard because God is found there. He has happily taken upon Himself the burdens and sufferings of creation, sharing in the joys and struggles of the universe. God is inseparably linked with humanity and creation.

Tagore awaits to be with God. He cherishes the moment when he can hear the voice of God, his love.

"The morning will surely come, ……

Thy melodies will break forth in flowers in all my forest groves."

Tagore's metaphorical words unite nature with God. He compares the pouring down of God's voice with the golden strokes of colour in the sky which seems like Golden streams breaking the sky. Then he expresses that God' s words have the songs of every

bird in nest and soar higher. He further states that God's melodies are emerging as flowers in his forest groves. The comparisons Tagore makes with God and nature are in grand, highly elevated style.

Tagore wants God to come to his house. He calls God as his friend and beloved and begs Him to come to his houses.

"The woodlands have hushed their songs….
do not pass by like a dream."

Tagore affirms that though every door has been shut, his gates are wide open for God. He proclaims God as his only friend and his best beloved.

"This is my prayer to you, my lord…….
give me the strength to surrender my strength to thy will with love."

These Prayerful poetic lines from Tagore's "Gitanjali" expresses the deep - rooted faith of Tagore towards God. He wants God to strike him hard to remove his mindset of scarcity, lack and limitation. He prays that God eradicates his fears, doubts and uncertainties and develops a heart that is generous, open- handed and willing to receive and share God's blessings. He wants to surrender his strength to the will of God with love.

"When my beggarly heart sits crouched…….
come with thy light and thy thunder."

Tagore invites God to arrive in his life when his heart feels frightened and when his mind is filled with worldly things such as lust and delusion. He invites God to come to his life with His light and His thunder. All the elements of mysticism can be traced here. Longing for God's presence and union, comparing God with Nature, surrendering to God's will and considering God as his only refuge are the ways through which Tagore expresses his connection to the divine.

"In one salutation to you……
its eternal home in one salutation to thee."

The poet Tagore constantly seeks for eternity. His reverence for the Divine can be comprehended through these lines where he wants everything of him to worship God. Tagore wants his life to offer salutation and praise to God. He deeply desires to take a journey to the eternal home and offer salutation and praise to God there. He feels home sick and his homesickness is compared to a flock of homesick cranes which fly day and night and long to reach their mountain nests.

Rumi's Divan-e Shams Tabrizi is mystical with poems that express divine love, unity, and transcendence. The mysticism in *Divan-e Shams* moves around key themes such as love for the divine, destruction of the self (fana), spiritual intoxication, the nothingness of the material world, and the voyage of the soul toward God.

Here are some lines that embody the mysticism in his poetry:

"I have no companion but love, ……
spark of my eternal love."

Here, Rumi equates himself entirely with love, suggesting that divine love is both the path and the destination. This love transcends time, identity, and physical existence.

These poetry lines declare Rumi's union with the Divine.

"I am not from the East…..
Adam and Eve or any origin story."

These lines reflect Rumi's mystical annihilation of the self (fana) and his belief in oneness with the divine beyond earthly distinctions. Mysticism in Rumi's poetry often speaks of self-dissolution — losing oneself in the presence of God.

"I am drunk and you are my wine.
I am the reed flute, you are my sound.
I am a fallen leaf, you are the wind.
Wherever you move, I go."

The poet's personal identity dissolves in divine love, much like a reed flute that plays only because of the breath of God passing through it.

Rumi often speaks of divine intoxication, where the seeker experiences ecstatic union with God, losing all attachment to worldly concerns.

"I have become mad,
I am no longer myself.
I have cut chains of reason and judgment,
I am free from everything but love."

In Sufi mysticism, sukr (spiritual intoxication) means being overwhelmed by divine presence,

forgetting the self and worldly worries. This is a state where the seeker transcends logic and reasoning in pure surrender.

Rumi frequently emphasizes that the material world is a mere reflection, and true reality lies beyond it.

"Don't get lost……
your pain will become your cure."

The ephemeral nature of suffering and joy is a fundamental idea in mysticism. What appears real—pain, sorrow, joy—is temporary, and the seeker must look beyond it to find ultimate truth.

The mystical journey of the soul toward God is a dominant theme in *Divan-e Shams*.

"I died as a mineral …… an animal,
I died as an animal and I was human.
Why should I fear? When was I ever less by dying?"

These lines describe the soul's continuous evolution—a journey through different forms toward spiritual enlightenment. This aligns with the Sufi belief in the purification of the soul as it moves toward unity with the divine.

Rumi often speaks of a hidden truth beyond physical perception.

"Don't look at your form, however ugly or beautiful.
Look at love and the aim of your quest.
The soul is neither above nor below,
Neither in hell nor in heaven."

These lines suggest that the true self is beyond form, beyond good and evil, beyond heaven and hell. In Sufism, the batin (inner reality) is more significant than external appearances.

