IJCSC 0973-7391 Vol 6 • Number 2 April - Sep 2015 pp. 238-244 Impact Factor: 2.5 Available at www.csjournals.com

Ear Pattern Recognition and Compression

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Abstract: Ear pattern recognition using eigen ears is a biometric technique of human identification in which we use PCA (principal component analysis) and also PCA for ear image compression technique in which also prefer eigen ears and if have some problems regarding enhancement of image which undergone noise addition or some other type of modification so after reducing these noises we can make it for recognition. Here do segmentation which is uniformly horizontal or non horizontal, also non horizontal segmentation. Calculate eigen values, covariance between two images, and also by we can match by Euclidean distance between two images minimum distance gives higher match.
Keywords: Pattern recognition, compression, principal component analysis.

I. INTRODUCTION

Biometric can be defined as the set of methods which are used to measure the physical and behavioural characteristics of a human being for recognition and verification of a human being[3],[31],[33]. Examples of physical biometric are face recognition, eye retina and iris scanning, hand shapes are very common and easier than behavioural biometric which in turn are hand writing, gait and typing pattern recognition.

Physical and behavioural methods are two different types of biometric methods which are divided again in two types invasive and non invasive. In invasive method we require a human being cooperation to gain the data which is needed for the comparison of human feature to the data already stored in the dataset. In non invasive method we do not require any human being to cooperate because we can also use their captured data without telling anything about our work. And the person does not know anything about it. Biometric methods are most applicable in robotics, security and medical purposes. In these areas we can use face recognition, iris, retina scanning, fingerprint. In these areas research communities gave their most attention.

Eye retina, iris scanning and fingerprint scanning are invasive method of biometrics which cannot be used in some application areas. Cameras and scanners are required for fingerprint scanning and for iris scanning where they are must having with high quality in all manners for extracting good quality images. On the second hand, gait and face recognition comes under the non invasive methods of biometrics. They don't need high quality cameras. Like face pattern recognition, ear pattern recognition also comes under non invasive biometric method. In ear biometric recognition same camera can be used which is used for face recognition.

Research communities gave a least attention towards ear pattern recognition rather than other biometric techniques given as iris scanning, face pattern matching, fingerprint and gait recognition. But in the previous year some researchers have started for considering the problem for computations of ear image recognition. Our research can show that ear pattern recognition is applicable to a great extent like all other biometric techniques. In this we can do compression of image or dimensionality reduction of image before doing this we can also enhance image also by removing noise.

Image Enhancement Technique

The image enhancement technique can be divided into three broad categories:

Frequency domain method, where enhancement is done by altering the frequency transform of given image using Fourier method.

Edge and sharp transitions (e.g., noise) in an image contribute significantly to high frequency content of Fourier transform.

Low frequency content in the Fourier transform are responsible to the general appearance of the image over the smooth areas.

The concept of filtering is easier to visualize in the frequency domain. Therefore enhancement of image $f(x,y)$ can be done in frequency based on DFT .This is particularly useful in convolution. If the spatial extent of point spread sequence $h(x,y)$ is larger than convolution theory. $g(x,y)= h(x,y)* f(x,y)$; where $g(x,y)$ is the enhanced image.

II. LITERATURE REVIEW

The researches made in the previous years gave us the idea of identification of human for ear[1]. Researchers fended the exterior ear which looks distinct for any character where in all over the age it doesn't change. Although nobody has proved that ear of every human being is different, studies in [12], [13] gave supported evidence to it.

Alphonse Bertillon in French criminologist is the first person who provides the idea to using identification for ears more than 100 years ago [11]. A lot of researches has been made to specify that the anatomy of outer ear is different and not change by increasing in age. While it has not been proved that every person ears are different but [10] gives a supporting evidence.

Iannarelli [12] work was very prominent in this field who examined more than 10,000 ears. By undergoing to some procedure found that all of them are different. Iannarelli developed an anthropometric method in which he used 12 measurements to distinguish the human beings depending on their ear images.

Later in 1995 **Carreira-Perpiñán [19]** gave a contribution to research by using artificial neural network where the nodes are continuously used for extracting the features because continuous nodes are having few differences in bit for singular decomposition value where the agreement for rule was made via outpace which provides the reconstruction error for threshold.

