Online ISSN : 0975-4172
Print ISSN : 0975-4350

Global Journal

of Computer Science and Technology: F

Graphics & Vision

Highlights

Content Based Image Fuzzy K-Means Algorithm

Finger Print Scanner Generation for Fingerprints

Discovering Thoughts, Inventing Future

VOLUME 13 ISSUE 6 VERSION 1.0

Global Journal of Computer Science and Technology: F
Graphics & Vision

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 13 Issue 6 (Ver. 1.0)

Open Association of Research Society

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USA Tax ID: 98-0673427

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Global Journal of Computer Science and Technology
Graphics & Vision
Volume 13 Issue 6 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

A Novel Technique for Cancelable and Irrevocable Biometric Template Generation for Fingerprints

By K. Kanagalakshmi & Dr. E. Chandra
DJ Academy for Managerial Excellence, India

Abstract - Cancelable biometric key generation is vital in biometric systems to protect sensitive information of users. A novel technique called Reciprocated Magnitude and Complex Conjugate-Phase (RMCCP) transform is proposed. This proposed method comprises of different components for the development of new method. It is tested with the multiple aspects such as cancelability, irrevocability and security. FVC database and real time datasets are used to observe the performance on Match score using ROC, time complexity, and space complexity. The experimental results show that the proposed method is better in all the aspects of performance.

Keywords : *cancelability, conjugate transpose, irrevocability, phase, reciprocate, shifting.*

GJCST-F Classification : *I.4.8*

Strictly as per the compliance and regulations of:

A Novel Technique for Cancelable and Irrevocable Biometric Template Generation for Fingerprints

K. Kanagalakshmi [α] & Dr. E. Chandra [σ]

Abstract - Cancelable biometric key generation is vital in biometric systems to protect sensitive information of users. A novel technique called Reciprocated Magnitude and Complex Conjugate-Phase (RMCCP) transform is proposed. This proposed method comprises of different components for the development of new method. It is tested with the multiple aspects such as cancelability, irrevocability and security. FVC database and real time datasets are used to observe the performance on Match score using ROC, time complexity, and space complexity. The experimental results show that the proposed method is better in all the aspects of performance.

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I. Introduction

Cancelable biometrics involves in repeated distortion of biometric signals or features on the noninvertible transforms. This approach reduces the compromise of the stored templates [43] using the substitution of transformed version of an image instead of original. It is very useful when a person is contributed with various applications. These kinds of approaches are used for the authentication [44] and identification purposes [37] [7]. Biometric based applications guarantee numerous security risks [3]. The brute- force attacks [47] both the biometric based and password based systems [4]. Cancelable biometrics refers to an intentional and systematically repeatable distortion (transformations) of biometrics data for the purpose of protecting sensitive user-specific features. The principal objectives of cancellable biometrics templates are Diversity, Cancelability, Reusability, Non-invertability, and Performance [5]. Cancelable biometric provides a perfect secrecy [45], [50]. The rest of the paper comprises are as follows: section 2 lists and describes the related fields. In section 3, a novel method is proposed. Experimental studies are followed and they are expressed in section 4. Performance evaluations are described in section5. Section 6 concludes the paper.

Author α : Doctoral Research Scholar, Department of Computer Science, DJ Academy for Managerial Excellence, Coimbatore, Tamilnadu, India. E-mail : kkanagalakshmi@gmail.com

Author σ : Supervising Guide, Dr.SNS Rajalakshmi College, Coimbatore, Tamilnadu, India. E-mail : crcspeech@gmail.com

II. Related Work

The related areas of cancelable biometric generation schemes were studied in prior and described in [7]. Summary of the study into different categories of cancelable systems are:

a) Biometric Transformations

This method is based on the transformations of biometric features. It is further categorized into two: Bio-Hashing (Salting) [8], [13], [15], [16], [19], [20], [21], [46], [48], [49] and Non-invertible approach [1]. Our proposed method falls under this category of Non-invertible transformation.

b) Biometric Crypto Systems

In this approach, helper data are generated from the biometrics. Further, it is classified into two: Key-Binding biometric cryptosystem and Key-generation biometric crypto system [9], [10], [11], [12], [14], [17], [23], [27].

c) Hybrid Approach

It follows both the transformation and cryptosystems; and also fuzzy schemes [18], [22], [25], [26], [38], [49].

III. Proposed Method

A novel method is proposed in this section. It is name as Reciprocated Complex Conjugate-Phase transform method.

It includes the building blocks of phases such as preprocessing, minutiae extraction, post processing and cancelable and irrevocable template generation. The proposed method uses fingerprint biometric to generate cancelable template. Based on the significant properties such as persistence and individuality, the fingerprint features are widely used [6], [39]. Specifically our proposed method uses local features of fingerprints like bifurcations and endings [40] for the template generation. The System level design of the proposed method is given in figure 1.

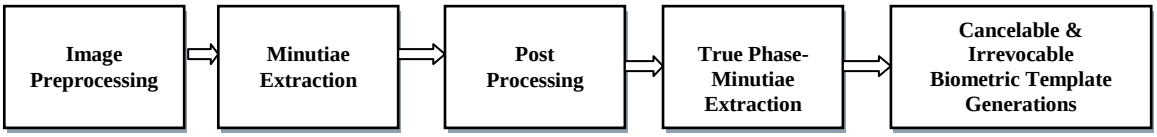


Figure 1 : System Level Design

The flow graph of the proposed method is given in figure 2 which includes main flow. Results of each stage are passed to the next level for further process. They are described in the following section.

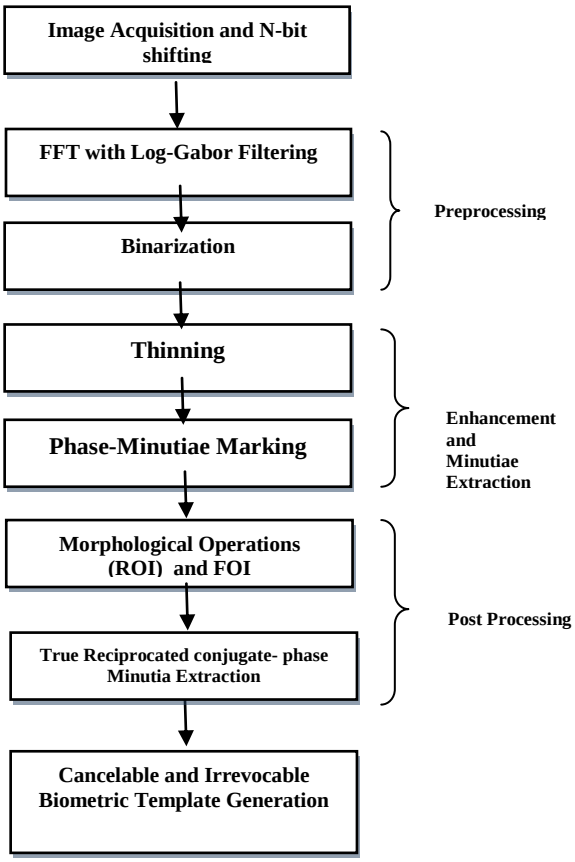


Figure 2 : Flow graph of the proposed system

Before going to design a method, the requirements and principles must be set. There are two main principles: cancelability and irrevocability. To achieve those, some conditions are followed [1]:

1. The transformation should be even while changing minutia position before transmission which leads to a small change in the minutiae position of after transformation.
2. The transformation should not lead the correlation of minutiae before and after transformation. That is the minutiae before transformation should not be matched with the minutiae after transformation
3. There should be high complexity in minimal transformations.

a) Reciprocated Magnitude and Complex Conjugate Phase (RMCCP) Transform Method: Function Design

The Reciprocated Complex Conjugate Phase transform is a proposed method which aims at the cancelability and irrevocability (One-way approach). To meet the objectives, various processing and minimal transformations are followed:

1. Initially the proposed method follows the N-bit shifting of an input fingerprint image as shown in eqn. 1.

$$x(j) = Sh_n[I(x,y)] \quad (1)$$

Where n is a positive natural number. Shifting returns an image I(x,y) shifted by n bits. The Shn function shifts the pixel value of each coordinates of an image N times.

2. The next level is the preprocessing and an enhancement. Image enhancement can be carried out in spatial [28], [29], [30] or frequency domain [31], [32]. The proposed method focuses only frequency domain enhancement. The frequency values are obtained by applying the Fast Fourier Transformations on the shifted image using equations 2 and 3.

$$\text{FFT: } \boldsymbol{X(k)} = \sum_{j=1}^{N} \boldsymbol{x(j)\omega_N^{(j-1)(k-1)}} \quad (2)$$

$$\boldsymbol{\omega_N} = \boldsymbol{e^{(-2\pi i)/N}} \quad (3)$$

Where ω_N is an Nth root of unity.

The returned Fast Fourier Transformed image is enhanced. That is the frequency domain enhancement is made using the Log-Gabor filter [31], [32]. It is designed by associating two components such as:

a) The Radial component: It controls the frequency band that the filter responds. Radial component of Log-Gabor function is:

$$LG(F) = e^{\left(-\frac{log\left(\frac{r}{rf_0}\right)}{2\log\left(\frac{\sigma}{rf_0}\right)}\right)} \quad (4)$$

Where r is the normalized radius from centre, rf_o is the normalized radius from centre of frequency plane corresponding to the wavelength.

b) The angular Component: It controls the orientation that the filter responds to.

$$\boldsymbol{FC} = \boldsymbol{e^{\left(\frac{-d\theta^2}{2\theta\sigma^2}\right)}} \quad (5)$$

Where FC is the angular filter component; it is obtained by calculating angular distance $d\theta$ of sin and cosine. The Log-Gabor filter (see eqn. 6) is derived from the product of eqn. 4 and 5.

$$LGF(f) = LG(f) \times FC \tag{6}$$

Now, the filter is applied on the frequency domain for the enhancement as in eqn. 7.

$$I_{FDE} = X(k) \times LGF(f) \tag{7}$$

Then, the Inverse Fast Fourier Transformation is performed to get back the original enhanced image using eqn. 8.

$$\text{IFFT: } x(j) = \left(\frac{1}{N}\right) \sum_{k=1}^{N} X(k) \omega_N^{-(j-1)(k-1)} \tag{8}$$

The x(j) is the function which returns an enhanced version of the shifted image. The output image is a complex image. By passing the enhanced cum shifted complex image to the next level, a new transformed version of an image is retrieved with the addition of reciprocated magnitude and the twin complex conjugate transposed phase image(see eqns. 9 and 10). Minutiae of the transformed version of an image are marked using Run-Length Coding method and performed post-processing. Then the RMCCP transformed minutiae (X, Y) of Terminations and Bifurcations only are extracted

$$X` = (1/M\,(x(i,j)) + [Kcos[\Phi_F\,(x(i,j))]']' \tag{9}$$

$$Y` = (1/M\,(x(i,j) + [Ksin[\Phi_F\,(x(i,j))]']' \tag{10}$$

where M is the magnitude and ΦF is the phase value of an image; X` and Y` gets the reciprocated magnitude and complex conjugate phase transposed values.

3. In third step, two parameters such as shuffling and chaffing are used. That is the extracted RMCCP minutiae (X`, Y`) of bifurcations such as X coordinate with Y and vice versa are shuffled randomly; and chaff (synthetic) points are also added. The chaff points are generated by adding constant floating point along with the extracted shifted phase-minutiae value using the following equations (11) and (12).

$$B_{X`}(n1) = B_{Y`}(i) + C_{f1} \tag{11}$$

$$B_{Y`}(n2) = B_{X`}(j) + C_{f2} \tag{12}$$

Where and are the X and Y coordinate points of bifurcations respectively; and are the different floating point constants; and n1, n2 are positive integers.

