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EDITORIAL

It gives me immense pleasure to present **Volume 7, Issue 1 of the *Trinitarian Journal***, our multidisciplinary bi-annual research journal, which continues its commitment to fostering academic inquiry, innovation, and interdisciplinary dialogue. This issue reflects the journal's vision of providing a scholarly platform where emerging ideas and advanced research converge to address contemporary scientific and technological challenges.

The present volume brings together a diverse collection of research and review articles that span the domains of computer science, electronics, management science, and industrial applications. Each contribution underscores the growing importance of data-driven approaches, intelligent systems, and optimized decision-making frameworks in today's rapidly evolving knowledge ecosystem.

Several articles in this issue explore the frontiers of **pattern recognition and image processing**, including research on free-style handwritten character recognition, the role of moments in fingerprint recognition, and enhanced structural similarity in fractal image compression using quad tree techniques. These studies highlight significant advancements in feature extraction, classification, and compression methodologies that have wide-ranging applications in security, automation, and digital communication.

The issue also features critical insights into **decision sciences and industrial management**, notably through the application of weighted goal programming to project management decisions involving multiple objectives. Complementing this, the article on cloud computing as a tool for the revival of sick sponge iron industries demonstrates how modern computational paradigms can support industrial sustainability and operational efficiency.

In the realm of **electronics and communication engineering**, the comprehensive review on advancements in micro strip patch antennas and the comparative study of OLEDs using varying thicknesses of the electron transport layer provide valuable perspectives on design optimization and performance enhancement. Additionally, the review of reading comprehension systems offers an analytical overview of techniques that support intelligent learning and natural language processing applications.

Together, the contributions in this issue reaffirm the interdisciplinary character of the *Trinitarian Journal*, emphasizing research that is not only theoretically robust but also socially and technologically relevant. I extend my sincere appreciation to the authors for their scholarly contributions, the reviewers for their rigorous and constructive evaluations, and the editorial team for their dedication in bringing this issue to fruition.

As we conclude this issue, we reaffirm our commitment to maintain rigorous academic standards and providing a vibrant platform for researchers to share knowledge and insights. We look forward to continued support from scholars, reviewers, and readers as the *Trinitarian Journal* progresses in its mission to advance research, innovation, and intellectual excellence.

With warm regards

Fr. Peter Kavumpuram

A FREE STYLE HANDWRITTEN CHARACTER RECOGNITION: FEATURE EXTRACTION AND CLASSIFICATION

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ABSTRACT

An off-line free style handwritten character recognition continues to be an active area for research towards exploring the new techniques that would improve recognition rate. There are various new technologies are emerging for the handwritten character/numeral recognition in the field of pattern recognition. The goal of pattern-recognition is to build machines, called, classifiers, that will automatically assign measurements to classes. With the spread of computers in public/private organizations and individual homes, automatic processing of tabular forms, bank checks, and postal mail is rapidly gaining importance in India. Our aim is to present a comprehensive study of previous attempts at Character Recognition using neural network and Genetic Algorithms (GA) in Pattern Recognition (PR) applications, with a special focus on Marathi handwritten script. We also investigate different feature extraction and classification methods for offline character recognition system.

KEYWORDS: Character Recognition, Feature Extraction, Classification, Pattern Recognition, Shape Descriptor, Moment Invarient

Pattern recognition is formally defined as the process whereby received patterns are assigned to one of a prescribed number of classes (categories)[1] [2] [22]The goal of pattern-recognition is to build machines, called classifiers that will automatically assign measurements to classes. A natural way to MSE class assignment is to define the decision surface. The decision surface is not trivially determined for many real-world problems. The central problem in pattern recognition is to define the shape and placement of the boundary so that the class-assignment errors are minimized.[3][23] In classification problem, the task is to assign new inputs to one of a number of discrete classes or categories. Here, the functions that we seek to approximate are the probabilities of membership of the different classes expressed as functions of the input variables. In classification, we accept a priori that different input data may be generated by different mechanisms and the goal is to separate the data as well as possible into classes[4] However, such automation needs research and development of handwritten character recognition methodology for Indian scripts. A major obstacle to research on handwritten character recognition of Indian scripts is the nonexistence of standard/benchmark databases. Previous studies were reported based on small databases collected in laboratory environments. Driven by the challenge of matching human performance and by the numerous possible applications in data processing, hundreds of researchers have contributed to this field.

Many systems have been developed but more work is still required before human performance is matched [24]. The handwritten character recognition can be carried out in the form of: on-line and off-line. The on-line method uses a stylus and electronic equipment's like tablets, mobile phones connected to a system to extract information like character or image and in off-line recognition, the handwritten script is usually captured by a scanner and complete writing is available as an image. Image processing play an important role in research area within engineering and computer science fields. [21][22][23] The output of recognition system is can be analyzed by various factors such as accuracy, recognition rate or classification error. The systems can be implemented for various languages. There are still a lot of researches to do towards the improvement, and we can make a further exploration about the research of character recognition [24].

FEATURE EXTRACTION

Feature identification for handwritten digit and character recognition is an important problem. The selection of appropriate feature extraction method is probably the single most important factor in achieving high performance. The widely used feature extraction methods are Template matching, Deformable templates, Unitary Image transforms, Graph description, Projection Histograms, Contour profiles, Zoning, Geometric moments invariants, Zernike Moments, Spline curve approximation, Fourier descriptors, Gradients feature and Gabor features.[6] [7] There are two main approaches to feature extraction. The more traditional approach is to handcraft the feature extraction process, as opposed to the other approach whereby the raw input is presented to a learning algorithm to discover whatever features are inherent in the domain. Each approach has its own merits and weaknesses. In the former approach, the main difficulty lies in determining the appropriate class of features to extract as well as in extracting those

features in a robust and reliable way [9][20]. Automatic Feature Generation for Handwritten Digit Recognition different evaluation measures orthogonally and information, are used to guide the search for features. The performance of character recognition system is largely depending on proper feature extraction and correct classifier selection. Slow Feature Analysis (SFA) is an unsupervised algorithm by extracting the slowly varying features from time series and has been used to pattern recognition successfully [9] There exist many feature extraction methods which have their own advantages or disadvantages over other methods, a rapid feature extraction method is proposed and named as Celled Projection (CP) that compute the projection of each section formed through partitioning an image. Method of recognizing handwritten digits by fitting generative models that are built from deformable Bsplines with Gaussian "ink generators" spaced along the length of the spline. The splines are adjusted using a novel elastic matching procedure based on the Expectation Maximization (EM) algorithm that maximizes the likelihood of the model generating the data[10][11] Feature sets play one of the most important roles in a recognition system. A good feature set should represent characteristic of a class that helps distinguish it from other classes while remaining invariant to characteristic differences within the class.[20][21] .

SHAPE DESCRIPTOR AND MOMENT INVARIANT

In this section give an overview of the shape based techniques used in object matching, object identification and object classification tasks. Shape descriptors are a powerful tool used in wide spectrum of computer vision and image processing tasks such as object matching, classification, recognition and identification.

The fact that the shape invariance under simple transformations like scaling can be achieved by point normalization motivates us to explore general shape invariance under affine transformation. In real-world problems, shape distortions caused by perspective projection, nonrigid deformation or articulated motion can be approximated by locally affine transformations [13]

The history of moment invariants begun many years before the appearance of first computers, in the 19th century under the framework of the theory of algebraic invariants. The theory of algebraic invariants probably originates from famous German mathematician David Hilbert [14] Moment invariants were firstly introduced to the pattern recognition community [15], employed the results of the theory of algebraic invariants and derived his seven famous invariants to rotation of 2-D objects. Since that time, numerous works have been devoted to various improvements and generalizations of Hu's invariants and also to its use in many application areas. Zernike invariants of 2nd and 3rd orders are equivalent to Hu's ones when expressing them in terms of geometric moments. He presented the invariants up to eight orders in explicit form but no general rule how to derive them is given. Significantly to the theory of moment invariants by correcting the Fundamental Theorem and deriving invariants to general affine transform. Several papers studied recognitive and reconstruction. All the above mentioned invariants deal with geometric distortion of the objects. Much less attention has been paid to invariants with respect to changes of the image intensity function and to combined radiometric-geometric invariants. In fact, just the invariants both to radiometric and geometric image degradations are necessary to resolve practical object recognition tasks because usually both types of degradations are present in input images.

CLASSIFIERS

The classification phase is the decision making part of the recognition system. The performance of a classifier relies on the quality of the features. There are many existing Classical and soft computing techniques for handwriting recognition. They are given as:

1. Template matching
2. Statistical techniques
3. Structural techniques
4. Neural networks (NNs)
5. Fuzzy- logic technique
6. Evolutionary computing techniques
7. Genetic algorithm

In this section we mainly focused on neural network and genetic algorithm as a classifier. Artificial neural networks have been recognized as a powerful tool for pattern classification problems. A neural network performs pattern recognition by first undergoing a training session, during which the network is repeatedly presented a set of input patterns along with the category to which each particular pattern belongs. Later, a new pattern is presented to the network that has not been seen before, but which belongs to the same population of patterns used to train the network. The network is able to identify the class of that particular pattern because of the information it has extracted from the training data. Pattern recognition performed by a neural network is

statistical in nature, with the patterns being represented by points in a multidimensional decision space. The decision space is divided into regions, each one of which is associated with a class. The decision boundaries are determined by the training process. The construction of theses boundaries is made statistical by the inherent variability that exists within and between classes. It is very difficult to know which training algorithm will be the fastest for a given problem. It depends on many factors, including the complexity of the problem, the number of data points in the training set, the number of weights and biases in the network, the error goal, and whether the network is being used for pattern recognition (discriminate analysis) or function approximation (regression). Sophisticated neural network classifiers to solve complex pattern recognition problems: multiple multilayer perceptron (MLP) classifier, hidden Markov model (HMM)/MLP hybrid classifier, and structure adaptive self-organizing map (SOM) classifier, based on the SOM classifier, which can adapt its structure as well as its weights.[16][17]

MLP NEURAL NETWORK ARCHITECTURE

The multilayer feed-forward neural network can be used for both function fitting and pattern recognition problems. With the addition of a tapped delay line, it can also be used for prediction problems [18] [19]. Feed-forward networks often have one or more hidden layers of sigmoid neurons followed by an output layer of linear neurons. Multiple layers of neurons with nonlinear transfer functions allow the network to learn nonlinear relationships between input and output vectors. The linear output layer is most often used for function fitting (or nonlinear regression) problems. On the other hand, if we want to constrain the outputs of a network (such as between 0 and 1), then the output layer should use a sigmoid transfer function. This is the case when the network is used for pattern recognition problems (in which a decision is being made by the network). The configuration of the MLP NN is determined by the number of hidden layers, number of the neurons in each of the hidden layers, as well as the type of the activation functions used for the neurons. It has been established that an MLP NN that has only one hidden layer, with a sufficient number of neurons, acts as universal approximations of non-linear mappings [20][23][24]. Experimentally, it can be verified that the addition of extra hidden layer can enhance the discriminating ability of the NN model. However, it does so at the cost of the added computational complexity.

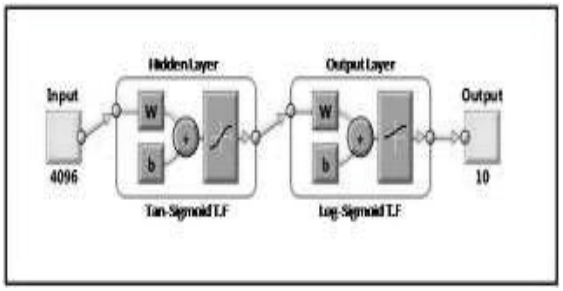

Figure 1: MLP Neural Network

MLP NN architecture as mentioned in fig. 1 shows use of tan sigmoid neurons in hidden layer output layer. As apparent from the network, it has 4096 inputs connected to predefined neurons in hidden layer and 10 neurons in the output layer. Neurons in hidden layer are varied from 16 to 128 in step of 16.

As a classifier the final output is always percentage error on misclassification on individual output classes (digits), the confusion matrix as mentioned in Figure 2 portray the % misclassification rate

Class	Training Set				Validation Set				Testing Set				Total DataSet			
ID	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
0	369	364	5	1.36	35	35	0	0	46	46	0	0	450	445	5	1.111
1	358	338	20	5.59	43	38	5	11.6	49	38	11	22.4	450	414	36	8
2	367	363	4	1.09	42	36	6	14.3	41	40	1	2.44	450	439	11	2.444
3	350	350	0	0	47	44	3	6.38	53	45	8	15.1	450	439	11	2.444
4	356	354	2	0.56	52	48	4	7.69	42	40	2	4.76	450	442	8	1.778
5	357	328	29	8.12	54	48	6	11.1	39	32	7	17.9	450	408	42	9.333
6	359	348	11	3.06	44	37	7	15.9	47	44	3	6.38	450	429	21	4.667
7	362	359	3	0.83	40	37	3	7.5	48	45	3	6.25	450	441	9	2
8	358	354	4	1.12	46	40	6	13	45	42	3	6.67	449	436	13	2.895
9	335	319	16	4.78	44	37	7	15.9	37	32	5	13.5	416	388	28	6.731
Total	3571	3477	94	2.63	447	400	47	10.5	447	404	43	9.62	4465	4281	184	4.121

A : Total No. of instances B:Total No. of instances classified as a designated class
C: Total No. of instances misclassified D: % misclassification rate

Figure 2: Overall performance of the neural network as a classifier

GENETIC ALGORITHM

The genetic algorithm (GA) is a powerful tool to handle optimization problems. This is especially useful for complex problems with a large number of parameters that make the global analytical solutions difficult to obtain. It has been widely applied in different areas such as fuzzy control , path planning, greenhouse climate control. The determination of optimal similarity threshold value is very important for the accurate classification. As we already discuss the genetic algorithm selection method maintained maximum performance so, to determine optimal similarity threshold value genetic algorithm (GA) is used.

Genetic algorithm consists of following steps:

1. Start with randomly generated population of n chromosomes.

2. Evaluate each chromosome in the population by calculating a fitness function.

3. Apply mutation and reproduction as the parents chromosomes mate.

4. Delete chromosomes from the current population to make room for the new chromosomes

5. Evaluate new chromosomes and insert it into new population.

6. If the stop condition is satisfied then stop and return the best chromosomes, otherwise repeat step 3.

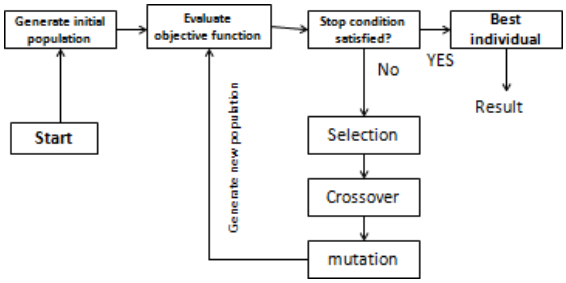

Figure 3: Basic steps of genetic Algorithm

Selection Operators

Give preference to better individuals allow them to pass on their genes to the next generation. fitness may be determine by an objective function.

Crossover

It is a used to vary the programming of a chromosome or chromosomes from one generation to the next

Mutation

It alters one or more gene values in a chromosome from its initial state. In mutation, the solution may change entirely from the previous solution. Hence GA can come to better solution by using mutation. Mutation occurs during evolution according to a user-definable mutation probability. This probability should be set low. If it is set too high, the search will turn into a primitive random search[23]

CONCLUSION

In this paper a comprehensive review in the literature review in the stage of an offline character recognition. Classifier like neural network and genetic algorithm discuss here and the feature extraction methods which help to improve recognition accuracy. In neural network approach As a classifier the final output is always percentage error on misclassification on individual output classes. The best one hidden layer MLP NN with log-log activation function for hidden and output layer investigated gives an impression to perform reasonably. When it is evaluated on the training instances, it works as an almost good classifier with error rate of 2.63% on training. Here, the regression fit is found to be 0.985.

The recognition problem is solved by the GA, which may yield a different solution for the same word each time, depending on the population and number of iteration. However, there is currently high similarity between the original solution and the anticipated oneThe research in the field of pattern recognition shows: For a complex problem of identification and classification, only one method always is difficult to identify the object well separated, while among the different classification methods, the high complementary exist, the integration of multiple classifiers can clearly improve the recognition rate

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IMPROVED STRUCTURE SIMILARITY IN FRACTAL IMAGE COMPRESSION WITH QUAD TREE

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ABSTRACT

Fractal Image compression uses different fractals is lossy compression technique. Textures and natural images are compressed & decompressed using fractal image compression. As there is repeation in the other parts of the same image. In proposed methodology, complete image is converted into mathematical equations. These equations are used to convert images into fractal codes. After reception these code may encoded with useful information. On the other hand fractal image compression is pixel based scheme such as JPEG, GIF and MPEG. After apply different Fractal image algorithm, peak signal to noise ratio is improved up to 25.83505of mandril standard image.

KEYWORDS: Fractal Image, Encoding, Decoding, PSNR.