Ping Yan et al. [26] proposed their work with 63.8% rank on the single recognition rate for eigen ear and the PCA based technique which was represent on range images that conclude the 55.3% rank for single recognition rate whereas also represents the matching for images in edges and concluding the 67.5% and final representation for edge matching on 3D images of ears that conclude their results with 98.7% rank for single rate recognition.

Prakash and Gupta recently described a new approach on ear recognition using edges [5]. They used skin segmentation and classified the edges into 2 groups: convex and concave.

Thereafter, the edges in the skin region are broken up into edge segments, which form an edge connectivity graph. The convex hull of all edges is computed from this connectivity graph. The enclosed region is the ear region. This study used full profile images and a 96.63% detection rate was attained.

H. Alastair et al. [4] proposed the ray transform approach, which detects the ear in different positions and ignores straight edges in the image (which are caused by glasses or hair). This method uses a light ray analogy to scan the image for cylindrical and curved structures, such as the outer helix. The simulated ray is reflected in bright tube-shaped regions, highlighting these regions in the transformed image. Since glasses have straight edges where they are not displayed via ray transform. This method had a 98.4% recognition rate.

III. PCA SPACE TRANSFORMATION

The matrix A is formed with arranging the eigenvectors which used same as transformation matrix to transform the images and further to the PCA space therefore this is done via subsisted in the formula below

$$\mathrm{Y} = \mathrm{A}(\mathrm{p} - \mathrm{m_x})^{\mathrm{t}}$$

Where expressed as P and mean value of all pixel in the position of all set of images which declared here with$m_x$then calculating the vector *y* which is transformed the image to PCA space therefore it also known as component transform of principle for all training set of images that are transformed into PCA space. The two images for a person in the training set where person will declare as two multidimensional to PCA space.

With the help of the above transformation we consider a new test image *t* which will help us in testing or we can say identification in training set therefore here applying the same transformation to image test as following shown.

$$\mathrm{r} = \mathrm{A}(\mathrm{T} - \mathrm{m_x})^{\mathrm{t}}$$

Where vector is provided in the above with *r* which defines the mapping of the image to the PCA space.

IV. DIMENSIONALITY REDUCTION

Eigenvector matrix size is (n x n) where concludes there are n eigenvectors therefore it represents the n as the number of pixel per image and by transformation to PCA space we got a n dimensional space. To compress that space or to decrease its dimensionality here taking the k which define as the eigen vectors that compare to the top k highest eigen values which help in the transforming matrix $\mathrm{A_k}$ that can use in the image transformation. Either we can choose k define as the arbitrary number which is used to represent the specific percentage for total variance for eigen vectors are compare to in this research where compress our image or we can say that to minimize dimensionality via half where using below formulae to calculate transformation matrix for size.

$$\mathrm{K} = \lfloor \text{number of pixel}/2 \rfloor$$

The greatest eigen value is represent as the first eigenvector which is excluded by us just because it is primarily reflects the illumination between the images [17],[22]. For example, let the size of image in the database for research purpose is 70×40, as 2800 per pixels in the image where after transformation to PCA space or dimensionality reduction to new reduced transformation matrix, the size of the image will become approximately 1400 pixel per image which is half of 2800.

For finding total variance percentage that the eigenvector represent we can calculate by this given formulae below:

$$\mathrm{M_j} = \left(\lambda_j \middle| \sum_{j=1}^{n} \lambda_j\right) \times 100$$

Here m represent as the resulting vector which contains the percentages of all comparing eigen value sorted by decreasing variances therefore finding the percentage from eigenvectors in $\mathrm{A_k}$ by the use of following formulae

$$\mathrm{TP} = \sum_{J=2}^{k} \mathrm{M_j}$$

TP is the resulting value where the percentage of total variance represent in the transformation matrix as $\mathrm{A_k}$. Therefore it is the main process which follows in all the experiments and uses the PCA transformation performed in our research.

V. FLOW CHART

The following flow chart carried out in the proposed work so as to achieve desired objectives.