4. From third step, finalized cancelable and irrevocable biometric template is generated (see table 1).

Table 1 : Cancelable and irrevocable biometric template generated from fingerprint

Bifurcations	
X	Y
285	129
85	109
275	114
175	227
234	241
54	255
.	.
.	.
.	.

IV. Experimental Study and Results

Sequence of experiments is followed to test the phenomenon of cancelability and irrevocability on the proposed method using benchmark databases such as FVC in 2000, 2002, 2004, and real time database. Each database contains 880(Set A: 100×8, Set: 10×8)) fingerprints and fifty different real time fingerprints are obtained from untrained volunteers. The same finger is needed to give 5 impressions.

Experiment 1 : Performance impact on cancelability

Cancelability leads multiplicity. The first criterion is cancelability of fingerprint. From the experiment, it is observed that the cancelability is trailed in the proposed method. The transformations are based on the cancelability of the biometrics. The transformed version of the image does not coincided with the original image. Multiple transformations are applied on it. No one is coincided with the original one. It seems that the product of multiple versions of the same image. The proposed RMCCP transform method starts the version transfer of an input fingerprint image at the entry level. That is the captured image is N-bit shifted primarily. Bit shifting causes the change of black pixels into white and vice versa due to the change of pixel value. So the shifted image gives a scattered pattern; additionally reciprocated magnitude and complex conjugate-phase of an image is derived. In association to that, chaff point and shuffling of the same are also implemented. Fig 3 shows the ridge patterns and their orientations before and after bit-shifting and also the RMCCP transformed image.

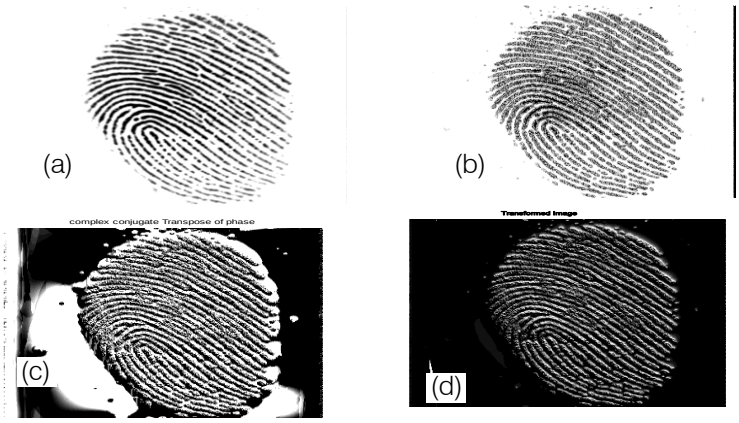


Figure 3 : Image comparison (a) Fingerprint image before shifting (b) N-bit Shifted image (c) Twin complex conjugate phase image (d) RCCP Transformed image

Figure 4 : Shows changes occurred among the pixels. It is clearly shown that the pixel value before and after shifting is varied

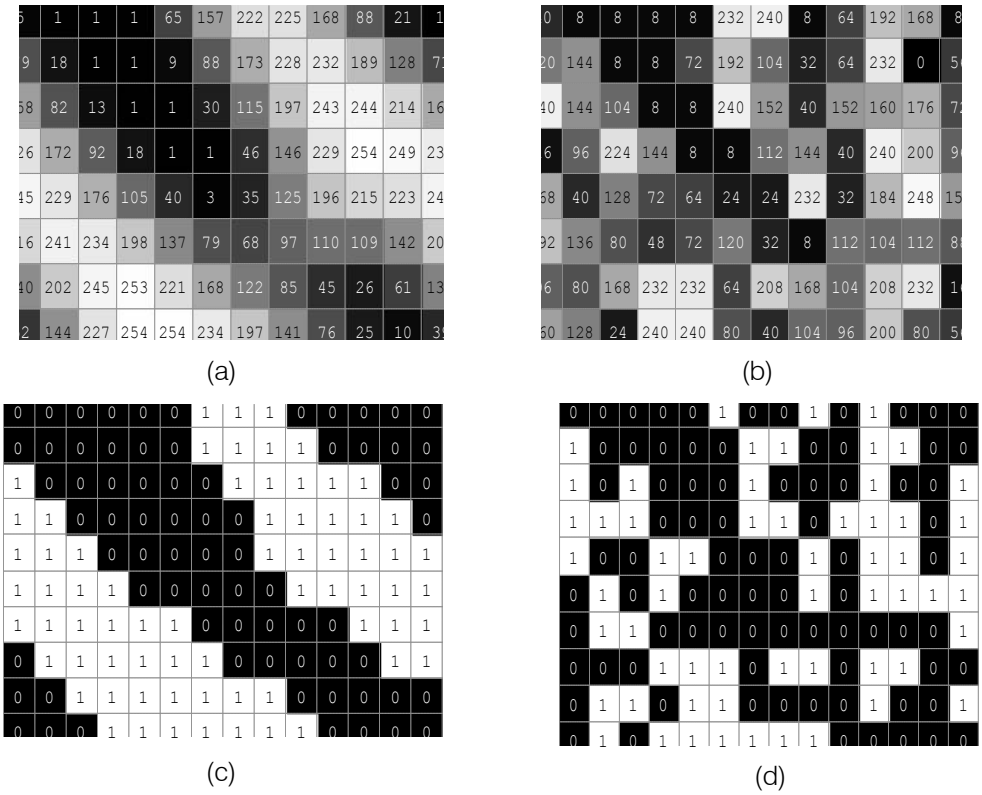


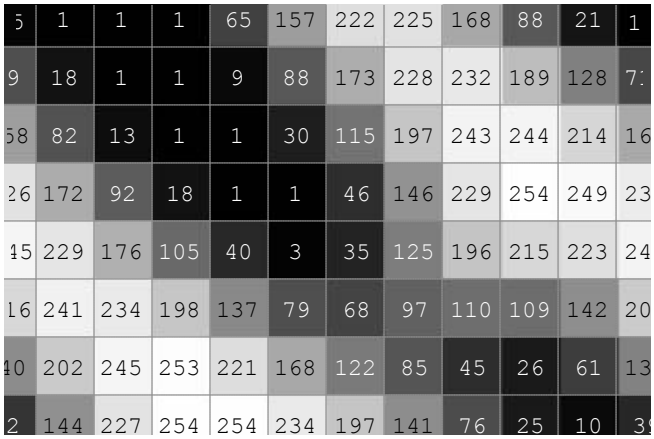
Figure 4 left Column figures (a and c) are the respective original gray and binary pixel values of an image before shifting; right column figures (b and d) are their N-bit shifted gray and binary pixel images respectively. By referring binary pixel values, it clearly visualizes the orientations of ridges and valleys before shifting; but the same are scattered (shuffled: 0's and 1's) after shifting(c).

Empirically it is found that there are more terminations and less bifurcation before shifting; but there are more bifurcations and very few, sometimes no terminations are found after performing N-bit shift on an image. This is because of scattering of ridge pixels (0's and 1's) as described in figure 4.

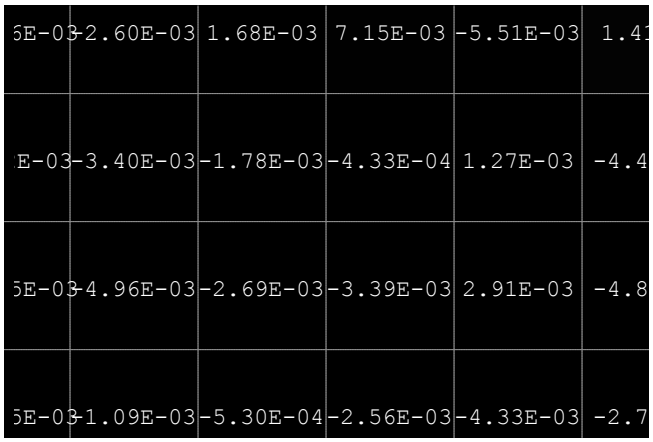
Experimental Result 1

It is observed that N-bit shifting causes scattered pattern as well as change of pixel values; if they are under RMCCP transform, then there is an occurrence of tremendous version transfer. Here, the reciprocal of the magnitude and the twin complex conjugate transpose makes a robust key for

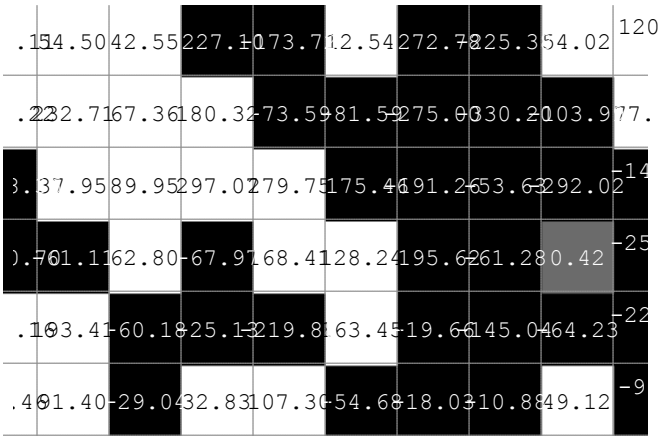
cancelability of the fingerprint features. Through the reciprocated magnitude, the originality of magnitude is affected and the same is combined with twin transposed phase where the sign of the phase is changed. That is, change of positive sign into negative and vice versa. So the phase value gets changed. This strategy further strengthens the cancelability. Figure 5 clearly shows the change of sign of individual pixels.



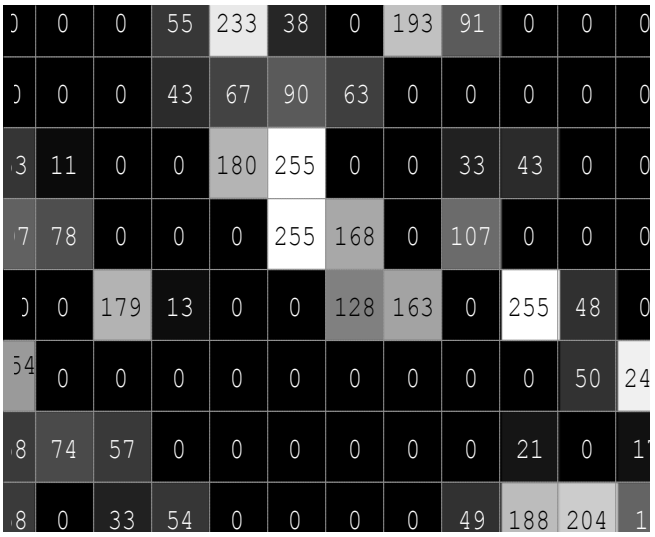
(a)



(b)



(c)



(d)

Figure 5 : Pixel regions of the RCCP transformation stages (a) Original image (b) Reciprocal magnitude (c) twin transposed (d) Final RCCP Transformed output

In summary of this experiment, the cancelable property of the proposed method is tested with the matching impact on intra fingerprints (8 impressions per person) and inter-fingerprints (8×10). It is found that there is no cross matching occurrence. Multiple transformations on single images are carried out and no one shows the similarity. It proves that one-into-many property. That is the single person's fingerprints are allowed to generate multiple transformed versions of the original image. Due to this property, a person's biometric can be used for more than one application. Hence, the cancelable property is proved.

