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ARTICLE

COMPARISON OF DIFFERENT BIOMETRIC FEATURES BASED IDENTIFICATION SYSTEM

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ABSTRACT

In the emerging technology security identification is one of the major challenges in various sectors because it is used to eliminate the unauthorized access while accessing the secure information. During the authentication purpose, various biometric features such as ear, fingerprint, knuckle, voice, iris are used. Among the different biometric features, in this work utilize the finger knuckle and ear features are utilized for performing the identification process. Based on the different features, the biometric authentication system is implemented with the help of the Graph based Geometric Approach and the Principal Curvature approach and Rapid Segment Analysis Feature Transform (RSAFT) method. Thus in this paper compares the different identification method for authenticate the user information. Then the best identification method is analyzed in terms of different metrics such as false acceptance rate, false rejection rate, equal error rate, and accuracy metrics.

KEY WORDS
Biometric features, finger knuckle and ear features,Graph based Geometric Approach and the Principal Curvature approach and Rapid Segment Analysis Feature Transform (RSAFT)

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INTRODUCTION

In the developing technology security is one of the major issue in various fields such as cloud computing, bank transaction, educational institutions and so on. This security problem is resolved with the help of the biometric system which effectively utilizes the human traits for authenticating the user identities [1]. There are various human traits such as ear, fingerprint, face, lips, retina, signature, DNA, hand geometry and voice features are used for implementing the effective biometric system. Among the different biometric features, in this work utilizes the two important biometric features namely finger knuckle print and ear biometric feature for implementing the authentication system because those features have several advantages when compared to the other biometric features [2]. The finger knuckle print features having several benefits such as it numerous image capturing, contact-less, user acceptance of the outer –palm surface is high, well defined texture feature, easily accessible and stable features because it does not change their characteristics during the personal emotions and behavioral aspects [3]. In addition the ear biometric features having separate advantages namely, ear features are effectively utilized in the forensic science because it does not change its structure and color while developing the human life cycle. More over the ear biometric features does not affected by human personal emotions; in addition the ear images are captured from very long distance without user interference [4]. Due to these advantages on the two biometrics features in this research work utilizes these features for implementing the identification system. These two biometric features are shown in the [Fig. 1].

The captured biometric features are processed by applying the different image processing approaches such as noise removal, segmentation, feature extraction and matching process. These steps are successfully analyzing the each and every pixel present [5] in the image with effective manner. In this work two different optimized image processing techniques such as Graph based Geometric Approach and the Principal Curvature approach and Rapid Segment Analysis Feature Transform (RSAFT) are introduced for processing the images with effective manner. After implementing the biometric system, comparison should be performed in for analyzing the effectiveness of the system in terms of using the performance metrics such as false acceptance rate, false rejection rate, equal error rate, and accuracy metrics. Thus the remaining of this paper organized as follows, Section 2 summarizes the related works for different biometric feature based identification process, Section 3 deals with the detailed biometric system, and Section 4 discusses the results and comparison of the identification system then the Section 5 describes the conclusion.

RELATED WORKS

In this section examines the various author's opinions regarding the biometric feature based identification system. Sayan Maity et al [6] recognize the system by using the 3D image based new data storage and information retrieval technique. This paper proposes that, University of Notre Dame Collection J2 dataset 3D ear images are segmented by using the automatic segmentation process and categorizes those images by shape and surface based features. Then the geometrical features are estimated with the help of shape and surface values and the features are categorizes using the tree based indexing which was done in tree based balance split and tree based unbalanced split. The resultant of the system produces the enhanced recognized system with minimum time.

Vaibhav et al., [7] develops the novel biometric recognition system using the Radon Transform. The captured finger knuckle biometric image considered as the texture image which is preprocessed and the noise has been removed for improving the recognition rate. Then the different direction based features are extracted using the Random transform which is classified by applying the weighted average difference measures. Then the performance of the system is evaluated using the PolyUFKP database knuckle print

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images which are analyzed using the 60 different directions ranging from 0-180 degree with the interval of 3 degrees. Then the feature vectors are mapped according to the 256×60 size, which provides the 94.33% recognition rate.