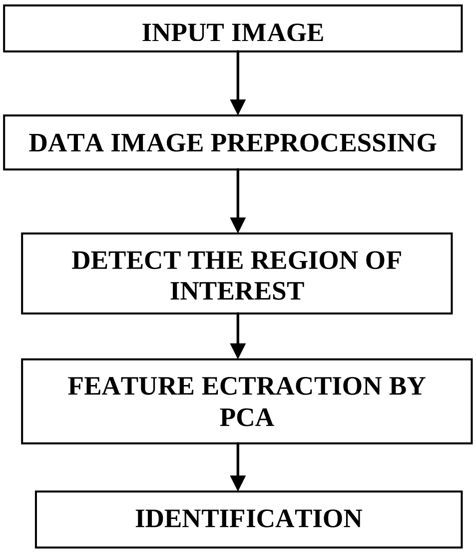

Figure 1: Flow Chart

VI. RESULTS AND DISCISSION

The techniques are implemented by using algorithm which defines the pattern recognition techniques and compression.

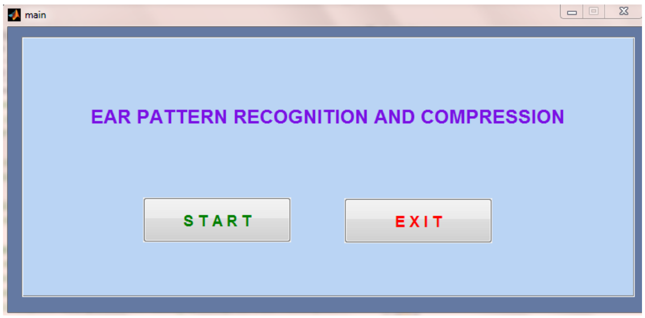

Figure 2

This is the main where start the ear pattern recognition and compression. Click on start button the next open the page which shown in figure 3.

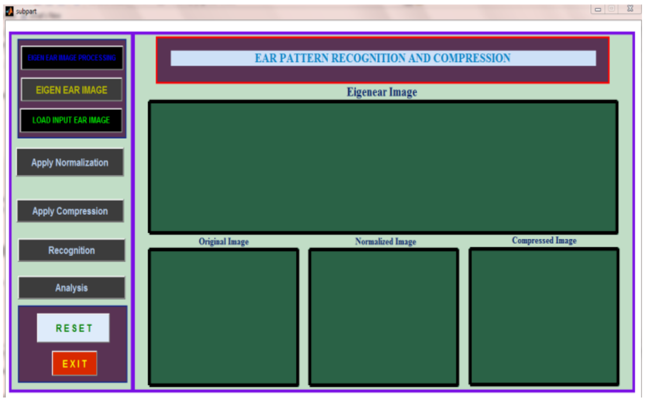

Figure 3

Here click on the eigen ear image then select the image. In the next figure 4 which shows the selection of file. Then load the input ear image.

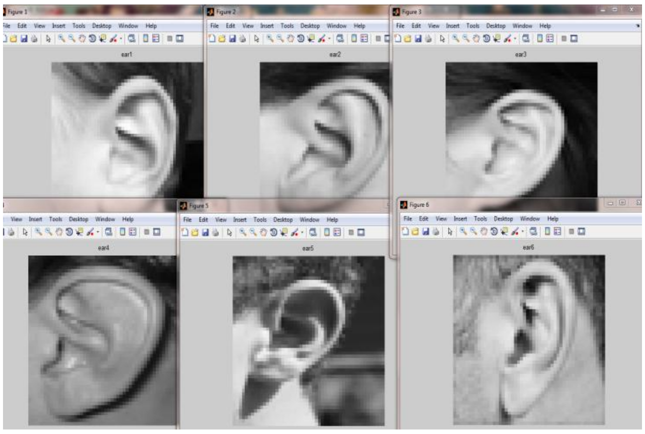

Figure 4

When image ear is loaded then the eigen ear image is loaded that shown in figure 5.

