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2022 11th IEEE International Conference on Communication Systems and Network Technologies

CSNT 2022

Table of Contents

Welcome from IEEE CSNT 2021 General Chairs.....	<i>i</i>
Welcome from IEEE CSNT 2021 Program Chairs.....	<i>ii</i>
Conference Committees.....	<i>iii</i>

Track-A: Microwave Components and Wave Propagation

<i>A Compact MIMO Antenna with High Isolation and Gain-Bandwidth Product for Wireless Personal Communication</i>	01
Anita Rani; Bhawna Sharma; Nitin Saluja; Geetanjali Singla; Thennarasan Sabapathy	
<i>Genetic Algorithm Optimized Gain Augumented Dual Band Printed Antenna for Cognitive eHealth Care (IoMT) Applications</i>	06
Ankush Kapoor; Ranjan Mishra	
<i>Enhancement in the Network Capacity using MIMO and Antenna array in 5G Technology.....</i>	12
Deepak Upadhyay; Pallavi Tiwari; Noor Mohd; Bhaskar Pant	
<i>A Broadband U-Slotted 2x2 Array Antenna for Millimeter-Wave Energy Harvesting</i>	18
Rajesh Das; Taimoor Khan; Gaurav Singh Baghel	
<i>A Compact, Two-Port MIMO Antenna for mm-wave 5G Application</i>	22
Manirathnam C.; Sourav Ghosh; Swati M V	
<i>Ultra wideband MIMO antenna design with high isolation for THz application</i>	26
Rohit Yadav; Ajay Parmar; Leeladhar Malviya; Dhiraj Nitnaware	
<i>High Gain (1x4) Compact Arrow Shaped Patch Antenna Array using Quarter Wave Transformer for 5G mm Wave Applications</i>	31
Harshit Bhatnagar, Shilpee Patil, Akshay Kumar, Abhay Sharma, Aditya Kumar Gupta	
<i>Fifth Generation MIMO Antenna Array with Diversity and Mutual Coupling Reduction Technique</i>	36
Mohit Pant; Leeladhar Malviya	
<i>Dumb-bell shaped Defected Ground Structures Circularly Polarized MIMO Antenna for UWB Applications</i>	42
Harshprabha Paliwal, Navneet Agrawal	
<i>Sub-Terahertz MIMO array antenna for future wireless applications</i>	49
Sneha Moghe; Rohit Yadav; Leeladhar Malviya	
<i>Design of Bandstop Filter using Double Dumbbell Shaped CSRR in Ground</i>	54
Shubham Mohker, Amit Naik, Ajay Parmar, Leeladhar Malviya	

Design of dual-band MIMO antenna with inverted L-shaped arms for 5G applications	60
<i>Mantar Singh Mandloi, Ajay Parmar, Priyanshi Malviya, Leeladhar Malviya</i>	
Sub-THz high efficiency MIMO antenna for short range wireless communication	66
<i>Sneha Moghe; Leeladhar Malviya</i>	
Stepped patch antenna for GSM applications	72
<i>Sanjay Chouhan; Leeladhar Malviya</i>	

Track-B: Power Systems, Energy and Control System

Evaluation of Energy Losses and Costs Based on the Location of PCC in Smart Grids	76
<i>Aloycius S Hauwanga, K.S. Sastry Musti</i>	
Estimation of Inductance and Capacitance Parameters of Single Phase Dual Winding Converter Transformer with FEM	83
<i>Shrikant Shantaram Mopari; Dagadu More; Pannala Krishna Murthy; Manendra Pal Singh Chawla</i>	
Improvement in Voltage Profile of Synchronous Generator Using PID Controller and Artificial Neural Network in Automatic Voltage Regulator	89
<i>Gitanjali Chadar, Sudeep k Mohaney, Pradeepti Lakra</i>	
A Combined Voltage and Frequency Stability Enhancement using Artificial Neural Network and Fast Voltage Stability Index Based Load Shedding	95
<i>Pradeepti Lakra; Anubha Gupta</i>	
Buck and Boost DC-DC Converters for industrial application with different load	102
<i>Arpit Nema, Siddrath Shukla</i>	
Metaphor-less RAO-1 Optimization Based Algorithm To Determine Shunt Capacitor Capacity in Distribution System	107
<i>Shrunkhala Shyamkant Halve; Rajesh Arya; Atul Koshti</i>	
Design and Implementation of a Desk lamp based on Intelligence and Health	113
<i>Haige Lin; Fu Yu; Xinxin Zhou</i>	
Protection Scheme for Utility Network with Wind Power Generation	119
<i>Abhishek Gupta; Om Prakash Mahela; Ramesh Kumar Pachar</i>	
Modeling and Simulation of Solar District Heating Systems.....	125
<i>Vera Njong; KS Sastry Musti; Johannes van der Walt</i>	