Experiment 2 : Strength against an invertible attack

Analyzing the strength of the invertible attack is the second criterion. Invertible attacks are impossible according to proposed method. Because it is aimed at one way approach that is non-invertible approaches. It extracts minutiae from the transformed version which is acquired from reciprocated magnitude and twin complex conjugate-phase combinations. The phase possesses very less sensitive information of an image. But the magnitude possesses all sensitive values (information) of an image. Our method focuses only on the reciprocated magnitude which results reciprocal of the original magnitude and twin complex conjugate-phase minutiae which changes the sign value of each pixel. Here, the change of magnitude and sign makes major changes in properties of an image. For instance, the original magnitude 178 is reciprocated into 0.0056 and 0 into -0.0030; according to Phase value, 52 is changed into -52 and -90 into 90 etc. This property integrates robustness and irrevocability of original features from the stored RMCCP -minutiae templates. Moreover the template is accumulated with only two

fields such as shifted and transformed locations: X and Y coordinate. While storing the coordinates, they are shuffled and added chaff points. This attempt also makes additional feature for the irrevocability.

Experimental Results 2

Figure 6 shows the attempt for an invertible attack against the original image at the entry level. It is clearly shown that the pixels after performing the reverse shifting do not match with pixels of original image. This is because of the compatible type conversion of an image occurred internally. This first attempt is made to prove the irrevocability at the entry level. The second attempt is to invert the stored biometric template to get back the original one. Though it is impossible to get original version of an image from the phase value as stated early, the stored biometric templates are used to revoke the original. Attempts are failed because of the insufficient parameters and shuffled chaff points. Experiments on reverse shifting are performed in order to get original image pattern; it results different pixels which are not coincided with the pixels of original image.

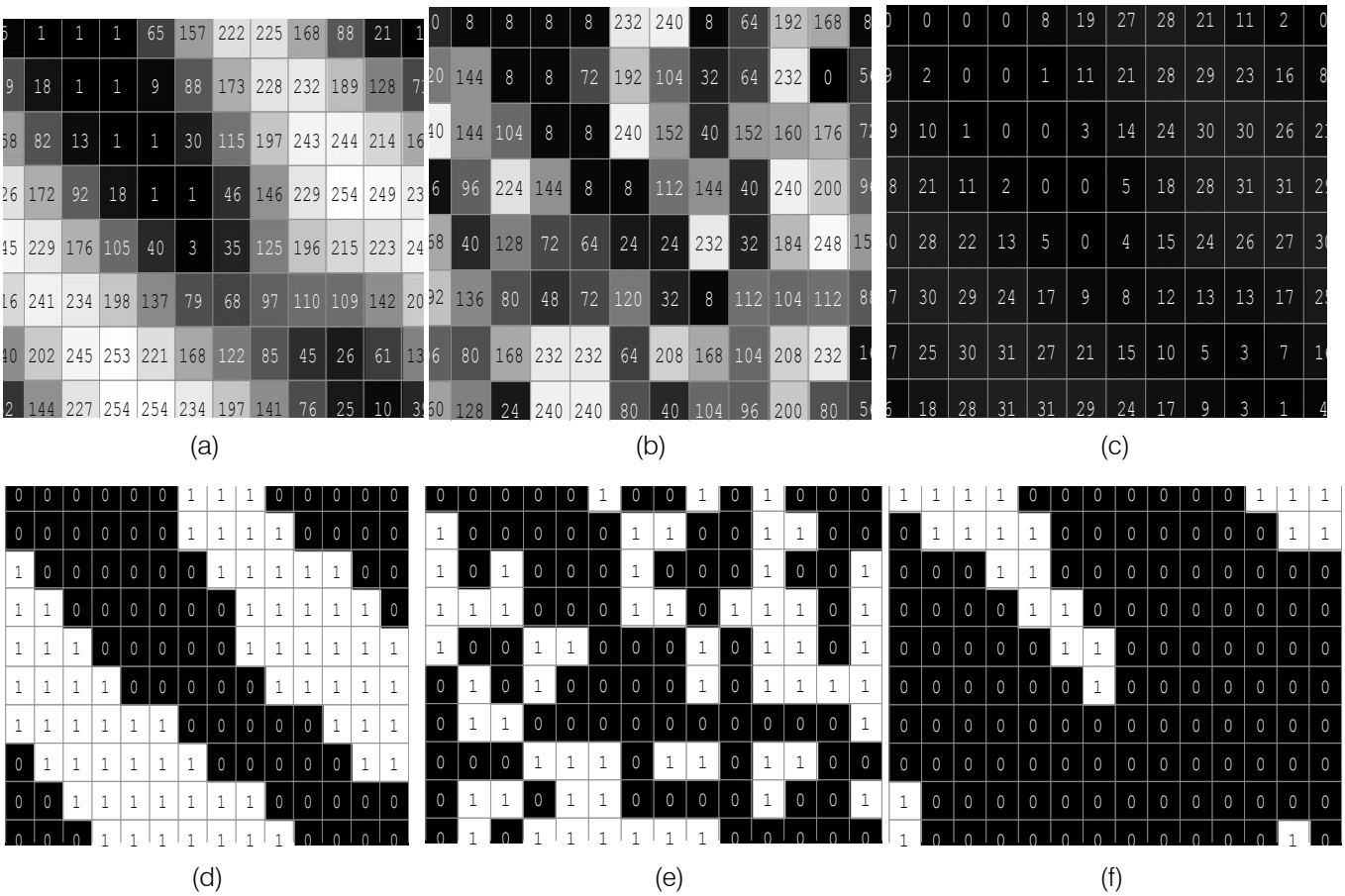


Figure 6 : Comparisons of images according to shifting and reverse shifting process (a) Original gray image (b) Nbit Shifted gray image (c) Reverse shifting of (b) To get original image pattern (d) Original Binary image (e) N-bit shifted binary image (f) Reverse shifting of (e) To get original binary image (d). The pixel values of reverse shifting do not coincided with the same of the original image (compare (a) and (c) in gray image; and (d) and (f) in binary image)

Experiment 3 : Distinctiveness

The third constraint to be considered is distinctiveness of the templates which is checked by using the correlation factor and also matching scores. The transformed version of an image should not be correlated with the original one. The distinctiveness is proved in the experiments. That is to ensure whether the original fingerprint and the transformed version are correlated or not. To prove this phenomenon, we performed the transformations on the database sets individually and compared the original fingerprint image against transformed version; and also the test is extended on transformed versions of the inter fingerprint images.

Experimental Result 3

It is proved that the transformed versions are no more likely to match the original images. Thus, the uniqueness is proved. Correlation between the Original and transformed version of images (see fig.7) shows the distinctiveness of both original image and its unique transformed version. If the two images are not same

then its correlation factor is zero or negative number otherwise 1.

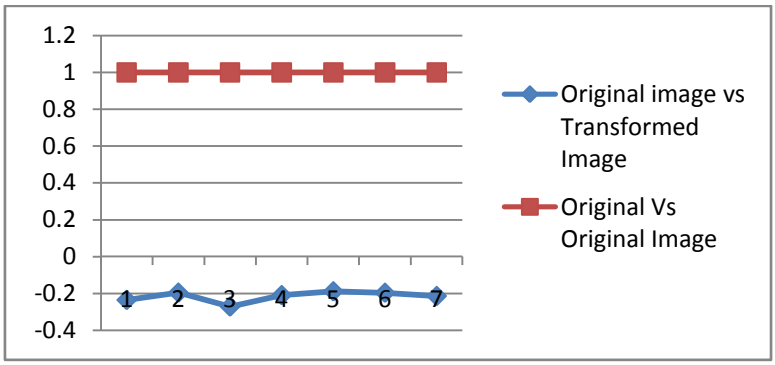


Figure 7 : Correlation chart: correlation between Original and the transformed version of the same image

a) Performance of the choice of parameters

The choice of parameters always boosts the performance. Conjugate Twin transpose, Chaff points and shuffling minutiae are the parameters of the proposed method. The potency of the parameters leads both cancelability and irrevocability. The chaff points generated are derived from the addition of the floating point values with the extracted bit-shifted and complex conjugate transposed phase image randomly along with the shuffling parametric keys such as X and Y coordinates. Identification of chaff points is not easy in our case. The shuffled minutiae set contain both the synthetic and conjugate phase minutiae (see fig. 8). So the separation or filtering of true minutiae is not possible. Hence, the performance of the choice of parameters are strengthen and sensitive.

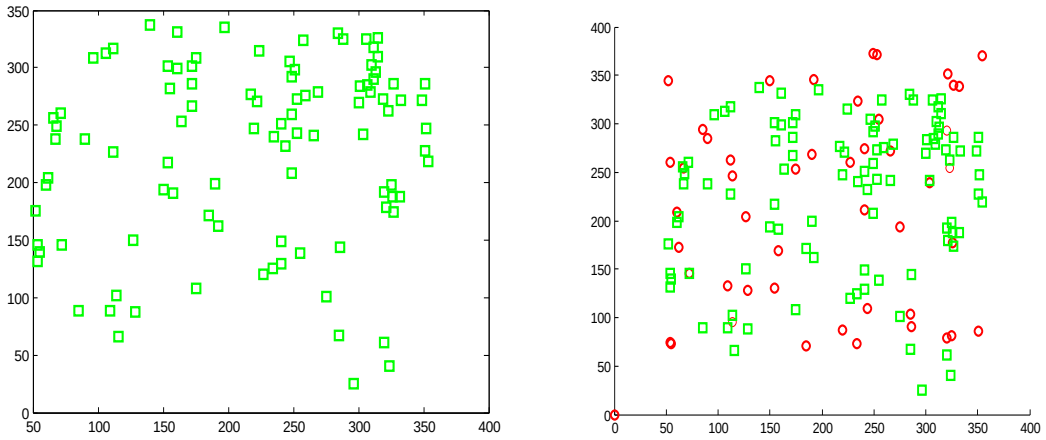


Figure 8 : (a) Extracted final shifted and RCCP-minutiae set (b) Chaff (synthetic) minutiae in association with RMCCP-minutiae. Chaff points are indicated by circle and shifted conjugate phase-minutiae are indicated by square

V. Performance Evaluation of Proposed Method

The performance of the proposed RMCCP transform method is evaluated based on genuine (matching two benchmark templates of the same finger) and impostor (matching two benchmark templates originating from different fingers) attempts. They are performed to compute False Rejection Rate (FRR), False Acceptance Rate (FAR) and Genuine Accept Rate (GAR). Fingerprint minutiae descriptors can be used to perform matching. There are two types of descriptors: Texture-based (orientations and Frequency values), Minutia-based (Local minutiae structures) [33], [41] and hybrid method such as local and global based [42]. Minutiae based matching (through the visual difference and correlation) method is followed in our proposed work to match the cancelable templates Figure 9 shows the Receivers Operating Curve. The ROC is a graph that expresses the relationship between the Genuine Accept Rate (GAR) and the False Accept Rate (FAR), and the same can be used to report the performance of a biometric authentication system. Minimum number of samples is required to achieve confidence bands of desired width for the ROC curve [34]. GAR is calculated through FAR. GAR= (1-FAR).

