RESEARCH AND DEVELOPMENT CELL

ACADEMIC RESEARCH

OBJECTIVES:

1. The mission of Research & Development cell in the Institute is to continuously engage in research and development activities and to promote scientific temper in the graduates, leading to life-long learning and imbibing a research culture in the institution.
2. Support to facilitate faculty and researchers in carrying out their research activities for promoting basic research ideas with R & D agencies in other sectors for expanding and enriching the knowledge base in their respective areas.
3. R & D Cell co-ordinates sponsored research, collaborative research and industrial consultancy projects. Through such projects, the R & D capabilities of the faculty members and students are enhanced and to participate in various exhibitions with their innovative ideas/creation of models, etc. Students and Faculty Members are highly encouraged to pursue research experiences.
4. Explore Collaborative research programs with National and International level institutions
5. Enhancement of High Quality publications with high impact factor, citations, SCI/Scopus indexed/web of science
6. Establishment of Research Centers in the selected domains.
7. Enhancement of research funding from Govt agencies and industries

R&D CELL

Institute has established a Research Cell to address and monitor Research and Development initiatives of faculty and students. The Cell has been formulated comprising of following faculty members having research inclination.

Sl. No.	Name	Designation	Department	Role
1	Prof.(Dr.) Pijush Pal Roy	Director	CE	Chairman

2	Prof.(Dr.)Chandan Kumar Ghosh	Head (R&D)	ECE	Convenor
3	Dr. Dola Sinha	Asstt Professor	EE	Member
4	Dr. Mrinmoy Chakraborty	Asstt Professor	ECE	Member
5	Dr. Jayanta Pal	Associate Professor	BSH	Member
6	Prof. (Dr.) Chandan Koner	Professor	CSE	Member
7	Dr. Sabyasachi Chandra	Professor	CE	Member
8	Dr. Abhijit Ghosh	Asstt. Professor	BSH	Member
9	Dr. Rajib Banerjee	Asstt. Professor	ECE	Member
10	Dr. Arijit Banerjee	Asstt. Professor	ME	Member
11	Dr. Kamalika Tewari	Asstt. Professor	IE	Member
12	Dr. Moumita Pradhan	Asstt. Professor	IT	Member
13	Prof. Arindam Ghosh	Asstt. Professor	CSE	Member
14	Prof. Abhijit Banerjee	Asstt. Professor	ECE	Member
15	Prof. Soumyadip Das	Asstt. Professor	CE	Member

HEAD, R&D

Dr. Chandan Kumar Ghosh obtained his PhD from IIEST, Shibpur. He has around 21 years of teaching experience including 10 years of extensive research experience in the area of Electronics & Communication Engineering – **RF Antenna**. Based on his research work and teaching, he was selected for prestigious Best Teacher Award IN 2018 by the affiliating University, MAKAUT. He has been working as a Professor at Dr. B. C. Roy Engineering College, Durgapur since 2009. He has published around 70 publications in various reputed International Journals and Conferences. He acts as a reviewer for few reputed International Journals and Conferences.

Various initiations of Research Cell:

- For enhancing the research activities and imbibing the research culture, Institute provides financial and other required support for research promotion at the Institute level. The researchers are financially supported for organizing and attending the research activities like Workshops, Seminars, National and International Conferences, Faculty Development Programs etc. The allocation of funds depends on level of the activity, number of participants and duration of activities.
- Funds are provided for Patents and Research Publications within India and abroad. The registration charges, travelling and other allowances are reimbursed.
- Researchers are provided with seed money to initiate the research work.

Status of Project Proposal preparation / Submission from Dr. B. C. Roy Engineering College, Durgapur

Sl. N.	Name of Project Leader / Project Coordinator	Department	Title of the Project	Date of Submission to PMIL Cell	Proposal Submitted to	Final Status	Remarks
1	Prof. (Dr.) Dola Sinha	EE	Performance and stability analysis of natural dye based DSSC with nanostructured metal oxides as photo anode	14.9.17 (submitted directly to DST)	DST-Women Scientist Scheme – B, Kiran Division	DST project cancelled, same Sent in UGC on 18.5.2018	
2	Prof. (Dr.) Dola Sinha	EE	Fabrication of modified multi-input interleaved DC-DC converter for competent utilization of solar power.	12.3.18	Ekta Incubation-MAKAUT	Under Review	
3	Prof. (Dr.) Dola Sinha and Prof. (Dr.) Debasis De	EE & AEIE	Fabrication of dye sensitized solar cell	12.3.18	Ekta Incubation-MAKAUT	Under Review	
4	Prof. (Dr.) Swapan Kumar Mazumder	ME	Drying of Wet River Sand and Transportation	22.3.2018	Submitted to Owner of the company		Industrial Project (Reviewed & Under hold)
5	Prof. (Dr.) Dola Sinha	EE	Development and implementation of modified multi-input interleaved DC-DC converter for efficient utilization of renewable sources.	24.3.2018	TARE-SERB	TAR/2018/000209	
6	Prof. (Dr.) Debasis De	AEIE	Fabrication, performance and stability analysis of dye sensitised solar cell with nanostructured metal oxide & their composite	31.3.2018	TARE-SERB	Under Review	
7	Prof. (Dr.) Vijayalaxmi Midda	AEIE	Development of optical fibre sensor based bragg grating sensor for measurement of respiratory effort signal of sleep apnea patient	5.4.2018	TARE-SERB	Under Review	

Sl. N.	Name of Project Leader / Project Coordinator	Department	Title of the Project	Date of Submission to PMIL Cell	Proposal Submitted to	Final Status	Remarks
8	Prof. Abhijit Banerjee	ECE	Level sensing and bulk volume measurement of Railway goods carriages.	7.4.2018	CSIR-CIMFR DHANBAD	No Reply	
9	Prof. (Dr.) Arijit Banerjee	ME	Design and Manufacturing of a Novel Terrace Top Reservoir Yielding Double Benefits	12.4.2018	Yet to submit For DST-TDP		
10	Prof. Arijit Kumar Banerji	CE	Investigation of Public Health Impacts and Traffic Management due to Traffic congestion around schools in Urban Areas: A Case Study in Durgapur	12.4.2018	Proposal Submitted	Gobeshonay Bangla	
** Proposal Sent to: The Special Secretary To the Government of West Bengal Higher Education, Science & Technology and Biotechnology (Science & Technology and Biotechnology Branch) Vigyan Chetana Bhavan (2nd Floor) DD-26/B, Sector- I Salt Lake, Kolkata-700064 e-mail: gobeshonaybangla@gmail.com on 13th September, 2018							
11	Prof. Sanjoy Sengupta	CE	Bridge Pier Health Monitoring using Acoustic Emission technique	12.4.2018	Yet to submit for DST-TDP		Programme (TDP) shows 'Inactive' from January till date
12	Prof.(Dr.) Chandan Kumar Ghosh, Prof. (Dr.) Tribeni Prasad Banerjee and one member from CSIR-CMERI-Durgaur	ECE	Design of a low cost miniaturised (4x4) microstrip antenna array for breast cancer detection	12.4.2018	TARE-SERB	Under Review	
13	Prof. Rupali	ME	Solar sanitary napkin incinerator		To be submitted in DST		
14	Prof. (Dr.) Jayanta Pal, Prof. (Dr.) Madhsree Kole, Prof. (Dr.) Kamal Hussain	BSH	Fabrication and Characterisation of cost effective Dye-sensitized solar cell		Submitted in CSIR 24.4.2018	Acknowledge the receipt. Ref. no. 7987/NS	Response to the query of CSIR on 31.7.2018