Track C: Digital Implementation and Application

An Architecture for Efficient encoding of Quasi cyclic LDPC codes and its implementation in FPGA	136
<i>Sowmya Gudipati; Keerthi K; Lalitkrushna J Thakar; Srividhya S; Jothy Soman; Vanitha M</i>	
Analysis of power in SRAM cell with various pull up, pull down and pass gate transistors	141
<i>Chintaluri Arun Teja; Radha Subramanyam; Victor du John H; Nagabushanam Perattur</i>	
Implementation of FIR Adaptive Filter with FPGA.....	146
<i>Shital Ganorkar; Shekhar Sharma; Anjana Jain</i>	
An Invesstigation & Analysis of Interference in Multicore Environment	154
<i>Surendra Kumar Shukla, Upendra Dwivedi, Mukul Shukla, Bhaskar Pant</i>	
Random pattern generation and redundancy analysis in memories.....	341
<i>Kanipogu Balu Anudeep; Radha Subramanyam; J Jagannath D; Nagabushanam Perattur</i>	

Track D: Machine Learning, Deep Learning and Optimisation techniques

Principal Component Analysis of VHO parameters	160
<i>Siddharth Goutam; Srija Unnikrishnan; Archana Karandikar; Aradhana Goutam</i>	
Segmentation of Rice Seedling using Deep Learning Algorithm	164
<i>Avinash Kumar, Ashish Rajanand, Anurag Deep Kujur, Yogesh Rathore, Rekh Ram Janghel</i>	
Comparative Analysis of Machine Learning models For Early Detection of Fetal Disease using Feature Extraction.....	169
<i>Vinayak Singh, Rakshit Agrawal, Mahendra Kumar Gourisaria, Pradeep Kumar Singh, Himansu Das</i>	
Design and Development of Machine Learning Techniques for Disease Prediction.....	176
<i>Siddharth Swami; Hiten Kanwar; Anirudh Gambhir; Kaushal Kishor; Prabhishesh Singh; Manoj Diwakar</i>	
Securing 5G Networks through Machine Learning - A Comparative Analysis	183
<i>Piyush Kulshreshtha, Amit Kumar Garg</i>	
Comparative Analysis of Machine Learning Techniques for Disease Prediction in Crops.....	190
<i>Vijay Choudhary; Archana Thakur</i>	
Application of Machine Learning for Sentiment Analysis of Movies Using IMDB Rating	196
<i>Sandeep Rathor; Yuvraj Prakash</i>	
Air Quality and Smog Detection in Smart Cities for safer transport using Machine Learning (ML) Regression Models	200
<i>Ayushi Mishra, Zuber Mohammed Jalaluddin, Chaitanya V. Mahamuni</i>	
Traffic Signs Recognition and Detection using Deep Convolution Neural Networks for Autonomous driving	207
<i>Abha M Bodas; Khushi Desarda; Prem Jadhav; Saylee Gulve; Roshani Raut</i>	
The Adoption of IoMT in Disease Prediction using Machine Learning: A benefit to Healthcare system.....	215
<i>Md Ramish, Ankit Pankaj, Ankit Lakra</i>	
Liver Disease Prediction using Machine learning Classification Techniques.....	221
<i>Ketan Gupta; Nasmin Kiwani; Neda Afreen, Divyarani D</i>	
Cancer Prediction Using Random Forest and Deep Learning Techniques	227
<i>Muskan Ranjan, Akanksha Shukla, Kartik Soni, Sunita Varma, Megha Kuliha, Upendra Singh</i>	
Detection of COVID-19 and Prediction of Pneumonia from Chest X-Ray Images using Deep Learning	232
<i>Gouri S Deo; Jyoti Totlani; Chaitanya Mahamuni</i>	
Age Prediction Model using Convolutional Neural Network.....	239
<i>Sandeep Rathor; Danish Ali; Shraddha Gupta; Ritika Singh; Harshita Jaiswal</i>	
Face mask Detection Analysis for Coid 19 using CNN and Deep Learning.....	244
<i>Dinesh Sharma, Geetam Singh Tomar</i>	
Q-Learning based Intelligent and Interactive Healthcare System.....	253
<i>Rashika Raina; Rakesh Kumar Jha; Ashish Suri</i>	
Prediction of OPTIMIZED Stock Market Trends using Hybrid Approach Based on KNN and Bagging Classifier (KNNB)	257
<i>T. Manimegalai, J Manju, M. Maria Rubiston, B Vidhyashree, R. Thandaiah Prabu</i>	
Implementing a Robust IoT Solution to Monitor Prone Position using Machine Learning Techniques	263

Semagn Shifere Belay, T. Prince, Tizazu Bayih Beyene, Walelegne Yirdew Marew, Andebet Dessiewu Kebede