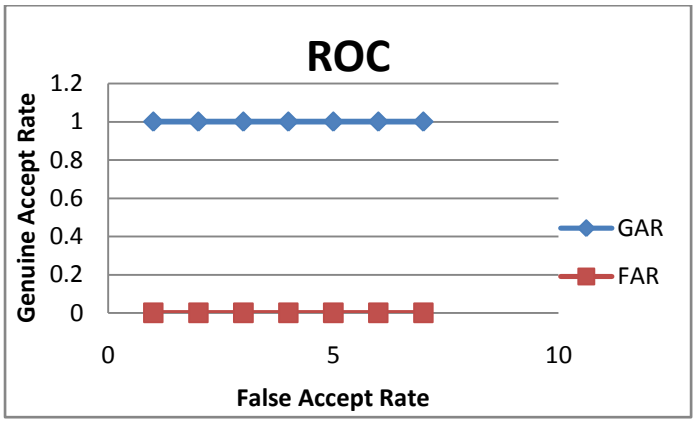


Figure 9 : ROC on Cancelable transforms performance

In addition to ROC analysis, the performance evaluations are carried out on proposed method in the following aspects too:

1. Space complexity (Maximum amount of memory)
2. Time Complexity
3. Security.

a) Space Complexity

Normally more memory spaces are occupied by images. In order to decrease the memory usage of biometric fingerprint images, the proposed method generates only the template with dual fields such as X and Y coordinates. Since the cancelable template possesses selective minutiae point, it occupies very little space in memory than the raw image. The average ratio of memory space between biometric template and raw image is about 0.005 only. Table 2 reports the memory space required to store the original image and the cancelable biometric template of fingerprints. Figure 10 shows the space complexity chart.

Table 2 : Memory space of an image and cancelable

	Fingerprint Image		Fingerprint Template	
Image #	Size of Image (KB)	Size on disk (KB)	Size of template in bytes	Size on disk (KB)
1	142	144	1078	4
2	142	144	693	4
3	142	144	638	4
4	142	144	836	4
5	142	144	836	4
6	142	144	858	4
7	142	144	792	4
Average	142	144	**818**	4

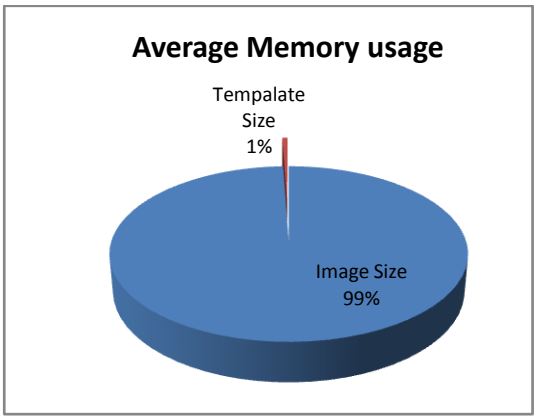


Figure 10 : Space complexity: Maximum amount of memory is used by an image and less amount of memory by template

b) Time Complexity

Performance of the method is measured in term of time complexity. The response time of the system is very important factor which integrates the performance of a system. An Average matching and template generation time is calculated (Intel i3 processor) which are reported in table 3.

Table 3 : Average template generation and matching time Image #

Image #	Template Generation time in seconds	Template Matching Time in seconds
1	19	0.001
2	25	0.016
3	28	0.0016
4	26	0.035
5	27	0.015
6	30	0.015
7	25	0.016
Average Time	**25.71**	**0.014229**

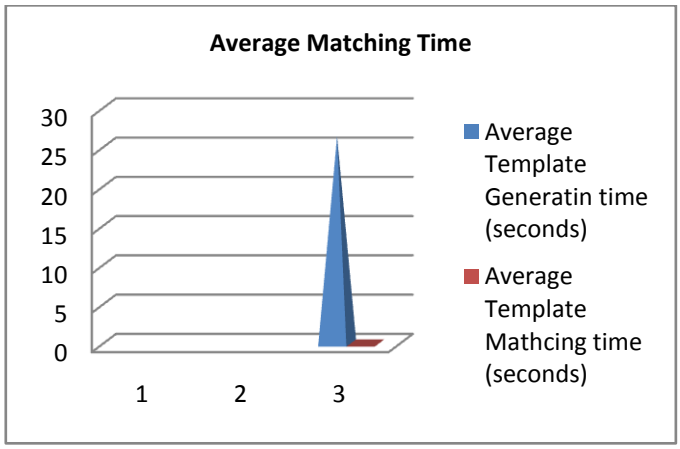


Figure 11 : Average Matching Times of Template Generation and Matching

c) Security

Preserving the stored template is a hotspot of the automatic biometric based authentication and identification systems. Preferably, biometric secrecy systems leak a negligible amount of information due to sending the helper data [35]. There is no helper data usage in the proposed method. The RMCCP transformation is performed only with the version transform of the existing features values; chaff point generation is also done with only the internal feature value transformation. It doesn't require any helper data externally. Thus, the secrecy and security are enforced. Biometric template security is an important issue. Enhancing the security of the biometric templates is essential [36]. The proposed method employs shifted and reciprocated magnitude with conjugated phase values. It creates a robust bond with one-way approach which will not be permitted the hackers to generate an original image from the transformed version's properties. The partial and transformed minutiae are helpless to derive an original image. Thus, the proposed method offers a robust and secured system.

VI. Conclusions

A novel method called Reciprocated Magnitude and Complex Conjugate-Phase transformation is proposed and implemented. It is a cancelable and irrevocable biometric template generating technique. It is assessed in different facets like Cancelability, Irrevocability and Security. In addition to that, the performance factors such as matching time and template memory usage are calculate and analyzed. The experimental results show that proposed RCCP transform gives a better performance and it is experienced as an efficient method.

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Global Journal of Computer Science and Technology
Graphics & Vision
Volume 13 Issue 6 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Content based Image Retrieval by using the Bayesian Algorithm to Improve and Reduce the Noise from an Image

By Ekta Rajput & Hardeep Singh Kang
RIMT-IET College Mandi Gobindgarh, India

Abstract - Image retrieval system is an effective and efficient tool for managing large image databases. A content based image retrieval system allows the user to present a query image in order to retrieve images stored in the database according to their similarity to the query image. In this paper content based image retrieval method is used as diagnosis aid in medical fields. The main objectives of this paper is to reduce the noise from an medical image with the use of Bayesian algorithm .Various algorithm are define in CBIR but we can use Bayesian algorithm to reduce the noise from an image . Bayesian algorithm provide the feedback and improve the performance of an image retrieval by using the resultant MSE(mean square error) and PSNR(peak signal to noise ratio).

Keywords : *medical informatics, CBIR and bayesian algorithm.*

GJCST-F Classification : *1.5.0*

Strictly as per the compliance and regulations of:

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Ekta Rajput [α] & Hardeep Singh Kang [σ]

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Keywords : medical informatics, CBIR and bayesian algorithm.

I. Introduction

Medical informatics is the sub-discipline of health informatics that directly impacts the patient physician relationship. It focuses on the information technology that enables the effective collection of data using technology tools to develop medical knowledge and to facilitate the delivery of patient medical care. The goal of medical informatics is to ensure access to critical patient medical information at the precise time and place it is needed to make medical decisions. Medical informatics also focuses on the management of medical data for research and education.

CBIR Content based image retrieval Content-based image retrieval (CBIR), also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR) is the application of computer vision techniques to the image retrieval problem, that is, the problem of searching for digital images in large databases. Content based image retrieval is opposed to concept based approached.

"Content-based" means that the search will analyze the actual contents of the image rather than the metadata such as keywords, tags, and/or descriptions associated with the image. The term 'content' in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself. Thus a system that can filter images based on their content would provide better indexing and return more accurate results. The term Content-Based Image Retrieval (CBIR) seems to have originated in 1992, when it was used by T. Kato to describe experiments into automatic retrieval of images from a database, based on the colors and shapes present. Since then, the term has been used to describe the process of retrieving desired images from a large collection on the basis of syntactical image features. The techniques, tools and algorithms that are used originate from fields such as statistics, pattern recognition, signal processing, and computer vision.

A better way to search is Content-based Image Retrieval.

1. CBIR consists of two elements:
   a. A feature extraction algorithm that describes the content of each image;
   b. A retrieval algorithm that uses the features to retrieve images according to a query.
2. Successful retrieval algorithms always work interactively with the user by a process called relevance feedback.

Feature Extraction 1

1. A computer extracts features of an image, to do with colour, texture, location and shape of objects.
2. These features (hopefully) describe well the content (or semantics) of the image.
3. This can be done off-line and needs to be done only once.
4. Searching the database is based on these features and a "similarity measure" between them.
5. This is a decreasing function of a distance between their features.

Feature Extraction 2

1. An image X is a matrix {Xij | i = 1, . . . ,n1; j = 1, . . ., n2};
2. Xij is colour of pixel (i, j); colour is a 3-vector, for example in RGB-space Xij = (Rij, Gij, Bij) ∈ {0, . .255} ^ 3.
3. Feature vector of length d is f (X) ∈ Rd;
4. Distance between images X1 and X2 is d(X1, X2) = k f (X1) − f (X2) k;

Author α : RIMT-IET College Mandi Gobindgarh, India.
E-mail : ektathakur87@gmail.com
Author σ : Assistant Professor.
E-mail : hardeep_kang41@rediffmail.com

5. Similarity measure s(X1, X2) = exp(−d(X1, X2)) or d(X1, X2) −1 etc.

a) Bayesian Algorithm

The Bayesian Classification represents a supervised learning method as well as a statistical method for classification. It can solve diagnostic and predictive problems. This Classification is named after Thomas Bayes (1702-1761), who proposed the Bayes Theorem. Bayesian classification provides practical learning algorithms and prior knowledge and observed data can be combined. Bayesian Classification provides a useful perspective for understanding and evaluating many learning algorithms. It calculates explicit probabilities for hypothesis and it is robust to noise in input data. Bayesian algorithm is used to reduce the noise from an image .noise can be reduced by using the resultant PSNR (peak signal to noise ratio) and MSE (mean square error).

PSNR is most easily defined via the mean squared error (*MSE*). Given a noise free $m \times n$ monochrome image I and its noisy approximation K, *MSE* is defined as:

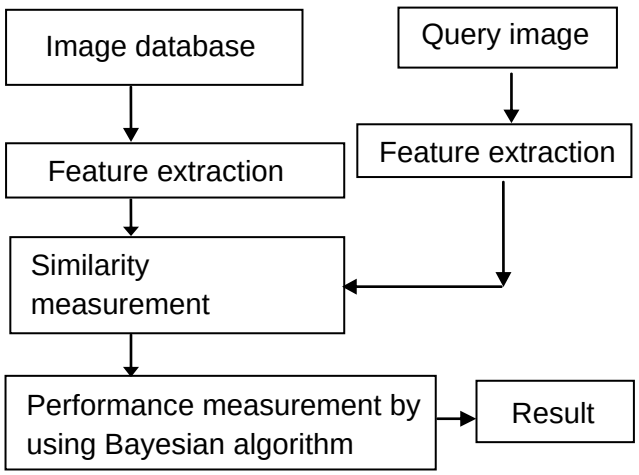
$$MSE = \frac{1}{m\,n} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [I(i,j) - K(i,j)]^2$$

The PSNR is defined as:

$$\begin{aligned} PSNR &= 10 \cdot \log_{10} \left(\frac{MAX_I^2}{MSE} \right) \\ &= 20 \cdot \log_{10} \left(\frac{MAX_I}{\sqrt{MSE}} \right) \\ &= 20 \cdot \log_{10} (MAX_I) - 10 \cdot \log_{10} (MSE) \end{aligned}$$

Here, MAX_I is the maximum possible pixel value of the image.