Figure 5

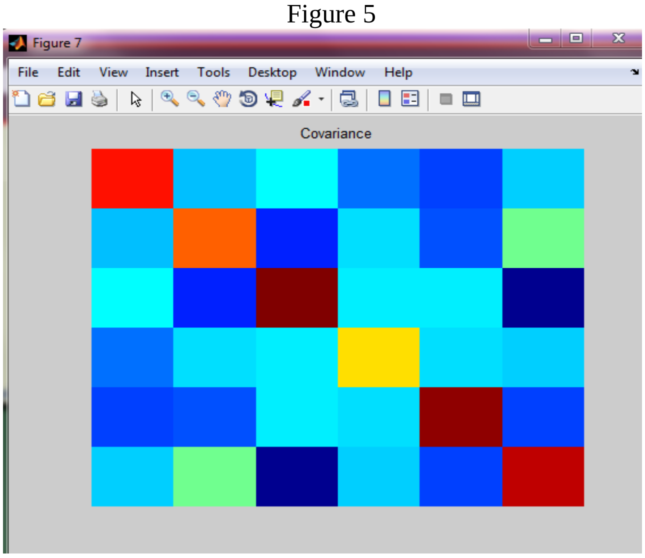

Figure 6

After the figure 6 is appears then the original image is appeared on the page which shown in figure7.

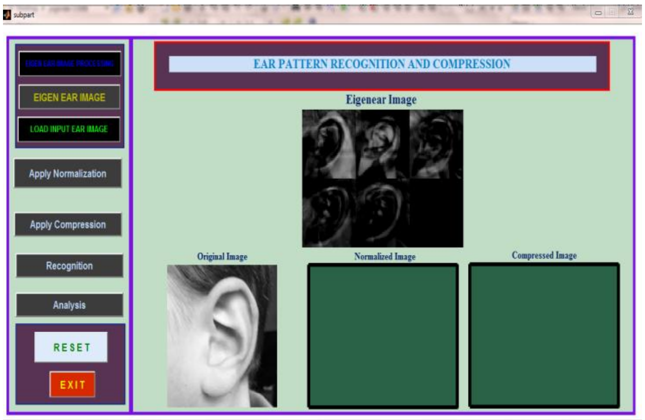

Figure 7

Then apply normalization on the original image after that the normalized image is appeared shown in figure 8.

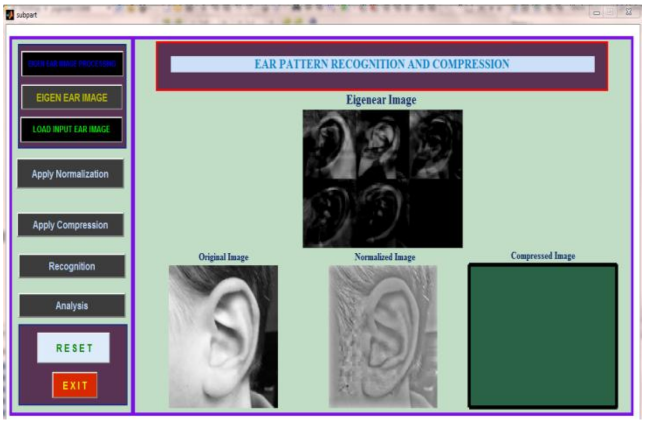

Figure 8

Apply compression on the image after normalization the compressed image appeared on the screen shown in figure 9.