INTRODUCTION

Compression ratio of an image can be calculated using standard fractal image compression techniques. An image can be represented in form of pixels to store an image, memory ratio is required. These images are store in compressed form. A no. of transform takes place that are in repeation form. A no. of implications is used for reconstruction of an image. There are different levels of transformations, first level of transformation is known as fern. In this level there is no natural size of decoded image. From this point of view it is clear that this technique can decode any size of image (Wang Jing, 2010).

In many cases, this technique have low magnification rate. But it is very useful method for data transfer. In fractal image compression technique, images are encoded with magnification of the original image. Pixels of image represent the magnifications. If there is more no. of dots in the image, there is more magnification. For visible images, dots should be maximum. With the help of local repetition of the pixels, images are magnified by a factor 4. Pixelazationdoes not appear in decoded image. For example, 768 bits data is used to store 65,536 in form of pixels (Ching-Hung , 2012).Fractal image compression can decode an image at any level. In image compression technique, the image can be divided into various range blocks. These range blocks are 4×4 , 8×8 and 16×16 depending upon the pixels of an image. For each range block, there are two transformation are required. One transformation is geometrical transformation and another one is relative transformation. The geometrical transformation is used to change the mapping of an image. On the other hand, relative transformation is used to change the intensity of an image up to an extent. The various portion schemes are used for compression of an image. These schemes are used to improve the peak signal to noise ratio. Compression ratio is also improved by this scheme.

The remaining of paper is organized as follows. The overall past work is describe in Section II. Methodology used for proposed work is described in Section III. Result analysis describe in section IV. Finally, Section V describes the conclusion of paper.

LITERATURE REVIEW

Wang Jing et al 2010 the authors describe Strong cryptographic security, short encryption time, and robustness against noise are three goals of cryptosystem. Theoretical analysis and simulation results show that the proposed algorithm has a good robustness against noise, and can effectively resist chosen-plaintext attack, statistical attack and differential attack.

Ching-Hung Yuen et al, 2012 describe a chaos-based cryptosystem with compression capability is proposed for lossy image compression. Simulation results show that the compression performance of their approach is encouraging.

Yepin Lu et al, 2012 focuses on the production, coding, transfer and receiving display of 3D video technology and mainly describes the mainstream and hot issue of disparity estimation of two way light signals.

Roberto Kawakam et al, 2013 describe a Successive Projections Algorithm (SPA) enables the construction of multiple linear regression (MLR) models which can efficiently determine the compression ratio. It

has applicable to experimental results generated by either time domain transient spectrometers or continuous-wave instruments.

Amir Anees et al, 2013 describe the problems of robustness and quantity of compression of digital independent spatial and frequency domains have been analyzed. In addition, few security statistical analyses such as correlation, entropy, energy, contrast, homogeneity, mean square error and peak signal to noise ratio have also been carried out.

Jin-Gang Yu et al, 2014 propose a novel bottom-up saliency model for detecting salient objects in natural images. In the proposed framework, the input image is first over segmented into super pixels, which are taken as the primary units for subsequent procedures and regional features are extracted. Then, saliency is measured according to two principles, i.e., uniqueness and visual organization, both implemented in a unified approach, i.e., the MERW model based on graph representation.

Luhong Liang et al, 2014 describe Example-based super-resolution (SR) approaches mostly reconstruct and optimize the high-resolution (HR) image according to objective criteria such as imaging model. Experimental results show the proposed approach has competitive quality and lower computational complexity compared with several state-of-the-art SR approaches.

TruptiMemane et al, 2014 describe the Discrete Wavelet Transform (DWT) ,offer the optimal results for image compression. The purpose of this paper is to selection of wavelet by comparing various wavelet functions like Haar, Daubechies, Symlets, Coiflets, Biorthogonal, Reverse-Biorthogonal and Discrete Meyer wavelet for satellite image compression.

R. Praisline Jasmi et al., 2015 describe Image compression, one of the advantageous techniques in different types of multi-media services. In this paper the proposal of image compression using simple coding techniques called Huffman; Discrete Wavelet Transform (DWT) coding and fractal algorithm is done. By using the above algorithms the calculation of Peak signal to noise ratio (PSNR), Mean Square error (MSE) and compression ratio (CR) and Bits per pixel (BPP) of the compressed image by giving 512512 input images.

Kiichi Fukuma et al., 2016 describe Computer aided diagnosis (CAD) systems are important in obtaining precision medicine and patient driven solutions for various diseases. The Cancer Genome Atlas (TCGA) and check for classification accuracy using support vector machine (SVM), Random Forests (RF). Our results indicate that they obtain classification accuracy 98.9% and 99.6% respectively.

Wenhan Yang et al, in 2016 describe the autoregressive (AR) model is widely used in image interpolations. In the objective quality evaluation, their method achieves the best results in terms of both PSNR and SSIM for both simple size doubling (2) and for arbitrary scale enlargements.

METHODOLOGY

The image decomposes into different blocks. Entropy coding is used for encoding and decoding. It is applied on the compressed image to decrease the encoding time and improve the compression quality.

The algorithm steps are as follows:

1. Read the input (color /gray) image, if color converts to gray.
2. Determine the image dimension; if the image is not square, convert to nearest square size.
3. The input is quantized to approximate the continuous set of values in the image data with a finite nearest set of allowed values.
4. Setting domain data.
5. Partition the image using quad-tree decomposition of threshold is 0.2, minimum dimension and maximum dimension is 2 and 64 respectively.
6. Domain, Range classification and matching.
7. Record the fractal coding information.
8. Applying Entropy encoding to complete image encoding and calculate the compression ratio (CR), encoding time (ET).
9. Applying Entropy decoding to reconstruct the image and quad tree partitioning method.
10. Calculate decoding time (DT), MSE and PSNR.

Fig 1 represents the encoding technique & fig 2 gives the decoding technique algorithm for fractal image compression. The procedure of proposed fractal image compression can be explained as follows: A brief account of the partitioning scheme (quad tree partitioning), procedure involved in computing the transformations for a given image (encoding algorithm) and steps to reconstruct the image (decoding algorithm) are presented.

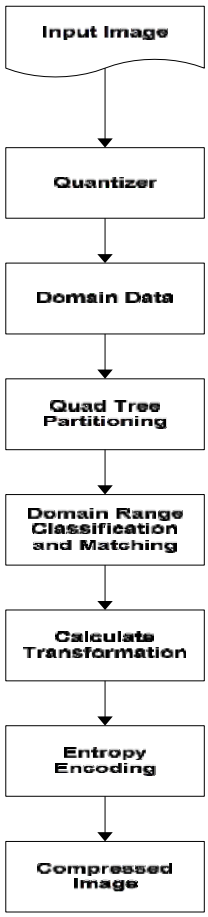

Figure 1: Proposed Fractal Image Compression Encoding Technique

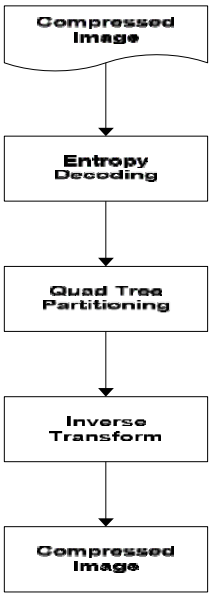

Figure 2: Proposed Fractal Image Compression Decoding Technique

RESULT ANALYSIS

Encoding is the process of putting a sequence of characters into a special format for transmission or storage purposes. Fig 3 shows that original image for fractal image compression. Fig 4 represents that quad tree decomposition of input image. There are different images used Mandrill, Barbara, Lena, Cameraman and Peppers Fig 5 gives the Huffman directory table of input image. Huffman directory of the input gives the vector probability of the compressed image. Fig 6 gives the comparison of input image with compressed image using PSNR.

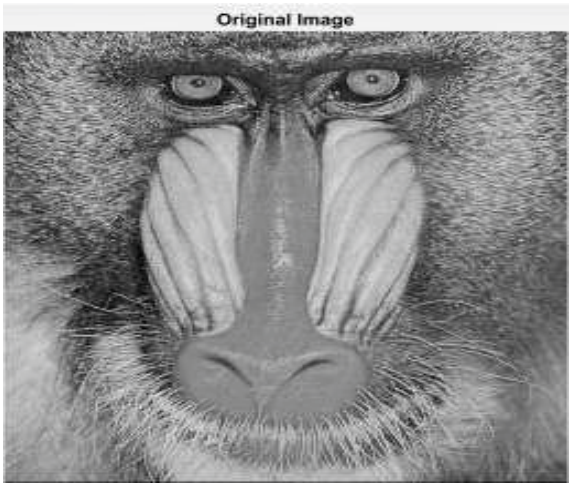

Figure 3: Original Image Taken for Fractal Compression

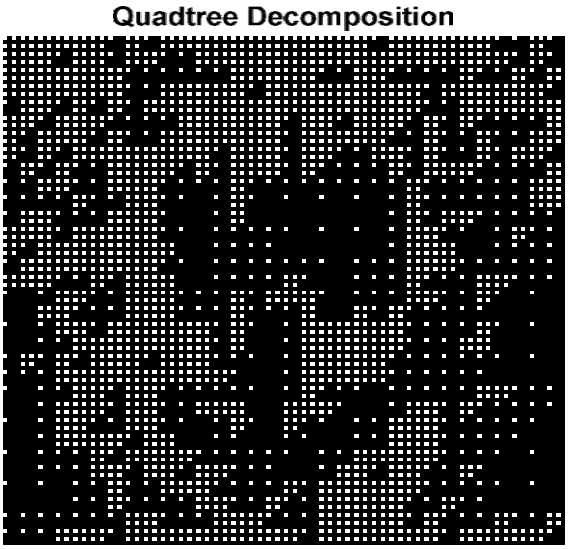

Figure 4: Quadtree Decomposition of input image

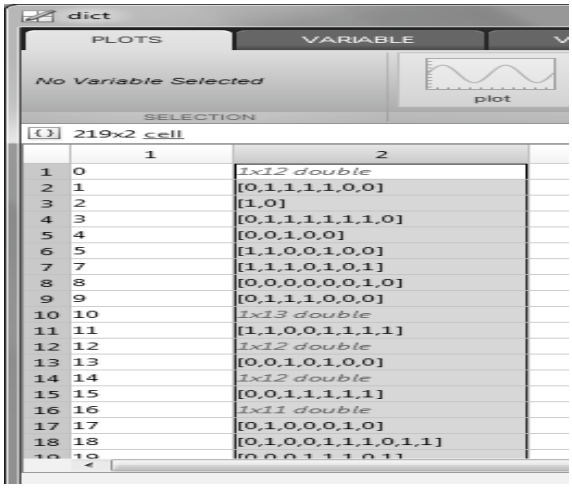

Figure 5: Huffman Dictionary of the input image

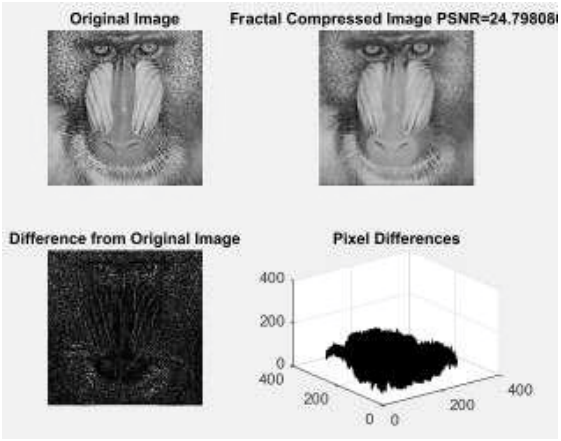

Figure 6: Comparison of input image with compressed image using PSNR, differences achieved and Pixel wise differences

Experimental results suggest the most images such as: trees, faces, houses, clouds etc. have similar portions within themselves and these features can be easily compressed by fractal compression and Quad-tree decomposition. The higher compression ratios for fractal images can be explained in terms of the occurrence of fractals due to repetition features at regular intervals. Hierarchical Quantized quad-tree decomposition and entropy coding are applied on images of different types and sizes. The results showed significant improvement in compression ratios, PSNR and better encoding time .These results are derived from the fractal compression with range block and iterations technique, the results are shown in Table belowFig 7 shows the comparison of different images for encoding time for the compression. As compression time is different for each image depending upon the size of image. For cameraman image compression is very less as compare to other images. Fig 8 shows the compression ratio for the various images. Mandrill image have very less compression ratio as compared to other. Fig 9 shows the peak signal to noise ratio of an image. Barbara has very high PSNR value.

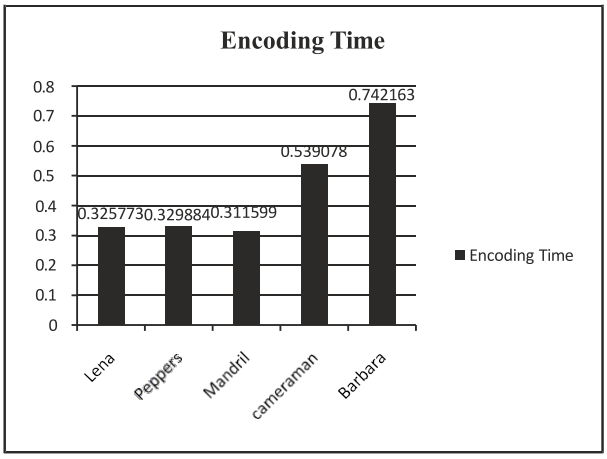

Figure 7: Encoding time for Various Images

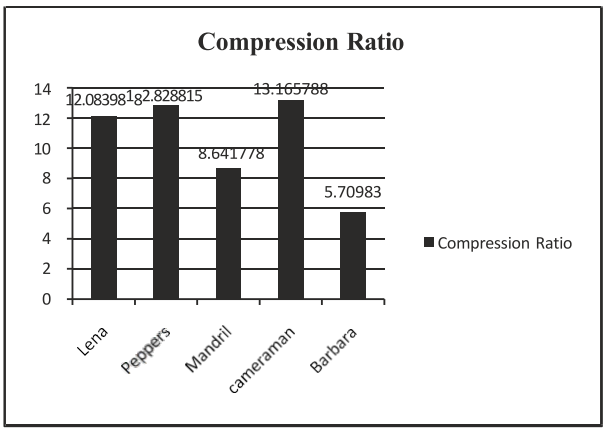

Figure 8: Compression Ratio for Various Images

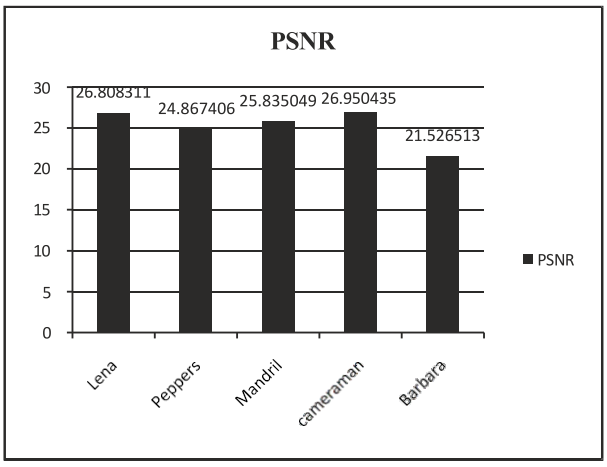

Figure 9: PSNR values for Various Images

Table 1: Fractal Image Compression Comparison

Image	Encoding Time	Compression Ratio	PSNR
Lena	**0.325773**	**12.083988**	**26.80831**
Peppers	**0.329884**	**12.828815**	**24.86741**
Mandril	**0.311599**	**8.641778**	**25.83505**
cameraman	**0.539078**	**13.165788**	**26.95044**
Barbara	**0.742163**	**5.70983**	**21.52651**

CONCLUSION

From the analysis carried out in the paper the following conclusions can be drawn. The quantized quad-tree decomposition and Entropy coding can be applied for improving the recovered image's quality and compression ratio significantly on different types of images. Perform scalar uniform quantization affected in the image quality, compression rate and encoding time. Fractal images can be easily compressed by fractal compression and Quad-tree decomposition. Decreasing images sizes making less encoding time, but decrease image quality.

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APPLYING WEIGHTED GOAL PROGRAMMING TO PROJECT MANAGEMENT DECISIONS WITH MULTIPLE GOALS

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ABSTRACT

The construction, architecture and engineering markets have been at the epicenter of the recent global economic recession. Following a phase of almost irrational growth and investment in real estate development, both residential and commercial, the industry faces copious challenges following the burst of the housing bubble. As a result, it has become obligatory for this the sector to reassess and reengineer its conventional business models to drive amplified efficiencies in operations and improvements in bottom line performance. In this article, a multi-criteria "knapsack" model is proposed to lend a hand to the planners to select the most feasible and realistic developmental proceedings in the conceptual phase of a project. Firstly, the methodology is portrayed. Then, case study is presented. Finally, advantages and disadvantage of the methodology are considered and requirements for future researches are suggested. The results indicate that a compact structure of development including smaller lots may transpire, externally controlling constraints and variations.