Enumerable learning based machine learning techniques for sentiment analysis 270
Deepti singh, Himanshu Yadav, Chetan Agrawal

classification of thinprep images of cervical precancerous cells based on deep learning models of alexNet and inceptionV3 276
Wikan Tyassari; Yessi Jusman; Slamet Riyadi; Siti Noraini Sulaiman

Track E: Data Analytics, Social Networking, Neural Networks and Automation

Rice Leaf Disease Detection Using Mobile Net & InceptionV3.....	282
<i>Uday Pratap Singh; Prithvi Raj Kumar; Raj Kiran; Yogesh Rathore; Rekh Ram Janghel</i>	
Galaxy Shape Categorization Using Convolutional Neural Network Approach.....	287
<i>Amritesh Nandan, Vikas Tripathi</i>	
Efficient Approaches to Predict Neurological Disorder using Social Networking Sites	294
<i>Tejaswita Garg, Sanjay Kumar Gupta</i>	
A Hybrid Convolutional Recurrent (CNN-GRU) Model for Stock Price Prediction	299
<i>Rashi Jaiswal; Brijendra Singh</i>	
A Study on Classifiers for Temporal Data	305
<i>Rashi Jaiswal; Brijendra Singh</i>	
DsetGenS: An Automated Technique for Building Dataset from Speech with respect to Gujarati-English	314
<i>Margi Patel; Brijendra Kumar Joshi</i>	
Offline Handwritten Text Recognition Using Hybrid CNN-BLSTM Network	318
<i>Rahul Kumar Namdeo; Chetan Gupta; Ritu Shrivastava</i>	
Development of a Hybrid Model using Deep Neural Network and XGBOOST for Mortality Prediction of ICU Patient's	324
<i>Babita Majhi; Aarti Kashyap</i>	
Analysis of Eucalyptus Regnans Form Characteristics	329
<i>Pavan Mohan Neelamraju; Sunil Kumar Segu; Anirban Ghosh</i>	
An Integrated Methodology of Ranking Based on PROMETHEE-CRITIC and TOPSIS-CRITIC In Web Service Domain	335
<i>Shadab Khan; Lalit Purohit</i>	
CNN architecture for lung cancer detection	346
<i>Chintakayala Tejaswini; Priyadarshini Rajasegaran, P Nagabushanam, Palyam Rohith Johnson</i>	
Optimized Web Searching Using Inverted Indexing Technique	351
<i>Dilip Kumar Jang Bahadur Saini; Pratap Patil; Vinay Yadav; Sarvesh Kumar; Prabhisek Singh; Manoj Diwakar</i>	
A Convolutional Neural Network Approach for Diabetic Retinopathy Classification	357
<i>Nasmin Jiwani; Ketan Gupta; Neda Afreen</i>	
Blood Pressure Detection Using CNN-LSTM Model	362
<i>Ketan Gupta; Nasmin Jiwani; Neda Afreen</i>	
Heterogeneous Software Defect Prediction using Generative Models	367
<i>Sanjay Patidar; Bhavye Jain; Divya Sudershan</i>	
Study of Spiking Neural Network Architecture for Neuromorphic Computing	373

Rahul Das; Chiranjit Biswas; Swanirbhar Majumder

Convolutional Neural Network System for Discriminate Drug Target Interactions with over Sampling Technique SMOTE 380

Hanumantu Joga Rao; Balajee Maram; T Daniya

Predicting Melancholy risk among IT professionals using Modified Deep Learning Neural Network (MDLNN) 385

S. Rosaline, M. Ayeesha Nasreen, P. Suganthi, T. Manimegalai, G. Ramkumar

Fall Accident Detection System for Bicycle Riders using Support Vector Machines N/A
Saurav Gupta; Ramanathan V; Sasithradevi Anbalagan

A Toxic Content Detection Technique in Sentimental Analysis with Convolution Neural Networks 398
Varun Mishra, Monika Tripathi

Track F: Network Protocols, Design, Algorithm and IOT Applications

Reactive particle swarm optimization based global energy balance protocol 403
Avtar Singh; Supreet Kaur

Modeling burst errors in a fading channel 409
Kundan Kandhway

Location based routing in multi-hop clustering based network structure of VANET 415
Abhay Katiyar; Nikeet Kumar Keshari; Dinesh Singh; Rama Shankar Yadav

Capacity Enhancement for Cellular System using 5G Technology, mm Wave and Higher order Sectorization 422
Deepak Upadhyay; Pallavi Tiwari; Noor Mohd; Bhaskar Pant

Impact of Network Heterogeneity on Epidemic Mitigation Strategies 428
Jagtap Kalyani Devendra; Kundan Kandhway