15	Prof. (Dr.) Kamal Hussain, Prof. (Dr.) Jayannta Pal , Prof. (Dr.) Kamal Hussain, Prof. (Dr.) Sashi Bajaj Mukherjee, Prof. Sudip Kumar Gorey	BSH	Development of analytic and numerical model for linear width reduction of (Al,In) GaN blue laser diodes with external feedback.		To be submitted in CSIR		
16	Mr. Aniket Subham- B.Tech Student	ECE	"Smart school" controls all the classroom (light, fan etc)				
17	Prof. Moutusi Mandal	ECE	Microwave system design for medical application purpose		Ekta Incubation - MAKAUT		
18	Prof. (Dr.) Debasis De	AEIE	Superhydrophobic nanostructured oxide coating on aluminium or self-cleaning applications		TARE-SERB	Under Review	
19	Prof. (Dr.) Dola Sinha	EE	Fabrication of modified multi input DC-DC converter		Ekta Incubation - MAKAUT		
20	Mr. Muktar Alam, Mr. Akash Pathak, B.Tech student	ECE	Man portable EOD Robot with Articulated 6 axis arm.		Ekta Incubation - MAKAUT		
21	Prof. Dinesh Pradhan	CSE	3 layers IoT systems.		Ekta Incubation - MAKAUT		
22	Prof. Sourabh Das	BSH	Removal of Alumina and hematite from silica by cost effective methodology	18.4.2018			
23	Prof. (Dr.) Swapan Kumar Mazumder	ME	Elimination of wire mesh blinding in Trommel Screener	20.4.2018	Submitted to Owner of the		Industrial Project (Reviewed & Under hold)

					company		
24	Prof. Saurabh Dutta	MCA	A Meta Model approach towards development of an integrated encryption system (IES)	18.4.2018			
25	Prof. (Dr.) Sukalpa Dey	BSH	Investigating common flower extract as green corrosion inhibitor for metals in corrosive environment	19.4.2018			
26	Prof. (Dr.) Swapan Kumar Mazumder	ME	Selection, Procurement and Installation of Multi-deck vibrating screener	20.7.2018	Submitted to Owner of the company		Industrial Project (Reviewed & Under hold)
27	Prof. Sanjay Sengupta / Prof. Soumyadip Das, Prof. Arijit Kumar Banerji.	CE	Real time crack detection in concrete pavements using Acoustic Emission Technique	Proposal sent to: Head, HRDG, CSIR Complex New Delhi 110012 On 18th Sep,2018	Submitted in CSIR on 18th Sep,2018		
28	**Dr. Dola Sinha (EE) as PI and Dr. Arijit Banerjee (ME) as Co-PI**	EE & ME	**"Design of litz wire based power efficient, thermal resistive, robust domestic Induction cooker."**		**The Department of Higher Education Science and Technology and Biotechnology, West Bengal**	**on the scheme of " Gobeshanay Bangla" submitted on 13.09.2018**	

Project Status from May'2019

Sl. No.	Name of the project	Submitted by	File name	Status
1	Investigating common flower extract as green corrosion inhibitor for metals in corrosive environment.	Dr. SukalpaDey (02.05.2019)	TAR/2019/000005 (TARE)	Not recommended
2	Production of environmentally friendly lactic acid from kitchen wastes and its application along with other organic acids in iron and aluminium removal from silica sand by acid leaching	Dr. Abhijit Kr. Ghosh	TAR/2019/000215 Teacher Associateship for Research Excellence (TARE)	Not recommended
3	Design of smart textile using fiberbragg grating sensors for monitoring of respiratory movement	Dr. BijoylaxmiMidya	TAR/2019/000142 (TARE)	Not recommended
4.	Bridge Pier Health Monitoring using Acoustic Emission Technique	Dr. SanjoySengupta and others	CRG/2019/000796 [Sc.&Engg Research Board (SERB)]	Not recommended
5.	Fabrication and characterisation of cost effective dye-sensitized solar cell	Dr. Jayanta Pal and Dr. MadhusreeKole	CRG/2019/002100 [Sc.&Engg Research Board (SERB)]	Not recommended due to unavailability of respective PG courses
6.	NASI-ScopusYoungScientist Awards 2019	Dr. Kamalika Tawari	Acknowledgement Received (13.06.19) Elsevier	Under review
7.	NASI-ScopusYoungScientist Awards 2019	Dr. Tapas Mondal	Acknowledgement Received (15.06.19) Elsevier	Under review
8.	Fuzzy based Solar egg incubator	Dr. Dola Sinha (PI), Dr.Chaity Sarkar (Co PI) and Mr. Subhajit Bhattacharya (Co PI)	PRISM-DSIR	Presented
9.	Solar energy based automated seed sowing bot for cultivation	Dr. Dola Sinha (PI), Dr.Chaity Sarkar (Co PI)	BIG	Not recommended
	MODROB			
1	ECE	28.08.19	AICTE	**Under Review**
2	EE	28.08.19	AICTE	**Under Review**
3	CSE	28.08.19	AICTE	**Under Review**

AQIS Applicatic	Status	AQIS Schemes	Faculty Id	Title	Surname	First Name	Father's Name	MobilePhone #	Email Address	Scale of Pay	Exact Designat	Appointment Type
1-7047974771	Expert Evalua...	STTP – Short ...	1-445173089	Mr.	RAY	RAJDEEP	SHYAMA PRA...	9433100075	rajdeep.roy@...	VIth Pay Scale	ASST PROFE...	Regular/Approved
1-7037205881	Expert Evalua...	STTP – Short ...	1-2192020030	Dr.	SAMANTA	RAJKUMAR	S.B. SAMANTA	9333336958	reesam03@g...	VIth Pay Scale	ASSOCIATE P...	Regular
1-7031680531	Submitted	RPS – Resear...	1-1476289808	Mr.	BANERJEE	RAJIB	ADHIR KUMAR	9434536819	rajib.banerje...	VIth Pay Scale	ASST PROFE...	Regular
1-7035526375	Expert Evalua...	STTP – Short ...	1-1476289808	Mr.	BANERJEE	RAJIB	ADHIR KUMAR	9434536819	rajib.banerje...	VIth Pay Scale	ASST PROFE...	Regular
1-7035526371	Submitted	RPS – Resear...	1-445173573	Mr.	CHAKRABORTY	MRINMOY	MRIGANKA M...	9232350522	mrinmoy.cha...	VIth Pay Scale	ASST PROFE...	Regular/Approved
1-7035526307	Expert Evalua...	STTP – Short ...	1-445173573	Mr.	CHAKRABORTY	MRINMOY	MRIGANKA M...	9232350522	mrinmoy.cha...	VIth Pay Scale	ASST PROFE...	Regular/Approved
1-7035526303	Expert Evalua...	STTP – Short ...	1-445173573	Mr.	CHAKRABORTY	MRINMOY	MRIGANKA M...	9232350522	mrinmoy.cha...	VIth Pay Scale	ASST PROFE...	Regular/Approved
1-7035526269	Expert Evalua...	FDP – Faculty...	1-445173085	Dr.	SAHA	ALOKE	AKHIL SAHA	9647263460	aloke.saha@b...	VIth Pay Scale	ASST PROFE...	Regular/Approved
1-7035526261	New Request	FDP – Faculty...	1-733807439	Dr.	KONER	CHANDAN	CHITTARANJA...	9434535556	chandan_dur...	VIth Pay Scale	PROFESSOR	Regular
1-7017064871	Submitted	RPS – Resear...	1-471475979	Dr.	GHOSH	CHANDAN	SRI SUBAL C...	9199999999	meet_ckg@y...	VIth Pay Scale	PROFESSOR	Regular