KEYWORDS: Real Estate Development, Weighted Goal Programming, Multi Criteria Decision Making

To design a most advantageous building has become more difficult than it has been before. In 2003 Kari, proposed a ''knapsack'' model to help designers to select the most feasible renovation actions in the conceptual phase of a renovation project. In their article discuss some distinctive challenges.

One of the challenges is associated with the fact that decisions concerning building design are mainly made by a design team consisting of a design group including at least an architect, an electricity engineer, a structural engineer, a real estate owner, a buyer and a supplier. The question is how to find a consensus between the members of a design team taking into account as many points of view as possible. A practical solution of this problem is presented by Azmoodeh et al. This article present a procedure to quantify the process for selecting the most advantageous technique.

An energy system opens a new opportunity for the local businesses and community development. Lack of support of the local community may be a drawback for the development (Afgan et al.). In today's business environment one of the challenges are associated with the sustainable development. According to the classification by Bruntland, that sustainable development is regarded as ''Development that meets the needs of the present without compromising the ability of future generations to meet their own needs''.

Sustainable development in the framework of construction industry simply means making buildings better satisfy the requirements of human beings and the situation, discuss in detail by Kaklauskas et al. In practice, sustainability is usually illustrated using numerical indicators providing information about the status of an observable fact, environment or region. An Example of a list of indicators describing sustainability of buildings and their hi-tech systems are presented by Bragança et al.

Smith, describes how buildings can be made to significantly reduce their dependence on fossil-based energy by the use of solar and geothermal resources. As sustainable building becomes increasingly essential with the advance of climate change, government legislation and international treaties, this is valuable knowledge for every architect, engineer and designer.

The sustainability of buildings and their systems is usually defined by means of differing criteria. The challenge is to make an optimal decision on the basis of these criteria.

Multi-criteria decision-making (MCDM) methods are usually presented as a solution of this kind of problems, like has been done by example (Andresen).

The other challenge is an increasing amount of hi-tech solutions on the market. In order to design a building with maximum sustainability, designers have to consider effects of more and more scientific options, these options discuss in detail by Flourentzou et al., Rosenfeld and Shohet.

The foreword of new, high-speed personal computers on everyone's desk makes it feasible to handle the difficulty in the form of a combinatorial optimization problem. This advance seems to be new in the field of building design. In Linkoping, Sweden, some studies have been carried out regarding this issue. In these studies, however, the multi-criteria and multi-

perspective nature of the problem has been deal (Gustafsson).

In this paper a weighted goal programming mathematical model is formulated to estimate the categories and number of new residential apartments constructed by a developer making an allowance for the targets ascertained for the project in Jaipur, Rajasthan.

CONSTRUCTION PROJECTS

The residential real estate at Jaipur is bound to roll out with a suite of integrated township projects, with housing units, lifestyle amenities of school, markets, clubhouses and infrastructure facilities of well laid out roads, landscaping, have been announced by developers likes Omaxe (Omaxe City), Suncity, Vatika (Vatika City), Ansal API (Sushant City), Grassfield, Panchsheel Colonizer and Parsvnath which has entered into a joint venture with a jaipur-based real estate developer. Besides, there are some jaipur based real estate developers such as Mahima, Narayan group, Narvik Nirman etc. who have launched ambitious residential township assignments.

With rising costs of land in the city, the real estate trends in Jaipur have shifted to the peripheral areas. But this is only true for property developers so far and not the end user for residential property. According to Vivek Jain of Narvik Nirman, "The end user is still not there in these projects so far. Developer after developer has been launching township projects in Jaipur but it is mainly the investor who is making speculative investments rather than the end user."

Theory and Methodology

Through this paper, we do not encourage creating unique monuments or architectural styles at the goal. Instead, the model can help at fabricating practical and useful buildings for average people.

Many architects (Friedman and Roaf et al.) too, felt a similar desire to clarify all the parallel goals of building and arrange them into a system.

In 1972 Nevanlinna made an attempt to deduce the goals of architecture from the basic values of modern Western culture, which is defined as:

A. Humanism or appreciation of man. This gives man a privileged position in respect to other nature,

B. Objective truth,

C. Prosperity (which materializes as technology),

D. Balance of the whole system.

Niukkanen, arranged the goals of building into a logical tree shown in figure-5.1.

SATISFACTION / FIT		
Input	**Output**	
Costs / Resources	Usefulness / Function	Experience / Perception
Building costs Costs of use Decrease to output	Spaces Indoor environment and climate Equipment and durability	Environmental factors Exteriors Interiors

Figure 5.1

Some researchers have tried to explain human goals with the concept of need. The "hierarchy of needs" suggested by Maslow, further Cianci et al. examine Maslow's hierarchy of needs and current related literature to determine whether or not it applies in a collectivist culture.

There are different interested parties (clients, users, architects, designers, utilities engineers, economists, contractors, maintenance engineers, suppliers, financing institutions, local government, state and state institutions) involved in the life cycle of a construction, trying to satisfy their requirements. The objectives hold the estimated cost of a building, maintenance costs, living space, number of floors as well as the requirements to its architecture, comfort ability, materials, sound insulation of partition walls, taxes and allowances, interest rates, etc. Besides, the environment of the site, its ecology, sound level and local infrastructure are also taken into consideration. This list may be continued. Therefore, the efficiency of a building life cycle is reflected through the rationality of its stages as well as on the ability to satisfy the needs of the interested parties and the rational character of environment conditions. Many features are being considered by the developers in recent times, but all these craft a project that bear out to be very much expensive for them, thus reducing their profit margin.

To solve this kind of problem, the developers need to be counseled and outfitted with a plan, apart from partial cost sharing (for specific facilities only) by the customers, which could endow

them with desired returns while enabling them to provide the customers with improved level of facilities.

The development planner may often encounter varied problems with multiple conflicting objectives while satisfying the customers. Goal programming endows us with a general methodology for sorting out such problems. Selection criteria are formalized into a set of goals which form the basis for a goal programming model.

Weights are used to analyze the respective effects upon the spatial distribution of investments. The approach is applicable to an extensive assortment of problems.

PROBLEM DESCRIPTION

In this paper developed a weighted goal programming model, taking construction company (to maintain the secrecy of data, we hide the company name as well as the exact financial figures while explaining the history of the case organization) as a case study to suggest the developers to construct which categories of apartments (Flats) and in what number, that could provide them with desired results.

Case Study

The model takes into consideration a specific project of the above mentioned construction company which with slight changes as per the project specifications will enable any developer to calculate the area of profit and no profit in their project.

It seems to be impracticable to combine the conflicting goals of building on a universal level. As a contrast, on the level of a single building project it is everyday practice. On this level, the goals are projected simply from the subjective viewpoint of the builder. If an architect and other experts use the same, even then they are supposed to adopt a matching perspective. Because most structures are relatively large, complicated and expensive products, it is normal that they must discharge quite a number of goals and requirements.

Targets

The task of combining the goals into a combination is primarily carried out by the architect, while he crafts his proposal, and at the next meeting the customers have the option of endorsing or rejecting it. The architect's tasks are, however, difficult already in it, and they should not be loaded with such extra operations that can be done separately. It is, therefore, usual that as much as possible of the work of defining and arbitrating of goals is done already before the architect begins with the design. This initial phase of the building project is often called a feasibility study.

Archetypal outcome of a feasibility study include:

(i) Lists of the intended activities that are to take place in the future building; lists of people to be accommodated; lists of the rooms or spaces for these; positioning and connections of the spaces,

(ii) Explanation of quality level. These can relate to e.g. safety, durability, finishing, intended life-time of the building

(iii) Estimate of costs and project time.

The presented case study formed by different particulars and corresponding cost of different apartment at fixed or floating rates has been taken from builder's website and construction company broacher.

In this study considered seven types of apartment (flats), Type-A, Type-B, Type-C, Type-D, Type-E, Type-F, and Type-G.

In which 1-B.H.K, 2-B.H.K, 3-B.H.K apartments with standard, deluxe, luxury categories have taken. Seven types of apartment have taken in form of decision variables as $X_1, X_2, \ldots, X_7$ respectively in weighted goal programming model formulation, which have to make a decision.

Different particulars taken as target (goal), and target value are based on our assumption. Total number of targets is thirteen. Weights (w_i^- and w_i^+) those reflect the decision maker's preferences regarding the relative importance of each goal have been taken in weighted goal programming model formulation.

Cost of each particular corresponding to each type of apartment taken as contribution of decision variables in weighted goal programming model formulation.

Significant features emphasized by developer shown in Table 1, Table 2 and collecting data shown in Table 3.

Table-1

As per Construction Linked Plan		Semi Furnished Option	Fully Furnished Option
On Booking	15%	**1. T.V Cabinet**	1. **Bed+Side Table**
On Agreement to Sell	10%	**2. Wardrobe**	2. **Sofa Set**
On Casting of Foundation	12.5%	**3. Dressing Table**	3. **Centre+Side Table**
On Casting of 1st Slab	12.5%	**4. LightFitting+Fans**	4. **Tv Cabinet**
On Casting of 3th Slab	12.5%	**5. Modular Kitchen**	5. **Wadrobe**
On Casting of 5th Slab	12.5%	**6. Curtain Rods**	6. **Dressing Table**
On Casting of 7th Slab	12.5%	**7. Shoe Rack**	7. **LightFitting+Fans**
On Casting of 12th Slab	7.5%	**8. Shower Curtain**	8. **Split AC's**
On Possession	5%	**9. Painting**	9. **Plasma TV**
		10. Wall Clocks	10. **Modular Kitchen**
			11. **Curtain Rods**
			12. **Shower Curtain**
			13. **Paintings**
			14. **Wall Clocks**
			15. **Geyser in all Bathroom**

Table-2

ACTIVITY	DETAILS
Security	24 Hours Patrolling Manning the entry and control room.
Horticulture	Take care of the health of the lawns, greenery and all Trees and flowers in the complex.
Sweeping/ Refuse Disposal	Sanitation and cleaning of the common areas.
Lifts	Lift AMC, assistance and technicians.
Temple	Pujaris and vidyarthis for doing all the pooja at the temple
Operation of STP, Generator Water Pump, Water Tower	Operators for the whole village complex to ensure water supply, power back up and working of STP.
Repair & Maintenance	On call electrician, plumbers, Manson for maintenance.
Administration and Activity	Administrations, activities management, account, stores, helpdesk, newsletter, stationary, and telephone cost.
Medical Services	Medical Assessment & OPD Facilities.

Table – 3

Decision Variables Type BHK S/ D/ L	X1 Type A1S	X2 Type B1D	X3 Type C2S	X4 Type D2D	X5 Type E3S	X6 Type F3D	X7 Type G3L	Target Value
GSA	509	556	799	919	1099	1269	1359	11658
Basic Price	9.16	10.01	14.38	16.54	19.78	22.84	24.46	209.82
Utility & Infra	0.51	0.56	0.86	0.92	1.10	1.27	1.36	11.67
Club	0.65	0.65	0.85	0.85	1.05	1.05	1.05	10.80
Maintenance Corpus	0.18	0.19	0.28	0.32	0.38	0.44	0.48	4.08
MRP	10.50	12.91	16.31	20.13	23.82	27.11	28.85	249.90
BTPT	0.99	1.08	1.56	1.79	2.14	2.47	2.65	22.71
Booking Advance 15% of (MRP+BTPT)	1.72	2.10	2.68	3.29	3.89	4.44	4.72	40.86
Corner Charges 5% of (Basic Price)	0.45	0.50	0.71	0.82	0.98	1.14	1.22	10.41
Park facing Charges 10% of (Basic Price)	0.91	1.00	1.43	1.65	1.97	2.28	2.44	20.91
CPS (Fixed)	0.00	1.50	0.00	1.50	1.50	1.50	1.50	22.50
Lease Charges (22Rs.PSF)	0.11	0.12	0.17	0.20	0.24	0.27	0.29	4.29
LPG PipeLine (20Rs.PSF)	0.10	0.11	0.15	0.18	0.21	0.25	0.27	3.90

BHK- Bedroom, Hall & Kitchen, BUA- Built-up Area, GSA-Gross Saleable Area, SFT-Square Feet CPS-Car Parking, MRP-Maximum Retail Price, BTPT-Buy Today Pay Tomorrow, S-Standard, D-Deluxe, L-Luxury, PSF-Per Square Feet.

WEIGHTED GOAL PROGRAMMING MODEL FORMULATION

Let b_i be the ith goal, d_i^+ be positive deviation from the ith goal and d_i^- be the negative deviation from the ith goal. The parameter (w_i^- and w_i^+) represent weights, those reflect the decision maker's preferences regarding the relative importance of each goal.

Then the problem of minimizing z may be formulated as:

$$Minimize\ z = \sum_{i=1}^{n} (w_i^- d_i^- + w_i^+ d_i^+) \quad \ldots (5.4.1)$$

Subject to

$$\sum_{j=1}^{m} A_{ij} X_j + d_i^- - d_i^+ = b_i \quad \ldots (5.4.2)$$

Non-negativity constraint,

$$A_{ij} \geq 0,$$

$$X_j \geq 0$$

$$b_i \geq 0$$

$$d_i^+ \geq 0,$$

$$d_i^- \geq 0,$$

Complementary constraints

$$d_i^+ \times d_i^- = 0$$

$$i = 1,2,\ldots,n \ and \ j = 1,2,\ldots,m$$

Where, X_j are decision variable for achieving target (goal) value and A_{ij} = matrix of "$\{a_{ij}\}$" (marginal contribution of decision variable Xj) for achieving goal b_i.

Formulating the problem, according the targets, into weighted goal programming model formulation:

$$Minimize\ z = \sum_{i=1}^{9} w_i^- d_i^- + w_i^+ d_i^+ + (w_{11}^- d_{11}^- + w_{11}^+ d_{11}^+) + (w_{12}^- d_{12}^- + w_{12}^+ d_{12}^+) + (w_{13}^- d_{13}^- + w_{13}^+ d_{13}^+) \quad \ldots (5.4.3)$$

Subject to following targets:

GOAL 1: GROSS SALEABLE AREA

$509X_1 + 556X_2 + 799X_3 + 919X_4 + 1099X_5 + 1269X_6 + 1359X_7 + d_1^- - d_1^+ = 11658$ **… (5.4.4)**

GOAL 2: BASIC PRICE

$9.16X_1 + 10.01X_2 + 14.38X_3 + 16.54X_4 + 19.78X_5 + 22.84X_6 + 24.46X_7 + d_2^- - d_2^+ = 209.82$

… (5.4.5)

GOAL 3: UTILITY & INFRASTRUCTURE

$0.51X_1 + 0.56X_2 + 0.86X_3 + 0.92X_4 + 1.10X_5 + 1.27X_6 + 1.36X_7 + d_3^- - d_3^+ = 11.67$

… (5.4.6)

GOAL 4: CLUB CHARGES

$0.65X_1 + 0.65X_2 + 0.85X_3 + 0.85X_4 + 1.05X_5 + 1.05X_6 + 1.05X_7 + d_4^- - d_4^+ = 10.80$

… (5.4.7)

GOAL 5: MAINTENANCE CHARGES

$0.18X_1 + 0.19X_2 + 0.28X_3 + 0.32X_4 + 0.38X_5 + 0.44X_6 + 0.48X_7 + d_5^- - d_5^+ = 4.08$

… (5.4.8)

GOAL 6: MAXIMUM RETAIL PRICE

$10.50X_1 + 12.91X_2 + 16.31X_3 + 20.13\ X_4 + 23.82X_5 + 27.11X_6 + 28.85X_7 + d_6^- - d_6^+ = 249.90$

… (5.4.9)

GOAL 7: BUY TODAY PAY TOMORROW CHARGES

$0.99X_1 + 1.08X_2 + 1.56X_3 + 1.79X_4 + 2.14X_5 + 2.47X_6 + 2.65X_7 + d_7^- - d_7^+ = 22.71$

… (5.4.10)

GOAL 8: ADVANCE PAYMENT BENEFITS

$1.72X_1 + 2.10X_2 + 2.68X_3 + 3.29X_4 + 3.89X_5 + 4.44X_6 + 4.72X_7 + d_8^- - d_8^+ = 40.86$

… (5.4.11)

GOAL 9: CAR PARKING SPACE CHARGES

$0X_1 + 1.50X_2 + 0.00X_3 + 1.50X_4 + 1.50X_5 + 1.50\ X_6 + 1.50X_7 + d_9^- - d_9^+ = 22.50$

… (5.4.12)

GOAL 10: CORNER CHARGES

$0.45X_1 + 0.50X_2 + 0.71X_3 + 0.82X_4 + 0.98X_5 + 1.14X_6 + 1.22X_7 + d_{10}^- - d_{10}^+ = 10.41$

… (5.4.13)

GOAL 11: PARK FACING CHARGES

$0.91X_1 + 1.00X_2 + 1.43X_3 + 1.65X_4 + 1.97X_5 + 2.28X_6 + 2.44X_7 + d_{11}^- - d_{11}^+ = 20.19$

… (5.4.14)

GOAL 12: LEASE CHARGES

$0.11X_1 + 0.12X_2 + 0.17X_3 + 0.20X_4 + 0.24X_5 + 0.27X_6 + 0.29X_7 + d_{12}^- - d_{12}^+ = 4.29$

… (5.4.15)

GOAL 13: LPG PIPELINE

$0.10X_1 + 0.11X_2 + 0.15X_3 + 0.18X_4 + 0.21X_5 + 0.25X_6 + 0.27X_7 + d_{13}^- - d_{13}^+ = 3.90$

… (5.4.16)

Non-negativity constraint,

$w_i^- = 1\ ,\ w_i^+ = 1,$

$w_{10}^- = 1\ ,\ w_{10}^+ = 2,$

$w_{11}^- = 2,\ w_{11}^+ = 1$

$w_{12}^- = 2,\ w_{12}^+ = 11,$

$w_{13}^- = 1,\ w_{13}^+ = 10$

$X_1, X_2, X_3, X_4, X_5, X_6, X_7 \geq 0,$

$d_i^-,\ d_i^+ \geq 0,$

$d_{10}^-,\ d_{10}^+ \geq 0,$

$d_{11}^-,\ d_{11}^+ \geq 0,$

$d_{12}^-,\ d_{12}^+ \geq 0, d_{13}^-,\ d_{13}^+ \geq 0$

Complementary constraints

$d_i^+ \times d_i^- = 0,$

$i = 1,2, \ldots, 13$

X_1, X_2, X_3, X_4, X_5, X_6, X_7, are the decision variables (type of apartments of different square feet) of goals, while d_i^- is the negative deviational variable of the i^{th} goal, it represents the level by which the target level is under-achieved and d_i^+ is the positive deviational variable of the i^{th} goal, it represents the level by which the target level is over-achieved.