BER Performance using BPSK modulation over Rayleigh and Rician Fading Channel 434
Pushpalatha, Prathyusha, Sindhu, Mohd Javed Khan, Indrasen Singh, and Shubham Tayal

Analyzing the best location for the central node placement for energy efficient and reliable WBAN 438
Neha Arora; Sindhu Hak Gupta; Basant Kumar

A review of HEMT for low noise and high frequency applications Current status and Technology Comparison 445
Swati Dhondiram Jadhav; Aboo Bakar Khan

Resource Aware Energy Efficiency Optimization by Using 6G Technology Based Advanced Virtual Multi-Purpose Embedding Algorithm 453
Ganti Sai Divya, Varadala Sridhar, K.V.Ranga Rao, Ch. Ashwini

Spectral Efficiency Evaluation of Network Coded Cognitive Radio Networks 459
Anjali Gupta; Brijendra Kumar Joshi

Application of DRL in Transformer Network for Traffic Signal Management using Fog Computing in ITS 464
Ananya Paul; Sulata Mitra

The effect of frequency slot demand in elastic optical network 470
Gulafsha Baig; Anjulata Yadav; Dharmendra Singh Yadav

Performance Analysis of SWIPT Enabled Decode-and-Forward based Cooperative Network 476
Deepak Kumar; Praveen Kumar Singya; Vimal Bhatia

Performance Evaluation of Energy Harvesting aided NOMA-HCN in IoT	482
<i>Abhinav Singh Parihar; Pragya Swami; Vimal Bhatia</i>	
An Improved Intrusion Detection System using BoT-IoT Dataset	488
<i>Babita Majhi, Prastavana</i>	
Evaluation of Hard Fusion Sensing Techniques under AWGN and Rayleigh Flat-fading Channel for Cognitive Radio Network	493
<i>Aparna Kushwah; Vineeta Saxena Nigam</i>	
Resource Optimization using Improved Genetic Algorithm for Device-to-Device Communication Under Cellular Network.....	499
<i>Munna Jatav; Ashutosh Datar, Leeladhar Malviya</i>	
Prediction and Prevention of Water Pollution by Industries using IoT based Monitoring System	504
<i>Abha Porwal; Sambit Kumar Mishra; Arya Kela; Gargi Singh; Manish Panchal; Anjana Jain</i>	
Zonal Irregularity Drift Characteristics of Ionospheric Scintillations from two closely-spaced Global Navigation Satellite System receivers at an Indian Low Latitude location	510
<i>Ram Kumar Vankadara; Venkata Ratnam Devanaboyina; Sampad Kumar Panda</i>	
Prioritization for time slot allocation and message transmission in TDMA MAC for VANETs	515
<i>Suchi Johari; M. Bala Krishna</i>	
A Query driven Backbone based Routing for Mobile Sink based Wireless Sensor Networks	521
<i>Shushant Kumar Jain; M Venkatadri; Neeraj Shrivastava</i>	
Cross-Layer based Energy Efficient Reliable Data Transmission System for IoT Networks	527
<i>Manish Panchal; Raksha Upadhyay; Prakash Vyawahare</i>	
Medical Data Retrieval By Named Data Networking Of Things Architecture In Contiki NG OS....	533
<i>Alper K. Demir; Gökçe Manap</i>	
A productive Feature Selection Criterion for Bot-IoT Recognition based on Random Forest Algorithm.....	539
<i>R. Pavaiyarkarasi, T. Manimegalai, S Satheeshkumar, K. Dhivya, G. Ramkumar</i>	
Implementing a Robust IoT Solution to Monitor Prone Position using Machine Learning Techniques	N/A
<i>Semagn Shifere Belay, T. Prince, Tizazu Bayih Beyene, Walelegne Yirdew Marew, Andebet Dessiewu Kebede</i>	

Track -G: Network Security and Cryptography

Blockchain Based Spectrum Sensing for Secured Cognitive Radio wireless networks.....	553
<i>Vuppupa Roopa, Himansu Shekhar Pradhan</i>	
Enhancing the Performance of Hash Function Using Autonomous Initial Value Proposed Secure Hash Algorithm 256	560
<i>Bhagvant Ram Ambedkar; Pawan Kumar Bharti; Akhtar Husain</i>	
Optimized Dual-mode Security Encryption Chip Design Based on Hash Algorithm.....	566
<i>Weihan Xu; Yongkang Xu; Guanting Huo; Yang Yang; Yufeng Jin</i>	
Proposal on NFT minter for blockchain-based art- work trading system	N/A
<i>Rupali Sachin Vairagade; Leela Bitla; Harshpal H. Judge; Shubham Dharpude; Sarthak Kekatpure</i>	
IT Attack Detection and Classification using Users Event Log Feature and Behavior Analytics through Fourier EEG Signal	577
<i>Anurag Sinha, Md Ramish, Jay Desai, Aditya Raj, Yuvraj Rajawat, Piyush Punia</i>	