Project Status from May'2020

Sl. No.	Name of the project	Submitted by	File name	Status
01	Solar Powered Automated Multi-crop seed cum fertilizer dispensing bot	Dr. Dola Sinha (PI), Dr.Chaity Sarkar, KingsukMajumdar, Suchismita Dutta on August, 2020	BIG, BIRAC	Submitted
02	An innovative and efficient IOT based approach of coal mine environmental monitoring for security aspects	Dr.Rajib Banerjee (PI) and Dr.Chandan Kumar Ghosh (Co PI) on August, 2020	Ministry of Coal	Submitted

3D-PRINTER

Introduction:

3D printing is a form of additive manufacturing technology where a three dimensional object is created by laying down successive layers of material. It is also known as rapid prototyping, is a mechanized method whereby 3D objects are quickly made on a reasonably sized machine connected to a computer containing blueprints for the object. The 3D printing concept of custom manufacturing is exciting to nearly everyone. This revolutionary method for creating 3D models with the use of inkjet technology saves time and cost by eliminating the need to design; print and glue together separate model parts. Now, you can create a complete model in a single process using 3D printing. The basic principles include materials cartridges, flexibility of output, and translation of code into a visible pattern. 3D Printers are machines that produce physical 3D models from digital data by printing layer by layer. It can make physical models of objects either designed with a CAD program or scanned with a 3D Scanner. It is used in a variety of industries including jewelry, footwear, industrial design, architecture, engineering and construction, automotive, aerospace, dental and medical industries, education and consumer products. 3D printing, also known as additive manufacturing (AM), refers to processes used to create a three-dimensional object in which successive layers of material are formed under computer control to create an object. Objects can be of almost any shape or geometry and are produced using digital model data from a 3D model or another electronic data source such as an Additive Manufacturing File (AMF) file.

Working Principle:

3D printable models may be created with a computer-aided design (CAD) package, via a 3D scanner, or by a plain digital camera and photogrammetry software. 3D printed models created with CAD result in reduced errors and can be corrected before printing, allowing verification in the design of the object before it is printed.

There are 3 main steps in 3D printing.

The **first step** is the preparation just before printing, when you design a 3D file of the object you want to print. This 3D file can be created using CAD software , with a 3D scanner or simply downloaded from an online marketplace. Once you have checked that your 3D file is ready to be printed , you can proceed to the second step.

The **second step** is the actual printing process. First, you need to choose which material will best achieve the specific properties required for your object. The variety of materials used in 3D printing is very broad. It includes plastics, ceramics, resins, metals, sand, textiles, biomaterials,

glass, food and even lunar dust! Most of these materials also allow for plenty of finishing options that enable you to achieve the precise design result you had in mind, and some others, like glass for example, are still being developed as 3D printing material and are not easily accessible yet.

The **third step** is the finishing process. This step requires specific skills and materials. When the object is first printed, often it cannot be directly used or delivered until it has been sanded, lacquered or painted to complete it as intended.

Hexapod

Introduction:

The main purpose of this work was to design a prototype of an autonomous hexapod robot. This project presents a novel hexapod robot with legs radially free distributing around the body. Compared with radial symmetric or rectangular symmetric robots, the legs of a radially free distribute hexapod can rotate around the body of it and redistribute their positions. The aim of this project is to build a six-legged walking robot that is capable of basic mobility tasks such as walking forward, backward, rotating in place, and raising or lowering the body height. This robot will serve as a platform on to which additional sensory components could be added or which could be programmed to perform increasingly complex motions. Hexapods are superior to wheeled robots because wheeled robots need a continuous, even and most often a pre-constructed path. Hexapod robots however can traverse uneven ground, step over obstacles and choose footholds to maximize stability and traction. Having maneuverable legs allows hexapods to turn around on the spot. In comparison to other multi-legged robots, hexapods have a higher degree of stability as there are can be up to 5 legs in contact with the ground during walking. Also, the robots center of mass stays consistently within the tripod created by the leg movements, which also gives great stability. Hexapods also show robustness, because leg faults or loss can be managed by changing the walking mechanism. This redundancy of legs also makes it possible to use one or more legs as hands to perform dexterous tasks. Because of all of these benefits, hexapod robots are becoming more and more common, and it will be interesting to see what modifications robot cists come up with to further improve and develop their form and function.

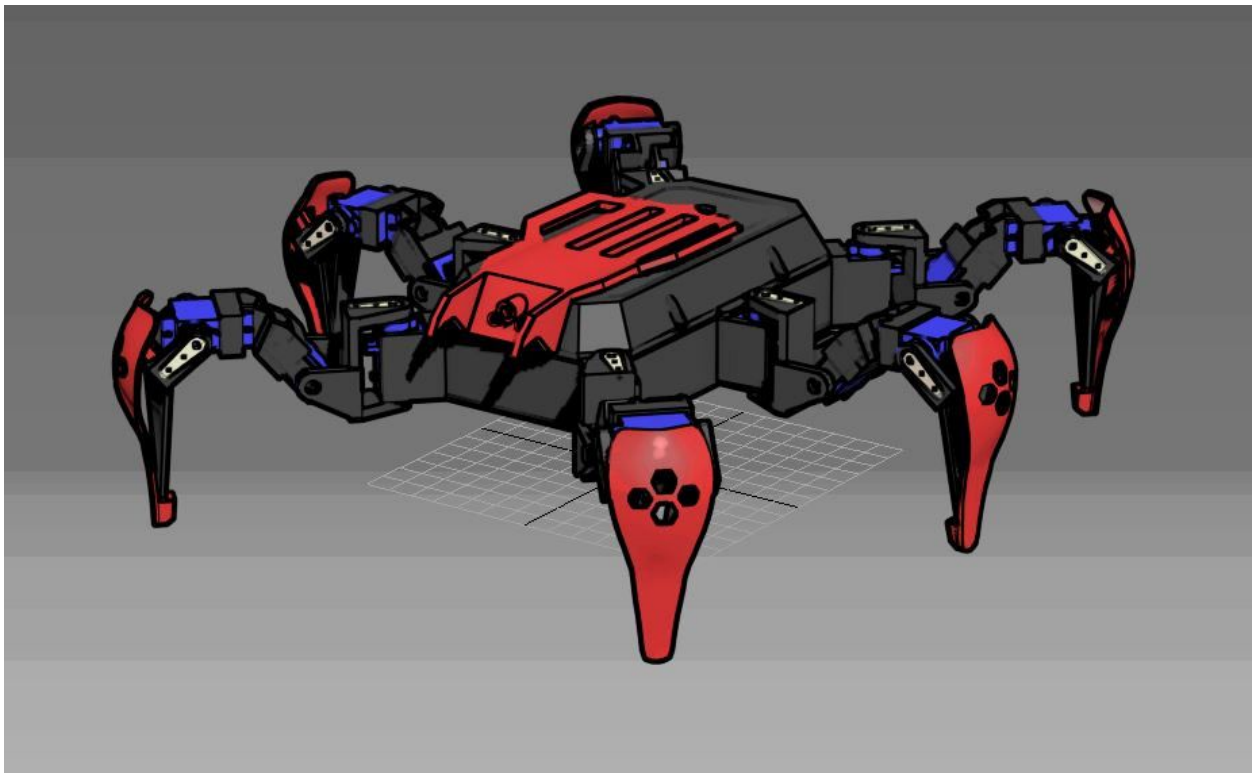
Objective :

The main objective of this project can be stated as follows.

1. To study the movement and dynamics of the Hexapod robot.
2. Designing the model of Hexapod robot on CAD software.
3. For modifying the design based on requirements.
4. Analysis and simulation of the hexapod.
5. Fabrication of hexapod.
6. Automation and controlling.
7. Testing

Working principle:

The hexapod robot acts as a rescue robot in a targeted arena. We will place the robot at a place where human are not able to go further. We will have the full control of the robot. We will control the robots movements and send it inside the disaster area. We will get an ultrasonic sensor. As we control the movements of the robot, the robot itself will also adapt its movements by detecting obstacles in front of it by the ultrasonic sensor.