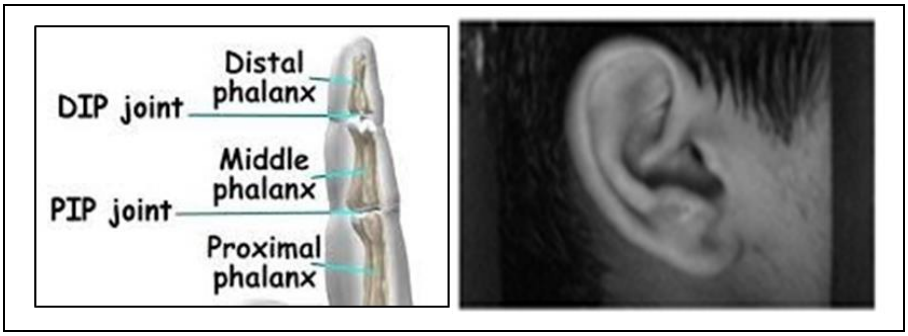

Fig. 1: Sample Biometric Features.

Mahesh Kumar, et al.,[8] proposes a finger print knuckle biometric system for improving the authentication and security to the user personal information's. The captured knuckle print biometric features are preprocessed and the local, global texture features are extracted by utilizing the symmetric discrete orthonormal Stockwell transform.

Meraoumia et al., [9] improves the multimodal biometric system using the palm print and finger knuckle print biometric features. The captured features are processed by using the Phase-Correlation Function (PCF). Then the two biometric features are combined with the help of the matching score level and the performance of the system is evaluated using the recognition rate. Based on the above discussions, the biometric features are processed by applying the different image processing techniques. So, in this paper utilizes the Graph based Geometric Approach and the Principal Curvature approach and Rapid Segment Analysis Feature Transform (RSAFT) method based image processing methods for implementing the identification system which is explained in the following section.

DIFFERENT BIOMETRIC FEATURE BASED IDENTIFICATION SYSTEM

In this section discusses the two different biometric feature based identification system such as Graph based Geometric Approach and the Principal Curvature approach and Rapid Segment Analysis Feature Transform (RSAFT) method implementation process which is explained one by one as follows.

Graph based geometric approach and the Principal curvature approach

First the finger knuckle biometric based identification system is developed by using the Graph based Geometric Approach and the Principal Curvature approach. Initially the finger knuckle image has been captured and the it has been converted into grayscale image[10] by applying the following eqn(1).

$$GS = 0.2989 * Intensity(r) + 0.58701 * Intensity\ (g) + 0.1140 * Intensity\ (b) \quad (1)$$

After converting the image color, noise present in the image has been eliminated by using the non-local median filter. The method effectively analyzes the self-similarity between the pixels in terms of using the intensity value which is measured as follows.

$$v(i) = u(i) + n(i) \quad (2)$$

Where v(i) is defined as the observed value from the given image, u(i) is defined as the "true" value and n(i) is defined as the noise agitation at a pixeli. After that the Gaussian noise has been eliminated by assuming the identical values and the non-local mean[11] value is estimated as follows,

$$NL(V)(p) = \sum_{q \varepsilon V} w(p,q)V(q) \quad (3)$$

Where V is defined as the noisy image, and weights w(p,q) meet the subsequent conditions $0 \leq w(p,q) \leq 1$ and $\sum_q [w(p,q)=1]$. Then the weighted and neighboring values are calculated for determining the noise value which is eliminated successfully. After eliminating the noise in the image contour off the image has been extracted based on the background pixel and object pixel. This pixels are analyzed effectively based on that graph has been constructed which helps to link the contour pixels with effective manner. Then the finger knuckle key point location is identified by applying the principle curvature based detector[12]. The point has been detected in terms of intensity and structure based detector. The principal curvature region is calculated by applying the Hessian Matrix, which is defined as follows,

$$H(x) = \begin{bmatrix} L_{xx}(x) & L_{xy}(x) \\ L_{xy}(x) & L_{yy}(x) \end{bmatrix} \quad (4)$$

