Ear Recognition Using Kernel Based Algorithm

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***Abstract*- A person's identity can be recognized and authorized using image preprocessing techniques. In traditional biometrics systems, a Person's face, iris and fingerprint are mostly used for recognition. The longevity of the data measured from these parts may change with age, health and makeup. It has been proved that no two person's ear is exactly alike. Human ears have specific characteristics and features that make them unique. The structure does not change much with individual age. Traditional biometric Systems lack in prediction accuracy and the images are with noise. So, to improve this condition a robust ear recognition system is proposed with the following phases 1) Preprocessing of ear image using Contrast Enhancement 2) Feature Extraction using Kernel Principal Component Analysis (KPCA) 3) Classification using Kernel Support Vector Machine Analysis (KSVM). The System will be tested for accuracy with various neural network configurations and with noisy images.**

***Keywords*- Ear recognition, Kernel Principal Component Analysis (KPCA), Kernel Support Vector Machine Analysis (KSVM).**

I. Introduction

Application and research of ear recognition technology is a new subject. In This research it has shown that the human ear is one of the biometrics in the science used for person authentication by its Uniqueness and stability. Biometric System has been used in airports, company, hospitals and consumer electronics. Here, ear Recognition is also a non-intrusive recognition as the face recognition. Biometrics is used for authenticate a person by capturing and analyzing biological data such as eye irises and retina, faces, voices, DNA's, hands and fingerprints. Each has some disadvantage such as DNA testing is costly and fingerprints can be affected by burns or ink. Faces are be changed with their age, heath and makeup. The human voice may be change due to illness [3].

Generally, Ear recognition is given as static or dynamic image [8]. In Statistical approach are obtain a set of Eigen vectors as any image can be represented using weighted combination and the weights are obtained by projecting the image into Eigen vector components using an inner product. The identification of the image is done by locating the image in the database, where the closest weights of the test image. In dynamic Approach is based on the local features of the ear, such that the geometry features composed of distance and curve relationship or force field feature.

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Ear biometrics is a good choice it has provided by the laboratory. Ear recognition is used to compare one or more person [2] or to verify a claimed identify against the template data stored in the database. Where, human ear has its own specific characteristics such as unique, uniform distribution color and no two identical twins are not same. It includes accuracy, cost and longevity of the measured of the biological data. Figure 1 depicts shape of the ear features.

Figure 1 Ear image

In the Proposed System, image preprocessing techniques are applied to input ear image to enhance the brightness of the image and to reduce the noise. The aim of image Enhancement is to improve the interpretability or perception of information in images to provide better input for next step. Kernel Principal Component Analysis (KPCA) is used to reduce the number of features to a more manageable number using Gaussian function. The performance of the Gaussian function are done by Eigen vector and Eigen value where the ear features to identify an ear and extract those features from an ear database, which feed into Kernel Support Vector Machine (KSVM). In various SVM techniques, we use Kernel SVM to recognize an ear image and identify the corresponding ear. In this experiment indicates the accuracy in ear identification that is achievable compared with the existing system.

II. Related works

A. Biometric Technique

Biometrics is a growing technology which is used in digital watermarking technique where the information embedding into a digital image in a way that is difficult to remove *tamije selvy et al* [13]. Here, SURF is used for extracting the feature by relying on integral images for image convolutions; by building on the strengths of the leading existing detectors and descriptors and simplifying these methods to the essential. Feature selection is done by Wavelet based counter let transform to be a better alternative choice than wavelets for image denoising. Next stage is classifying the images using SVD algorithm on all the subbands of the randomized host image and the gray scale watermark. Then, perform the inverse randomization to obtain the watermarked image. Wavelet filters are not perfect in splitting the frequency space to the low pass and high pass components.

Biomedical image mining technique performs mining signature enables the representation, extraction, and mining of high order latent event structure and relationships within single and multiple event

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sequences *Fevi.W. et al* [4]. Where, proposed knowledge representation maps the heterogeneous event sequences to a geometric image by encoding events as a structured spatial-temporal shape process. Then, the doubly constrained convolution sparse coding framework that learns interpretable and shift-invariant in the data as well as in the latent factor model by inducing a double sparsity constraint on the divergence to learn an overcomplete sparse latent factor model. Time complexity is high when compared with other feature extraction method.