Image forgery localization using image patches and deep learning.....	583
<i>Syed Sadaf Ali; Iyyakutti Iyappan Ganapathi; Ngoc-Son Vu; Naoufel Werghi</i>	
A Hybrid (Po-Thk) Method For Ids And Privacy-Preserving In Distributed Data Environment Using Metaheuristic Techniques	589
<i>D.Priyadarshini, Ajay Bale</i>	
A Key Escrow Free Anonymous Identity Based Encryption scheme using Ring Signatures.....	596
<i>Khaleda Afroaz; Subba Rao; Rukma Rekha N.</i>	
A Novel approach for Data mining Classification using J48DT Classifier for Intrusion Detection System.....	601
<i>T. Manimegalai, T. Nadana Ravishankar, L. Kannagi, K. Kannan , G Anitha</i>	
Secure and Traceable QR Code Using Blockchain enabled Certificates	608
<i>Robin Singh Bhadaria, Akshat goyal, Arka Prabha Das, Abul Bashar, Mohammed Aikria</i>	

Track -H: Signal and Image Processing

Iterative Hard Thresholding Using Least Squares Initialization	612
<i>Bamrung Tausiesakul</i>	
Unscented Kalman Filter-Based Bayesian Filtering of RC Circuit.....	616
<i>Ranu Sharma; Rahul Bansal</i>	
Hardware implementation of lossless hyperspectral compression.....	623
<i>Neelima Vinjamuri; Sowmya Parameshwaran; Shantala SH; Chayan Dutta; Srividhya S; Jothy Soman; Vanitha M</i>	
A BPSO and Deep Learning Based Hybrid Approach for Android Feature Selection and Malware Detection	628
<i>Ravi Mohan Sharma, Chaitanya P Agrawal</i>	
Monitoring Social Distancing based on Regression Object detector for reducing Covid-19	635
<i>Ruchi Jayaswal; Manish Dixit</i>	
Design Pattern Detection by Using Correlation Feature Selection Technique	641
<i>Seema Dewangan; Rajwant Singh Rao</i>	
SER Analysis of Generalized Frequency Division Multiplexing in Pulse Shaping Root Raised Cosine Filter	647
<i>Megha Gupta; Radheshyam Gamad</i>	
Hybrid Approach for Image Enhancement and Corner Detection Framework Using Contrast Enhancement Technique and Edge Preserving Filter	651
<i>Anand Jawdekar, Manish Dixit</i>	
Color Adaptive Robust DWT-SVD Watermarking Algorithm and Limitations: Color Space Comparisons.....	656
<i>Arun Kumar Patel; Prabhat Patel</i>	
Imagined Speech Classification using EEG based Brain-Computer Interface	662
<i>Dipti Pawar, Sudhir Dhage</i>	
Brain Tumour Detection using Image Processing.....	N/A
<i>Vivek Dhruv Ugale, Swati S. Pawar, Sheetal Pawar</i>	
Author Index	673

Hybrid Approach for Image Enhancement and Corner Detection Framework Using Contrast Enhancement Technique and Edge Preserving Filter

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Abstract— Image processing is the new edge of computing. Images are very useful for variety of purposes or to solve real life problems. Image enhancement is the key factor of image processing because it effects the outcome of end result. Here we propose the hybrid technique for image enhancement framework. This hybrid technique combination of contrast enhancement technique and edge preserving filters. Contrast enhancement enhanced the image which is acquisition by the variety of cameras and edge preserving filters locate the boundaries or corner which is present in the image. This hybrid approach applied to some medical images, it also helpful for any other types of images as well. Experimental result calculated in MATLAB 2020.

Keywords-Medical imaging, Image Enhancement, Histogram Techniques, Adaptive Histogram, Guassian Smoothing Filter

I. INTRODUCTION

Digital image processing has increases rapidly in recent years also get popularity as medical imaging techniques have improved. The most important topic in the realm of image processing is image contrast enhancement, which is a preprocessing step. The fundamental goal of image contrast enhancement is to increase the contrast between the objects and their surroundings. Image Enhancement is widely used in all major areas like medical, satellite imaging, digital photography and underwater image processing as well.[1]

Medical Imaging is a major trending area in the field of digital image processing. In medical imaging some major trends like image enhancement, image segmentation, object detection and many more. Today's traditional healthcare transformed to smart healthcare system due to some advancement of technology and infrastructure. Some kind of medical imaging system always require for accurate prediction and diagnostic purpose.

Very important and first major steps in medical imaging is medical image enhancement. Medical image enhancement enhances the image which is obtained from image acquisition process or any digital camera or any device used in basic healthcare like MRI, PET SCAN.