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whereL_xx (x) is the second partial derivative of the image at a point x in the x direction and L_xy (x) is the mixed partial second derivative of the image at a point x in the x and y directions. Then the key point is detected in different direction, location according to the maximum and minimum value with different orientation. The extracted key points are stored in the database by training the features using the compositional neural networks[13]. The network train the feature according to the key point importance and the error has been rectified by updating the Gaussian sigmoid function which is stored in the database. When the new features arriving to the identification process the finger knuckle image is compared with the trained features with the help of the Levenshtein distance which is done as follows,

$$D_{a,b} = \begin{cases} \max(i,j) & if \min(i,j) = 0, \\ min \begin{cases} D_{a,b}(i-1,j)+1 \\ D_{a,b}(i,j-1)+1 \\ D_{a,b}(i-1,j-1)+1_{(a_i \neq b_j)} \end{cases} & otherwise \end{cases} \quad (5)$$

Where
D_(a,b) is the distance between the user query and template features, 1_((a_i≠b_j)) is the indicator function which is equal to 0 when a_i=b_j
The length of the features like template and user query with respect to the i and j which is used to estimate the distance between the features. Then the computed similarity value is compared with the threshold value 0.3. If the value is greater than the threshold value, then the user related query value is considered as the valid template otherwise leaves as the invalid one. Thus the proposed system extracts the principal curvature based features of the finger knuckle print and those features are trained by Compositional Neural Networks, matching is done with the help of the Levenshtein Distance measure. Then the identification system is implemented by another biometric feature using the Rapid Segment Analysis Feature Transform (RSAFT) method which is explained as follows.

Rapid Segment Analysis Feature Transform (RSAFT) based Identification System

The next identification system is implemented by using the rapid segment analysis feature transform method. Initially ear images are captured and converted into the gray scale image which is done by using the eqn (1). After eliminating the noise from the image, median filter has been applied for removing the noise image which effectively analyze each and every pixel present in the image. The noise has been eliminated by sorting the neighboring pixels[14], if the pixel is corrupted by noise that is replaced by the median value. Once the noise is eliminated by using the rapid segment analysis feature extraction method. This method effectively analyzes the image in terms of using the 16 pixels which helps to determine the key point from the image. From the detected key point, the orientation has been assigned using the magnitude and orientation which is calculated as follows,

$$m(x,y) = \sqrt{\left(L(x+1,y) - L(x-1,y)\right)^2 + \left(L(x,y+1) - L(x,y-1)\right)^2} \quad (6)$$

$$\theta(x,y) = atan2\left(L(x,y+1) - L(x,y-1)\right), \left(L(x+1,y) - L(x-1,y)\right) \quad (7)$$

Where, m(x,y)=magnitude of the key image, θ(x,y)=orientation the key point image
Based on the magnitude value, the direction of the pixel is estimated by using the 36 bin with 360 degree histogram. From the estimated direction [15], the key descriptors are detected by using the candidate image that consists of 16*16 histogram image. The estimated elements are normalized by using the threshold value i.e 0.2 (default threshold value). The key point whose value is within the threshold value as consider as the ear feature. Then the identified ear features are stored in the database which used to match the user query template for further processing. If the new features are entered into the identification system which is compared with the template feature using the Hausdorff distance [16] that is done by as follows,

$$d_H(X,Y) = \max\{\sup_{x \in X} \inf_{y \in Y} d(x,y), \sup_{y \in Y} \inf_{x \in X} d(x,y) \quad (8)$$

Sup- supremum, inf- infimum.

Where, - Similarity between the training and testing features.
Calculated similarity value is compared with the threshold value 0.2. If the value is greater than the threshold value, the user template considers as the valid template otherwise template is invalid. Thus the proposed system recognizes the ear features by Rapid Segment Analysis Feature Transform and those features are valid by Hausdorff Distance measure. Thus the two biometric features are effectively identifying the user while accessing the particular information. Then the efficiency of the system is analyzed using the following experimental results and discussion.