PRESS MEET ON IEEE-NCETSTEA 2020

Dr. B.C. Roy Engineering College, Durgapur is going to organize IEEE-National Conference on Emerging Trends on Sustainable Technology and Engineering Applications (IEEE-NCETSTEA 2020) on 7th and 8th February 2020.

04thDecember, 2019 a Press Meet was organized at BCREC campus wherein all the members of important print and electronic media participated enthusiastically. Prof.(Dr.)Pijush Pal Roy informed the media that this is going to be the biggest National Conference of IEEE organized by any Engineering College around Durgapur Industrial belt. Out of 82 papers received, 54 high-standard papers submitted by scholars from India and abroadhave been selected for oral presentations. Expecting nearly 200 participants will comprise a cross section of professional engineers, corporate officials, research scholars and aspiring faculty members from every part of the country. The resolutions to be adopted in this National Conference is expected to go a long way in shaping the future advancements of technological innovation in the country said, the College Director.IEEE-NCETSTEA 2020 Conference is targeted and exposed to a highly motivated and talented audience related to technical, research, operational, and policy-making in professional and technical society/community. It will act as a platform where all the stakeholders from Industries, Research organisation, Engineering colleges, Universities, can take part and discuss various issues on emerging research areas on Engineering and Science along with their applications and to generate ideas for sustainable growth in engineering applications.

Dr. B. C. ROY ENGINEERING COLLEGE, DURGAPUR
(Approved by AICTE & Affiliated to MAKAUT, WB)

CAMPUS : JEMUA ROAD, FULJHORE, DURGAPUR-713206 (W.B.), INDIA
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BCR/Not/17/6651

Date: 29/08/2019

NOTICE

Academic journals serve as permanent and transparent forums for the presentation, scrutiny, and discussion of R&D initiatives of the college. With the above objective, the authorities of Dr. B. C. Roy Engineering College, Durgapur, are pleased to re-open the Research Journal, **The Bulletin of Engineering & Science (BES)** of the college with immediate effect.

To start working for publishing the 9th issue of the journal at the earliest, a board has been reconstituted with the members (attached herewith).

All the faculty members are requested to take great initiative to submit their research papers which is an important activity within the academic community.

All concerned are requested to extend their whole-hearted cooperation to make the effort of the R&D Cell of the college a grand success.

(T.Bhattacharya)
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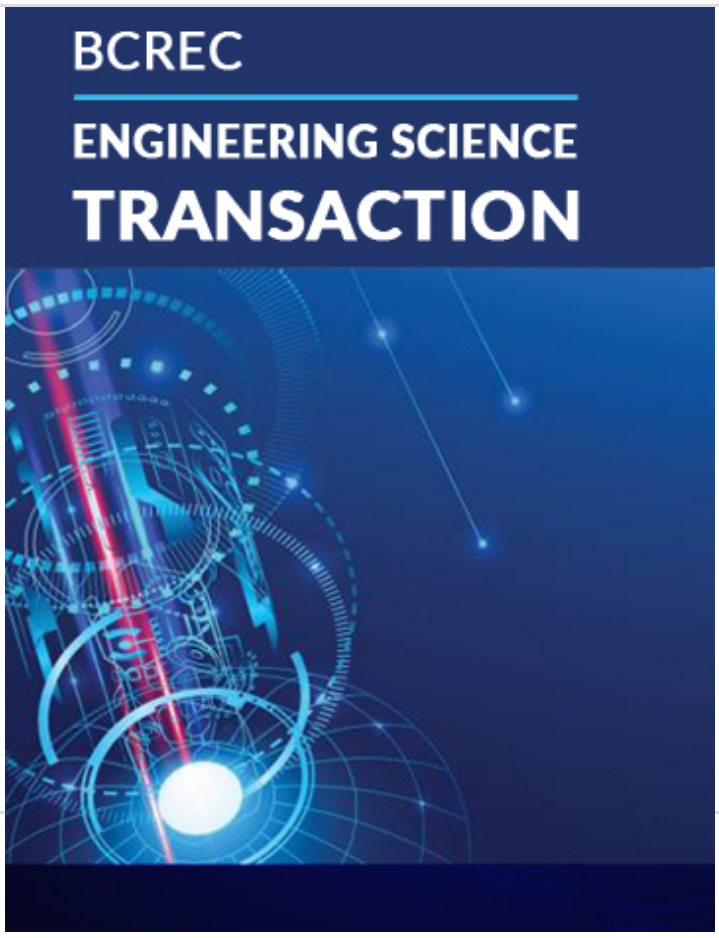

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BCREC Engineering & Science Transaction (BEST) publishes peer-reviewed original and comprehensive articles on all branches of engineering and applications. This is an open access, on-line journal (E-ISSN awaited). It is freely available to all readers via the Internet.

BEST is a non-profit initiative towards promotion of research and development by Dr. B.C. Roy Engineering College, Durgapur, West Bengal, India.

Manuscripts submitted to BEST Journal must not have been submitted simultaneously to other journals. Authors are solely responsible for the factual accuracy and originality of their articles, and all articles are understood to have received clearance(s) for publication. Authors found submitting manuscripts simultaneously to other journals will be suspended for a year from further submission. Authors found submitting plagiarized manuscripts will be banned for three years from further submission.

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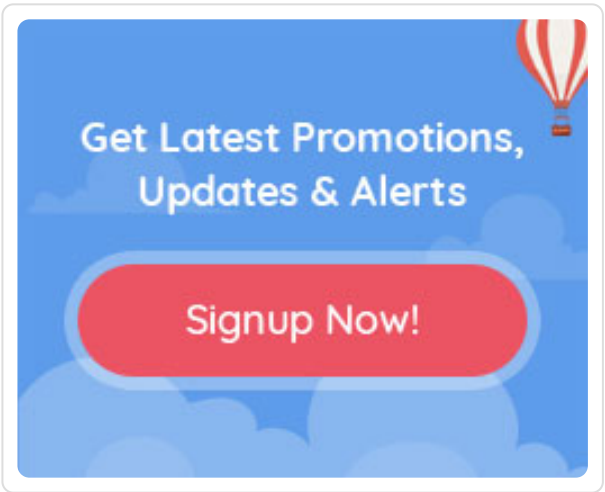

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ELECTRICAL TRANSPORT OF LI^+ ION CONDUCTING GLASSY NANOCOMPOSITES

Amartya Acharya[1 *], Sanjib Bhattacharya[2], Chandan Kumar Ghosh[3], Koyel Bhattacharya[4]

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Abstract — This review paper presents a comparative study in structural and electrical properties of some Li_2O doped glassy nanocomposites that are being studied in recent time. It gives information about the preparation process, various structural and electrical analysis processes and also discusses the outputs received. Both the chemistry and physics of the samples under study is discussed briefly. The overall motion of Li^+ ions has been inferred and so has the dimensionality.

Keywords — ***Nanocomposite, XRD, Almond-West Formalism electrical analysis, glass, glassy system, ionic conductivity***

1. INTRODUCTION

Lithium batteries are slowly becoming of vital importance in terms of tehnological advancement, especially energy storage; this is in part due to the high energy density, flexibility and longer lifespan exhibited by other comparable battery technologies [1]. Since metallic lithium combines with an anode having high negative redox potential and low equivalent weight. This anode combined with a cathode electrode material, such as a transition-metal oxide or chalcogenide capable of reversible lithium reaction and rechargeable cell can be constructed [2]. Recent literature survey [3] reveals that the traditional Li^+ ion batteries have been found to have issues relating to safety, due to organic liquid electrolytes, which are highly flammable, or polymer electrolytes, incorporated in the batteries. To avoid these issues, inorganic solid electrolytes are used as replacement, due to their higher energy density, and higher electrochemical and thermal stability [4]. The interfaces in these Nanocomposites have been found to exert a significant control over the ion transport phenomena and other physical properties of materials. All these properties, has ensured the Li^+ ion conductor to be developed in glassy forms, as new scopes are revealed in the near future [5].