In medical field radiology is major is very crucial for diagnosing the disease and symptoms. A lot of major advancement in technology has already done in this field for better results, but still some uncertainties and

error still persist. The purpose of radiology is different for any kind of disease so image should be very clear to identify the situation and predict the results. A small kind of error also disturb the image and the prediction is not up to the mark [2].

Furthermore, the number of image information, quality, and clarity are critical. To achieve these criteria, researchers offered a variety of image enhancing approaches to increase image perception quality.[2]

Furthermore, the number of image information, quality, and clarity are critical. To achieve these criteria, researchers offered a variety of image enhancing approaches to increase image perception quality.[3] Feature extraction of images is required for diagnosis and research purposes. Edge detection and picture enhancement are critical elements in this process. The major three aspects of the feature extraction method for an image are pixel, local, and global, in which the feature of a visual image is mostly based on pixel value. Detecting an edge, on the other hand, reduces the amount of data and filters the image's meaningless data [4].

This paper organized as section II, related work where previously related work is discussed in image enhancement, Section III, proposed methodology where main algorithms and proposed architecture has discussed, Section IV illustrate the experimental results and discussion, section V finally conclude the conclusion and future work.

II. RELATED WORK

A. Point based enhancement

Digital images always contain very important value which is known as pixels. Some basic operations can be performed on digital images for enhancing the pixel value. This approach commonly known as point-based technique. Some major approaches in point-based approaches are as:

1) Brightness Modification

In this approach some kind of constant should be added in existing image. value of constant should be change according to the image.

For increase the brightness of the image we add some fix or constant value in the image.

$$M(i, j) = N(i, j) + W \dots \dots \dots (1)$$

For reduction in the brightness we should decrease the pixels of the image by subtracting constant value..

$$M(i, j) = N(i, j) - W \dots \dots \dots (2)$$

2) Contrast Adjustment

This method illustrates to upsurge the contrast of the image by multiplying some constant value of the image.

$$M(i, j) = N(i, j) * W \dots \dots \dots (3)$$

3) Image negative or inverse transform

This approach is very useful in particular medical imaging. In several time inverse of the image is very crucial for identifying the diseases. This is a very old technique to enhance the digital image. here the dark and light shade replaced with each other. Inverse of the image obtained by subtracting the original image from 255.

$$M(i, j) = 255 - N(i, j) \dots \dots \dots (3)$$

B. Histogram based techniques

Due to its precision and simplicity, histogram equalization is the furthermost esteemed and extensively used in contrast enhancement. It is accomplished by employing its cumulative density function to normalize the intensity distributions, which increases the contrast of an input image and produces a consequent image with a uniform intensity distribution.[3]

The image histogram is the foundation for many spatial domain processing algorithms. It can be used for picture improvement, compression, and segmentation, as well as providing relevant image statistics. Calculating it in software and even hardware implementations is straightforward. Histogram Equalization (HE) creates an image with equally likely intensity levels over the entire image.[5]

Histogram based approach suffers some illuminating related effects. Various different histogram-based approaches already introduced by various researchers. To address problem of mean shift in the output image, numerous researchers have suggested various global histogram equalization methods in recent years. To manage the brightness present in the image and for contrast increases another novel approach brightness preserving HE approach was discussed. [6]

Wang et al. suggested a similar technique called dualistic sub image histogram equalization (DSIHE), this approach is based on median value which is segmented [7], [8]. According to experimental results, DSIHE outperforms BBHE in terms of brightness preservation and entropy. Recursive mean separate histogram equalization (RMSHE) and recursive sub image histogram equalization (RSIHE) were proposed to solve the problem of unwanted side effects.[9][10]

Both strategies are recursive algorithms based on the BBHE and DSIHE techniques. Then, to improve image contrast, researchers look at a novel approach called recursively separated weighted histogram equalization (RSWHE). This method is identical to RMSHE and RSIHE, with the exception that RSWHE uses a normalized power law

function [11]. These three HE methods (RSIHE, RMSHE, and RSWHE) provide high contrast enhancement and reasonable brightness retention, however the final image has an over enhancement problem.

To address these flaws, a group of authors proposed adaptive gamma correction with weighted distribution (AGCWD), a novel automatic transformation technique. With the help of Gama Correction approach changing the value of probability distribution in pixels of the image, this technique raises the brightness level of a low contrast image.[12]

Another study uses a combination of bi-level weighted histogram equalisation and adaptive gamma correction to achieve good brightness retention and contrast enhancement, although this method introduces the issue of uneven illumination [13].

As a result, these new discoveries look at another effective AGC-based method for striking a compromise between excellent enhancement and low computational cost. The range limited bi-histogram equalisation (RLBHE) and AGC techniques are combined in this method [14]. In comparison to RLBHE and adaptive gamma correction with weighted distribution, this suggested method more better for enhancement for lesser contrast images, according to experimental data (AGCWD).