Cost of each particular corresponding to each type of apartment (shown in Table-3) have been taken as contribution of decision variables (X_1, X_2, X_3, X_4, X_5, X_6, X_7) in weighted goal programming model formulation.

SOLUTION

The solution of the above formulated problem through simplex method using TORA computer software package are-

$X_1 = 3,\ X_2 = 0,\ X_3 = 0,\ X_4 = 3,\ X_5 = 3, X_6 = 0,\ X_7 = 3$

$d_9^+ = 9\ ,\ d_{12}^- = 2\ ,\ d_{13}^- = 2$, Results analysis shown in Table 4 and Table 5.

In model formulation, weights assigned to the deviational variables for first nine goals are equal as $w_i^- = 1, w_i^+ = 1$ and weights assigned to the deviational variables for rest four goals are unequal as: $w_{10}^- = 1, w_{10}^+ = 2, w_{11}^- = 2, w_{11}^+ = 1, w_{12}^- = 2, w_{12}^+ = 11, w_{13}^- = 1, w_{13}^+ = 10.$

In this sequence consider nine sets of weights shown in Table 6 at S.No.2 to S. No. 10. Assign these weights one by one to deviational variables in presented goal formulation and solve by through simplex method using TORA computer software. We get set of values of decision variables and deviational variables shown in

Table-4 at S. No. 2 to S.No.10 and Table 5 at S.No.2 to S.No.10.

Result analysis shows that many solution set have same values out of 10 solution sets in Table 4, so summarize these in common three set of solution shown in Table-4A and using these results we get M.R.P. (in Lacs.) from equation 5.4.9, for make a comparison with original target value of M.R.P as an example to proven best set of result in compare to other set of results.

Table 4: Decision Variable

S. No.	1	2	3	4	5	6	7	8	9	10
X_1	3	0	0	0	3	3	3	3	4	4
X_2	0	3	3	3	0	0	0	0	0	0
X_3	0	0	0	0	0	0	0	0	0	0
X_4	3	0	0	0	3	3	3	3	6	6
X_5	3	0	0	0	3	3	3	3	0	0
X_6	0	0	0	0	0	0	0	0	0	0
X_7	3	7	7	7	3	3	3	3	3	3

Table-4A

Decision Variable	Result-I	Result-II	Result-III	Actual MRP (in Lacs.)	MRP (in Lacs.) Corresponding To Result -I	MRP (in Lacs.) Corresponding To Result -II	MRP (in Lacs.) Corresponding To Result -III
X_1	4	0	3	10.5	42	0	31.5
X_2	0	3	0	12.91	0	38.73	0
X_3	0	0	0	16.31	0	0	0
X_4	6	0	3	20.13	120.78	0	60.39
X_5	0	0	3	23.82	0	0	71.46
X_6	0	0	0	2.11	0	0	0
X_7	3	7	3	28.85	86.55	201.95	86.55
				49.90	**249.33**	**240.68**	**249.90**

Table 5: Deviational Variable

S. No.	1	2	3	4	5	6	7	8	9	10
d_1^-	0	65	65	65	0	0	0	0	0	0
d_1^+	0	0	0	0	0	0	0	0	0	0
d_2^-	0	1	1	1	0	0	0	0	0	0
d_2^+	0	0	0	0	0	0	0	0	0	0
d_3^-	0	0	0	0	0	0	0	0	0	0
d_3^+	0	0	0	0	0	0	0	0	0	0
d_4^-	0	1	1	1	0	0	0	0	0	0
d_4^+	0	0	0	0	0	0	0	0	0	0
d_5^-	0	0	0	0	0	0	0	0	0	0
d_5^+	0	0	0	0	0	0	0	0	0	0
d_6^-	0	0	0	0	0	0	0	0	0	0
d_6^+	0	0	0	0	0	0	0	0	0	0
d_7^-	0	0	0	0	0	0	0	0	0	0
d_7^+	0	0	0	0	0	0	0	0	0	0
d_8^-	0	0	0	0	0	0	0	0	0	0
d_8^+	0	0	0	0	0	0	0	0	0	0
d_9^-	9	7	7	7	9	9	9	9	0	9
d_9^+	0	0	0	0	0	0	0	0	0	0
d_{10}^-	0	0	0	0	0	0	0	0	0	0
d_{10}^+	0	0	0	0	0	0	0	0	0	0
d_{11}^-	0	0	0	0	0	0	0	0	9	9
d_{11}^+	0	0	0	0	0	0	0	0	0	0
d_{12}^-	2	2	2	2	2	2	2	2	2	2
d_{12}^+	0	0	0	0	0	0	0	0	0	0
d_{13}^-	2	2	2	2	2	2	2	2	2	2
d_{13}^+	0	0	0	0	0	0	0	0	0	0

Table 6: Weights Taken

S. No.	1	2	3	4	5	6	7	8	9	10
w_1^-	1	0	0	0	1	1	1	1	1	1
w_1^+	1	1	1	1	1	1	1	1	1	1
w_2^-	1	0	0	0	1	1	1	1	1	1
w_2^+	1	1	1	1	1	1	1	1	1	1
w_3^-	1	0	0	0	1	1	1	1	1	1
w_3^+	1	1	1	1	1	1	1	1	1	1
w_4^-	1	0	0	0	1	1	1	1	1	1
w_4^+	1	1	1	1	1	1	1	1	1	1
w_5^-	1	0	0	0	1	1	1	1	1	1
w_5^+	1	1	1	1	1	1	1	1	1	1

w_6^-	1	0	0	0	1	1	1	1	1	1
w_6^+	1	1	1	1	1	1	1	1	1	1
w_7^-	1	0	0	0	1	1	1	1	1	1
w_7^+	1	1	1	1	1	1	1	1	1	1
w_8^-	1	0	0	0	1	1	1	1	1	1
w_8^+	1	1	1	1	1	1	1	1	1	1
w_9^-	1	0	0	0	1	1	1	1	1	1
w_9^+	1	1	1	1	1	1	1	1	1	1
w_{10}^-	1	0	0	0	1	1	1	1	1	1
w_{10}^+	2	1	2	1	2	2	2	2	2	2
w_{11}^-	2	0	0	0	2	2	2	2	2	2
w_{11}^+	1	2	1	1	1	1	1	1	1	1
w_{12}^-	2	0	0	0	2	0	0	1	11	11
w_{12}^+	11	10	11	1	1	2	11	10	10	1
w_{13}^-	1	0	0	0	1	0	0	1	10	10
w_{13}^+	10	11	10	1	2	1	10	11	11	1

DISCUSSION AND CONCLUSION

According to values of deviational variables shown in Table-5, that maximum number of goals have been achieved completely and some goals under achieved, No one over achieved, because of all $d_i^+ = 0$ for $i = 1,2, \dots, 13$. It clearly shows that maximum difference between Basic price and Maximum retail price appearance when gross saleable area are 1359 sq. ft, 1099 sq. ft, 919 sq. ft, 509 sq. ft. This implies that maximum profit can be achieved according to result-III.

Total amount earn from other charges (charges on facilities decided by builder) corresponding to decision variable according to results (I, II, III) it is that total charges earn accordingly from various results, it is maximum accordingly result-III. Finally conclude that the result –III, provide best decision for decision makers to earn maximum profit in construction.

Here we are trying to present a model of goal programming for a construction field as today's requirement as a frame work taking a sample data and few goals from a running construction project. It can be extended to the entire construction project or in practical project management decisions with different grades and sizes. This can be applied to any construction industry by taking many goals. The weighted goal programming model designed here attempts to simultaneously minimize total project costs with reference to direct costs, indirect and contractual penalty costs, duration of activities and the constraint of available budget.

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CLOUD COMPUTING AS A TOOL FOR REVIVAL OF SICK SPONGE IRON INDUSTRIES

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ABSTRACT

Cloud computing is the idea that all forms of computing can be delivered wholly over the Internet and is based on cloud drawings. Cloud computing is a cluster of shared servers those provide Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) to enormous number of resources and hosting to customers on a free or payment as per their use basis. It affects the regular conventional process because one should not have to go to the workspace to collect information which affects monetary transactions in IT spending. Sometimes it is reported on the manner in which companies make their solutions without proper knowledge about the architecture, model and services provided by cloud computing. The information is digitized and provided as a service in the cloud computing model. The cloud mimics an online data store which users can easily access by simple authentication process without any prior training on managing the resources involved and simultaneously users concentrate on their core business processes. Cloud computing customers are not supposed to own the infrastructure physically; rather the usage is taken on rent from a third-party provider. The proper implementation of cloud services reduces cost by sharing hardware, software and services. As the data is stored in remote servers and duplicate copies are maintained redundantly so recovery from failure is not a herculean task. The ability of scale up or down depending upon demand has made it more convenient option among different segment of customers. This paper is organized as related work done by several researchers as documentation and discusses about the security in cloud infrastructure, its key issues and open challenges. This describes different cloud situations to be applied to a cluster of sponge iron industries in the state and can be applied to other industries as well; the concept could be an eye opener for reviving the sick industries in the nation perspective.

KEYWORDS: Cloud Computing, Cloud Infrastructure, Cloud Services, Cloud Mimics And Digitized

Cloud computing is a term used to describe computing that is based solely on the Internet. The cloud is like a online virtual ware house with unlimited storage capacity where stuff is stored and easily accessed, especially web-based services and applications. It's called the cloud because it's out there for everyone to use, and also because the complex infrastructure that makes it possible remains hidden to the user. The other important thing to note about cloud computing is that it is all hosted by a major cloud computing service provider, which means you don't necessarily need the physical hard disk space to support your activities. Understanding the premise of cloud computing is important if one learns how to benefit from it.

Cloud computing is good for any business because of customer relationship management. It's no secret that people have flocked to the Internet in droves for all sorts of things. In some cases, it's to communicate with friends and family, but it's also to look for products and keep track of their favorite companies and brands. Getting involved with these services is a key way to reach the target consumers.

Cloud computing solutions have had a substantial impact on the way in which business is conducted, both internally and within the marketplace as a whole. The advantages have been significant, and since cloud computing developments have not even reached their full potential and are still in their infancy, there is vast room for further growth and effects on the marketplace. Offering Web-based cloud computing solutions can help your business in a number of ways.

ADVANTAGES OF CLOUD COMPUTING

Limit use of IT Resources

First, by contrast, compare the information technology (IT) efforts required with on-premise software versus cloud computing. On-premise software requires that each individual work station is installed with software that must also be legally licensed to that work station[1]. The software functions independently of other work stations, and so, too, is its maintenance. This requires time, energy, and cost, as businesses have had to hire IT staff and even, depending on the business size, entire IT departments to ensure that each work station's software is maintained and functioning

properly. With cloud computing solutions, the software is Web-based, and requires only Internet access and a Web-browser.

Easy Storage and Maintenance

Not only does the Web-based software not require any installation or IT maintenance within your business, but the responsibility of storing, maintaining, and processing the information on the software is outside of the company [1][2]. Any glitches or malfunctions, should there be any, are handled elsewhere—remotely, on the cloud—meaning that the business need not participate in concern over such problems.

Improve Internal Communications

Cloud computing solutions can work wonders in improving the internal communications of the business. With on-premise software, data may be stored in one or more computers, and often requires manual entry and tedious communication efforts. The margin for miscommunication error is, thus, not quite large.

Accurate, Real-Time Information

Cloud computing solutions also ensure that the data is accurate and current. Web-based solutions focused on customer relationship management (CRM) track, store, and monitor all the activity of individual customers, but perhaps even more significantly, it is done in real-time[4]. This means that any permitted employee or executive can retrieve data on-demand and compile reports that accurately reflect the most up-to-the-minute information.

Drives

By having accurate, up-to-the-minute data, sales and marketing departments have readily available information with which to more rapidly begin formulating sales and marketing strategies.

Understand the Customer

The marketing and sales department have access to accurate and current information, which can be easily analyzed and opportunities for growth can be exploited using sales strategies those are specially tailored to meet the specific needs of customer.

Improved Customer Relationship Management

Since sales and marketing initiatives become customer centric and customers are allowed to personalize their buying exchanges with the business, this wholly improves customer relationship management, which is very crucial for the success of a business in current market scenario.

Use Resource Elsewhere

Cutting out the administrative work associated with manually keeping information, the same resources can be spent elsewhere, like tracking sales leads.

Better Business Tracking

By implementing cloud computing solution gives the ability for top executives, partners and company heads to carefully monitor the business's profitability, with more accuracy up-to the minute information.

Cut Costs

Businesses will find that cloud computing solutions ultimately cut costs. Costs will be cut in data entry, customer service call centers, IT departments and marketing research.

THE FUNCTIONALITY OF CLOUD COMPUTING

The strong emergence of cloud computing, particularly in the business world, has had a tremendous impact on the computer age. Cloud computing solutions have relieved businesses of many former information technology problems, increased efficiency, streamlined operations, improved sales and marketing strategies, and have ultimately increased productivity levels of businesses of all sizes[8]. Cloud computing has relieved many of the problems and issues associated with on-premise software. On-premise software requires that each individual computer work stations software is installed, and legally licensed (which, for mid to large-sized companies can cause confusion and tedious work efforts). This software runs on each station independently, and maintenance must be performed independently as well, requiring time, energy, and more often an, additional staff [9]. Cloud computing solutions only require that the user have access to the Internet and a Web browser through any device which can facilitate the connectivity services and the bulky work stations are out of the picture. The cloud removes time-consuming and costly IT responsibilities from the business responsible for the maintenance and upkeep the software provided thereby [12].

Cloud computing also improves the internal communications of a business. With all permitted users accessing the same software and viewing the same data on the same interface, the margin for miss-communication is extremely slim, if not eliminated in its entirely. On-premise software requires that databases and spreadsheets be revised, and then that those revisions be communicated [13]. Having accurate information, readily available and current, then, is something that requires tedious sub-tasks, and therefore, ultimately, more time and energy. With cloud computing solutions, these tasks are eliminated. The information reflected and monitored on the Web-based software is accurate; revisions are reflected automatically; and the data is available on-demand. All decision makers and permitted employees have access to the same information, and therefore functions can be performed more rapidly. Also, because the information is accurate and available in real-time, sales and marketing initiatives are improved substantially. Having accurate and up-to-date information is key for marketers and salespeople to formulate sound sales and marketing strategies [10]. Customer data stored in the cloud computing software can be compiled, segmented, and analyzed much more rapidly. Marketers can create specific reports that segment the data, such as demographics, geographic location, purchasing times, and whichever category or segment is applicable to the business. Because these reports can be produced on-demand, the ability to interpret the data to identify consumer behavior, either in trends or patterns, or identify product areas or times of low or high sales volumes, is a much faster process. Sales and marketing initiatives can thus be developed and implemented much more rapidly, which ultimately improves a business' response time, strengthening it alongside competitors in the marketplace [11].

It also benefits the customers as well. Being able to identify the trends, patterns, buying behaviors, and demands of customers, sales and marketing efforts can be tailored to meet the specific needs of the customers. The buying experience for customers, therefore, is more pleasing, in that it is easier, more convenient, and faster by appealing to the customer's needs, adding a higher value and more stable positioning to the business in the customer's mind. The way cloud computing solutions improves customer relationship management, then, is mutually beneficial to both sales and marketing executives and the customers themselves. Amazon is an example of how cloud computing solutions have improved customer relationship management in ways that are mutually beneficial. Amazon, with its use of revolutionary cloud computing technology, has devised sales efforts so specific and so tailored to their customers' needs that the results have only proven how important such tailored approaches are [15]. Their customer relationship management is basically responsible for establishing the company's entire brand positioning, and maintaining its smooth, friendly relationship with its customers.