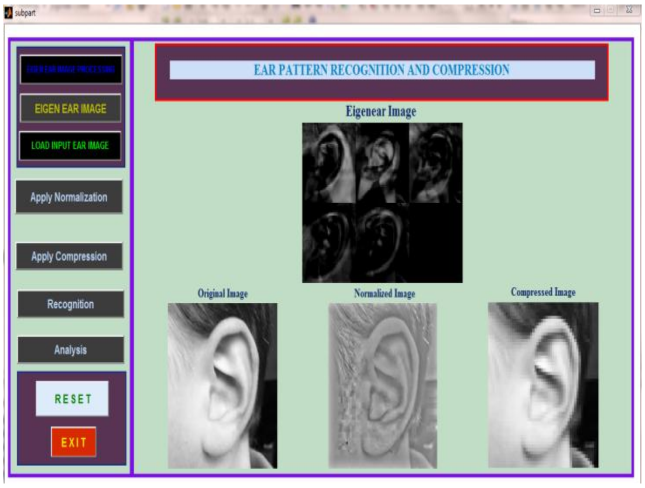

Figure 9

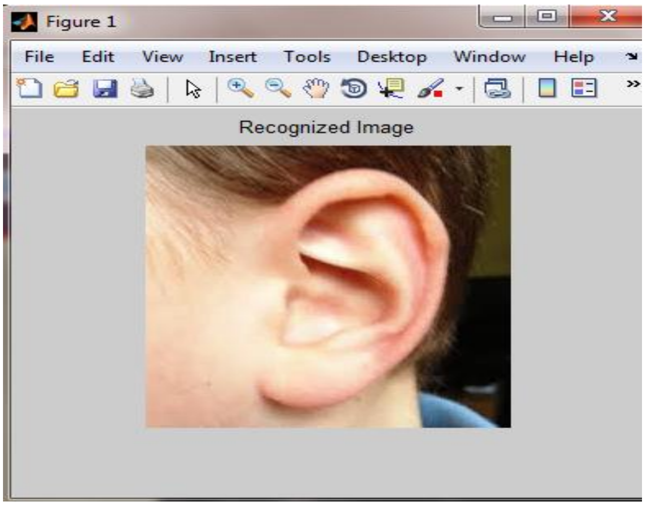

Figure 10

```
Matched

recognized =

ear1.jpg

fx >>
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Figure 11

The graphs appeared with comparison of base paper and proposed work. Where, parameters are used PSNR, MSE, Entropy, BER see in figure

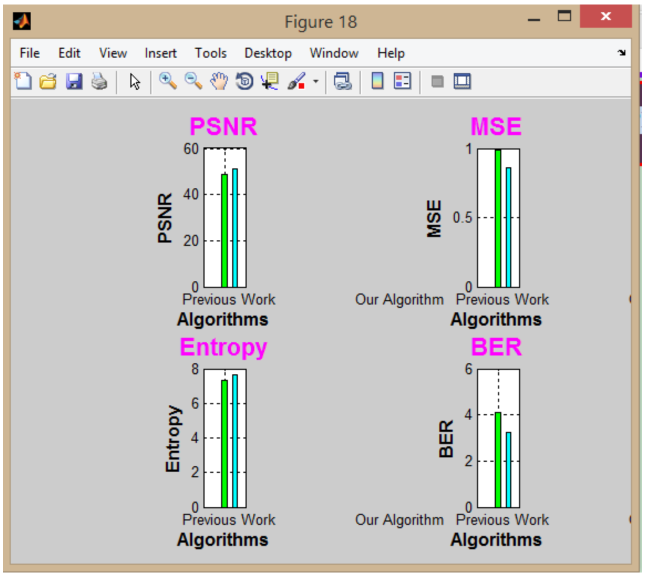
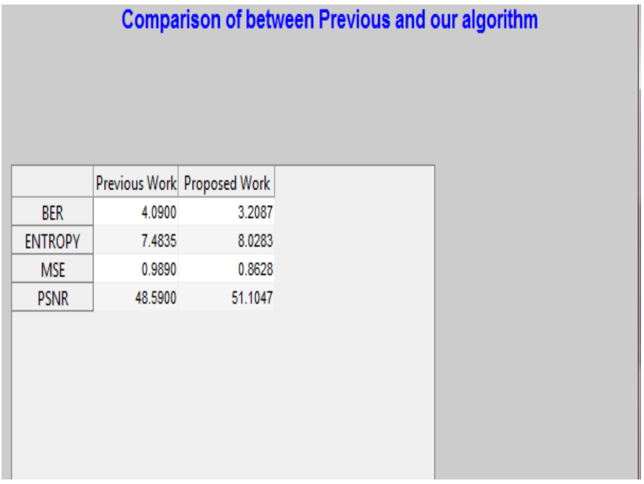


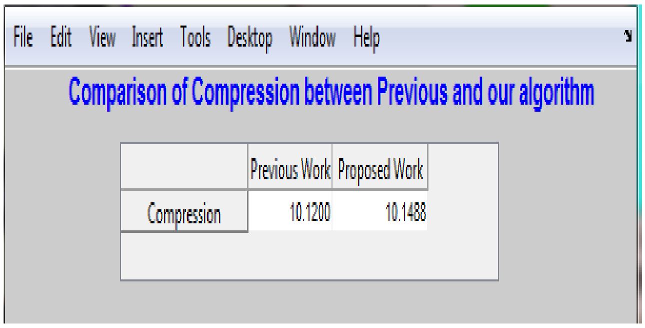
Figure 12

The values of four parameters are compared between previous and our algorithm which shown in figure 13



	Previous Work	Proposed Work
BER	4.0900	3.2087