Block Diagram



II. Methodology

The content-based image retrieval (CBIR), relevance feedback has been put on many efforts for the past few years, a new relevance feedback approach with progressive leaning capability. It is based on a Bayesian classifier and treats positive and negative feedback with different strategies.

According to the Bayesian algorithm firstly we take the image and applying the thresholding technique on that image .After the thresholding technique the given size of the image is changed or we can say that the given retrieved image is impact image and that impact on the retrieved image is defined by the MSE & PSNR. MSE is generally used to calculate the improve the performance percentage of the given image by using the thresholding technique and that result is SNR value. After calculating the MSE & SNR value we have to calculate the PSNR value by using the formula.

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Here, MAX_I is the maximum possible pixel value of the image.

When the pixels are represented using 8 bits per sample, this is 255. More generally, when samples

are represented using linear PCM with B bits per sample,

$$MAX_I \text{ is } 2^B - 1.$$

For color images with three RGB values per pixel, the definition of PSNR is the same except the MSE is the sum over all squared value differences divided by image size and by three. Alternately, for color images the image is converted to a different color space and PSNR is reported against each channel of that color space.

III. Conclusion

Analysis and improvement in CBIR using Bayesian approach by analyzing on the basis of texture, histogram equalization and edge density. Improving the quality and reduce the noise of retrieved image. The Bayesian algorithm provide the better result as compare to all other CBIR algorithm .In the future we can also work on DICOM images to improve the quality.

IV. Future Scope

According to this paper Bayesian is the best methodology for improving the image quality and also used in noise reduction.

In future work, also more improve the quality of an DICOM image with some another algorithm. It can also used in future with another algorithm for feature extraction.

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Global Journal of Computer Science and Technology
Graphics & Vision
Volume 13 Issue 6 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Attendance Management System for Industrial Worker using Finger Print Scanner

By Md. Shakil & Rabindra Nath Nandi
Khulna University of Engineering & Technology (KUET), Bangladesh

Abstract - Attendance management is the act of managing attendance or presence in a work setting, which maximizes and motivates employee attendance thereby minimizing loss. Not only does it affect productivity, it can cost the company profits or even additional contracts. For the industrial sector attendance management system can develop alacrity among the workers to work regularly and also help them to motivate their co- worker to attend work regularly. Fingerprints are considered to be the best and fastest method for biometric identification. They are secure to use, unique for every person and do not change in one's lifetime. Fingerprint recognition is a mature field to-day, but still identifying individual from a set of enrolled fingerprints is a time taking process. This paper illustrates improvement of attendance management system based on fingerprint identification for implementation on large databases e.g. of an industry or a garments factory etc. In this project, many new algorithms have been used e.g. gender estimation, key based one to many matching, removing boundary minutiae. Using these new algorithms a new attendance management system has been developed which is faster and cheaper in implementation than any other available today in the market.

Keywords : *attendance management system, fingerprint scanner, authentication, biometric.*

GJCST-F Classification : *I.5.4*

Strictly as per the compliance and regulations of:

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This paper illustrates improvement of attendance management system based on fingerprint identification for implementation on large databases e.g. of an industry or a garments factory etc. In this project, many new algorithms have been used e.g. gender estimation, key based one to many matching, removing boundary minutiae. Using these new algorithms a new attendance management system has been developed which is faster and cheaper in implementation than any other available today in the market.

Keywords : attendance management system, fingerprint scanner, authentication, biometric.

I. Introduction

Attendance Management System (AMS) is the easiest way to keep track of attendance for community organizations such as industrial organization, business organizations and volunteer groups. Attendance Management System is useful in terms of manpower analysis, day-to-day monitoring of attendance, maintaining statutory registers, monitoring leave records, calculation of overtime and transferring information to the payroll system. Attendance Management System can be grouped into four categories namely Manual System, Biometric System, Card-based System and E-Commerce System:

a) Manual System

This system makes use of a log book. Users arrive at a terminal where the book is placed. They write their names, the time of arrival and then sign against their names. Some organizations provide clock for arrivals to use at the terminal. This system is limited by lack of user authentication. Users may write wrong time and the log book may even be stolen or destroyed.

b) Biometric System

This system recognizes a person by his body parts such as face, voice, iris and fingerprint linking that to an externally established identity. The common type is the use of fingerprints. Fingerprint system can either be minutiae-based, image-based or textured-base systems. In the minutiae-based, ridge endings and ridge bifurcations are extracted forming the feature vector to be used for identification. This system has small size but it requires large processing power for image identification and enhancement The image-based system uses raw pixel intensity information in its operation. It uses optical matching and correlation-based matching. Though this system is prevalent among the recognition systems, it is however, affected by brightness variation, image quality variation, scars and global distortions in the image. It also requires much storage. The textured-based system matches features of fingerprint extracted in a transform domain generating sequence distribution. This system has smaller size of feature vector and it does not need pre-processing. Hence reduces computational overload and saves time.

c) Card-based System

Cards are inserted into a machine which records the exact time when the user has arrived Paper cards have eventually been replaced by sturdier cards that are sized just like the bank card which can also be used for time keeping. An issue with the attendance card is that some workers will ask co-workers to time-in for them. Some have attempted to remedy this dilemma through the use of signature logs that are attached next to the attendance recorder.

d) E-Commerce System

This is a performance based attendance keeping system. This is increasingly utilized to ensure not only users' attendance but also their productivity and efficiency as well. This system captures user logs into the organizational website alongside other activities such as mouse clicks and keyboard taps. This system is in the experimental phase.

This paper presents attendance management system for the industrial worker using fingerprint

Author α : Undergraduate student, Department of Industrial Engineering & Management (IEM), Khulna University of Engineering & Technology (KUET), Khulna-9203, Bangladesh.
E-mail : shakil.anowar@yahoo.com
Author σ : Undergraduate student, Department of Computer Science & Engineering (CSE,) Khulna University of Engineering & Technology (KUET), Khulna-9203, Bangladesh. E-mail : rabindro.rath@gmail.com

identification. Biometrics refers to the automatic identification of a person based on his or her physiological or behavioral characteristics. It includes fingerprint, iris, facial and retinal. Biometrics technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solutions. Today, biometric is being spotlighted as the authentication method because of the need for reliable security.

Fingerprint authentication has been in use for the longest time and bears more advantages than other biometrics. It has been verified through various applications. In 1924, Federal Bureau of Investigation (FBI) is already known to have maintained more than 250 million civil files of fingerprints for the purpose of criminal investigation and the identification of unknown casualties. It now is being used in numerous field including financial, medical, e-commerce and customer application as a secure and effective authentication method.

II. Problem Statement

Traditionally, worker's attendance is taken manually by using attendance sheet. With this manual system, there are some cases that worker can cheat. This occurs because the worker's just wanted to fulfill the 100% of the attendance so that they can get the full salary on this month. Management can't monitor for all workers in the organization and it is difficult for management to record the attendance of worker accurately and efficiently. Managements are responsible to monitor the entire worker's attendance for the whole month. For that worker that fails to meet the 100% of their attendance rate will be given a reminder as a warning from company.

Because of this problem, a system may be needed in order to records the attendance of the workers more accurately without have to trace manually. The attendance management system will record the attendance of worker in industry when the work began and at the end of work. This is to ensure that the workers have attended the work.

III. Objective

The main objective of this paper is to develop an attendance management system for the industrial worker by using fingerprint saner so that workers of the industry does not get any opportunity to give fake attendance. The top management of the industry can always get the update information of their attendance. Another objective is to ensure the efficiency of this system by comparing this attendance management system with the manual system and it's important to ensure that proposed system will provide more efficiently than the manual system.

IV. Methodology

This project is based on hardware and software. Required hardware used should be easy to maintain, implement and easily available. Proposed hardware consists following parts:

a. Fingerprint Scanner,
b. LCD/Display Module (optional),
c. Computer.

Fingerprint scanner will be used to input fingerprint of worker into the computer software. LCD of the computer will be displaying the attendance of the worker. Computer Software will be interfacing fingerprint scanner and LCD and will be connected to the server. It will input fingerprint, will process it and extract features for matching. After matching, it will update database attendance records of the workers. For this system continuous internet connection is necessary because updated data is directly transferred to the server.

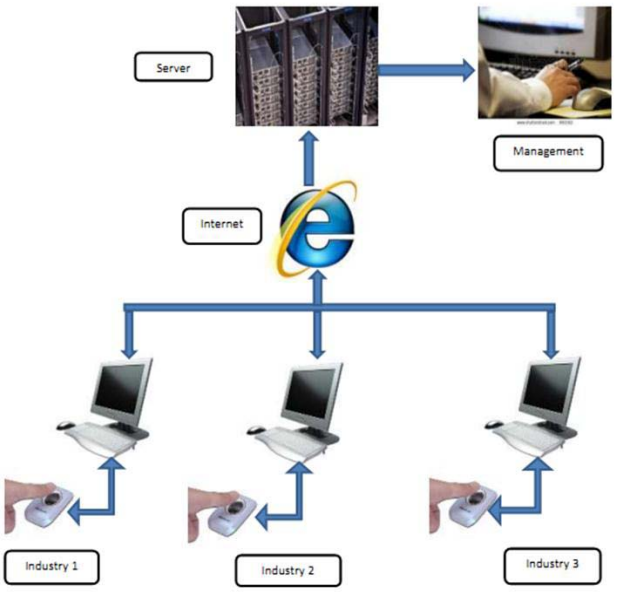

Figure 1 : Network Diagram of Attendance Management System

From this figure there is three industry's branch where workers of the industry will give the fingerprint by using fingerprint scanner and data will be uploaded to the server through the internet. Top management can enter the server by giving user id and password. They will get the every worker's attendance from the server.

a) Fingerprint

Fingerprint identification, known as hand print identification, is the process of comparing two instances of friction ridge skin impressions from human fingers or toes, or even the palm of the hand or sole of the foot, to determine whether these impressions could have come from the same individual. The flexibility of friction ridge

skin means that no two finger or palm prints are ever exactly alike in every detail; even two impressions recorded immediately after each other from the same hand may be slightly different. Fingerprint identification, also referred to as individualization, involves an expert, or an expert computer system operating under threshold scoring rules, determining whether two friction ridge impressions are likely to have originated from the same finger or palm (or toe or sole).

Figure 2 : Fingerprint

There are three basic fingerprint patterns: loop, whorl and arch, which constitute 60–65%, 30–35% and 5% of all fingerprints respectively. There are also more complex classification systems that break down patterns even further, into plain arches or tented arches, and into loops that may be radial or ulnar, depending on the side of the hand toward which the tail points. Ulnar loops start on the pinky-side of the finger, the side closer to the ulna, the lower arm bone. Radial loops start on the thumb-side of the finger, the side closer to the radius. Whorls may also have sub-group classifications including plain whorls, accidental whorls, double loop whorls, peacock's eye, composite, and central pocket loop whorls.

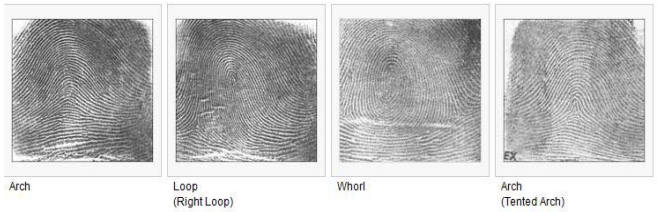

Figure 3 : Types of Fingerprint

b) Fingerprint Identification

Fingerprint identification is the oldest method that has been successfully used in numerous applications. Each of our ten fingerprints is different from one another and from those of every other person. Even identical twins have unique fingerprints. That makes them ideal for personal identification. A finger print is made of a series of ridges and furrows on the surface of the finger. The uniqueness of a fingerprint is determined by the pattern of ridges and furrows as well as the minutiae points. Minutiae points are local ridge characteristics that occur when a ridge splits apart or a ridge ends.