THE FUTURE OF CLOUD COMPUTING

We are still at the beginning of the cloud computing business model, so it is important for any business that relies on its services to look ahead to see the improvements of technology in the upcoming days. Couple of years ago, the earlier version of cloud computing failed when "thin client" services mostly failed to take hold; today, however, the infrastructure has been tremendously developed over a long period of time [17][9]. The popularity and awareness about the cloud has increased the commercial interest of the cloud industry hence the next ten years will make cloud computing more powerful, reachable and reasonable.

We can expect to see a change to the ways in which we interact with computers in general, thanks to new mobile platforms such as smart phones and net book computers. An iPhone is far more than a telephone and an Internet media connection; with the right software, it can be used as a complete mobile computing device, and as on-the-fly dashboard to essential business services [8].

You should expect to see ubiquitous, fast Internet connections become the norm for such devices, as 4G telecommunications and wide area wireless hotspots are implemented. Far-reaching connectivity and easy mobile hardware expands the range of when work can be completed, and widens the range of what that work can entail [16]. Finally, look for increasing maturity in deployment of cloud-based security and reliability, as well as the business understanding necessary to maintain that security within the organization

THE GLOBAL ECONOMICS OF CLOUD COMPUTING

The optimal production is completed by units (countries, people, etc.) with the greatest comparative advantage, and that the brain child, following this principle to the latter is global and free trade. When it comes to product support, the Internet is a great equalizer [18]. As long as information is communicated in a recognized language and technicality, customers will flock to online help desks when they seek assistance. In the meantime, corporations can outsource production of help desks while they focus on what they do best – producing their product [12].

Cloud computing is the current trend which is fueling such international partnerships. Say a marketing department needs someone to administrate their customer relationship management database, but they do not have the resources to perform that administration in-house. So, they send the data via the Internet to a company in Thailand which will provide servers and administration panels that allow the marketing department to add to the database without having to worry about its safety and security [14]. Essentially, cloud computing is like attaching an auxiliary IT department of the exact size and scope necessary whenever they are needed.

Sponge Iron Industries can use the tremendous power of cloud to subordinate many services those can be easily handled by clouds in a more distributed and secure way. While manufacturers focus on producing their product, they can outsource technology needs to exterior companies which have a comparative advantage in providing these services [15]. These exterior companies may be across the street, but cloud computing transforms the distance into a negligible issue.

Free trade is the natural result of following the principle of comparative advantage. However, protective tariffs and duties prevent this process from coming to fruition. As such, the impact of cloud computing on the global economy will only be as large as governments allow it to become. This is true for each and every time international companies attempt to provide a new and innovative process.

BUSINESS APPLICATIONS OF CLOUD COMPUTING

Variety of business applications [5]. In today's technology driven business environment, it is crucial to find a system that supports those applications that will drive your business to success. What kind of business applications does cloud computing support? The short answer is that cloud computing can support practically any business application your company requires [18]. However, elaboration is needed to express the versatility of cloud computing and how that versatility can satisfy any business application need.

Just as there are many types of businesses, there are an abundance of business applications that a computing system must support. As a business chooses its application requirements, it is important to understand the company's needs and identify the particular applications that the computing system must support [17]. Some of these applications are: product information dissemination, design and manufacture support requirements, inventory and production control, accounting and payroll functions, quality assurance and control constraints, and shipping tracking needs. These are but a few of the many requirements that are business applications supported by cloud computing systems. Each of these applications have nuances within themselves and cloud computing systems, with their versatile scalability can easily support them [17] [18].

Cloud computing systems can easily support those applications that meet both you and your customer's expectations. How about purchasing, inventory control, and manufacturing requirements? Cloud computing systems easily support all of the platforms that control the purchase, manufacture, and product in a real-time, "just as needed" environment. However, while these production and quality control functions are easily supported by cloud computing systems, they are by no means the only applications cloud computing business systems can handle. Customer relationship management (CRM) is an important function in any business, and cloud computing supports a myriad of CRM functions [17]. CRM abilities of Cloud computing in areas such as marketing helps generate leads and monitors customer activities to more effectively use information for your sales department. Activity management through cloud computing applications help you answer customer

generated queries in a confident manner, thus building and strengthening your client relationship. Other CRM capabilities found in cloud computing can be realized through assignment management to employees who are most effective in satisfying your customers questions or complaints [16]. In addition, cloud computing supports a variety customer relation functions such as "help-desks," which answer customer inquiries in a real-time environment.

These are just some of the business applications found with cloud computing, but there are many others, and company can benefit from each and every one.

ATTRACTING CUSTOMERS WITH CLOUD COMPUTING

One of the most common challenges for any business is how to attract new customers, while still retaining and satisfying existing customers. Especially in the internet age – which makes it extremely easy for a savvy shopper to research companies, products, prices and customer service – getting new customers on board with your company can be particularly difficult [19]. Why not use the internet and, more specifically, the cloud computing revolution, to help grow your business through attracting new customers?

Cloud computing is the ideal platform for a customer relationship management system. By enabling all users to be on the same page, and view the same up to date information, the cloud helps many diverse departments – sales, marketing, advertising, customer service, even executive management – to communicate more effectively with one another [17]. Market research data, feedback from customers, Internet buzz, even competitors' promotional campaigns can all be analyzed using sophisticated techniques in order to compile a complete picture of both current and prospective customers [18]. The marketing and advertising departments can use this information to identify their target audience and create focused promotions and campaigns. Sales projections are also easy to formulate with cloud-based applications.

CONCLUSION

Because using the cloud can help automate processes, sales representatives are able to focus on wooing customers. They can also get the information they need, such as inventory quantity, pricing or discount approvals, and presentation content, in order to close the deal on the spot. Cloud-based customer relationship management systems can also harness the power of social media and Web-driven campaigns to generate and manage leads. Potential customers can be gleaned from Web site traffic, social networking sites, and traditional Internet advertising methods such as banner ads or pop-up ads, and can be seamlessly integrated into the system or routed to salespeople. When a new or potential customer reaches out to a agent, whether to ask a question or place an order, that agent is empowered by the impact of cloud computing on customer relationship management to access the most timely, reliable information possible – price; current or future promotions; in-stock verification; or services, features or upgrades that may be available. They can also be provided with opportunities to up sell or cross sell depending on the customer and the product. Delivering exemplary customer service is one great way to attract and retain new customers. The benefits of a cloud-based customer relationship management initiative are many. One of the most valuable of those benefits, however, is the intersection of information and customer service.

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ROLE OF MOMENTS IN FINGERPRINT RECOGNITION

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Abstract

Orthogonal rotation invariant moments are powerful region based image descriptors that find vast applications in many pattern recognition and image processing applications. Moments play an impotent role in image analysis and invariant pattern recognition. They have two types orthogonal moments and non-orthogonal moments. Orthogonal moments perform better than non-orthogonal moments, they have properties such as robustness to image noise and geometrical invariant properties such as scale, rotation and translation. The popular continuous orthogonal moments are Zernike moments, Pseudo Zernike moments, Orthogonal Fourier Mellin moments, Chebyshev Harmonic moments, Radial Harmonic Fourier moments and Discrete Orthogonal moments are Tchebichef moments, Krawtchouk moments etc. They have the ability to characterize digital information with minimum redundant information and therefore have been used in various areas such as face recognition, fingerprint recognition and image reconstruction etc. This paper presents comparative analysis of continuous and discrete moments in the field of fingerprint recognition.

1. Introduction

Fingerprints recognition refers to the automated method of verifying a match between two fingerprints of the same person. Fingerprints include patterns such as ridges and minutiae points. A ridge is a curved line in finger image and minutiae are the major features of a fingerprint. A fingerprint recognition system can be used for both verification and identification. A fingerprint sensor is used to capture a digital image of fingerprint pattern. Pre-processing includes image enhancement, image binarization and image segmentation. Moments are used for feature extraction. They have image representation capability. In this paper we will analyze the performance of moments on image analysis and compare their results.

Moments gives information about geometrical features of the image. Non orthogonal moments are decomposed into complex moments, geometric moments and rotational moments. Orthogonal Moments are divided into two categories discrete and continuous moments, they have interesting features for image applications. Orthogonal moments specify independent features of the image; therefore, their information redundancy is minimum. Orthogonal moments have many applications in pattern recognition and image analysis because they have ability to represent image features. Continuous orthogonal moments are Zernike moments (ZMs), Legendre moments(LMs), Pseudo Zernike moments (PZMs), Radial Harmonic Fourier moments (RHFMs), Chebyshev's

Harmonic Fourier moments (CHFMs) and Orthogonal Fourier Mellin moments (OFMMs). The discrete orthogonal moments are Tchebichef moments,Racah moments, Krawtchouk moments and Dual Hahn moments have also been introduced. Orthogonal Rotation Invariant Moments (ORIMs) are wide variety of applications and imaging science is one of the significant application areas. ORIMs have invariant to rotation property. They can be made invariant to translation and scale [1, 2]. Jacobi-Fourier moments (JFMs) are a generic class of ORIMs investigated by Ping *et al.* [3]. Hoang and Tabbone [4] introduced a wide range of ORIMs. Teague [5] presented orthogonal Zernike moments and Legendre moments which are less sensitive to noise and has rotation invariance property. ZMs are very useful in fingerprint recognition and image processing. Bhatia and Wolf [6] introduced pseudo Zernike moments. ZMs and PZMs have similar characteristics of their minimum information redundancy and noise sensitivity. Sheng and Shen [7] presented Orthogonal Fourier Mellin moments. In terms of noise sensitivity for small size of images, OFMMs perform better than ZMs and PZMs. Because the repetition parameter q in ZMs and PZMs polynomials is not independent. Orthogonal radial moments are computationally complex and numerically unstable at higher order of moments. Radial Harmonic Fourier moments (RHFMs) [8] are introduced to minimize these problems, which are also orthogonal. These moments face the problem of numerical instability in computing higher order moments. Because many factorial terms are involved for calculating the moments. Chebyshev-Fourier moments are special cases of JFMs. CHFMs are introduced by Ping *et al.* [9]. They have observed that it possess better reconstruction capability and noise sensitivity as compared to OFMMs. The computations of CHFMs involve factorial terms, which are computation intensive. Upneja and Singh [10] have proposed fast computation of JFMs of which CHFMs are a special case. Discretization error is the main problem with continuous momentsintroduced by Yap et al. [11]. Discrete orthogonal moments are introduced to minimize these problems. Zhu et al. [12, 13] have shown that Dual Hahn and Recah discrete orthogonal moments are more superior than continuous moments in terms of robustness to noise. Mukundan [14] introduced another set of discrete orthogonal moments is known as Tchebichef moments. TMs do not include any numerical approximation. So this property makes TMs superior. The new set of discrete orthogonal moments is known as Krawtchouk moments [15, 16]. The Krawtchouk moments can be used to extract local features of the image but other moments capture only global features of the image. Hmimid et al. [17] investigated Charlier moments. Charlier invariants moments are used in pattern recognition.

2. Feature Extraction

Feature extraction means calculate features to define the behaviour of the image and useful in classifying and recognition of images. Orthogonal radial moments are used for feature extraction. These moments are selected as feature extractor due to its properties like geometrical invariant properties, orthogonal properties and robustness to image noise.

3. Orthogonal Radial Moments

Orthogonal Radial moments are commonly used in pattern recognition. They are able to characterize digital information with minimum redundant information. Orthogonal radial moments have invariant properties; therefore, they are useful in feature extraction. Feature extraction is useful for achieving high recognition. Invariant means an image feature remains unchanged if that image undergoes the geometrical changes such as scale, rotation, translation and reflection. Orthogonal radial moments are specify independent features of the image; therefore, their information redundancy is

minimum. There are various efficient moments which are used in feature extraction.

4. Fingerprint Recognition Techniques

There are various prominent fingerprint recognition techniques which are used in fingerprint matching and can be divided into three types such as minutiae based technique, correlation-based techniques and pattern-based techniques.

4.1 Minutiae Based Matching

In this technique, extract the minutiae of template and input image are from the same finger. Fingerprint verification is obtained by using minutiae matching (point wise matching) instead of pixel-wise matching. This technique includes two stages alignment stage and match stage. Firstly match the ridges of two minutiae points and in the alignment stage, two minutiae are aligned for matching. The minutiae-based technique includes finding the alignment between the two images. It gives results in maximum no. of minutiae pairing.

Wahid, Tasweer and muhammed [24] has applied Minutiae based technique for fingerprint verification. Fast Fourier transform is used to enhance the image and converted into binary image. In next step minutiae of images are extracted. Then match the two minutiae points.

Sahuet al. [26] introduced minutiae based technique with low FRR rate. In this paper image enhancement, feature extraction and minutiae matching is included. Hough transform is applied for robustness and distortion of fingerprint image.

Jiang et al. [27] presented Local and Global structures of minutiae for fingerprint matching. The local structure of minutiae defines the rotation and translation invariant features of image. Global structure describes the uniqueness of fingerprint image. The minutiae matching through local structure are less reliable. So to improve the reliability, global structure is used.

4.2 Pattern Based Matching

The performance of pattern-based matching technique is better. Ridges and valleys are used for fingerprint verification. Pattern-based technique compared basic fingerprint patterns (arch, whorl, and loop) between input and enrolled images.

Jin et al. [9] presented a hybrid method to improve the fingerprint recognition rate by using pattern based matching techniques. This technique is used for feature extraction. To find the similarity between two objects Euclidean distance is used. After improvement of matching score 98.75% is obtained. The performance of hybrid method for both low and high quality images is able to achieve 100% recognition rate.

Patel et al. [29] In this paper effective fingerprint matching based on pattern based technique is discussed. The quality of input image doesn't matter is the main advantages of this paper. In pre-processing, first the image is converted into gray scale image then it converted to binary image. In post processing, all the features of image are extracted.

4.3 Correlation Based Matching

The correlation-based technique is used to compare the grey level images and find a correlation between input and enrolled images for each corresponding pixels. It is based on the local features of the image. In global features of the image, results obtained from different impressions of the same finger are inaccurate.

Lindoso et al. [30] introduced correlation based fingerprint matching with orientation field alignment. In this paper, alignment step is introduced to reduce the amount of correlation. The pre-processing includes steps: Normalization,Low frequency filter, Orientation field frequency map, Gabor filtering, Equallization. Fingerprint matching has

three steps: image alignment, selection of correlation regions, correlation based matching. For correlation local regions are used. The orientation field is used to select local region of correlation. This paper presented that the Fingerprint matching accuracy are improved.

Bazen et al. [32] presented a correlation based fingerprint verification system. For bad quality images correlation based fingerprint verification system is used because no minutiae can be extracted reliably from them. In this paper, instead of using minutiae locations they use directly gray level information from input image. Because it includes much richer information then minutiae locations. As compared to other approaches it does not require pre-processing. It is capable to dealing with non-uniform shape distortions problems.

Sandbhor et al. [31] In this paper correlation based fingerprint recognition technique is discussed. It uses pixel values of image and gray scale information. Correlation based fingerprint recognition technique chooses template, pixel values of template which is correlates with pixel values of database image and see the maximum value which is greater than threshold value. This technique is less time consuming.

5. Comparative Analysis

In this section, we did comparative analysis of various continuous and discrete moments**.** Table (I) details the moments and their performance metrics.

TABLE1. Comparative Analysis of Moments on Fingerprint Recognition

Moments	**Reference**	**Highlights**	**Results**
Zernike moments	Qader et al.[20]	Region of interest, Euclidean distance, ZMI feature extractor	ZM is able to match the fingerprint image with recognition rate 92.89%
Pseudo Zernike moments	Deepika et al. [21]	ROI extraction, Wavelet transform, Bayes net classifier	At lower order moments, PZMs gives accuracy of the system is 96.89%.
Orthogonal Fourier mellin moments	Sheng et al.[7]	Noisy image reconstruction error, Signal to noise ratio	Orthogonal Fourier mellin moments perform better than Zernike moments for small size of images.
Radial Harmonic Fourier moments	Kejia et al.[24]	Feature extraction, normalization	The accuracy of the system was found to be 99.57% in real world datasets and 99.49% in artificial datasets.
Chebyshev Harmonic Fourier moments	Ping et al.[9]	Noisy image reconstruction error, Signal to noise	The performance of CHFMs in describing images in comparison

		ratio	with performance of the OFMMs is investigated. Both have almost the same performance
Legendre moments	Saradha et al.[25]	Linear discriminate analysis, nearest neighbour, Euclidean distance	A good recognition percentage 98.25% is achieved with feature representation using Legendre moments. It is found superior to Hu's moments.
Racah moments	Zhu et al.[12]	Racah polynomials, weighted racah polynomials, recurrence relation	The results show the behaviour of the racah moments over the other transforms in terms of compression capability is superior.
Krawtchouk moments	Yap et al.[15]	Krawtchouk polynomial, Weighted Krawtchouk polynomials, recurrence relation	In both noisy and noise free conditions, Krawtchouk moments have better performance than Hu's moments.
Tchebichef	Mukundan	Tchebichef	The Tchebichef
moments	et al.[14]	polynomials, orthogonal moments	moments have superior feature representation capability as comparative with Zernike and Legendre moments.
Dual Hahn moments	Zhou et al.[26]	Hahn polynomials, mean square error	Comparative analysis of Chebyshev moments, Krawtchouk moments and Hahn moments shows that the Dual Hahn moment is superior then others in terms of reconstruction methods.
Charlier moments	Hmimid et al.[19]	Mean square error, Euclidean distance, Charlier discrete orthogonal polynomials	Under noisy conditions, The Charlier moments are more robust to image transformations.