B. Ear Recognition

In Ear Recognition Biometric authentication of a person is highly challenging and complex problem *Sukhdeep et al* [12]. Recognizing people by their Ear is relatively new class of biometrics. First step Capturing of side face image by digital camera or other sensor. Extracting of ear and preprocessing to get template by using Lab View. Compare the template of testing an image with sample training images. Now check whether the image can be match or mismatch of the person. It is the effective method by comparing with other biometric technique such as fingerprint, iris, DNA and face.

In Recent year's ear has been proposed to identify a person authentication using some technique *Fadi.N. et al* [3]. Where features are selected manually by using measuring with scale and the value are stored in excel format. Then, convert it by using brain maker simulator and net maker simulator and feed into feed-forward neural network where more number of input layer and multiple hidden layers with various neurons to produce single output. Performance degrades with noise. Automatic measurements are not performed.

In the proposed system, ear recognition is used for recognizing the person identity. The kernel method is used for extracting and classifying the images from the ear database.

The original images have been enhanced to get a brightness pixel and reducing noise using contrast enhancement Technique. Then, the kernel methods are used for both Feature Extraction and Classification in a high dimensional space. The Kernel Principal Component Analysis (KPCA) is used for extracting the features using ear images such as helix, Anti tragus, lobule, tragus, concha, intertragica notch and Scaphoid fossa. The images are extracted and the values are in matrix format (rows and columns), the values are represented as Eigen value used for classification technique as Kernel Support Vector Machine (KSVM) to identify the person whether it is match or mismatch.

III. Methods

In this section overall process of the system is depicted in Figure 2 which contains image Enhancement, feature extraction and classification technique. Image preprocessing is used for enhance the brain images to identify the features. In Feature Extraction, statically features are extracted from the image. Kernel based classifiers such as SVM are used to differentiate the unknown person ear to identify whether they can authenticate or not. The whole 100 Ear images are collected from the ear Dataset. In this System, first stage is enhancing the brightness of the image and next step is to extract the features of the image. After extracting the feature the images are classified into set of attributes with training and testing images to extract whether the image of the person are match or mismatch.

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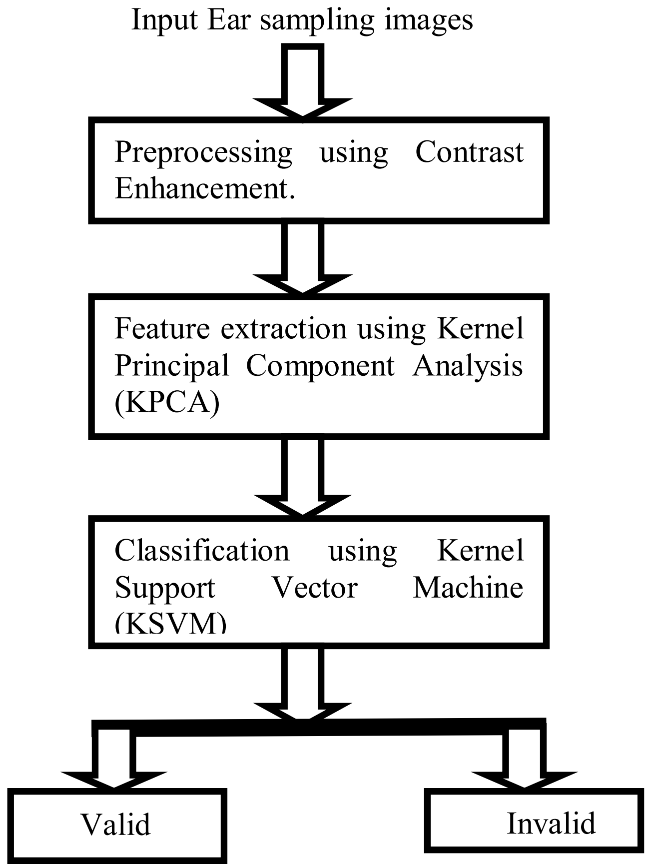

Figure 2 overall process of the System

A. Contrast Enhancement

Contrast Enhancement process plays an important role in enhancing the quality and contrast of images [1]. Different types of Contrast Enhancement methods are local contrast adjustment, global contrast adjustment, partial contrast adjustment, bright and dark contrast adjustment. Images with ear rings, other artifacts with hairs have not been processed in this research work. Each images is gone through the following steps before feature extraction.