TABLE I LITERATURE SUMMARY

Author Name and Year	Approach	Performance	Remarks
Y.T. Kim (1997)[6]	Bi Histogram technique based on histogram preserving	Resulting images and corresponding histograms	It looks like over enhance image
Y. Wang, Q. Chen, B.M. Zhang (1999)[7]	Similar to Bi histogram based approach but division is median basis	Mean ,entropy and other relevant images	Also over enhance but preserves mean
S.D. Chen, A.R. (2003)[9]	Recursive segmentation based approach	Improved images	Resolves the over enhancing problem and also preserve brightness
K.S. Sim, C.P. Tso, Y.Y. Tan (2007)[10]	Also similar with recursive approach but division is basis on median	PSNR value of image	Preserve more brightened image and enhance quality is good
Kim & Chung (2008)[11]	It is also similar with earlier approaches but it has weighting process	PSNR and entropy level	Preserve brightness, also produced good contrast value
S. Haung, F. Cheng, Y. Chiu (2013)[12]	Adaptive Gama Correction method	Useful for colour images	Very less distortion

III. PROPOSED METHODOLOGY

As seen in literature survey some issues still not resolved in earlier approaches, like low light images still not enhance by the existing approaches and we also improve PSNR value. The proposed model works all types of images either colour images or gray scale images. Also enhances the low light images very efficiently. In proposed methodology we proposed hybrid approach for image enhancement and introduce model for edge or corner detection.

A. Adaptive Histogram Based Approach (AHE)

This is the very popular algorithm for image enhancement. After capturing the image, it contains several types of noise in image. Various histogram-based approaches are already introduced by the researchers.

AHE is the variation in histogram-based approach. In histogram-based techniques some issues arise like we cannot manage the contrast of the image. after enhancement, resulting images diminished contrast as compare with the original image.

Adaptive histogram-based approach also known as CLAHE, where we limit contrast in the original image. Adaptive histogram-based technique deals in small regions, where normal histogram-based approach works on the entire image. Adaptive nature of the algorithm is very useful in all types of images like medical images and many more.

AHE approach uses the image in small regions or tiles, and later on all regions combined together to get the resultant image. Here bilinear interpolation is used to eliminate the boundaries which is induced in the resultant image. In AHE the noise present in the image is also get more contrast to avoid this situation we use CLAHE to avoid noise amplification which is get more enhance in the image enhancement process.

Steps are as follows:

Step 1: Load the image

Step 2: Apply histogram function to the original image.

Step 3: Generate histogram and enhance image using existing library

Step 4: Get the resultant image

B. Edge Detection

This is the another very interesting approach which is used in edge or corner detection. In image enhancement, after the enhancement process edges may be blur or difficult to separate the images with each other. This hybrid approach also useful for the detection purposes. After the enhancement process edges may blur or difficult to separate the objects or difficult to locate boundaries among in image. Here image gradient is used to highlight the corners or boundaries.

Step 1: Load the original image

Step 2: convert the image into gray scale image if required

Step 3: Add some noise like gaussian noise in the image

Step 4: Now compute the gradient magnitude of the image using sobel.

Step 5: Sobel 3*3 magnitude filter is used

Step 6: After applying Sobel or any operator like Prewit image still noisy.

Step 7: Apply Guassian smoothing filter for noise removal process.