6.Conclusion

Fingerprint recognition is a modern imaging technology. In this paper, we have explained discrete orthogonal moments and continuous orthogonal moments along with their performance analysis. These moments are invariants to scale, rotation and translation; therefore, they are used for feature extractor. Comparative analysis of continuous and discrete moments in the field of fingerprint recognition is presented. ZMs and PZMs have ability to match the fingerprint image with high accuracy. For small size of mages OFMMs perform better than ZMs and PZMs. CHFMs and OFMMs have same performance in describing the image. LMs are found superior to Hu's moments. The results show that behaviour of RAMs in terms of compression capability is good. The feature representation capabilities of TMs are superior to ZMs and LMs. Both in noisy and noise free conditions, KMs are used. The DHMs based reconstruction method is superior to CHFMs and KMs. CMs gives good recognition accuracy. Prominent fingerprint recognition techniques which are used for the fingerprint matching have been discussed in this paper.

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Advancements in Microstrip Patch Antennas: A Comprehensive Review

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Abstract

Microstrip patch antennas (MPAs) have emerged as one of the most widely adopted antenna structures due to their low profile, lightweight nature, ease of fabrication, and compatibility with planar and non-planar surfaces. Since their conceptual foundation in the early 1970s, MPAs have undergone significant advancements to meet the ever-growing requirements of modern wireless communication systems. This review examines the evolution of MPA technology with emphasis on design innovations, performance enhancement techniques, and emerging application domains. Recent developments—including metamaterial loading, defected ground structures (DGS), substrate integrated waveguides (SIW), reconfigurable techniques, and multiple-input multiple-output (MIMO) concepts—have addressed classical limitations such as narrow bandwidth, low gain, surface wave losses, and polarization constraints. The paper also analyzes contributions from the past decade, including graphene-based MPAs, flexible and wearable antennas, millimeter-wave designs, and integration of artificial intelligence for optimization. Despite notable improvements, challenges remain in achieving ultra-wideband operation, reduced mutual coupling in compact arrays, high-efficiency mm-wave radiation, thermal robustness, and seamless integration with future 6G and IoT infrastructures. Key research gaps are identified, followed by a synthesis of future directions, emphasizing hybrid material engineering, intelligent reconfiguration, bio-integrated antennas, and quantum-inspired designs for future wireless platforms. The review concludes that microstrip patch antennas will continue evolving as indispensable components across communication, sensing, biomedical, defense, and space technologies, supported by continual advances in fabrication technologies and computational modeling.

1. Introduction

Microstrip patch antennas were first conceptualized in the early 1970s by Howell and Munson, who demonstrated that a metallic patch placed over a dielectric substrate could radiate effectively while maintaining a low profile and simple geometry (Munson, 1974; Howell, 1972). During this early phase, MPAs gained attention due to their lightweight planar structure, simple manufacturability using printed circuit board (PCB) technology, and compatibility with conformal surfaces—features that made them particularly suitable for airborne and spaceborne systems (Bahl & Bhartia, 1980).

The basic MPA consists of a radiating metal patch, a dielectric substrate, and a ground plane. Early configurations commonly used rectangular and circular patches due to the availability of closed-form analytical models for resonant frequency and input impedance. However, these early designs suffered inherent drawbacks, including narrow bandwidth (typically 2–5%), low gain (around 6–7 dBi), low power-handling capability, and strong excitation of surface waves (Pozar & Schaubert, 1995). From the late 1980s to early 2000s, researchers focused on overcoming limitations of bandwidth and efficiency. Bandwidth enhancement was addressed through techniques such as using low permittivity substrates, stacking patches, employing parasitic elements, slotting the patch, and modifying ground plane geometries (Kumar & Ray, 2003). Aperture-coupled and proximity-coupled feeding mechanisms were introduced to improve impedance matching and broaden bandwidth. The introduction of electromagnetic bandgap (EBG) structures marked a major milestone, effectively suppressing surface waves and enhancing forward radiation (Yang & Rahmat-Samii, 2009).

With the rapid expansion of wireless technologies in the 21st century, MPAs diversified into mobile communication, RFID, GPS, WLAN, satellite communication, biomedical sensing, and radar systems. The emergence of millimeter-wave (mm-wave) communication and 5G triggered another surge in research, focusing on high-frequency behavior, miniaturization, and integration with array and beamforming architectures (Hong & Lancaster, 2001). Advances in materials science further accelerated improvement. Composite substrates, flexible polymers, textile materials, and more recently graphene and 3D-printed substrates expanded the possibilities for wearable and conformal antennas (Zhang et al., 2017). Researchers also explored artificial materials such as metamaterials and metasurfaces, which enabled extraordinary electromagnetic responses, including negative permeability or permittivity, not possible in natural materials (Caloz & Itoh, 2006). These materials significantly improved bandwidth, gain, and polarization control.

In recent years, reconfigurable and tunable MPAs have gained prominence. Techniques such as PIN diodes, varactors, MEMS switches, phase-change materials, and liquid-metal channels allowed antennas to dynamically alter frequency, polarization, and radiation patterns (Bernhard, 2007). This adaptability is essential for cognitive radio, multi-band systems, and intelligent communication networks. Furthermore, the evolution of multiple-input multiple-output (MIMO) systems transformed MPA architecture by introducing compact multi-antenna configurations on a single substrate with considerable challenges in mutual coupling reduction (Sharma et al., 2021). Researchers adopted fractal geometries, DGS patterns, neutralization lines, and orthogonal placement strategies to enhance isolation.

The current decade has seen a shift toward integrating computational intelligence—genetic algorithms, particle swarm optimization, deep learning, and topology optimization—to automate MPA design for improved accuracy and reduced prototyping cost (Harrington et al., 2022). Overall, the evolution of MPAs reflects continuous innovation driven by the demands of wireless systems. From simple single-band patches to complex multi-

functional, flexible, and intelligent antennas, MPAs remain at the forefront of modern electromagnetic research.

2. Literature Survey

- Ahmed and Kumar (2016) demonstrated bandwidth improvement using slotted rectangular patches for WLAN applications.
- Li et al. (2017) introduced textile-based wearable MPAs using flexible conductive fabrics with stable performance under bending.
- Singh and Kaur (2017) analyzed metamaterial-loaded MPAs to enhance gain for C-band applications.
- Zhang et al. (2018) researched graphene-based MPAs showing tunable conductivity and frequency agility.
- Khan and Pathan (2018) applied DGS techniques to achieve miniaturization and mutual coupling reduction in compact arrays.
- Rao et al. (2019) proposed SIW-based patch antennas achieving high Q-factor and low radiation loss at mm-wave frequencies.
- Patel & Roy (2019) implemented MIMO MPA arrays with orthogonal modes for isolation greater than 20 dB.
- Sharma et al. (2020) integrated fractal geometries for multi-band and UWB applications.
- Verma and Singh (2020) optimized feed structures using proximity coupling for expanded impedance bandwidth.
- Jain et al. (2021) developed flexible printed MPAs for biomedical wearables.
- Bansal & Kapoor (2021) implemented metasurface superstrates to enhance directivity.
- Zhou et al. (2021) proposed AI-based optimization for compact MPA layout generation.
- Singh et al. (2022) designed reconfigurable MPAs using PIN diode switching for multi-band 5G.
- Lee et al. (2022) investigated compact mm-wave MPA arrays for automotive radar.
- Gupta et al. (2023) developed transparent ITO-based MPAs for smart glass IoT systems.
- Yadav & Chawla (2023) explored hybrid metamaterials for dual-polarized high-gain MPAs.
- Raman et al. (2024) integrated 3D printing with liquid-metal channels for tunable MPAs.
- Das et al. (2024) used topology optimization to design ultra-compact wideband patches.
- Kumar & Saxena (2025) proposed quantum-dot-enhanced substrates for futuristic 6G platforms.

3. Discussion

MPAs have undergone transformative changes due to the combined influence of material engineering, geometric innovation, and computational modeling. Contemporary research clearly reflects three prevailing trends: miniaturization, bandwidth enhancement, and reconfigurability.

Miniaturization strategies such as fractal geometries, shorting pins, high-permittivity substrates, and DGS structures have enabled MPAs to serve in compact mobile and IoT devices (Sharma et al., 2020; Khan & Pathan, 2018). However, trade-offs persist, as higher permittivity

substrates can deteriorate radiation efficiency. Similarly, fractalization often introduces unwanted resonances that complicate impedance matching.

Bandwidth enhancement remains a central goal. Stacked patches, dual-feed arrangements, aperture coupling, and metamaterial loading have shown significant potential (Bansal & Kapoor, 2021). Yet, multilayer structures increase fabrication complexity and may raise insertion losses. MIMO designs have gained tremendous momentum, especially with 5G and beyond—demanding high isolation and low envelope correlation. Techniques such as neutralization lines and orthogonal placement have been promising (Patel & Roy, 2019).

Reconfigurability has emerged as one of the most impactful advancements. Technologies such as PIN diodes, varactors, and MEMS allow antennas to dynamically adapt to changing spectral environments (Singh et al., 2022). However, reliability, biasing complexity, increased ohmic losses, and nonlinear behavior remain substantial challenges. Material advancements such as textile fabrics, transparent conductive oxides, graphene coatings, and 3D-printed polymers are opening new domains in wearable technology, smart structures, and biomedical monitoring (Jain et al., 2021; Zhang et al., 2018). Nonetheless, durability, environmental robustness, and manufacturing consistency are concerns.

Finally, the rise of AI-driven optimization allows automatic exploration of complex design spaces, reducing prototyping cycles. Still, validating such designs experimentally remains essential to avoid over-reliance on simulation-driven optimization.

4. Research Gaps

Despite numerous advancements, several research gaps persist:

1. **Ultra-wideband and mm-wave operation**:
   Existing techniques struggle to sustain high radiation efficiency and stable patterns at very high frequencies. Surface wave losses become dominant, and feeding networks become highly lossy.
2. **Compact MIMO systems**:
   Achieving high isolation in extremely small footprints remains difficult. Many current solutions introduce complexity or impair bandwidth.
3. **Flexible and wearable MPAs**:
   While textile-based antennas have progressed, challenges in durability, moisture absorption, human-body loading, and SAR reduction remain major concerns.
4. **Thermal and environmental stability**:
   MPAs using advanced materials like graphene or composites often display performance degradation under temperature variations, bending, or humidity.
5. **Reconfigurability trade-offs**:
   Switching mechanisms introduce parasitic effects and reduce reliability over time. Integrating low-loss, energy-efficient tunable materials is still an unmet challenge.
6. **Biocompatibility and implantable antennas**:
   Antenna miniaturization for biomedical implants still lacks efficient solutions at low frequencies where human tissue absorption is high.

7. **Simulation-to-fabrication mismatch**:
   AI-optimized and topology-optimized structures often suffer from performance deviation due to fabrication tolerances.
8. **6G-ready technologies**:
   The shift toward THz bands demands new material systems and low-loss fabrication techniques not yet fully explored.

5. Future Scope and Conclusion

Future advancements in MPAs will be driven by emerging wireless paradigms such as 6G, IoT, autonomous systems, smart healthcare, and satellite mega-constellations. Key future directions include:

- **Hybrid materials** combining metamaterials, graphene, and quantum-dot structures for tunable, broadband operation.
- **AI-driven fully automated design workflows** integrating real-time optimization and fabrication prediction.
- **Self-healing and shape-morphing antennas** using liquid metals or soft robotics concepts for adaptive platforms.
- **Bio-integrated antennas** for in-body sensing with ultra-low SAR.
- **3D-printed multi-material MPAs** enabling arbitrary geometries and embedded passive components.
- **THz and optical MPAs** for quantum communication and nanoscale sensing.

In conclusion, microstrip patch antennas have evolved from simple planar radiators to highly sophisticated and multifunctional electromagnetic devices. Continued innovation in materials, fabrication, and intelligent optimization will ensure MPAs remain indispensable in future communication and sensing ecosystems.

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READING COMPREHENSION SYSTEM – A REVIEW

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ABSTRACT

Reading Comprehension (RC) Systems are to understand a given text and return answers in response to questions about the text. Reading Comprehension can be viewed as single document question answering system. Machine reading comprehension becomes more vital to get the required information in no time. Many researchers are working in the area of machine reading comprehension since 1990s. Maturity of Natural Language Processing and AI has lead to the re-search in machine reading comprehension. Main aim of this paper is to review the various approaches adopted in Reading Comprehension system and to discuss the issues which are to be addressed.

KEYWORDS: Machine Learning, Pattern Matching, Reading Comprehension, Textual Entailment

IN the modern era, information growth is exponential. Reading all the text that are generated is a time consuming process. The main aim of reading is to understand the text, but the level of understanding always differs from one reader to another reader. So an automated system must be devised to understand the text given. Automatic understanding of text helps in text summarization, question answering system and many more NLP applications.

Anselmo Penas et al. (2011) defined Machine Reading (MR) as a task that deals with the automatic understanding of texts. Evaluation of this "automatic understanding" can be approached in two ways: the first one is translating the text into formal language representation and evaluate those using structured queries. This approach is used for Information extraction. The second one understands the given text and evaluates it through natural language questions.

Machine Reading Comprehension System is a system that understands knowledge about the content of text given and generates answers for the questions queried. In this paper Reading Comprehension System and Machine Reading Comprehension are used interchangeably to refer Machine Reading Comprehension System. Reading Comprehension System provides computational solution for the query raised either by the user or auto generated by machine for any given comprehension/text. The research towards machine reading comprehension has started during the late 1990's and still it becomes an open ended research for researchers to achieve better results.

Earlier systems introduced for Reading Compression attempted simple approach based on pattern matching (bag-of-words) or through some handcrafted rules. But the level of understanding was not good enough to answer all the questions raised. To provide better answer good understanding is needed, so researcher developed many methods to improve the understanding level of the system. In this paper we have discussed various methods that produce surface level understanding to deeper level understanding with their evaluation results.

The paper is organized as follows: Section 2 gives an overview of Reading Comprehension System. Section 3 describes different methodologies involved in RCS. Finally, conclusions are given in Section 4.

READING COMPREHENSION SYSTEM (RCS)

Reading comprehension is the ability to read text, process it, and understand its meaning. Reading comprehension is a dynamic and an interactive process. To understand a text, the reader needs to recognize each word and retrieve its meaning, combine this information with syntactic knowledge to make meaningful sentences and integrate the meanings of each sentence to construct representation of the state of affairs described by the text. However the level of understanding differs from reader to reader. To evaluate their understanding levels, reading comprehension tests are proposed. Such tests ask reader to read a story and to demonstrate his/her understanding of that story by answering questions about it.

Reading Comprehension System is required since millions and millions of documents are generated every day. It is tedious for human to read and understand each and every document manually. Reading Comprehension system alleviates this problem. Fig. 1 depicts the general block diagram of reading comprehension system.

The block diagram shows four main blocks. The blocks comprehension text and set of questions are given as input by the user. The block final answer will receive answers for the questions queried from the central block. The central block is the heart of the Reading Comprehension System where NLP/AI techniques are applied to the text for understanding. Researchers propose different methodology to analyze the text and produce the relevant answer for the question given. Many methods are used to evaluate the performance of Reading Comprehension System. Simple method uses bag of words method for representing the text. Questions given are compared with the bag of words and the relevant answers are extracted from the text. Answers extracted are compared with the correct answer and the system is evaluated.

Fig. 2 shows an example story and set of questions to be answered.

Library of Congress Has Books for Everyone

(WASHINGTON, D.C., 1964) - It was 150 years ago this year that our nation's biggest library burned to the ground. Copies of all the written books of the time were kept in the Library of Congress. But they were destroyed by fire in 1814 during a war with the British.

That fire didn't stop book lovers. The next year, they began to rebuild the library. By giving it 6,457 of his books, Thomas Jefferson helped get it started.

The first libraries in the United States could be used by members only. But the Library of Congress was built for all the people. From the start, it was our national library.

Today, the Library of Congress is one of the largest libraries in the world. People can find a copy of just about every book and magazine printed.

Libraries have been with us since people first learned to write. One of the oldest to be found dates back to about 800 years B.C. The books were written on tablets made from clay. The people who took care of the books were called "men of the written tablets."

1. Who gave books to the new library?
2. What is the name of our national library?
3. When did this library burn down?
4. Where can this library be found?
5. Why were some early people called "men of the written tablets"?

Figure 2: Sample Remedia Reading Comprehension Story and Questions

This paper covers most of the important methods used for text understanding in Reading Comprehension System.