• Ear images are manually cropped from the
Complete head image of a person.
• Cropped ear images are resized into 120 *120 pixels.
• Next, Colored images are converted to grayscale
Images.

Manual cropping has been done in the work because automated ear cropping is under process. The sizes of cropped ear images are different. In order to find same number of features from each ear images, resizing the images into to the unique fixed size of 120*120 pixels is made. Each image was converted from RGB to grayscale (if not in grayscale). Image enhancement adjusts the relative brightness and darkness of objects in the scene to improve their visibility. The contrast and tone of the image can be changed by mapping the gray levels in the image to new values through a gray-level transform. It is the image enhancement technique that is commonly used for scanned images.

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B. Kernel PCA

Principal Component Analysis (PCA), is a powerful technique for reducing a large set of correlated variables to a smaller number of uncorrelated components, has been applied extensively for both Ear representation and recognition [6]. In Kernel based approach, a carefully selected kernel is used for rich linear representation in a high dimensional space. Kernel technique is an alternative way for linear manifold representation in non-linear tensor under consideration. Rather, we use a carefully selected kernel as a Gaussian radial basis function with an appropriate kernel width parameter to obtain a rich linear representation in a high dimensional reproducing kernel Hilbert space (RKHS) and to reduce the noise. The advantages of PCA using linear statics can be more easily identified in the higher-dimensional space.

Kernel Principal Component Analysis (KPCA) techniques are used to analyze extracted features of the 2D Brain images. KPCA algorithms to deal with noise, outliers, or missing data have been proposed. Here, we find similar principal Eigen directions in the higher dimensional RKHS by solving an Eigen value problem. The statically extracted features are trained in an inner product of KPCA using kernel matrix. These linear representations are found by computing onto appropriate RKHS direction using Kernel trick. Figure 3 depicts extracted features from ear image.

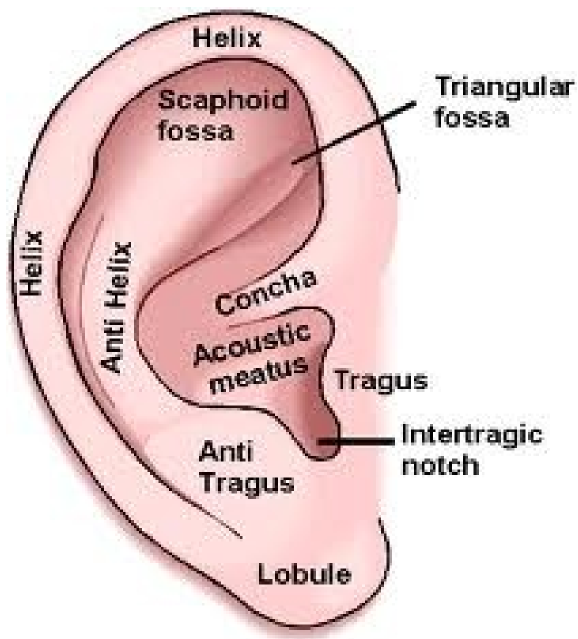

Figure 3 view of an ear features

C. Classification using Kernel SVM

Support Vector Machine (SVM) is said to be supervised learning model associated with learning algorithm that analyzes data and recognize patterns which is used for classification and regression analysis. The basic SVM takes from a set of input data and predicts, for each given input, which of two possible classes forms the output, making it a non-probabilistic binary linear classifier [9].

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The ear features are extracted and feed into Kernel SVM for a set of training and testing images, each marked as belonging to one of two categories. The training algorithm builds a model that assigns into one category or the other. SVM model is a representation points in space, mapped to separate categories are divided by a clear gap. The main goal of SVM is to generate the model, which predicts the target value of data instance in the testing set that is provided only in the training set. From 100 Ear images we are taking 51 for training and 49 for testing. First, the images should be trained using labeled pairs. Then, ear images are to be tested using Kernel SVM and predicts the age person with accuracy.

IV. Experimental Results

The proposed System was applied in three steps which include Image Enhancement, feature extraction and classification to identify the person can be authenticate or not from the Ear database. The performance of images is measured using different evaluation metrics. The algorithm is implemented using matlab 7.12 in windows 7 platform. A number of experiments are performed on different Ear images of size 120 × 120 pixels. The ear images are denoised by Gaussian filter. Then the features are extracted by brightness of the pixel values from 0 to 255. The image is stretched starting from low to high value from 0 to 1. The Ear images are collected from Ear dataset. It contains 100 Ear images of size 120 * 120 pixels. The images are in JPEG format. Ear images of unknown person are taken as input. The images are sharpened using contrast Enhancement method. Figure 4 depicts the original image of the person ear.