The objective of this paper is to investigate electrical transport properties of new glass-ceramic lithium ion conductor, which is expected to reveal their structural information, essential for the knowledge of conduction mechanism. The results are expected to be interesting not only for technological applications but also for academic interest.

*Corresponding author: Amartya Acharya, amartyadodo123@gmail.com

2. EXPERIMENTAL

A series of glass ceramics, xLi_2O-(1-x)($0.5ZnO$ - $0.5P_2O_5$) [values of x varied from 0.1 – 0.5] were prepared using melt quenching technique utilizing highly pure (99%) precursors. These chemicals were weighed properly , mixed in alumina crucible, and then melted in high-temperature electric muffle furnace having a temperature range of 800 K - 850 K depending on the concentration of Li_2O (x). To ensure homogeneity in mixing, the melts were stirred to ensure equilibrium in mixture; immediately after they were instantly quenched at room temperature (300 K) by pouring between two aluminium plates. Consequently, glassy ceramics are formed having a thickness ~ 1mm; and then the resulting flakes are finely powdered. X-ray diffraction (XRD) patterns were recorded using a Seifert (model 3000P) X-ray diffractometer. From the XRD peaks, the presence of different glass nanocomposite, of varying size and distribution, can be confirmed. Silver paste was applied on both sides of the flakes, consequently converting them to conducting electrodes. Using a high precision programmable automatic LCR meter (HIOKI, model no. 3532-50), the values of conductance (G), capacitance (C) and dielectric loss tangent (tan δ) of all glass-ceramic samples were measured at various temperatures in the frequency range 42 Hz - 5 MHz

3. RESULTS AND DISCUSSION

A. XRD Spectra

For this discussion, we take three glassy ceramics, $0.1Li_2O$ – 0.9 ($0.5\ SeO_2$ – $0.5\ P_2O_5$), $0.1Li_2O$ – 0.9 ($0.4\ SeO_2$ – $0.1Nd_2O_3$ - $0.5\ P_2O_5$) and $0.1Li_2O$ – 0.9 ($0.4\ SeO_2$ – $0.1MoO_3$ - $0.5\ P_2O_5$), prepared by solid state reaction. These samples are labelled here as Base, Nd_2O_3 doped and MoO_3 doped samples. Second and third samples are obtained when SeO_2 contents in the Base are partially substituted by Nd_2O_3 and MoO_3 respectively. The XRD patterns of Base, Nd_2O_3 doped and MoO_3 doped samples are presented in Figure 1, which shows some sharp peaks, indicating the nature of long-range order or crystalline nature. The presence of lower angle broad diffused portions in the XRD pattern reflects the characteristics of short-range order or amorphous nature [5]. Hence it can be concluded that the present samples are of mixed phased or polycrystalline in nature. Different nanophases, dispersed in the glassy matrices have been identified from different diffraction peaks from authenticated available literature data.

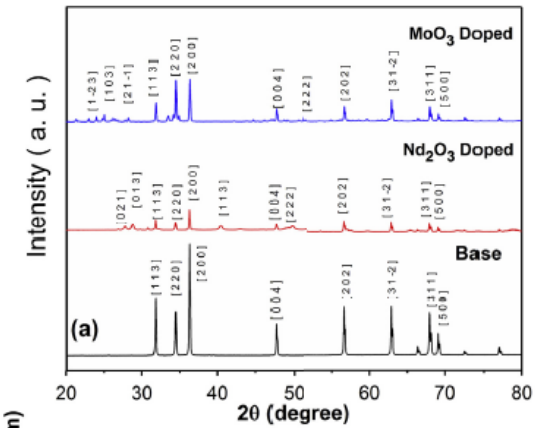

Figure 1. XRD Spectra of as-prepared samples

The peaks in Figure 1 are also suitably indexed. It is observed from Figure 1 that some nanophases like Li_2SeO_4, Li_3PO_4, LiO_2, Li_2O_2, Se_2O_5, Li_2O and SeO_3 are dispersed in all samples under investigation. The presence of many sharp peaks, signifying long-range order or crystallinity, has been disclosed from Figure 1. Thus, it can be asserted that the present glass-ceramic compositions are of mixed-phased or polycrystalline in nature. With the help of available literature data, the dispersed nanophases within the amorphous matrices have been recognized from different Bragg's angle (2θ) peaks. The sizes of nano-crystallites have been estimated using Debye-Scherer relation [6, 7]

$$d_c = (0.89\lambda)/(\beta \cos\theta) \quad (1)$$

Here, β is the full width at half maximum (FWHM), θ is the Bragg's diffraction angle and λ is the wavelength (1.54 Å) of the Cu-K_a X-ray radiation. The values of strain (ε) of each nanocrystallite have been computed using the broadening of diffraction line as defined by Williamson and Hall [5, 8], given by the relation –

$$\varepsilon = \beta/(4\tan\theta) \quad (2)$$

where, ε is the micro-strain and β is the peak breadth or FWHM due to strain, caused by the formation of nanocrystallites in the present glass matrices. The inter-planar spacing (D) between the lattice planes has been estimated using Bragg's law i.e. $2D\sin\theta = n\lambda$.

B. Study of Ionic Conductivity

The analysis of frequency dependent ionic conductivity at several temperatures of the solid electrolytes under investigation reveal some scientific factoids : ion hopping frequency, temperature dependency of conductivity, dc conductivity and also the mobile ions exhibiting a thermally activated nature [9-12].

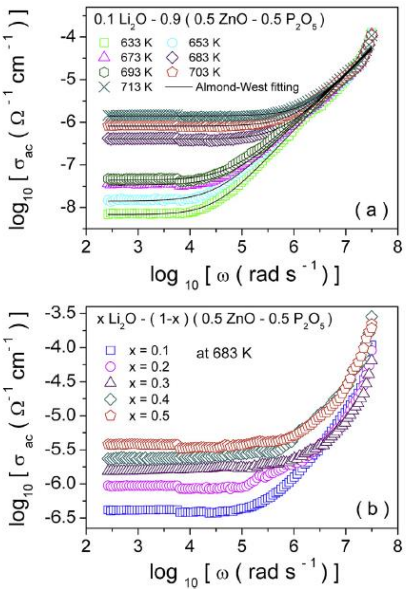

Figure 2 - (a) Temperature and frequency dependent conductivity of 0.1 Li_2O - 0.9 (0.5 ZnO - 0.5 P_2O_5) glass-ceramic, solid lines indicate best-fitted curves using Almond - West formalism, (b) the comparative study of ac conductivity at 683 K for all the glass

Figure 2 (a) exhibits frequency dependent conductivity plot for x = 0.1. Ac conductivity (σ_{ac}) spectra at a particular temperature for all the glass-ceramics are illustrated in Figure 2(b). The prime observations can be demarcated between (i) the high frequency dispersive region (ac conductivity) due to increased probability of short-range ionic motion, and (ii) the low frequency plateau region, corresponding to dc conductivity, caused as a result of diffusion of Li^+ ions [13,14] The conductivity spectra depicts the effect of non-neutral defects and enormous interrelating vacancies as too important to be ignored [14]. The characteristics of conductivity at both regions of the spectra can be analysed using Almond-West formalism relation [13, 14]

$$\sigma(\omega) = \sigma_{\delta\chi} [1+ (\omega/\omega_{\iota\mu})^{\nu}] \quad (3)$$

From the above equation, σ_{dc} is identified as the frequency independent or dc conductivity, ω_{im} is the ion migration frequency (hopping/crossover frequency), indicating the beginning of conductivity relaxation, and n is the frequency exponent, or dimensionality. It can be deduced from the above models that individual Li^+ ions move from one crystal lattice to another via diffusion along the inter-related diffusion channels available in the structural framework. The conduction of Li^+ ions [13, 15], can thus be attributed to this ionic motion. Also since the kinetic energy and vibrational frequency of Li^+ ions undergo enhancement, the conductivity spectra starts showing dispersion at the hopping frequency, noticeably shifting towards higher frequencies with temperature increase. As a result of different values of activation energy, thermally activated nature of dc conductivity and ion migration frequency is observed.