Evaluation Method

This section briefs various evaluation methods used in Reading Comprehension System. Reading Comprehension tests are considered to be one of the best evaluation methods for machine reading. When the machine reading system understands the text/story given, the system is evaluated based on answers it return for the question given. The system is tested with the available answer key. Returned answers are compared with the answer key to validate its correctness. Based on the number of questions queried and the number of correct answers the accuracy is evaluated as in (1).

$$accuracy = \frac{n_R}{n} \quad (1)$$

where

n_R: number of questions correctly answered.

n: total number of questions.

Anselmo Penas et al. (2010) came up with a new idea for evaluation that the system need not answer the question if it does not find a correct answer. System can leave a question unanswered in case it was not sure about the correct answer to that question. The objective was to reduce the incorrect answers while keeping the correct ones, by leaving some questions unanswered. The evaluation measure proposed was c@1.

Anselmo Peñas and Alvaro Rodrigo (2011) used the new accuracy measure (c@1) and demonstrated how this measure was able to reward systems that maintain the same number of correct answers and at the same time decrease the number of incorrect ones, by leaving some questions unanswered. This measure is well suited for tasks such as Reading Comprehension tests, where multiple choices per question are given, but only one is correct. The formulation of c@1 is given in (2)

$$c@1 = \frac{1}{n}\left(n_R + n_U \frac{n_R}{n}\right) \quad (2)$$

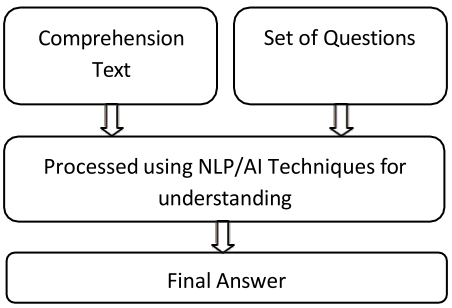

Figure 1: Simple Block Diagram of Reading Comprehension System.

where,

n_R: number of questions correctly answered.

n_U: number of questions unanswered.

n: total number of questions

c@1 acknowledges returning NoA answers in the proportion that a system answers questions correctly, which is measured using the traditional accuracy. (the proportion of questions correctly answered). Thus, a higher accuracy over answered questions would give more value to unanswered questions, and therefore, a higher final c@1 value. This measure will encourage the development of systems able to check the correctness of their responses because NoA answers add value to the final value, while incorrect answers do not.

There is another secondary measure called accuracy used in traditional QA (3).

$$accuracy = \frac{n_R + n_{UR}}{n} \quad (1)$$

where,

n_R: number of questions correctly answered.

n_{UR}: number of unanswered questions whose candidate answer was correct.

n: total number of questions.

The following section will give a detailed discussion on different methodologies and their evaluation results in Reading Comprehension System.

LITERATURE REVIEW

In this literature survey, we had explained various methodologies developed for RCS, the dataset used and their achieved results are shown.

L Hirschman et al. (1999) at MITRE Corporation had proposed an automated reading comprehension system called DeepRead. This system accepts comprehension text as input and finds answers in the text for the question queried by the user. The technique used in DeepRead is pattern matching (bag-of-words) technique to retrieve the sentences (both question and text) are represented as the set of words, and then the information content is extracted from them. Different methods are applied for extraction and those are removal of function or stop words, stemming, name tagger, noun classification and finally noun resolution system. After the extraction of information content search task is performed to find the best match between the word set representing the question and the sets representing the sentences in the task. The corpus consisting of 60 stories of remedial reading materials for grade 3-6 is used as dataset for evaluation and the result achieved by this system is about 30% - 40%.

Ellen Riloff and Michael Thelen (2000) had developed a rule based question answering system called QUARC (QUestion Answering for Reading Comprehension). QUARC used set of heuristic for each 'Wh' question type (Who, What, When, Where, Why). QUARC takes comprehension text (story) and a question as input and process them to find the correct answer for the question from the given text. This system parses the question and all sentences of the story using a parser called Sundance. It uses morphological analysis, part of speech tagging, and semantic class tagging and entity recognition. Apart from 'Wh' rules a special set of rules is formed for dateline, which will be helpful for answering when and where questions. The rules are applied to each and every sentence of the story and each rule is awarded a point and those points were keys for finding the answer to the question. QUARC uses the same dataset used by DeepRead and achieves 40% accuracy.

Hwee Tou Ng et al. (2000) had developed a new QA system named AQUAREAS (Automated QUestion Answering upon Reading Stories) using machine learning approach. This system is independent of handcrafted rules followed in previous approaches. Here they represent each question-sentence pair as feature vector. This feature vector representation helps learning algorithm to build five classifiers automatically for each question type. The machine learning approach used here was comprised of two steps. First, a set of features was designed to capture the information that in turn helps to distinguish answer sentences from non-answer sentences. Second step is to generate a classifier for each question type from the training examples using learning algorithm. The learning algorithm used was C5. The tested the same dataset used by DeepRead. The approach achieved competitive results on answering questions for reading comprehension.

Tiphaine Dalmas et al. (2003) had developed and evaluated robust Question Answering (NLQA) methods. The corpus used by them is CBC4Kids and in that corpus they added a XML annotation layers for tokenization, lemmatization, stemming, semantic classes, POS tags and best ranking syntactic parsers to support experiments with semantic answer retrieval and inference. Due to the enhancements made into the corpus they proposed this would be a standard resource for inference based techniques to come in future. Also the corpus was tested with DeepRead and found the method performs slightly better than on the REMEDIA corpus.

Ben Wellner et al. (2006) presented an automated system called ABCs (Abduction Based Comprehension system). This system understands the role of various linguistic components in reading comprehension with respect to its questions. ABCs had an

abductive inference engine with three main capabilities: (1) first-order logical representation, (2) graceful degradation and (3) system transparency. In first-order logical representation entities relations and events in the text and inference rules are represented. Inclusion of abduction in the reasoning engine helps knowledge representation and reasoning systems. Abductive inferences provides cue to where the system is performing poorly and to where the existing knowledge is inaccurate or new knowledge is provided. Few subcomponents are not automated and still the system achieves 35% to 45% accuracy and on few question types like who it achieves 50% accuracy.

Juan Martinez-Romo and Lourdes Araujo (2011) had developed a system which constructs a co-occurrence graph with words. In their system architecture they had focused on four main modules as Background preprocessing, Co-occurrence graph, Detecting communities and Question Answering. In background preprocessing, they used one reference corpus consisting of about 30,000 un-annotated documents related to the topic. GENIA tagger was used for PoS tagging and it is done only on nouns and verbs. In co-occurrence graph, aim is to create a link joining every two words sharing a common meaning. For doing this they had extracted nouns and verbs, further stemming was done using porter algorithm. In detecting communities, WalkTrap program is used to compute communities in large networks using random walk. In question answering, detected communities are treated as different context of a question in the corpus. Each question is assigned to a community based on their similarity. Similarly for answers, each response is assigned to a community and selected the answer based on highest similarity. The c@1 of 0.27 was obtained.

Suzan Verberne (2011) had proposed retrieval based question answering system for machine reading evaluation. In QA4MRE, they followed a relatively knowledge poor approach based on Information Retrieval techniques. It involves two steps: (1) retrieval of relevant fragments from the document for the input question (2) matching of the multiple choice answer candidates against the retrieved fragments in order to select the most likely answer. For retrieval of fragments they followed two information expansion methods: (1) Statistical expansion (2) question to fact expansion. They concluded that statistical expansion gives better results over question to fact expansion and there need further improvement to achieve better results. The overall c@1 of 0.37 was obtained in this method.

Detmar Meurers et al. (2011) had presented CoMiC-DE (Comparing Meaning in Context - DE), the first content assessment system for German. Content assessment supports the integration of context and task information into analysis. The comparison of student answers and target answer is based on an alignment of tokens, chunks, and dependency triples between the student and the target answer at different levels of abstraction. It is not sufficient to align only identical surface forms. In student answers there is chance for lexical and syntactic variation hence alignment would support different levels of abstraction. Here, the different question types and the ways in which the information asked for is encoded in the text. Then analyze the role of the question. The surface-based account of information given in the question should be replaced with the answer in the context of the question. The experiments are tested on the Corpus of Reading comprehension Exercises in German called CREG. CoMiC-DE performs on a competitive level of accuracy at 84.6%.

Adrian Iftene et al. (2012) participated in QA4MRE 2012 evaluation task and proposed their new method which is based on textual entailment. They constructed the Text and the Hypothesis for initial test Data. The test data is organized in the form of tags, <document> tag used to build the text whereas <question> and <answer> tags were used to build the hypothesis. Both Text (T) and Hypothesis (H) are given to Textual entailment system to get the partial and global scores per answer. The test data and background knowledge are related to four topics: AIDS, Climate Change, Music and Society and Alzheimer. The test is conducted for both Romanian and English. The c@1 was 0.28 obtained for English and 0.25 for Romanian.

Pinaki Bhaskar et al. (2012) had developed a QA system for QA4MRE @ CLEF 2012. In their system first they form the Hypothesis(H) by combining the question and each answer option. Using Lucene stop words are removed from each H and query words are identified to retrieve the most relevant sentences from the associated document. For retrieving relevant sentences they used TF-IDF. Each retrieved sentence defines the text T. Each T-H pair is assigned a ranking score based on textual entailment principle. Using ranking score, weight is automatically assigned to each answer options. Further each sentence is assigned an inference score with respect to each answer pattern, which is then multiplied with validate weight based on their ranking to find the highest selection score. The identified selection score is considered to be the answer to the given question. The results are evaluated for 3 datasets, 2 with domain knowledge and 1 without domain knowledgebase. The datasets with domain knowledgebase are producing satisfactory results and the result of dataset without domain knowledgebase is very poor. They proved that domain knowledgebase had a strong effect. The test data taken for evaluation is same one which is used in QA4MRE 2012 track.

Peter Clark et.al (2012) proposed an Entailment Based approach for the QA4MRE Challenge. This approach estimates the likelihood of textual entailment between sentences S in text and the question Q and each candidate answer A_i. The entire approach is divided into two important task: entailment assessment and implication assessment. In entailment assessment, the candidate answer A_i had to be found from sentence S, to do so first the sentence S is created by means of formal representation. It is difficult, but the author used natural logic approach to achieve it. Once the candidate answer A_i is found in S, the next step implication assessment is processed. In implication assessment, it is mandatory to validate the candidate answer A with Question Q. The author had investigated the syntactic connection between the Q-A pair. It may difficult in some cases due to the indirect connection of Q-A pair. To resolve this, the author found the closest pair by measuring the distance between the sentences. However the end result achieves only 40% accuracy. The author concluded that the accuracy can be improved when the knowledge problem and reasoning problem achieves good result.

Michael Hahn and Detmar Meurers (2012) had proposed a semantic based approach for reading comprehension questions. They presented CoSeC-DE system for evaluating the content of answers to reading comprehension. The dataset used for evaluation is CREG. Here they use Lexical Resource Semantics (LRS) representation for the student answer, the target answer and the question are automatically derived on the basis of the part of speech tags assigned by tree tagger and the dependency parser by MaltParser. After LRS representation then alignment takes place both with local criteria and global criteria. The aligning meaning representation supports the integration of important information structural differences in a way that is closely related to the information structure research in formal semantics and pragmatics. The result shows CoSeC-DE outperform the earlier system called CoMiC-DE on the same dataset.

Helena Gomez-Adorno et al. (2013) had presented a methodology for handling the question answering system for reading comprehension tests. The developed system accepts a document as input and it answers multiple choice questions about it. Pre processing works were done through Lucene information retrieval engine. The proposed system architecture is organized into four main modules: document processing, information extraction, answer validation, answer selection. To determine the performance of the system they used the corpora provided in the QA4MRE task at CLEF 2011 and 2012. The average overall best run obtained in 2011 is outperformed in 2012.

Somnath Banerjee et al. (2013) focused on Multiple Choice Question answering system for entrance examination. In their system, first they generated answer pattern by combining the question and each answer option to form the hypothesis (H). Next, they removed stop words and interrogative words from each H. Using Lucene the most relevant sentences are retrieved from the associated document with respect to the query word. Each retrieved sentences defines text T and each T-H pair is assigned a ranking score calculated based on textual entailment principle. After calculating the ranking score the matching score was assigned to answer options. Thereafter the inference score was found for each sentence with respect to each answer pattern. The inference score and matching score for each answer option is added. Finally the answer option that gets highest selection score is selected as answer for the given question. The test set chosen from the Japanese center test which is conducted for Japanese University admissions. This system achieves overall c@1 of 0.42 is achieved.

Xinjian Li et al. (2013) had proposed a QA system for entrance exams in QA4MRE at CLEF 2013. They used three components namely character resolver, Sentence extractor and Recognizing Textual Entailment. The character resolver is used to identify the characters who were involved in the story and are assigned with an ID. The sentence extractor would extract the related sentences for each question, the extracted sentences are then used to create a T|H pair. Finally this T|H pair is given as input for the RTE system which will produce answer. The test data for evaluation in the entrance exams task is from Japanese university entrance examination. This system obtained a c@1 of 0.35 during evaluation.

Simon Ostermann et al. (2014) presented a system in CLEF QA Track 2014 Entrance Exam. The system is designed to correctly answer multiple choice reading comprehension exercises. The system is originally designed for scoring short answers given by language learners to reading comprehension questions. This was implemented by two step procedure. In the first step, the sentence which best matched with question is selected. In the second step, the selected sentences are compared with four possible answer choices to find their similarity score. The choice with highest similarity score is returned as correct answer. Preprocessing are done through all standard NLP tools such as sentence splitting (OpenNLP), tokenization (Stanford CoreNLP), PoS Tagging and stemming (TreeTagger) synonym extraction (WordNet). Using alignment model the similarity score is calculated. The system achieved c@1 of 0.25 on the given dataset.

Helena et al. (2014) in their approach presented that the given document and multiple choice answers are transformed into graph based representation which

contains lexical, morphological and syntactic features. After the construction of graph, it was traversed into different paths both in texts and in the answer choices to find the syntactic features of the graph. This results in construction of several feature vectors. Finally the cosine similarity is calculated for feature vector to rank the multiple choice answers. The feature that rank achieved highest rank results as correct answer. The dataset used for evaluation is Japanese Center Test. The system achieved a c@1 of 0.375 in the evaluation.

Neil Dhruva et al. (2014) presented a open domain Reading comprehension System to text understanding evaluation. It is based on text similarity measures, textual entailment and coreference resolution. The text is represented in XML document. It was then preprocessed using stanford NLP tools. For retrieving sentence this system uses three similarity measures ie, lexical similarity, ESA-based similarity and PoS similarity. Based on the results of similarity measures textual entailment is calculated for T-H pairs. After calculating textual entailment answer similarity is computed. For answer selection the entailment confidence score and the answer similarity scores are used to calculate the correctness score. Finally the answer option corresponding to the T-H pair with the highest correctness score was selected as correct answer for a given question. This system achieved c@1 score of 0.375 for the given track dataset.

So far we had discussed different methods on MCQ based reading comprehension system. But here Martin Gleize et al. (2014) proposed a method to invalidate the answer options to find correct answer. In this system first the relevant passage for the question was retrieved. Then it generates Predicate Alignment Structure (PAS) to each answer options. Likewise PAS was generated to the retrieved passage. To remove wrong answer a new rule is proposed by the author and its goal was to eliminate as many possible answer options without removing the correct answer option. Finally the answer option is returned based on their alignment score. Tokyo University entrance exam dataset was used for evaluation and this system achieved random baseline score c@1 of 0.25 after submitting several runs.

Dominique Laurent et al. (2015) had proposed an entrance exam evaluation task at CLEF 2015. In this task they had used a special structure to save the results called CDS (Clause Description Structure). The main components of the structure are descriptions of a clause, a subject, a verb and an object. Apart from this the structure also allows indirect object, temporal context, spatial context and so on. For the evaluation a dedicated module is added to compare the CDS from task questions and answers. This module measures the degree of correspondence between the elements. The evaluation result shows 52 good answers out of 89 questions in English and 50 good answers out of 89 in French.

Martin Gleize et al. (2015) had presented a methodology called LIMSI. It selected set of passages as graphs and made enhancement through external sources. The main aim is to reduce the gap between human and computer for extracting knowledge from the text. From there modifications were carried out to get candidate graph from passage graphs. Then they applied classifiers for validation and rejection. Finally, the final score is calculated as difference of validation score and rejection score. The system achieved c@1 of 0.36 during evaluation.

Ramon Ziai and Bjorn Rudzewitz (2015) had proposed a new method called CoMic. In this method the text segment identification was carried out for segmenting the text into meaningful paragraphs. Later it was compared with the question to be answered using similarity metric. It results in ordering the meaningful partition with the questions based on their similarity. Similarity features were then extracted for each candidate answer to each paragraph. For ranking the features the author had chosen a machine learning approach called SVM. This approach achieved c@1 of 0.29 for the given entrance exam task.

We had discussed various methodologies that dealt with text understanding evaluation using Reading Comprehension System.