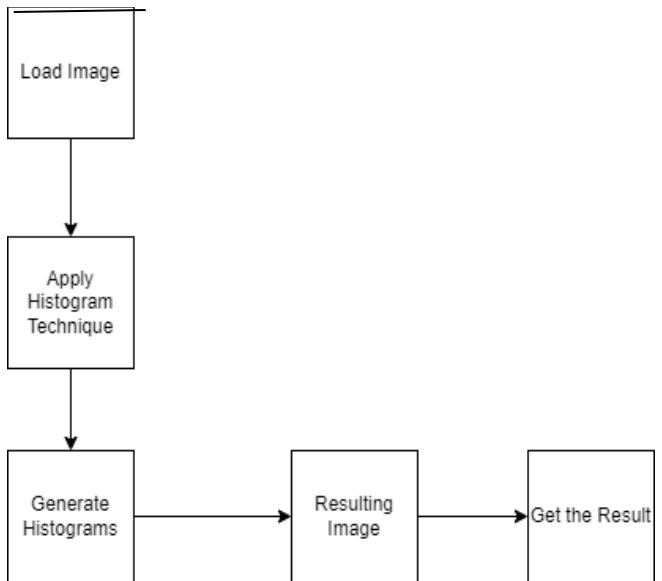


Figure: 1 Image Enhancement Model

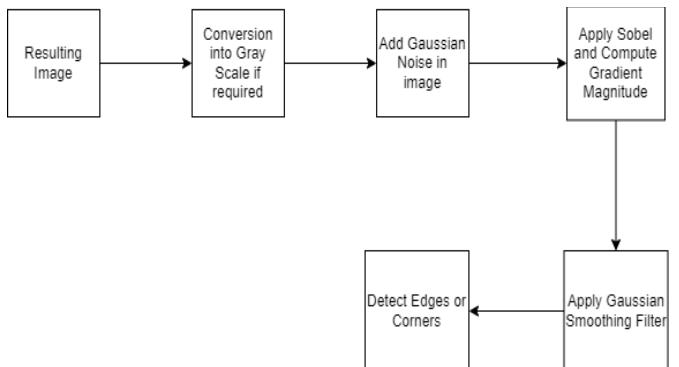


Figure: 2 Edge detection Model

IV. EXPERIMENTAL RESULTS ANALYSIS

The model implemented in MATLAB 2020, a very powerful tool for image processing. In MATLAB rich set of library functions are available. There is a separate image processing toolbox available, where we can perform variety of operations over images.

A. Simulation Results

The complete simulation process can perform in MATLAB. The set of images taken from different databases. Some medical images and some ordinary images taken from open-source dataset. Here we can obtain the result on MRI, XRAY images and also some common images. We can get the enhanced images and also compute some parameters like entropy and PSNR. Entropy and PSNR gives the quantitatively measure of the image. While enhance image shows the

qualitative results. Both types of results are very important for analysis.

a) Entropy

It is a very important factor for quantify measurement of the image. Entropy shows the intensity level in the image. Higher entropy indicates that the lesser intensity saturation.

b) PSNR (Peak signal to noise ratio)

In enhancement process always retain its original looks it means noise level should not magnify in the enhanced image. PSNR is the ratio of signal power and input power. A higher PSNR indicates the noise level should be eliminated and reconstruction of the image is higher intensity value.

This model have a combination of Image enhancement and Edge detection mechanism which provides uniqueness and some specialty into existing methodologies. Some previous researchers have calculated the entropy and PSNR values for the medical images as well. Some images have some degradation into PSNR values and also maintain the level of entropy. Figure 3 to 6 are images of input and output. Figure 7 showing the histogram of the proposed work.



Figure 3: Original Medical Image and Contrast Enhanced Image



Figure 4: Original Image and corner detection in respective image



Figure 5: Original Image and corner detection in respective image

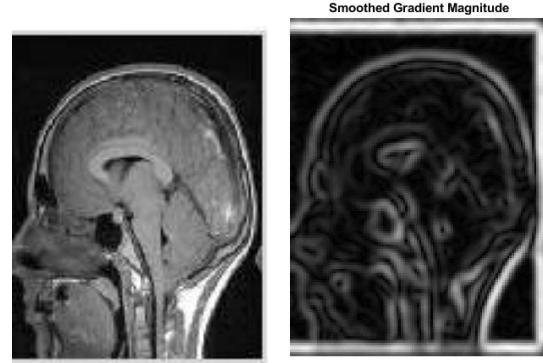


Figure 6: Original Image and corner detection in respective image

TABLE I. ENTROPY CALCULATION IN DIFFERENT IMAGES

Table Head	Entropy	
	Original Image	Enhance Image Subhead
Hand	6.8385	5.5852
Skull Image	7.3296	5.8807
Bone XRAY	7.2567	5.7925

(Entropy of different images)

TABLE II. PSNR CALCULATION IN DIFFERENT IMAGES

Table Head	Peak Signal to Noise Ratio (PSNR)	
	Original Image	Enhance Image Subhead
Hand	6.8385	5.5852
Skull Image	7.3296	5.8807
Bone XRAY	7.2567	5.7925

(PSNR of different images)

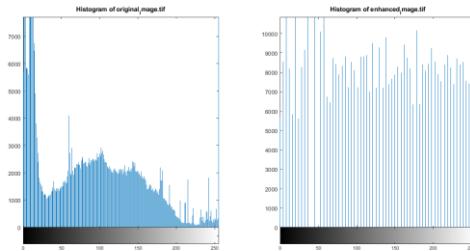


Figure 7: Histogram of the original Image and Contrast Enhanced Image

V. CONCLUSION AND FUTURE SCOPE

In this work we introduce the hybrid approach for image enhancement framework. This approach solves two objectives Image enhancement with high contrast and also compute corners or edges within the images. Here medical images are studied for simulation process. This

hybrid approach is very useful in the field of medical image processing where enhancement and edges detection are required. In this work the quantitatively measurement is also impressive but still some improvement needed in entropy value. Also introduce new edge of computing like CNN and deep learning model for enhancing the results.

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