AK Jonscher has proposed the dispersive behaviour of ac conductivity (σ_{ac}) of ionic materials, which shows dependency on the angular frequency (ω) of the form [16] :

$$\sigma(\omega) = A\ \omega_{im}^{S} \quad (4)$$

where, A is the pre-factor and the s is the power-law exponent, which lies normally in the range $0 < s < 1$ The above proposed conductivity, also recognized as the "Universal Dynamic response" [16, 17], has been observed for highly disordered materials like ion conducting glasses and amorphous semiconductors. The power-law exponent (s) has been derived from the slope of the dispersive region of the ac conductivity (σ_{ac}) plot. For the present system, the values of power-law exponent exhibit values greater than 1, which can be described as a nearly constant loss (NCL) regime [18], or a super-linear power law exponent [18]. From the variation of log (A/s) with temperature plot [18], the hopping or non-hopping process of the glass ceramics is verified. Here, the value of the constant (A) can be extracted from Eq. (4) as $A = \sigma_{dc}\ X\ \omega_{im}^{-S}$. A notable observation is that the values of (log10 A)/s exists independent of temperature and composition [18]. Similar work done on Ag^+ ions [19] shows the dependency of $\log_{10}$ (A/S) on temperature and composition.

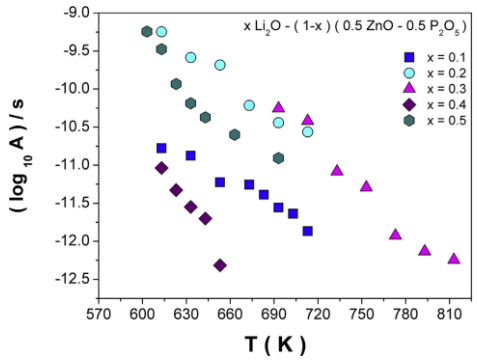

Figure 3 - Variation of $\log_{10}$ (A/S) as a function of temperature

From Figure 3, which shows the variation of $\log_{10}$ (A/s) as a function of temperature, and indicates that the ratio $\log_{10}$ (A/s) depends on temperature for all the samples, it is inferred clearly that advancement of temperature for $\log_{10}$A and for S, is not comparable. Thus from the above result, the samples are predicted to exhibit hopping conduction process [18, 19].

4. CONCLUSION

A series of doped Li_2O doped glass ceramics, which have been prepared by the conventional melt quenching technique, is made to undergo through a series of analyses. XRD structural studies revealed the presence of nano-crystallites over amorphous matrices, showing the sample to be polycrystalline in nature. The decrease of the mean crystallite size with increase in Li_2O content was also noted. Dc ionic conductivity-temperature relation showed the dependence of Arrhenius law for glass ceramics. DC conductivity spectra are fitted with the help of models like Jonscher's Power Law & Almond West Formalism. The higher concentration of Li^+ ion causes conduction channels for hopping to become wider, dc activation energy (E_{dc}) decreases while dc ionic conductivity (σ_{dc}) increase. Well- It is inferred that heterogeneous glass-ceramics facilitates the formation of low energy percolating Li^+ ions conduction pathways, consequently increasing the ac conductivity

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(IMAGE COMPRESSION A STUDY AND ANALYSIS USING DISCRETE WAVELET TRANSFORM Abstract— The quality of a compressed image is one of the essential criteria nowadays. Compression of images is a technique which is concerned with the reduction of the image redundant data, where data redundancy is one of the primary issues in digital image processing. The reduction process is removal of only redundant data so there will be improvement in the data storage capacity and the bandwidth required for data compression and reconstruction of images with insignificant loss of information.

Even though there are many compression techniques to facilitate better performance in matter of memory efficiency and image compression, wavelets are trendier and are widely used in the field of digital images. In this paper a new image compression scheme and an algorithm is proposed based on discrete wavelet transformation (DWT). The usefulness of the algorithm has been applied in excess of some real images, and the performance of the algorithm has been compared with other common compression standards. This technique is simple in implementation and utilizes less memory and time.

Also a software algorithm has been developed and executed to compress and decompress the given images using Wavelet in a MATLAB platform. This proposed technique provides adequate high compression ratios compared to other existing (DWT) based compression techniques without insignificant compromise of image quality. Index Terms— Image compression; Discrete Wavelets; multi-resolution; filter band coefficient; LDWT algorithm; Compression Ratio; PSNR; MSE.

INTRODUCTION T he functional goal of image compression is to reduce the bit rate for transmission or storage while maintaining acceptable image quality. Images and videos

are stimulated around the World by millions of users almost in a nonstop approach. An image which is still to be definite is represented as an array of numbers, integers to be more precise. The image array is usually two dimensional if it is black and white and three dimensional if it is a color image [1]. Frequently we process signals are in the time domain; with the intention to process them more simply frequency needed.

Fourier transform translate the information of signals into different representations, but as time and frequency are viewed independently so Fourier transform cannot provide information on which frequencies occur at which times in the signal By the proposal of windows in Short Term Fourier transform, different parts of a signal is viewed in time as well as frequencies [2]. Consistent with Heisenberg's Uncertainty Principle which states that 'as the resolution of the signal improves in the time domain, by zooming on different sections, the frequency resolution gets worse'.

To overcome this problem, a method of multi-resolution is needed, which allows certain portion of the signal to be determined well in time, and other parts to be determined well in frequency[3]. Naturally any images contain large amounts of information that requires much storage space, large transmission bandwidths and long transmission times. Therefore it is useful to compress the image by storing only the essential information preferred to reconstruct the original image. An image can be considered as a matrix of pixel (or intensity) values.

In order to compress the image, redundancies must be exploited, for example, areas where there is little or no change between pixel values. For that reason images having large areas of homogeneous color will have large redundancies, and conversely images that have frequent and large changes in color will be less redundant and harder to compress [4]. For efficient transmission and storage image compression is very important. Increasing demand for communication of multimedia data through the telecommunications network and accessing the multimedia data through Internet is growing explosively.

An uncompressed image file is very large and occupies plenty of memory space. For example, a gray scale image that is 512 x 512 pixels have 2,62,144 elements to store and a typical 1200 x 1600 color image have nearly twenty millions. Downloading of these files from internet can be very time overwhelming task. Image data comprise of a significant portion of the multimedia data and they occupy the foremost portion of the communication bandwidth for multimedia communication. Therefore development of efficient techniques for image compression has become quite essential [5]. A common characteristic of most images is that the neighboring pixels are highly correlated and therefore contain highly redundant information.

The fundamental objective of image compression is to get an image representation where pixels are less correlated. The two fundamental principles used in image compression are redundancy and irrelevancy. Redundancy removes redundancy from the signal source and irrelevancy omits pixel values which are not visible by human eye. Compression technique is classified in the field of image compression by two ways, lossless compression & lossy compression [6]. Lossless data compression is a class of data compression algorithms that allows the original data to be perfectly reconstructed from the compressed data. This type of compression is also known as entropy coding.