ENTROPY	7.4835	8.0283
MSE	0.9890	0.8628
PSNR	48.5900	51.1047

Figure 13



	Previous Work	Proposed Work
Compression	10.1200	10.1488

Figure 14

The compression result has shown in Figure 14 and 15 where it is compared with previous and our algorithm.

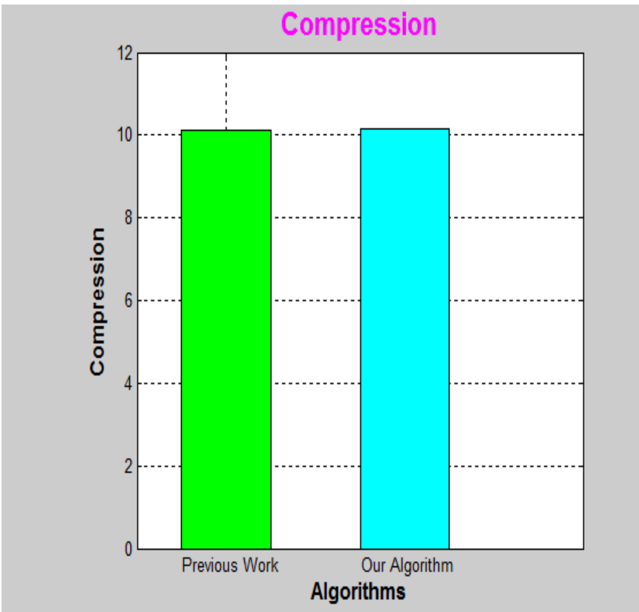
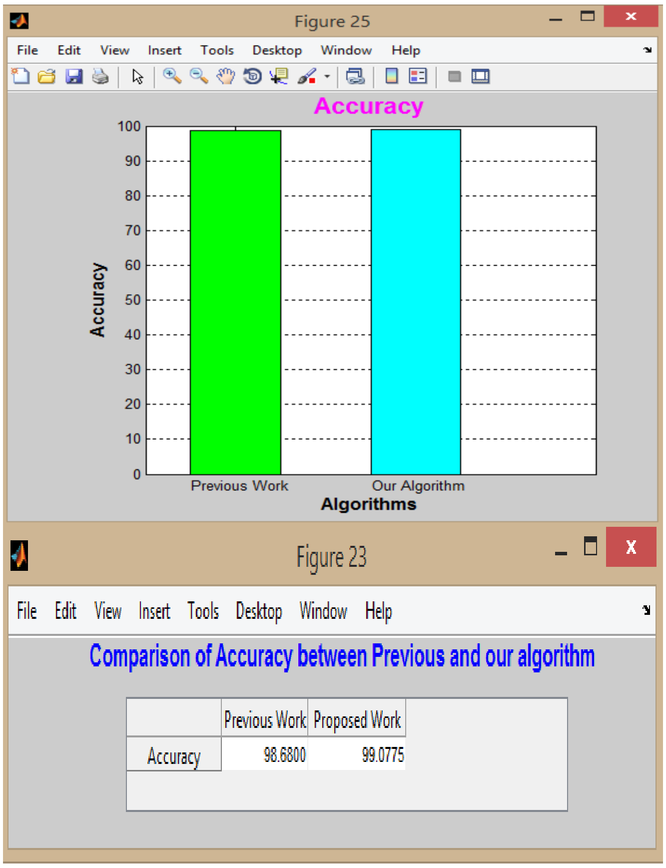


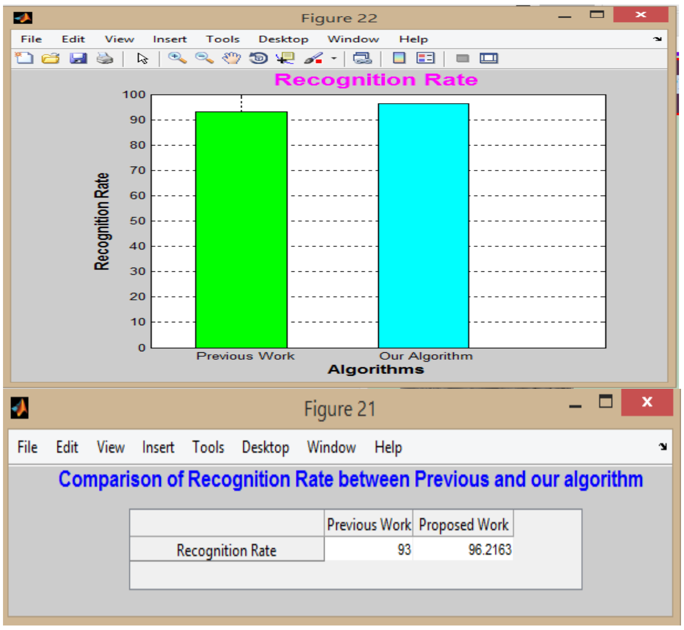
Figure 15



	Previous Work	Proposed Work
Accuracy	98.6800	99.0775

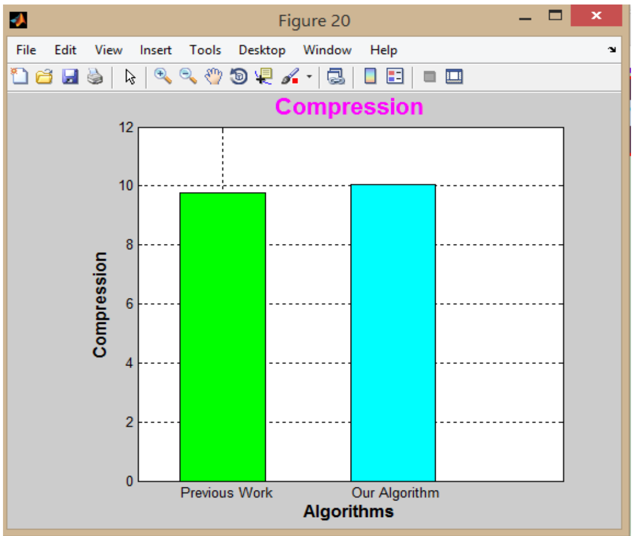
Figure 16: Accuracy

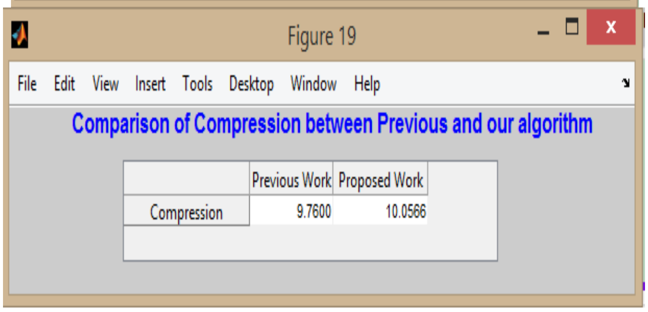
Here this above figure shows the accuracy graph with values and compare with previous work which shows that our proposed work values are better than previous one.



	Previous Work	Proposed Work
Recognition Rate	93	96.2163

Figure 17: Graph and value of recognition rate





	Previous Work	Proposed Work
Compression	9.7600	10.0566

Figure 18: value of compression and graph

VII. CONCLUSION

To implement ear pattern recognition and compression where conclude the values by using parameters PSNR, MSE, BER and entropy is better results than the previous base paper results where theses are compared. The results are better and increasing efficiency and error free. .

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