CONCLUSION

Automatically answering reading comprehension questions is a challenging task and still it is an open ended research for the research community in NLP. In this paper we have seen methods that involve surface level understanding to deeper level understanding. In surface level understanding sentence will be extracted as answer, whereas in deeper level understanding the given text is analyzed through textual entailment technique, answer validation and text similarity measures. Here the evaluation is done using multiple choice question answers. The highest evaluation result achieved for c@1 is 0.42 to the best of our knowledge. This clearly shows still there is huge gap to be filled to obtain more accurate results.

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A COMPARATIVE STUDY OF OLED USING VARIOUS THICKNESS OF ELECTRON TRANSPORT LAYER

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ABSTRACT

In this work a number OLED have been presented at various thicknesses of electron transport layer ranging from 5nm to 18nm and study their performance which are fabricated by vacuum deposition method. We find that at particular thickness of ETL layer the luminance efficiency of device structure is maximum. The optimum thickness of Bphen layer used as electron transport layer and the constant thickness of hole injection layer (V_2O_5) were 15nm and 5 nm respectively. With this combination of thicknesses, charge balancing is achieved and luminous efficiency is optimized. Here we obtained maximum value of current density and current efficiency are 170mA/cm^2 and 3.9cd/A respectively.

KEYWORDS: Electron Transport Layer, Charge Injection, Mobility, Efficiency and OLED

Solid state lighting devices, the charge carriers have to be injected from the anode and cathode but the performance, lifetime, efficiency and stability of these devices are typically governed by the proper thickness of the material layers and electrode/organic interfaces at the electrode contacts. Efficient light emission from OLEDs can be achieved by reducing energy barriers of interfaces between organic layer and electrodes and by balancing hole and electron injection. Now a day's Remarkable technical process have been made to increase the efficiency of OLED. For the first time published a paper on OLED, (C.W. Tang, S.A. Vanslyke) during 1987 and they report a method for fabricating small molecular OLEDs. Since then number of research work, have been carried out and many papers have been published (R.H.Friend et al. 1999, M.A.Baldo et al. 1999, M.Ikai et al. 2001, C.Adachi et al. 2002, G.He et al. 2004, X.H.Yang et al. 2004 and H.M.Liu et al 2005) in the field of OLEDs. Research work on various techniques such as external doping, incorporation of phosphorescent and organometallic compounds alloying of organic materials and thickness variations of organic film layers have been carried out. In fact today's technology allows fabrication of OLED over a flexible plastic substrate with external quantum efficiency of 63% (Z.B.Wang 2011). Recently effect of thickness variation of hole blocking layer has been studied (Y.Masumoto et al. 2000 and L.Zhou, et al. 2010) but these works have been reported with doped layers. Similarly comprehensive study on effect of variation in thickness of hole injection layer has been done (S.M.Tadayyon et al. 2004) and they report on hole injection barrier height. Study on thickness variation of emitting layer (C.H.Hsiao et al. 2010) has also been available in the research literature for phosphorescent OLEDs with a focus on colour stability. The injection efficiency and mobility of holes are higher as compared to electron injection efficiency and electron mobility (B.J.Chen et al. 1999 and S.Naka et al 2003). Therefore, various techniques have been carried out to improve the electron injection efficiency and mobility of electrons to achieve better charge balancing. Our work is based on the region of electron transport layer (ETL), where improved electron injection is obtained by modulating the charge carrier injection and their mobility. This is done by varying thickness of hole blocking layer (or ETL) at constant hole transport layer. These two layers have opposite functions. There is a specific combination of their thicknesses when they act in tandem to achieve enhanced charge balancing. At this optimized thicknesses the luminous efficiency is maximized at low current density because of better charge balancing. In this work we use Bphen as a ETL and TPD as hole transport layer (HTL). We study the performance of four OLEDs at various thickness of ETL by evaluating their luminous efficiency. Finally we reported the best combination of organic layer (Bphen) film thickness which can optimize the luminous efficiency in our device configuration.

EXPERIMENTAL DETAILS

All devices were fabricated on ITO (Indium doped tin oxide) coated glass and thermally deposited AL was used as cathode. The ITO glass was cleaned in ultrasonic bath of acetone and isopropanol for 15 minutes and the deposition was carried out at a pressure less than 5×10^{-5} torr . All the organic and inorganic layers were evaporated at the deposition rate higher than 10Å/sec. The devices have an active emissive area of 8×8 mm^2. All the devices were fabricated by using Thermal Vacuum

Evaporation Unit using proper shadow masking system and the corresponding film thickness were recorded by thickness monitor (Model DTM-10). The J-V-L characteristics were measured by digitally controlled source-meter and luminance meter unit. All tests are performed in air at room temperature without any encapsulation and all materials are purchased from Sigma-Aldrich. Chemical structure of Alq3 and TPD is shown below

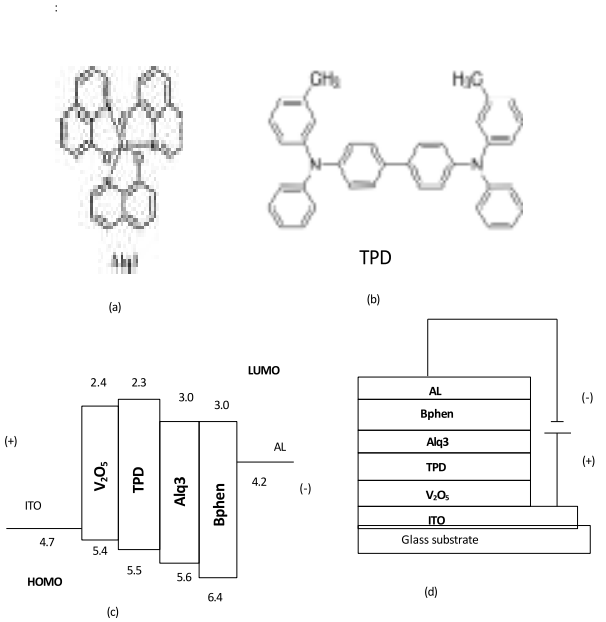

Figure 1: (a) chemical structure of Alq3, (b) chemical structure of TPD, (c) energy level alignment of OLED and (d) schematic presentation of OLED.

RESULTS AND DISCUSSION

We have fabricated the standard OLEDs using V_2O_5 as hole injection layer(HIL), N,N'-bis (3-methyle phenyl)-N,N'(phenyl)- benzidine(TPD) as hole transport layer(HTL), Tris (8-hydroxy quinolinato) aluminium (Alq3) and 4,7-diphenyl-1,10-phenanthroline(Bphen) are used as emitting layer and electron transport layer(ETL) respectively and compared their J-V-L characteristics of OLEDs with different thickness of ETL at constant HIL layer. The structures of the bottom emitting OLEDs used in this study are:

Device: A. ITO/V_2O_5 (5nm) /TPD (40nm)/Alq3 (50nm)/Bphen(5nm)/Al (110nm)

Device: B. ITO/V_2O_5 (5nm)/TPD (40nm)/Alq3 (50nm)/Bphen(8nm)/Al (110nm)

Device: C. ITO/V_2O_5 (5nm)/TPD (40nm)/Alq3 (50nm)/Bphen(12nm)/Al (110nm)

Device: D. ITO/V_2O_5 (5nm)/TPD (40nm)/Alq3 (50nm)/Bphen(15nm)/Al (110nm)

Device: E. ITO/V_2O_5 (5nm)/TPD (40nm)/Alq3 (50nm)/Bphen (18nm)/Al (110nm)

The current-voltage and the luminance-voltage characteristics of OLED having configuration ITO / V_2O_5 (5nm) / TPD (40 nm) / Alq3(50nm)/ Bphen(varying thickness)/Al (110 nm) respectively is shown in Fig: (2).

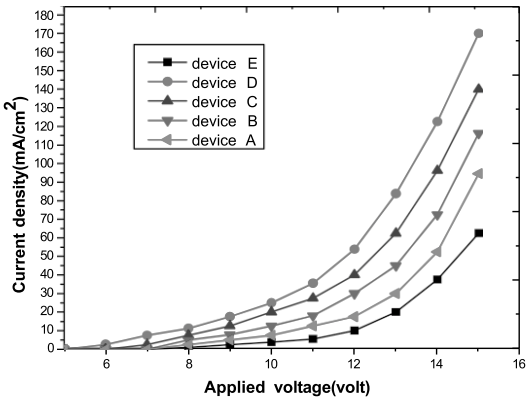

Figure 2(a): Graph of applied voltage and current density

Fig 2: (a) represents the graph of current density *vs* applied voltage and (b) represents the graph of Luminance *vs* applied voltage.

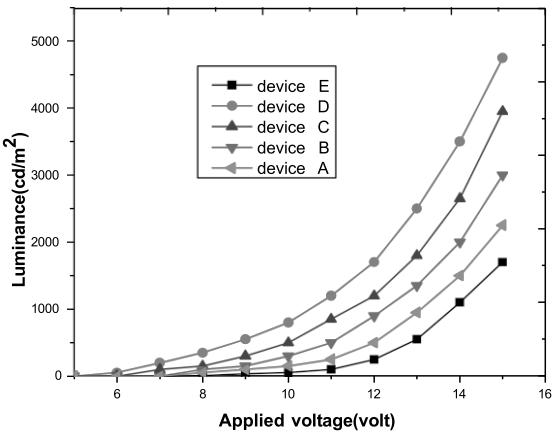

Figure: 2(b) Graph of applied voltage and luminance

The relationship between current density *vs* current efficiency and current density *vs* Luminance is given by fig 3 (a) and 3(b) respectively.

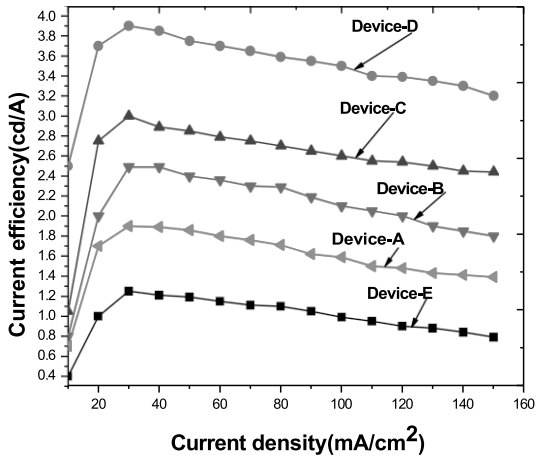

Figure 3(a): Graph of current density and current efficiency

Fig. 3(a) displays the current density-current efficiency characteristics of each device; Device D exhibits a maximum efficiency of 3.9 Cd/A at current density of 35mA/cm^2. Similarly as shown in fig 3(b) a maximum luminance as high as 4500 cdm^{-2} at current density of 150 mA/cm^2 which represents the brightest and best green OLED in our work. To see the effect of thickness variation of ETL (i.e.Bphen) on device performance, we keep the thickness of all layers constant except Bphen layer thickness which was varied between 5 nm and 18 nm. The effect of thickness variation of electron transport later is explained below:

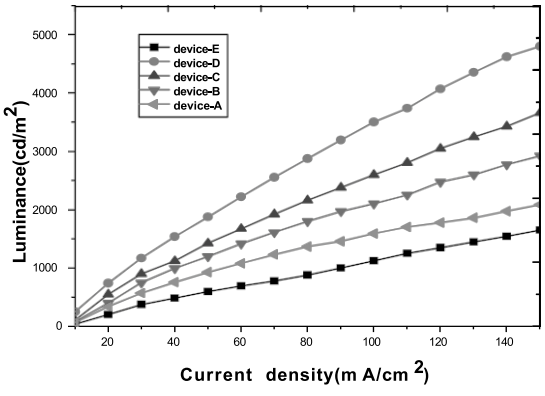

Figure 3(b): Graph of current density and luminance

Energy levels alignment diagram of of our OLED are given in Fig.1 (c). At the interfacial junction of Bphen and Alq3 layers their HOMO energies values are 6.4 eV and 5.6 eV respectively. Due to large energy barrier (0.8 eV) between HOMO levels of Bphen and Alq3, it is difficult to travel the positive charge carrier towards the cathode through ETL layer. But however this layer does not provide the same amount of resistance for the moving of electrons from cathode to the Alq3 layer through it. Therefore the degree of opposition faced by both electrons and holes for their travel through Bphen layer is different. Also the degree of opposition is depends on thickness of ETL layer [16]. A thin Bphen layer is poor in hole blocking ability, whereas a thick Bphen layer can effectively block the passage of holes through it. Therefore this ETL layer provides a critical path for the travel of electrons and holes and thus the thickness of this layer play an important role in determining the relative motion of holes and electrons within emissive layer. Table (1) shows the performance of the OLED devices at their different thickness of film deposition. Now if we increases the thickness of Bphen layer (above 15 nm) then there is higher probability of shifting the recombination zone from emitting layer to the ETL layer as reported earlier (H.Tang et al. 2003 and H.Yoshida et al 2011) where excitons will have higher probability of undergoing non-radiative decay near the cathode and will result in lesser luminous efficiency. Also there is a chemical reaction which takes place between the interface of Al and Alq3 interface (M.G.Mason, C.W.Tang and L.S.Hung 2001), which results in release of Alq3 anions. These anions are responsible for the improved injection of electrons from cathode (H.Heil, J.Steiger, S.Karg and M.Gastel 2001) to the emissive region. However if thickness of Bphen layer is increased beyond critical thickness (15nm) then the layer of Alq3 is deeply covered below the Bphen layer. Therefore very thick Bphen layer will decrease the progress of this chemical reaction and which affect the injection of electrons into emitting layer. In this work optimum thickness of ETL layer is 15 nm where maximum number of electron and hole pairs undergoes recombination to produce the highest green luminance. The standard deviation (which is a measure of the spread of their efficiency in a set of data at different voltages from their mean value) of current efficiency and luminance of different OLED devices at their different film thickness are given by following graph. This graph clearly provide the all the information regarding the

standard deviation value of all the OLEDs at different electron transport layer during the working period.

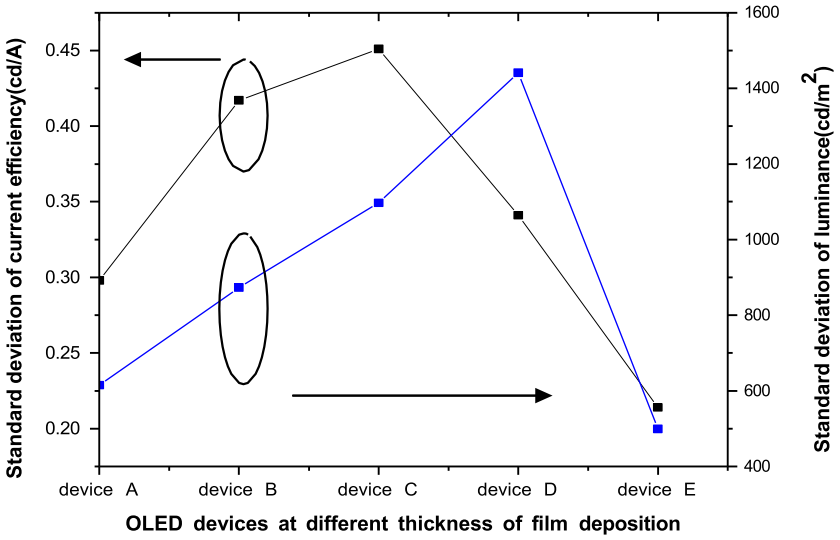

Table 1: Luminance and efficiency characteristics for the devices with different thicknesses Bphen layer

S.N	Bphen layer thickness	Maximum Luminamce (cd/m^2)	Turn-on voltage(volt)	Maximum Luminous efficiency (cd/A)	Standard deviation of current efficiency (cd/A)
1	5nm	**2085**	**7.3**	**1.90**	**0.298**
2	8nm	**2925**	**7.0**	**2.49**	**0.417**
3	12nm	**3660**	**6.5**	**2.89**	**0.451**
4	15nm	**4800**	**5.4**	**3.90**	**0.341**
5	18nm	**1650**	**7.6**	**1.25**	**0.214**

From this table it is seen that the turn-on voltages are7.3, 7.0, 6.5, 5.4 and 7.6 for the devices with Bphen layer thickness in 5nm, 8nm, 12nm, 15nm and 18nm respectively. Thus the turn-on voltage of 8nm, 12nm and 15nm is to be lower than that of the device with 5nm ETL layer. But after the critical thickness turn-on voltage is tend to increases due to the decreasing of the chemical reaction. Therefore it can be concluded that the thickness of electron transport layer has a direct effect of device performance by controlling the flow of charge carrier through the organic layer.

CONCLUSION

In our work we varied the thickness of ETL (i.e. Bphen) layer, in the range from 5 nm to 18 nm at constant hole injection layer. Even though these two layers have opposite functions, but by fine tuning their proper thicknesses better charge balancing can be achieved in the emissive region. The optimum thickness of electron transport layer is 15nm with 5nm of hole injection layer. The enhancement in device performance is attributed to a lower energy level difference between the cathode and emissive layer which are proved by J-V and L-V characteristics. In this standard configuration of OLED structure high luminous efficiency that we achieved is 3.9 Cd/A.

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