Lossless compression is used generally for discrete data and particularly useful for medical and security images application. Lossless compression can achieve only a modest amount of compression of data so it is not useful for sufficiently high compression ratios. Some image file formats, like PNG or GIF, use only lossless compression. Lossless data compression algorithms cannot guarantee compression for all input data sets. There are various methods in lossless compression, they are Entropy coding, Huffman coding, Bit-plane coding, Run-length coding and LZW (Lempel-Ziv-Welch) coding.

Lossy compression is a data encoding scheme that compresses data by loosening some of it [7]. The procedure minimizes the amount of data that needs to be considered, handled, or transmitted by a computer. The compression ratio of lossy techniques is greater than lossless method. Due to the high compression ratios the decompressed image is not exactly identical to the original image sample as a large amount of the detail is redundant without greatly changing the manifestation of the sampled image.

Characterized by the quality of the reconstructed images and its adequacy of application different types of lossy compressions methods are used. The quantization processes result in loss of information in the field of lossy compression technique. The methods that fall under lossy compression include, Vector quantization, Fractal coding, Block truncation coding, Sub band coding, Transformation Coding, DCT transform, Fourier related transform, Wavelet transform. Television broadcasting, videoconferencing, facsimile communication, where a certain amount of error is acceptable, there lossy compression is widely used for its dramatically improved compression ratios.

The main objective of this paper is to propose a new and extremely proficient & simple image compression scheme and an Algorithm based on discrete wavelet transform with less computational complexity & less renounce in image quality. Also the proposed algorithm has been applied in excess of some real images, and the performance of the

algorithm has been compared with other common compression methods. The new technique is simple in implementation and utilizes less memory and time. Several major quality measurement variables like peak signal to noise ratio (PSNR), mean square error (MSE), compression ratio (CR), threshold values, have been projected to determine how well an image is reproduced with respect to the reference image.

The whole paper is organized in the following progression. In section-(II) need for the compression is stated, section-(III) various types of data redundancies are explained, section-(IV) describes basic data compression technique, section-(V) illustrates the wavelet analysis, section-(VI) describes the concept of multi-resolution in DWT, section-(VII) describes flow chart and the proposed algorithm using discrete wavelet transform and in section-(VIII) the results were presented with explanation. Lastly the paper concludes with references.

necessitate FOR COMPRESSION The speedy development of today's digital imaging applications, including desktop publishing, multimedia, teleconferencing, and high-definition television (HDTV) has blown up the need for effective and consistent image compression techniques. An enormous amount of data is formed when 2-dimensional light intensity function is sampled and quantized to form a digital image. In fact the sum of storage is so vast that it creates problem in convenient storage, processing and communication requirement. Uncompressed multimedia (graphics, audio and video) data requires extensive storage competency and transmission bandwidth.

The subsequent example illustrates the need for Compression of digital images [8]. I) to store a color image of a moderate size, e.g. 1024×1024 pixels; one needs 1.5 MB of disk space. II) A 35mm digital slide with a resolution of 12μm requires 18 MB. III) One minutes uncompressed digital 720p HD video requires 270 MB disc space. To store these images & videos and make them available over internet, compression techniques are needed. Image compression addresses the problem of reducing the amount of data required to represent a digital image. The fundamental basis of the reduction process is the taking away of redundant data. The example below clearly shows the importance of compression.

An image, 1600 pixel × 2500pixel ×24bit, without compression, would require 4 MB of storage and 1.4 minutes for transmission, utilizing a high speed, 64 Kbits/s, ISDN line. If the image is compressed at a 20:1 compression ratio, the storage requirement is reduced to 800 KB and the transmission time drop to less than 15 seconds. VARIOUS TYPES OF REDUNDANCIES Data redundancy is the fundamental essence in digital image processing [9]. It's not only a theoretical perception but a mathematically quantifiable

entity.

If n1 and n2 represent the number of information carrying units in two data sets that stand for the same information, the virtual data redundancy Rd of the first data set can be define like _(1), where Cr usually called the compression ratio is Cr and _ . For the case n2=n1, Cr=1 and Rd=0 indicating that the first representation contains no redundant data. When n2>n1, Cr?0 and Rd?8, indicating that the second data set contains much more data than the original representation. PRINICIPAL OF COMPRESSION Compressing an image is significantly different than compressing raw binary data. Of course, general purpose compression programs can be used to compress images, but the result is less than optimal.

This is because images have certain statistical properties which can be exploited by encoders specifically designed for them. Also, some of the finer details in the image can be sacrificed for the sake of saving a little more bandwidth or storage space. This also means that lossy compression techniques can be used in this area. Lossless compression engages with compressing data which, when decompressed, will be an exact imitation of the original data. This is the case when binary data such as executable, documents etc. are compressed. They need to be exactly reproduced when decompressed. On the other hand, images need not be reproduced 'exactly'.

An approximation of the original image is enough for most uses, as long as the error between the original and the compressed image is acceptable. Neighboring pixels of maximum images are correlated and therefore contain redundant information. Our aim is to find less correlated representation of the image. Two fundamental components of compression are seen, and they are redundancy and irrelevancy reduction [10]. In an image, which consists of a matrix of data, there are three types of redundancies in order to compress file size. They are: a. Coding redundancy: Fewer bits to represent frequently occurring symbols. b.

Inter pixel redundancy: Neighboring pixels have almost same value. c. Psycho visual redundancy: Human visual system cannot simultaneously distinguish all colors. A typical image compression decompression system using wavelet transform is shown in below Fig.1. Fig. 1. Schematic block diagram of Image Compression system. Two of the error metrics used to compare the various image compression techniques are the Mean Square Error (MSE) and the Peak Signal to Noise Ratio (PSNR).

The MSE is the cumulative squared error between the compressed and the original image, whereas PSNR is a measure of the peak error. The mathematical formulae for the two are _ (2) _ (3) Where [I(x, y)] is the original image, [I'(x, y)] is decompressed image

and M, N are the dimensions of the images. A lower value for MSE means lesser error, and as seen from the inverse relation between the MSE and PSNR, this translates to a high value of PSNR. Logically, a higher value of PSNR is good because it means that the ratio of Signal to Noise is higher.

Here, the 'signal' is the original image, and the 'noise' is the error in reconstruction. So, the compression scheme which has a lower MSE and a high PSNR value be able to recognize that it is the better one. Fig. 2. Schematic block diagram of image decompression system. WAVELET ANALYSIS Wavelet transform has greatly impacted the field of signal analysis especially image analysis and compression. The fundamental idea behind wavelets is to analyze according to scale [11-13, 15]. Wavelets are functions which allow data analysis of signals or images, according to scales or resolutions. Indeed.

The processing of signals by wavelet algorithms in fact works much the same way the human eye does, or the way a digital camera processes visual scales of resolutions, and intermediate details. Wavelet Image Processing enables computers to store an image in many scales of resolutions, thus decomposing an image into various levels and types of details and approximation with different-valued resolutions , it also allow to compress the image using less storage space with more details of the image. Our interest in the study of wavelet transforms centers on its exploitation in image compression.

The amount of compression that can be achieved depends on the energy compaction property of the transform being used. The wavelet transform also has a high-energy compaction property that makes it very suitable for image compression. In addition, it has other interesting properties such as 'progressive reconstruction' that makes wavelet transforms a powerful tool for image and video compression [14]. When compressing an image, if we can distinguish areas of intense activity from flat regions, we may be able to allocate different number of bits of quantization to these different regions, thereby achieving a high compression without sacrificing visual quality. Even though this is possible with transforms based on sinusoids, wavelets are more efficient because of their inherent property of capturing transients.