Mysticism in *Divan-e Shams* is deeply experiential. His poems express divine love, loss of self, ecstatic surrender, and the soul's ultimate return to its source.

Both Rabindranath Tagore's *Gitanjali* and Rumi's *Divan-e Shams* express mysticism through themes of divine love, surrender, self-annihilation, and unity with the Divine. Below are some mystical lines from both poets that reflect their shared same vision of spirituality:

The Longing for the Divine is expressed in Tagore's *Gitanjali*:

"My heart, the bird of the wilderness,
has found its sky in your eyes."

And in Rumi's *Divan-e Shams*:

"I am yours, don't give myself back to me."

Both poets compare the soul to a bird longing to fly toward the beloved (God), expressing deep spiritual yearning and surrender.

In Tagore's *Gitanjali*, he expresses

"The song that I came to sing……
unstringing my instrument."

In Rumi *Divan-e Shams* he says

"Don't grieve.
Anything you lose comes in another form."

Both poets express the impermanence of the material world, influencing the spiritual seeker to focus on spiritual fulfilment rather than desires that are temporary.

Tagore "Gitanjali" focuses on the Soul's voyage toward the divine.

"On the seashore of endless …….
water is boisterous."

Rumi in *Divan-e Shams* says

"You were born with wings,
Why prefer to crawl through life?"

Both poets describe the soul as infinite, encouraging it to transcend earthly limitations and embrace divine reality.

Tagore and Rumi share a universal mysticism beyond borders, seeing God not as a distant deity but as an intimate presence within the heart. Their poetry reflects surrender, divine love, and the journey toward spiritual awakening. The doting love they have towards God unites them beyond borders and culture.

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STRENGTH BEYOND YEARS: MOSES' LEADERSHIP IN OLD AGE AND THE POWER BEYOND HUMAN LIMITS

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Abstract
This paper explores the leadership of Moses from the Holy Bible as an elderly man guiding a vast number of Israelites despite the physical and mental deterioration associated with ageing. As depicted in biblical narratives, Moses faces challenges common to old age, including fatigue, frustration, and self-doubt. However, these limitations do not stop him from being an effective leader, performing extraordinary actions beyond human capability. This paper aims to analyse the cognitive and physical decline typically observed in elderly individuals, drawing parallels between Moses' struggles and the realities of ageing. This also investigates the source of his enduring strength, stating that divine intervention enables his sustained leadership. This dual approach, examining both the decline of an ageing leader and the supernatural force sustaining him, offers insight into how faith and divine guidance can empower individuals beyond their perceived limitations.
Keywords: *old age, deterioration, cognitive decline, divine intervention*

Introduction

Old age has usually been linked with physical deterioration, mental debilitation and reduced leadership acumen. However, Moses, perhaps the most influential biblical leader, guided the Israelites, through the desert for forty years in spite of his aging years. The Bible has him as 120 years old when he died, but still with great strength: "Moses was 120 years old when he died, yet his eyes were not weak, nor his strength gone" (Deuteronomy 34:7). The paradox here is crucial and raises several questions: How was Moses still able to lead when there was the expected weakening of old age? Was his power all about individual grit or was he being maintained by a greater power? This essay examines Moses' leadership in two ways:

1. The Natural Wearing Down of Old Age: How does Moses display evidence of human frailties—both physically and mentally—as he leads a nation through the most severe of circumstances?

Moses' leadership experience is accompanied by the universal decline that comes with age, an indication of human frailties that even the strongest leaders have to endure. As Moses transitions from a young leader to a mature statesman, physical and mental deterioration can be seen. The Bible describes his aging indirectly through episodes of weariness and need for assistance, as in the way Aaron and Hur support his hands when he is fighting the Amalekites (Exodus 17:12). This episode represents his declining physical strength, demonstrating the human frailty associated with aging.

Mentally as well, Moses struggles with decision fatigue and emotional fatigue, which naturally result from shepherding an obstinate and demanding people. His tantrum at Meribah, where he hits the rock in anger (Numbers 20:10-12), is a display of emotional burnout, betraying his inability to keep himself patient and composed. This event, which led to God's judgment that he would not be allowed to enter the Promised Land, highlights how the demands of leadership, coupled with age, can result in moments of poor judgment.

Furthermore, Moses' requirement to entrust duties to capable leaders, after Jethro's counsel (Exodus 18:17-26), shows his recognition of his limitations as a human being. This calculated delegation of authority not only lightens his load but also reflects his diminishing ability to control the nation on his own. In his last discourses (Deuteronomy 31), Moses addresses the people in a contemplative mood, well aware of his imminent demise. His recognition, "I am no longer able to go out and come in" (Deuteronomy 31:2), movingly captures his realization of the natural aging process. Therefore, the life of Moses outlines the human side of leadership in which aging signifies not only physical weakness but also emotional susceptibility, impacting his choices and relationships with his people.