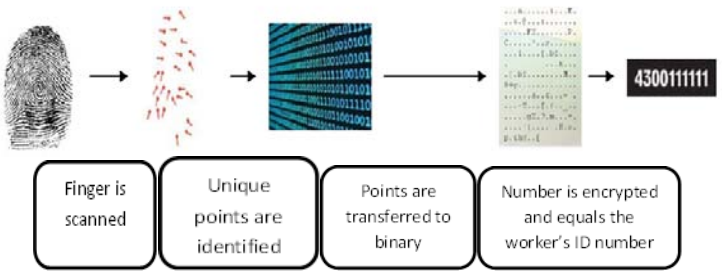

Figure 4 : Transformation of Fingerprint to Binary Number

When the worker returns to be identified, the finger scanner again scans the finger. The computer software now compares the new template with the other templates in the database. When a matching template is found, the worker is identified. This identification and matching process takes under one second to complete. At no time is a fingerprint image ever stored and no fingerprints can be recreated from the template.

c) Hardware

Fingerprint scanner is the external device and it is the only one hardware used in this project. A portable fingerprint scanner is directly connected to computer using USB port. Fingerprint scanner is generally used for the identification of a person based on unique patterns and ridges of fingerprint. Fingerprint matched a reference number or pin number with a person's name or account. Biometric plays a huge role for the identification of worker's information and security. There are two types of fingerprint scanner:

a. Optical scanner
b. Capacitance scanner

Figure 5 : Fingerprint Scanner

The basic function of scanner is to get the image of worker's fingerprint and match this image with database.

V. Software Design & Implementation

The purpose of software part of the embedded attendance system is to store necessary information including individual finger print data of users, workers and other member of an organization. Besides this, it also provides a way to identify with the fingerprint scanner output, the actual member of the organization and provide an interface to leave a comment especially if the worker does not come in time. The admin can check all the information about the entrance time and the leaving time and personal message of the workers Admin may be one or many. In a large organization admin of one branch can check out the status of the workers of other branches and can get whole information of all workers of the organization.

The software is web based and developed by using HTML, CSS, php, MySQL, JavaScript, Smarty. The following figures describe the software.

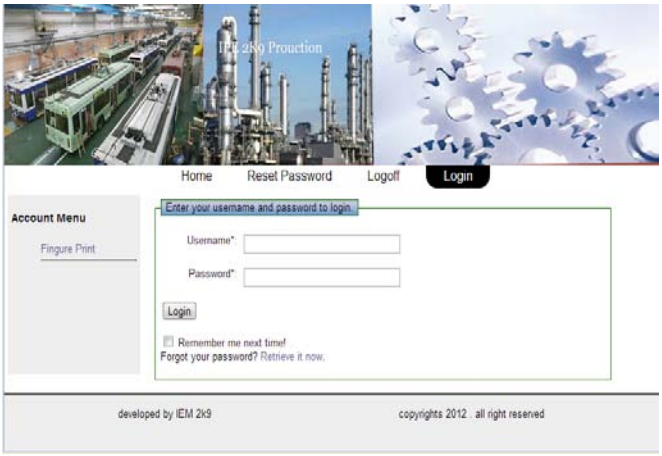

Figure 6 : Login Page for Admin

This figure provides the way to get login for admin. A particular username and a unique password will be provided before using this software for a particular industry. After login admin can set the required information according to his company or industry. Like as industry's worker's information, working period, Range of time for attendance if first period is started at 8.00AM then what is the range of time to attend? Admin can set it 5 minutes that is if worker is attend within 8.00AM to 8.05AM than attendance is accepted otherwise Not.

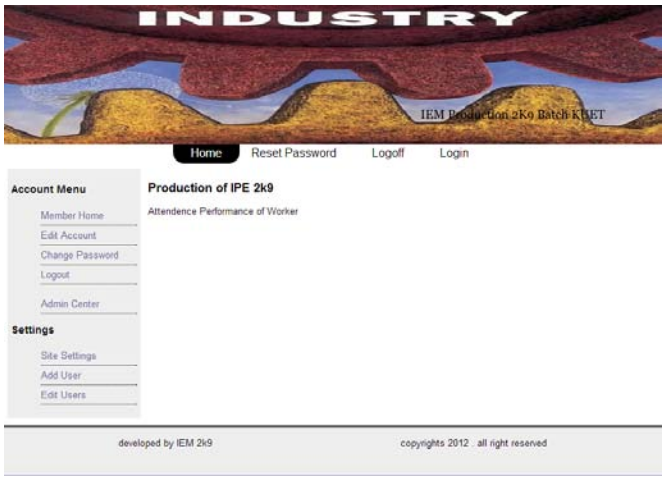

Figure 7 : Home Page of Site

Figure 7 is the home page for admin. By clicking Member Home menu admin can see his profile. By Edit Account, admin can change his account information. Admin Center provides an window to do a few task, these are Site Settings, adding new user, showing members information and attendance details.

Site Setting provides the admin a lot of tasks. At First setting the site URL, site name, admin info, site description. Second, setting look and feel of the site. Third, Email Setting enabling or not STMP, Captcha mood. Last, Maintenance Setting including Maint Mood, User Tracking, Force Compile ,User approval, Active Removal etc.

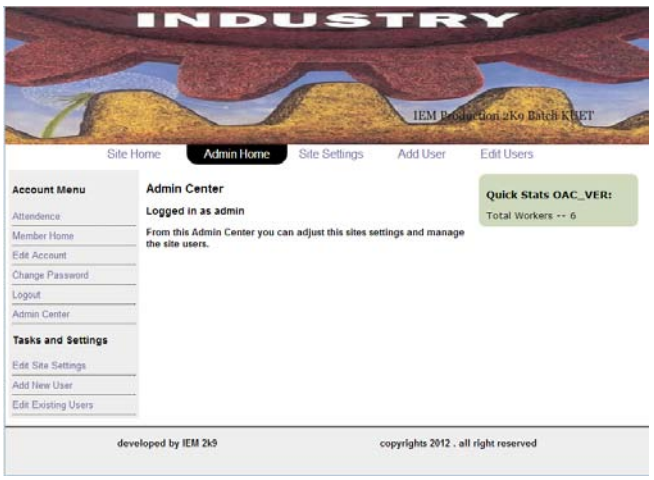

Figure 8 : Admin Home Page

By clicking Attendance Menu Admin can see the attendance details of all workers including the coming and leaving time with comments of each attendance. In right side of the corner shows the total workers in an organization. The attendance details depicts in fig. Add New User provides to take all information including fingerprint of the members depicts in fig.9 Edit Existing Users provides the list of all users as well as the advantage of viewing details and delete them.

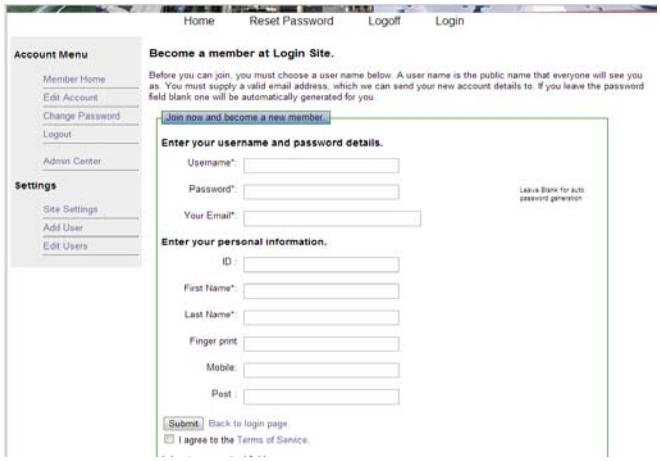

Figure 9 : Add New User Page

This figure shows the way of adding new user to the site. Only admin have the rights to add a new worker's information. Here username, Password and mail are the worker's account information. Each worker has unique ID according to the company's provisions. Full name of the worker and fingerprint is added by the scanning of worker's finger. After than put the mobile number and post of worker. Now just agree to the terms of service and click submit button. New worker will be added and a confirmation email will be sent to the worker's mail.

Figure 10 : Edit Existing User Page

Figure.10 shows the entire workers information, Admin can see the details from this page and edit the worker's information. By clicking View Full details, details information of worker will be presented to the admin. Admin can see the last activity of workers with date and time and also delete the worker.

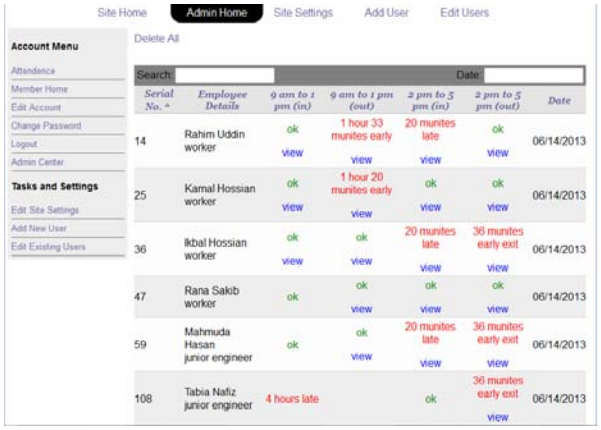

Figure 11 : Worker Attendance Page

Figure. 11 shows the attendance history of worker in an industry. For this industry working period is divided into two sections one is called first half which is between 9.00 AM - 1.00 PM and the second half is 2.00PM – 5.00 PM. During entrance time and outgoing time 5.00 minutes late is ignored for the worker which is adjusted by admin of industry. The ignorance time is depended on the industry's rules and regulation.

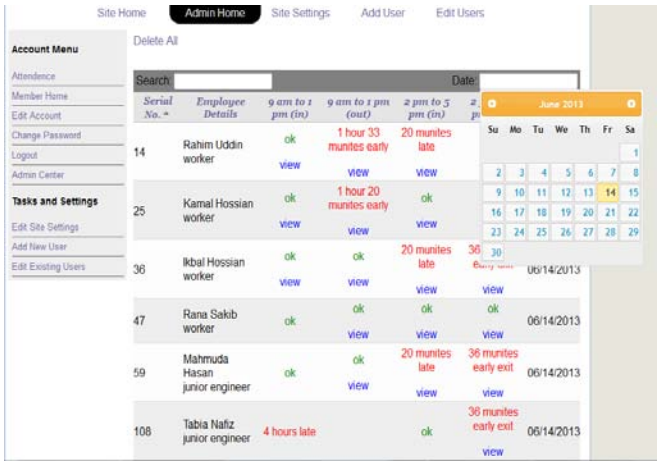

Figure 12 : Date of Attendance

Figure. 12 shows the worker's attendance details for selected date.