Wavelet transform comes in two aromas: continuous wavelet transforms (CWT) and discrete wavelet transforms (DWT). From a computational point of view, the discrete version of the wavelet transform is very useful and meaningful. Therefore, we will concentrate on the DWT [15]. The DWT represents an image as a sum of wavelets with different location and scale. The DWT is computed by successive low pass and high pass filtering of the discrete time-domain signal. It is easy to implement and reduces the computation time and resources required. In the given figure.2 'X (m, n)' is represented

as an input image. This input image is compressed using DWT technique.

The block diagram of image compression using DWT technique is shown as in Fig.2. An image is a 2-dimensional signal. So, it is compressed from row-wise as well as column-wise separately. Therefore, the input image 'X (m, n)' is passed to the filter bands which get decomposed into an approximation and the detail coefficients [16]. The basic idea of the wavelet transform is to represent any arbitrary function f(X) as a superposition of a set of such wavelets or basis functions.

These basis functions are obtained from a single prototype wavelet called the mother wavelet_by dilations or scaling and translations. Wavelet bases are very good at efficiently representing functions that are smooth except for a small set of discontinuities. For each n, k ? Z, define, _ by _ _ (4) Constructing the function_, _ on R, such that _is an Ortho-normal basis on R. This framework for constructing wavelets involves the concept of a multi-resolution analysis. CONCEPT OF MULTIRESOLUTION In any DWT, there are only a finite number of wavelet coefficients for each bounded rectangular area in the upper half plane. At rest, each coefficient requires the evaluation of an integral.

A multi-resolution analysis which was formed from the scaled and shifted wavelets can avoid numerical complexity. This means that there has to exist an auxiliary function, the father wavelet f in L2(R), and that is an integer. The most well-known pair of father and mother wavelets is the Daubechies wavelet (db1). Not every Ortho-normal discrete wavelet basis can be associated to a multi-resolution analysis. avoid numerical complexity. This means that there has to exist an auxiliary function, the father wavelet f in L2(R), and that is an integer. The most well-known pair of father and mother wavelets is the Daubechies wavelet.

Not every Ortho-normal discrete wavelet basis can be associated to a multi-resolution analysis. Multi-resolution analysis is a device for computation of basis coefficients in, _ (5) It is defined as follows [16], _ (6) Where, _ (7) Then a multi-resolution analysis on R is a sequence of subspaces _of functions_on R, satisfying the following properties: (a) For all_. (b) If f(x) is _on R, then f(x_. That is, given_>0, there is an n ? Z and a function _ such that_. (c)_. (8) (d) A function f(x) ? V0 if and only if _.

(e) There exists a function f(x),_ on R, called the scaling function such that the collection f(x - n) is an ortho-normal system of translates and_. (9) PROPOSED ALGORITHM AND FLOWCHART Fig. 3. Schematic block diagram of Image Compression system. Appendix Appendixes, if needed, appear before the acknowledgment. Acknowledgment The preferred spelling of the word "acknowledgment" in THE RESULTS & EXPLANATION In

this research, an efficient compression technique based on discrete wavelet transform (DWT) is proposed and developed.

The algorithm has been implemented using daubechies wavelet [16] in MATLAB platform. A set of test images (jpg format) are taken to justify the effectiveness of the algorithm. Resolution (1600x1200)Compression by LDWT b) Resolution (1600x1200) Compression by LDWT c) Resolution (1600x1200) Compression by LDWT d) Resolution (1600x1200) Compression by LDWT Fig.4 Original & Experimental Compressed Images by proposed Lossy Discrete Wavelet Transform. Above figures shows a test image and the resulting compressed images using the proposed DWT compression methods in MATLAB.

The computational complexity of the proposed scheme is competitive with the existing schemes and experimental results with the proposed compression method have been arranged in the Table.1 Computational complexity for different kind of images. From this Table.2, we find that a threshold value of d = 3 is a good choice on the basis of trade-off for different compression ratios also from this table we can see the before and after compression size of the images. Table 3, shows the basic image compression parameters like PSNR, MSE, PERF, PERFL etc of the images after by the proposed DWT method. Table.4

represents the gained compression ratio with maximum percentage of image energy preserved and negligible loss of image quality, compared to the existing DWT method. Experimental results demonstrate that the proposed compression technique gives better performance compared to other compression techniques. METHODS _RUNTIME _ _DWT _0.15sec _ _LDWT _0.14sec _ _ TABLE1: COMPUTATIONAL COMPLEXITY OF ALGORITHM SAMPLE IMAGES _THRESHOLD VALUES _SIZE OF ORIGINAL IMAGES _SIZE OF IMAGES AFTER LDWT _ _alovera _3.00 _446KB _10.4KB _ _flower _4.50 _458KB _10.7KB _ _lena _0.50 _441KB _9.14KB _ _girgiti _1.00 _443KB _9.40KB _ _TABLE 2: IMAGE PARAMETERS AFTER COMPRESSION WITH PROPOSED LDWT METHOD. SAMPLE IMAGES _*PERF0 _**PERFL2 _***MSE(DB) _****PSNR (DB) _ _alovera _42.2167 _99.9966 % _9.8655 _38.1896 _ _flower _42.8673 _99.9817 % _22.0920 _34.6884 _ _lena _40.2843 _99.9997 % _0.6753 _49.8361 _ _girgiti _42.0817 _99.9989 % _2.3351 _44.4478 _ _TABLE 3:COMPRESSION RESULTS BY PROPOSED LDWT. *PERFO:Percentage of wavelet coefficient set zero. **PERFL2: Percentage of image energy preserved. ***MSE: Mean Squared Error.

****PSNR: Peak Signal to Noise Ratio. *CR: Compression Ratio SAMPLE IMAGES _COMPRES-SION METHOD _FILE SIZES _*CR _TIME TAKEN(S) _ _alovera _LDWT _446KB _42.884:1 _2.533 _ _flower _LDWT _458KB _42.803:1 _2.530 _ _lena _LDWT _441KB _48.249:1 _1.985 _ _girgiti _LDWT _443KB _47.127:1 _2.544 _ _ TABLE 4: IMAGE

PARAMETERS AFTER COMPRESSION WITH PROPOSED LDWT METHOD DWT(existing) [16] _ _SAMPLE IMAGE _ORIGINAL IMAGE SIZE _COMPRESSED IMAGE SIZE _*CR _PSNR _ _Image(BMP) _470KB _10.94KB _24.22:1 _19.86 _ _LDWT(proposed) _ _flower (jpg) _458KB _10.7KB _42.80:1 _34.68 _ _ TABLE.5: COMPARISON BETWEEN EXISTING DWT [16] AND THE PROPOSED LDWT METHOD CONCLUSION The experiment shows that the higher data redundancy helps to achieve more compression.

The above presented a new compression and decompression technique based on DWT. Experimental results show that up to 42.80:1 compression ratio for the above image is obtained, hence we conclude that the new image compression scheme, based on discrete wavelet transform proposed which provides sufficient compression ratios with no appreciable degradation of image quality as percentage of image energy preserved up to 99.9997. DWT is an image compression technique uses multi-resolution analysis through which we get compression at higher levels without any false contouring and blocking artifacts.

An image having larger dimension can be easily compressed with DWT Algorithm .But as the image compresses at higher levels, it is not easy to obtain the high quality of the reconstructed image. Wavelet compression did show remarkable performance especially with smaller threshold value; it was not differentiable in between the original image and the compressed image for some cases.. The effectiveness and robustness of this approach has been justified using a set of real images. From the experimental result it is evident that, the proposed technique gives better performance compared to the other traditional techniques.

As the future work on compression of images for storing and transmitting images can be done by other lossy methods of image compression. However, more improvements can still be made. As there is more room for improvement by adding more stages to the compression such as quantization, entropy encoding, etc. Also, we have not covered all the wavelets that is out there, that it cannot be decided as to which one performs the best image compression.

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