2. The Supernatural Strength That Upholds Him: How much of a role does God's intervention have in maintaining Moses in leadership?

Despite the natural weakening that is a result of aging, Moses' leadership is surprisingly maintained through divine intervention, demonstrating the supernatural strength factor in his life. Through his lifetime, Moses experiences phenomenal empowerment, which enables him to lead the Israelites through trying moments. From the burning bush incident to his dying days on Mount Nebo, God's guidance is ever present and at the source of strength and leadership.

The reason why Moses was able to retain leadership in spite of human weakness can be attributed largely to direct divine intervention. During the battle against the Amalekites (Exodus 17:11), the Israelites win as long as Moses holds up his hands, symbolizing divine power channeled through human power. The miracle of victory illustrates how God is compensating for Moses' weakness by granting victory greater than human capabilities. Similarly, at Meribah, although Moses is doing so out of frustration, God still provides water to the people, highlighting divine mercy that sustains leadership in spite of human weakness.

The supernatural power is also observable in the foresight and wisdom of Moses. He rules with absolute authority, guiding the Israelites through situations of distress and enunciating God's legislation with accuracy and confidence. His face radiates after encountering God on Mount Sinai (Exodus 34:29-35), symbolizing divine power that invigorates and legitimates his leadership. Moreover, the speeches of Moses in Deuteronomy exhibit great eloquence and foresight, suggesting that his wisdom is given by God.

Even late in life, Moses is exceptionally strong: "His eye was not dim, nor his vigor abated" (Deuteronomy 34:7), indicating a remarkable preservation of his capacities by the divine. His vigor is testimony to the divine power behind him to discharge his leadership role to the fulfillment of his commission. Moses' life is thus a pointer that human frailty is unavoidable but that divine strength empowers leaders to succeed beyond their weaknesses and fulfill their divine delegated task.

1. Biblical Analysis

This research is based mainly on the biblical books of Exodus, Numbers, and Deuteronomy, which record Moses' life as a leader. Important sections that reflect his endurance, setbacks, and divine support are analyzed to identify the depiction of his physical and mental condition.

Physical Decline and Limitations

Exodus 17:12: "When Moses' hands grew tired." – Illustrates physical tiredness in the fight against Amalekites, necessitating the support of Aaron and Hur.

Numbers 20:10-12: Moses strikes the rock twice in frustration, demonstrating emotional depletion in conjunction with his physical exhaustion.

Deuteronomy 34:7: "Moses was 120 years old when he died, yet his eyes were not weak, nor his strength gone." Although this verse indicates extraordinary vigor, it also points to his old age and the miraculous character of his strength.

Mental and Emotional Distress

Exodus 5:22-23: Moses questions God's intention, expressing his self-doubt and mental exhaustion.

Numbers 11:14-15: "I cannot carry all these people alone; the burden is too heavy for me." – Reveals Moses' emotional fatigue and desperation, verging on despair.

Deuteronomy 3:23-26: Moses asks God to let him enter the Promised Land but is refused, which reveals his emotional weakness and resignation.

Divine Interaction and Empowerment

Exodus 3:2-12: The burning bush experience, in which Moses first resists his mission but is given divine reassurance and empowerment.

Exodus 33:11: "The Lord would speak to Moses face to face, as one speaks to a friend." Demonstrates the close and empowering relationship between Moses and God.

Numbers 11:16-17: God shares Moses' burden of leadership by empowering seventy elders, easing his mental tension.

Deuteronomy 34:10-12: Moses' unparalleled prophetic status is explained by his divine connection, affirming the idea of supernatural empowerment in spite of human weakness.

This research is based mainly on the biblical books of Exodus, Numbers, and Deuteronomy, which record Moses' leadership journey. The most important passages that describe his endurance, struggles, and divine support are analyzed to comprehend the depiction of his physical and mental condition.

Conclusion

Moses' tale is ultimately a tale of human deterioration combined with divine intervention. As an elderly leader guiding a nation through brutal and merciless times, Moses exhibited unmistakable physical and mental decline. His hands tired in combat, his patience was tested by stress, and his vigor weakened as age gained its toll. These instances of weakness and exasperation uncover a deeply human quality in Moses, a worn-out leader struggling with the limitations of his own body and mind. Even while he was seemingly declining, Moses achieved extraordinary actions that are beyond mere human abilities. From dividing the Red Sea to bringing intricate laws and leading a whole nation through the desert, his life was filled with feats that are impossible for a man of his age and status. How does one account for the energy that stayed with him until his last days or the wisdom and authority that formed a nation? The answer is not in human strength but in divine intervention. God's hand is manifest in Moses' perseverance and the accomplishment of his calling despite weakening strength. The miraculous battles, the prophetic clarity, and the perseverance to continue on, all indicate a power far greater than natural human potential. Moses' journey, therefore, is not merely the narrative of an older man but a powerful testimony to how divine strength can overpower human frailty.

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