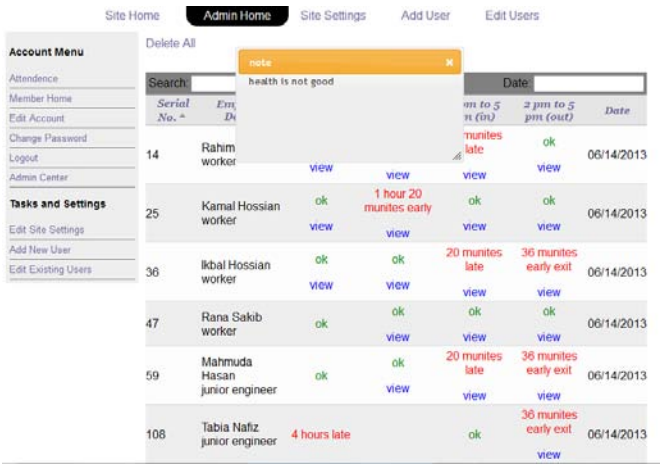

Figure 13 : Viewing worker's message

Worker can directly give their personal message or problem to the admin in note box for every time of attendance and admin can see their message by clicking view. Particular worker can be found by typing his or her name in search box. Here serial number shows the personal identity number of workers.

VI. Conclusion

For developing countries like Bangladesh, people working in industries and garment factories are not enough educated and conscious about their attendance. Also they have no direct communication with the Admin or top management authorities of the industry. As attendance is vital thing for the development of the industry and so understand the thoughts or reason of being late is also a very important thing. So an attendance management system providing this privilege is crying need for now-a–days. Our attendance system with fingerprint scanner provides the accurate attendance information of the workers and an interface to communicate with the workers. As all data is uploaded in server, internet connection is a must during attendance taking. Our automated attendance management system is user friendly, easy to use and provides a better security and privacy than manual attendance system.

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Global Journal of Computer Science and Technology
Graphics & Vision
Volume 13 Issue 6 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Image Segmentation using Rough Set based Fuzzy K-Means Algorithm

By E. Venkateswara Reddy & Dr. E. S. Reddy
Acharya Nagarjuna University, India

Abstract - Image segmentation is critical for many computer vision and information retrieval systems, and has received significant attention from industry and academia over last three decades. Despite notable advances in the area, there is no standard technique for selecting a segmentation algorithm to use in a particular application, nor even is there an agreed upon means of comparing the performance of one method with another. This paper, explores Rough-Fuzzy K-means (RFKM) algorithm, a new intelligent technique used to discover data dependencies, data reduction, approximate set classification, and rule induction from image databases. Rough sets offer an effective approach of managing uncertainties and also used for image segmentation, feature identification, dimensionality reduction, and pattern classification. The proposed algorithm is based on a modified K-means clustering using rough set theory (RFKM) for image segmentation, which is further divided into two parts. Primarily the cluster centers are determined and then in the next phase they are reduced using Rough set theory (RST). K-means clustering algorithm is then applied on the reduced and optimized set of cluster centers with the purpose of segmentation of the images. The existing clustering algorithms require initialization of cluster centers whereas the proposed scheme does not require any such prior information to partition the exact regions. Experimental results show that the proposed method perform well and improve the segmentation results in the vague areas of the image.

Keywords : *uncertain images, RGB images, rough set, K-means algorithm.*

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E. Venkateswara Reddy [α] & Dr. E. S. Reddy [σ]

Abstract - Image segmentation is critical for many computer vision and information retrieval systems, and has received significant attention from industry and academia over last three decades. Despite notable advances in the area, there is no standard technique for selecting a segmentation algorithm to use in a particular application, nor even is there an agreed upon means of comparing the performance of one method with another. This paper, explores Rough-Fuzzy K-means (RFKM) algorithm, a new intelligent technique used to discover data dependencies, data reduction, approximate set classification, and rule induction from image databases. Rough sets offer an effective approach of managing uncertainties and also used for image segmentation, feature identification, dimensionality reduction, and pattern classification. The proposed algorithm is based on a modified K-means clustering using rough set theory (RFKM) for image segmentation, which is further divided into two parts. Primarily the cluster centers are determined and then in the next phase they are reduced using Rough set theory (RST). K-means clustering algorithm is then applied on the reduced and optimized set of cluster centers with the purpose of segmentation of the images. The existing clustering algorithms require initialization of cluster centers whereas the proposed scheme does not require any such prior information to partition the exact regions. Experimental results show that the proposed method perform well and improve the segmentation results in the vague areas of the image.

Generalterms : *image processing, pattern recognition, segmentation.*

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I. Introduction

Image segmentation is one of the most challenging tasks in image analysis. It is also useful in the field of pattern recognition. Image mining deals with the extraction of implicit knowledge, image data relationship, or other patterns not explicitly stored in the images [5][6][7]. Image Segmentation is becoming more important for medical diagnosis process. Currently, development an efficient computer aided diagnosis system that assist the radiologist has thus become very interest, the aim being not to replace the radiologist but to over a second opinion [3, 4]. Consequently, the need of efficient research on features extracted and their role to the classification results makes researchers to select features randomly as input to their systems. In image segmentation an image is divided into different regions with similar features. There are many different types of approaches of image segmentation. Edge-based method, region-based techniques and threshold-based techniques and so on. Images are partitioned according to their global feature distribution by clustering based image segmentation methods. In this paper, a image segmentation method based on K-means using rough set theory is proposed, in which pixels are clustered according to the intensity and spatial features and then clusters are combined to get the results of final segmentation. The paper is organized as follows. In section 2 rough set theory is described. In section 3 rough set based K-means algorithm is proposed. In section 4 we have shown the experimental results and in section 5 some conclusions have been made.

Author α : Research Scholar, Acharya Nagarjuna University Guntur.
E-mail : evr.eluri@gmail.com
Author σ : Principal, University College of Engineering, ANU, Guntur.
E-mail : edara_67@yahoo.com

II. Rough Set Concepts

Rough Set Theory was firstly introduced by Pawlak in 1982 [2][3] and is a valuable mathematical tool for dealing with vagueness and uncertainty [4]. Similar or indiscernibility relation is the mathematical basis of the Rough Set theory. The key concept of rough set theory is the approximate equality of sets in a given approximation space [2][3]. An approximation space A is an ordered pair (U, R), where U is a certain set called universe, and that equivalence relation $R \subset U \times U$ is a binary relation called indiscernibility relation; if $x, y \in U$ any $(x, y) \in R$, this means that x and y are indistinguishable in A; equivalence classes of the relation R are called elementary sets (atoms) in A (an empty set is also elementary), and the set of all atoms in A is denoted by U / R . In the Rough Set approach, any vague concept is characterized by a pair of precise concepts, that is the lower and upper approximation of the vague concept. Let $X \subseteq U$ be a subset of U , then the lower and upper approximation of X in A are respectively denoted as:

$$\underline{A}(X) = \{x \in U : [x]_R \subset X\} ,$$

$$\overline{A}(X) = \{x \in U : [x]_R \cap X \neq \phi\} ,$$

Where $[x]_R$ denotes the equivalence class of the relation R containing element x. In addition, the set

$BN_A(X) = \bar{A}(X) - \underline{A}(X)$ is called a boundary of X in A [2][3]. If set X is roughly definable in A it means that we can describe the set X with some "approximation" by defining its lower and upper approximation in A [3]. The upper approximation $\bar{A}(X)$ means the least definable set in A containing the objects that possibly belong to the concept, whereas the lower approximation $\underline{A}(X)$.

a) Reduction of Attributes

Discovering the dependencies between attributes is important for information table analysis in the rough set approach. In order to check whether the set of attributes is independent or not, it is a way to check every attribute whether its removal increases the number of elementary sets in an information system [6]. Let the $S = (U, Q, V, \rho)$ be an information system and let $P, R \in Q$. Then, the set of attributes P is said to be dependent on set of attributes R in S (denotation $R \to P$) iff $IND_R \subseteq IND_P$, whereas the set of attributes P, R are called independent in S iff neither $R \to P$ nor $P \to R$ hold [2]. Moreover, finding the reduction of attributes is another important thing. Let the minimal subset of attributes $R \subseteq P \subseteq Q$ such that $\eta_P(\ddot{Y}) = \eta_R(\ddot{Y})$ is called $\ddot{Y}$ – reduct of P, and is denoted by $RED_{\ddot{Y}}(P)$. then the intersection of all $\ddot{Y}$ – reducts is called the $\ddot{Y}$ – core of P. especially, the core is a collection of the most relevant attributes in the table [5] and is the common part of all reducts [6].

b) Fuzzy-Rough Sets

In many real-world applications, data is often both crisp and *real-valued*, and this is where traditional rough set theory encounters a problem. It is not possible in the original theory to say whether two attribute values are similar and to what extent they are the same; for example, two close values may only differ as a result of noise, but RST considers them as different as two values of a dissimilar magnitude. It is, therefore desirable to develop techniques which provide a method for knowledge modelling of crisp and real-value attribute datasets which utilise the extent to which values are similar. This can be achieved through the use of *fuzzy-rough* sets. Fuzzy-rough sets encapsulate the related but distinct concepts of vagueness (for fuzzy sets) and indiscernibility (for rough sets), both of which occur as a result of uncertainty in knowledge. A T-transitive fuzzy similarity relation is used to approximate a fuzzy concept **x** the lower and upper approximations are:

$$\mu_{\underline{R_P X}}(x) = \inf_{y \in U} I(\mu_{R_P}(x, y), \mu_X(y)) \quad (1)$$

$$\mu_{\overline{R_P X}}(x) = \sup_{y \in U} T(\mu_{R_P}(x, y), \mu_X(y)) \quad (2)$$

Here, I is a fuzzy implicator and T a t-norm. R_P is the fuzzy similarity relation induced by the subset of features P:

$$\mu_{R_P}(x, y) = T_{a \in P}\{\mu_{R_a}(x, y)\} \quad (3)$$

$\mu_{R_a}(x, y)$ is the degree to which objects x and y are similar for feature a, and may be defined in many ways. In a similar way to the original crisp rough set approach, the fuzzy positive region can be defined as:

$$\mu_{POS_{R_P}(D)}(x) = \sup_{X \in U/D} \mu_{\underline{R_P X}}(x) \quad (4)$$

An important issue in data analysis is the discovery of dependencies between attributes. The fuzzy-rough dependency degree of D on the attribute subset P can be defined as:

$$\gamma'_P(D) = \frac{\sum_{x \in U} \mu_{POS_{R_P}(D)}(x)}{|U|} \quad (5)$$

A fuzzy-rough reduct R can be defined as a minimal subset of features which preserves the dependency degree of the entire dataset $\gamma'_R(D) = \gamma'_C(D)$.

III. Fuzzy K-Means Algorithm

The fuzzy *k*-means clustering algorithm partitions data points into *k* clusters $S_l (l = 1, 2, \ldots k)$ and clusters S_l are associated with representatives (cluster center) $\boldsymbol{C_l}$. The relationship between a data point and cluster representative is fuzzy. That is, a membership $u_{i,j} \in [0, 1]$ is used to represent the degree of belongingness of data point $\boldsymbol{X_i}$ and cluster center $\boldsymbol{C_j}$. Denote the set of data points *as* $S = \{\boldsymbol{X_i}\}$. The FKM algorithm is based on minimizing the following distortion.

$$J = \sum_{j=1}^{k} \sum_{i=1}^{N} u_{i,j}^{m} d_{ij}$$

With respect to the cluster representatives $\mathbf{C}_j$ and memberships $u_{i,j}$, where N is the number of data points; m is the fuzzifier parameter; k is the number of clusters; and d_{ij} is the squared Euclidean distance between data point $\mathbf{X}_i$ and cluster representative $\mathbf{C}_j$. It is noted that $u_{i,j}$ should satisfy the following constraint:

$$\sum_{j=1}^{k} u_{i,j} = 1, \text{for i=1to N}$$

The major process of FKM is mapping a given set of representative vectors into an improved one

through partitioning data points. It begins with a set of initial cluster centers and repeats this mapping process until a stopping criterion is satisfied. It is supposed that no two clusters have the same cluster representative. In the case that two cluster centers coincide, a cluster center should be perturbed to avoid coincidence in the iterative process. If $d_{ij} < \eta$, then $u_{i,j} = 1$ and $u_{i,l} = 0$ for $l \neq j$, where η is a very small positive number. The fuzzy k-means clustering algorithm is now presented as follows.