Infection is a dynamic process involving invasion of body tissues by pathogenic micro-organisms and their toxins. Nosocomial/ hospital/ acquired infections are those which are not present or incubated before admission of patient to the hospital but obtained during the patient's stay in hospital. Lab coats, nurses' uniforms and other hospital garments, materials and articles may play an important part in transmitting pathogenic bacteria in a hospital setting .The hands of healthcare personnel are most commonly implicated in transmitting the pathogens [1]. Various nosocomial pathogens, such as methicillin-sensitive *Staphylococcus aureus* (MSSA), methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococci* (VRE) and gram negative organisms is well documented [2]. Specifically in the area of dentistry, health care professionals are routinely exposed to potentially pathogenic microorganisms which

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are present in the surrounding environment. Most of them originate from the mouths of patients [3]. Contamination may occur from instruments through contamination vectors. These contaminated object infections may be transferred from patient to patient or from patient to professionals [4]. Methicillin resisitant*Staphylococcus aureus* which is the most pathogenic microorganism, comes in contact with health care professionals via direct hand contact with contaminated body fluids, devices, items or environmental surfaces [5].

There are very few studies regarding the wearing and laundering of lab coats in hospitals and medical practice. This study highlights the role of lab coats acting as vector for transmitting health care infections to the patients and the common areas where contamination occurs.

RESULTS AND DISCUSSIONS

In this section analyze the efficiency of the proposed two biometric system in terms of using the false acceptance rate, false rejection rate, equal error rate and accuracy. False Acceptance Rate (FAR) [17] is the process of identifying that rate of unauthorized user acceptance during the identity identification process. The FAR is measured by using the following eqn 9.

$$FAR = \frac{Number\ of\ features\ accepted}{Number\ of\ features\ tested} * 100 \qquad (9)$$

Then the efficiency of the proposed system false acceptance rate is shown in the [Table 1] and the relevant graphical representation is shown in [Fig. 2].

Table 1 : False Acceptance Rate

Methods	Fingerknuckle	ear
SVM	1.65	1.43
NN	1.23	1.14
MLP	0.98	0.86
GGAPC	0.54	0.42
RSAFT	0.32	0.29

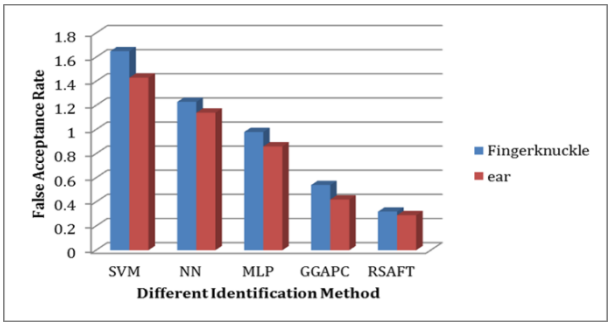

Fig. 2: False acceptance rate.

The [Fig. 2] clearly shows that the two proposed methods consists of minimum false acceptance rate when compared to other identification methods. The minimum false acceptance rate means, the system completely eliminates the unauthorized user while accessing the information from any application. In addition the efficiency of the system is evaluated with the help of the false rejection rate which is shown in the [Table 2] and the relevant graphical representation is depicted in [Fig. 3]. False Rejection Rate [18] is the process of incorrectly rejecting the authorized user during the matching process which was measured in terms of percentage. The FRR is measured by using the following eqn 10.

$$FRR = \frac{Number\ of\ original\ features\ rejected}{Number\ of\ original\ features\ tested} * 100 \qquad (10)$$

Table 2: False rejection rate

Methods	ear	finger knuckle
SVM	0.19	0.23
NN	0.16	0.21
MLP	0.126	0.17
GGAPC	0.072	0.09
RSAFT	0.03	0.02

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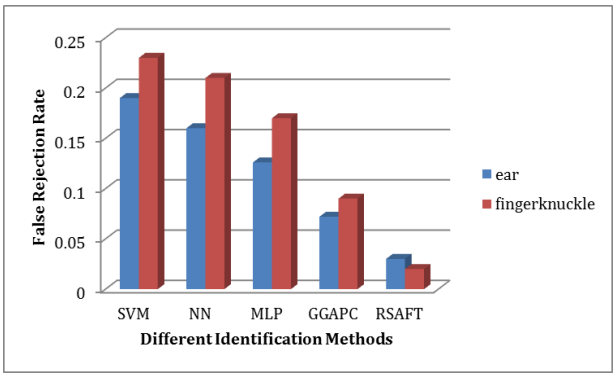

Fig. 3: False rejection rate.