1. Input a set of initial cluster centers $SC_0 = \{\mathbf{C}_j(0)\}$ and the value of ε. Set $p = 1$.
2. Given the set of cluster centers SC_p, compute d_{ij} for $i = 1$ to N and $j = 1$ to k. Update memberships $u_{i,j}$ using the following equation:

$$u_{i,j} = \left((d_{ij})^{1/m-1} \sum_{l=1}^{k} \left(\frac{1}{d_{il}} \right)^{1/m-1} \right)^{-1}$$

If $d_{ij} < \eta$, set $u_{i,j} = 1$, where η is a very small positive number.

3. Compute the center for each cluster using next equation below to obtain a new set of cluster representatives SC_{p+1}.

$$C_j(p) = \frac{\sum_{i=1}^{N} u_{ij}^m \mathrm{X}_i}{\sum_{i=1}^{N} u_{ij}^m}$$

If $\|C_j(p) - C_j(p-1)\| < \varepsilon$ for $j = 1$ to k, then stop, where $\varepsilon > 0$ is a very small positive number. Otherwise set $p + 1 \rightarrow p$ and go to step 2.

The major computational complexity of FKM is from steps 2 and 3. However, the computational complexity of step 3 is much less than that of step 2. Therefore the computational complexity, in terms of the number of distance calculations, of FKM is $O(Nkt)$, where t is the number of iterations.

IV. Proposed Method

Fuzzy k-means is one of the traditional algorithms available for the clustering. However this algorithm is crisp as it allows an object to be placed exactly in only one cluster. To overcome the disadvantages of crisp clustering fuzzy based clustering was introduced. The distribution of member is fuzzy based methods can be improved by rough clustering. Based on the lower and upper approximations of rough set, the rough fuzzy k-means clustering algorithm makes the distribution of membership function become more reasonable.

a) *Rough Set Based Fuzzy K-Means Algorithm*

Specific steps of the RFKM clustering algorithm are given as follows:

Step 1 : Determine the class number k (2<=k<=n), parameter m, initial matrix of member function, the upper approximate limit A_i of class, an appropriate number $\varepsilon > 0$ and s = 0.

Step 2 : We can calculate centroids with the formula given below:

$$C_i = \sum_{j=1}^{n} \mathrm{U}_{ij}^m \mathrm{X}_j / \sum_{j=1}^{n} \mathrm{U}_{ij}^m \qquad (6)$$

Step 3 : If $\mathrm{X}_j \notin$ the upper approximation, then $\mathrm{U}_{ij} = 0$. Otherwise, update U_{ij} as shown below:

$$\mathrm{U}_{ij} = \frac{1}{\sum_{l=1}^{k}, \mathrm{x}_j \in \mathrm{Rwi}(\frac{\mathrm{d}_{ij}^2}{\mathrm{d}_{ij}^2}) \frac{1}{\mathrm{m-1}}} \qquad (7)$$

Step 4 : If $\| \mathrm{U}^{(s)} - \mathrm{U}^{s+1} \| < \varepsilon$

i. *Obtain each Feature's Membership Value*

First, initial cluster centers {P1, P2… Pc} were generated by randomly choosing c points from an image point set. Where c ∈ [cmin, cmax], cmin =2, cmax = $\sqrt{n}$ (n is the image pixels number). Each cluster centers Pi is represented by n numeric image features $\{\mathrm{F}_i, i=1, 2,...n\}$. Then each feature F_i is described in terms of its fuzzy membership values corresponding to three linguistic fuzzy sets, namely, low (L), medium (M), and high (H), which characterized respectively by a π - membership function.

$$\mu(F_i) = \begin{cases} 2\left(1-\frac{|F_i - c|}{\lambda}\right)^2 & for \ \frac{\lambda}{2} \le |F_i - c| \le \lambda \\ 1-2\left(\frac{|F_i - c|}{\lambda}\right)^2 & for \ 0 \le |F_i - c| \le \lambda \\ 0 & \text{otherwise} \end{cases}$$

Where λ is the radius of the π - membership function with c as the central point. To select the center c and radius λ. Thus, we obtain an initial clustering centers set where each cluster center is represented by a collection of fuzzy set.

ii. *Constitute a Decision Table for the Initial cluster Centers Set*

Definition 1 Degree of similarity between two different cluster centers is defined as:

$$\alpha = \frac{\sum_{i=1}^{n} \mu(F_i)}{n}$$

Higher the value of the similarity, the closer the two clustering center is. Definition 2 in a same cluster centers set, if a cluster center has a same similarity value to another one, then they are called redundant cluster center each other. Proposition 1 If A and B are redundant cluster center each other, B and C are

redundant cluster center each other, then A, B and C belong to a same redundant cluster center, Viz.

$$A \leftrightarrow B, B \leftrightarrow C \Rightarrow A \leftrightarrow B \leftrightarrow C$$

Based on what mentioned above, taking initial cluster centers as objects, taking cluster centers features F_i, the central point c and the radius λ as conditional attributes, taking degree of similarity between two different cluster centers as decision attribute by computing the π-membership function value, then a decision table for the initial cluster centers set can be constituted as follows:

$$T = \langle U, P \cup R, C, D \rangle$$

Where $U = \{x_i, i=1, 2\ldots m\}$, it denotes a initial cluster centers set; $P \cup R$ is a finite set of the initial cluster center category attributes (where P is a set of condition attributes, R is a set of decision attributes); $C = \{p_i, i=1, 2\ldots n\}$ (where pi is a domain of the initial cluster center category attribute);

$D: U \times P \cup R \rightarrow C$ is the redundant information mapping function, which defines an indiscernibility relation on U.

iii. *Eliminating redundant cluster centers from the initial cluster centers set*

Assuming $D(x)$ denotes a decision rule, $D(x)|P$ (condition) and $D(x)|R$ (decision) denote the restriction that $D(x)$ to P and R respectively, I and j denotes two different cluster centers respectively, and other assumptions are as the same as what mentioned above. Based on what described above, the initial cluster centers set can be optimized by reduction theory according to the following steps:

1. Deducing the compatibility of each rule of an initial cluster center set decision table z If $D(I)|P$ (condition)= $D(j)|P$ (condition) and $D(i)|R$ (decision)= $D(j)|R$ (decision), then rules of an initial cluster center set decision table are compatible;

   If $D(i)|P$ (condition)= $D(j)|P$ (condition), but $D(i)|R$ (decision) $\neq D(j)|R$ (decision), then rules of an initial cluster center set decision table are not compatible.
2. Ascertaining redundant conditional attributes of an initial cluster center set decision table.

   If an initial cluster center set decision table are compatible, then when $p \in P$ and $Ind(P)=Ind(P-p)$, p is a redundant attribute and it can be leaved out, otherwise p can't be leaved out.

   If an initial cluster center set decision table are not compatible, then computing its positive region $POS(P, R)$. If $p \in P$, when $POS(P, R)=POS(P-p, D)$, then p can be leaved out, otherwise p can't be leaved out.
3. Eliminating redundant decision items from an initial cluster center decision table. For each condition attribute p carries out the process mentioned above until condition attribute set does not change. As soon as redundant initial cluster centers in the initial cluster set is eliminated, a reduced cluster center set is used as the FCM initial input variance for image segmentation. To evaluate the quality of clusters, the Xie-Beni index was used.

$$XB = \frac{\sum_{j=1}^{c}\sum_{i=1}^{n} \mu_{ij}^2 \left\| x_i - v_i \right\|^2 / n}{\min_{ij} \left\| v_i - v_j \right\|}$$

A smaller XB reflects that the clusters have greater separation from each other and are more compact.

Based on what descript above, now the procedure for Rough Sets based FKM image segmentation method can be summered as follows:

Step 1 : Randomly initialize the number of clusters to c, where $2 \leq c \leq \sqrt{n}$ and n is number of image points.

Step 2 : Randomly chooses c pixels from the image data set to be cluster centers.

Step 3 : Optimize the initial cluster centers set by Rough Sets.

Step 4 : Set step variable $t=0$, and a small positive number ε.

Step 5 : Calculate (at $t=0$) or update (at $t>0$) the membership matrix $U = \{u_{k,x}\}$ using equation (6).

Step 6 : Update the cluster centers by equation (7).

Step 7 : Compute the corresponding Xie-Beni index using equation (12).

Step 8 : Repeat step 5-8 until $\| XB^{t+1} - XB^{t} \| < \varepsilon$

Step 9 : Return the best XB and best center positions.

V. Experiment Results

In this section, experimental results on real images are described in detail. In these experiments, the number of different types of object elements in each image from manual analysis was considered as the number of clusters to be referenced. They were also used as the parameter for FKM. The Xie-Beni index value has been utilized throughout to evaluate the quality of the classification for all algorithms. All experiments were implemented on PC with 1.8 GHz Pentium IV processor using MATLAB (version 9.0).

(a) Original Image

(b) FCM

(c) RFCM

(d) RFKM

(a) Original Image

(b) FCM

(c) RFCM

(d) RFKM

Proposed algorithm applied on all the images shown above. This RFKM image segmentation method partitions into different regions exactly. Visually as well as theoretically our method gives better results other than state of the art methods like, FCM, RFCM. We present a clustering time of experiment for 2 experiments and shows that RFKM performs better than FCM and RFCM.

Table 1 : Table captions should be placed above the table

	Average of the XB index values	Clustering time (in sec)
FCM	0.034024	13.64
RFCM	0.031578	6.48
RFKM	0.029197	5.92

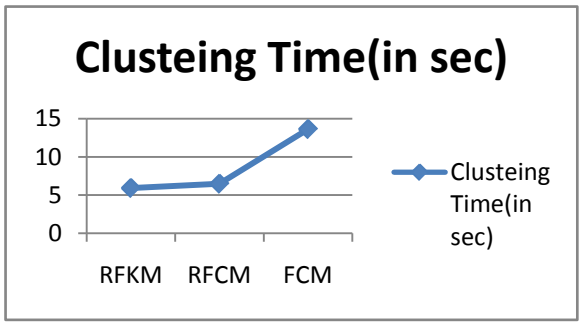

Figure 1 : Clustering Time(in sec) for RFKM, RFCM, FCM

VI. Conclusions

We employed Rough Sets to FKM image segmentation. By reduction theory (the core of Rough Sets), the vagueness and uncertainty information inherent in a given initial cluster center set is analyzed, and those redundant initial cluster centers in the initial cluster set is then eliminated, the reduced initial cluster center set as input to FKM for the soft evaluation of the segments, this is very useful for overcoming the drawbacks of conventional FKM segmentation over-dependence on initial value. To evaluate the quality of clusters, the Xie-Beni index was used as the cluster validity index. Experimental results indicate the superiority of the proposed method in image segmentation.

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Final Points:

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- Significant conclusions or questions that track from the research(es)

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- Center on shortening results - bound background information to a verdict or two, if completely necessary
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- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
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Approach:

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- If use of a definite type of tools.
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The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

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	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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ISSN 9754350