The [Fig. 3] depicted that the false rejection rate of the proposed two methods which is compared with the traditional identification methods. This indicates that the proposed system minimizes the right feature rejection while matching the test and training features. Thus the system consists of equal error rate [19] which is shown in the [Table 3] and the graphical representation is shown in [Fig. 4].

Table 3: Equal error rate

Methods	ear	finger knuckle
SVM	0.046	0.036
NN	0.031	0.024
MLP	0.019	0.012
GGAPC	0.009	0.006
RSAFT	0.004	0.003

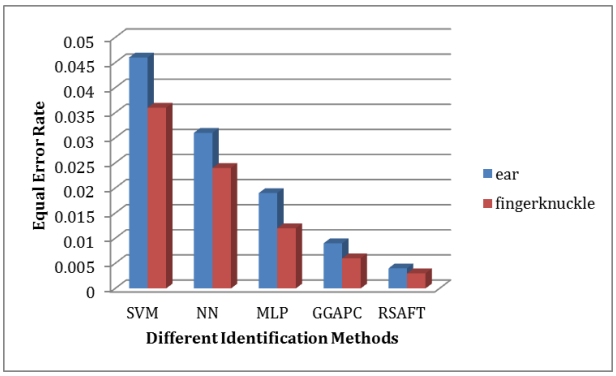

Fig. 4: Equal error rate.

Thus the proposed system successfully recognizes the features which helps to authenticate the user information. The efficiency of the system is analyzed using the following [Table 4] and [Fig. 5].

Table 4: Efficiency

Methods	Ear	finger knuckle
SVM	83	84
NN	88	90
MLP	91	93
GGAPC	97	98
RSAFT	98.43	99.1

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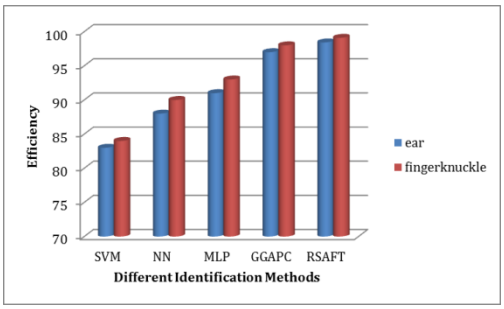

Fig. 5: Efficiency.

From the [Fig. 5], it clearly shows that the proposed system consumes high accuracy [20] for both biometric features, with defined methods. Thus the proposed GGAPC method consumes 97% for ear feature and 98% for finger knuckle biometric feature. In addition the RSAFT method consumes 98.43% for ear feature and 99.1% for finger knuckle biometric feature when compared to the other biometric identification method.

CONCLUSION

Thus the paper compares proposed two biometric based identifications systems such as Graph based Geometric Approach and the Principal Curvature approach and Rapid Segment Analysis Feature Transform (RSAFT) method. These methods utilize the ear and finger knuckle biometric feature for examining the efficiency of the system. This system uses different image processing steps such as color transformation, noise removal process such as non-local median filter median filter and the principle curvature based detector, rapid segment feature extraction process and matching process is done by using the Levenshtein distance and Hausdroff distance measure. Based on the above steps the biometric systems are successfully implemented. The efficiency of the system is evaluated with the help of different performance metrics such as false acceptance rate, false rejection rate, equal error rate, and accuracy metrics. Thus the proposed system ensures the high accuracy when compared to the other identification methods.

CONFLICT OF INTEREST
There is no conflict of interest.

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