Figure 4 original image

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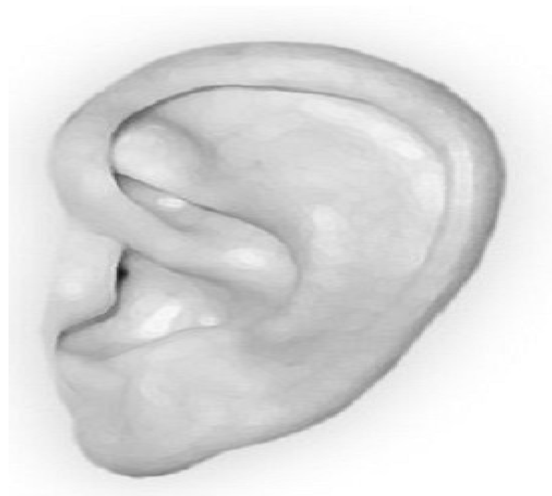

Figure 5 cropped and resize image

Figure 5 depicts the cropped and resize image of the ear .To increase robustness; images are pre-processed using contrast Enhancement for pixel brightness. Contrast Enhancement adjusts the relative brightness and darkness of objects in the scene to improve their visibility. The image enhancement technique that is commonly used for scanned images. The contrast and tone of the image can be changed by mapping the gray levels in the image to new values through a gray-level transform. The process plays an important role in enhancing the quality and contrast of images. Figure 6 depicts preprocessed image of the ear.

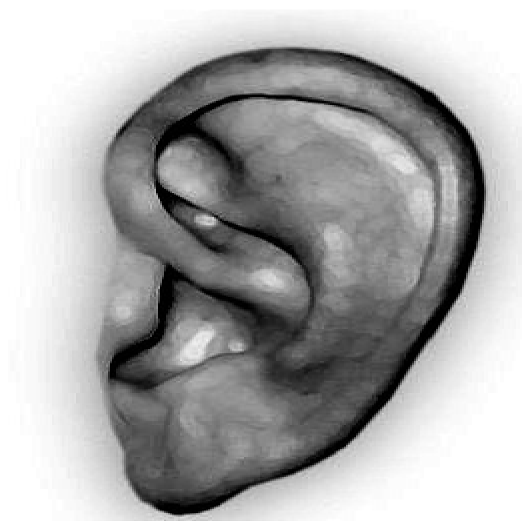

Figure 6 Preprocessed Image

The Kernel Principal Component Analysis (KPCA) technique used to describe the pixel value of Ear image. Then, the extracted features are in matrix format as rows and columns that have both positive and negative but no zero value are occurred.

The Kernel Support Vector Machine (KSVM) technique is used to classify ear Images from the ear database. The datasets are split into testing and training to predict the human ear images. The datasets are splitted into testing and training from the classes. By Using linear statics in kernel SVM method can be

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more easily identified in the higher-dimensional space. SVM takes a set of input data and predicts, each given input, of two possible classes and forms the output, making it a non-probabilistic binary linear classifier. The supervised learning technique associated with learning algorithm that analyze data and recognize patterns, which is used for classification and regression analysis. In testing the Ear images with training dataset shows the accuracy 85%. Here, the performances are measured using accuracy and specificity between algorithms. Here Table 1 shows the comparison between PCA and KPCA. Table 2 shows the comparison between SVM and KSVM.

In General, Positive = identified and negative = rejected. Therefore:

Accuracy=TP+TN/(TP+FN+TN+FP)
Specificity=TN/TN+FP
Where,
TP= True Positive
TN= True Negative
FP= False Positive
FN= False Negative

Table 1 Performance Analysis between PCA and KPCA

S.NO	Performance Measure	PCA	KPCA
1	Accuracy	71.48%	78.30%
2	Specificity	70.82%	78.98%

Table 2 Performance Analysis between SVM and KSVM

S.NO	Performance Measure	SVM	KSVM
1	Accuracy	80.34%	84%
2	Specificity	79.83%	84.87%

Accuracy and specificity shows the performance measure of PCA and KPCA. Figure 7shows Accuracy and Specificity between of PCA and KPCA.

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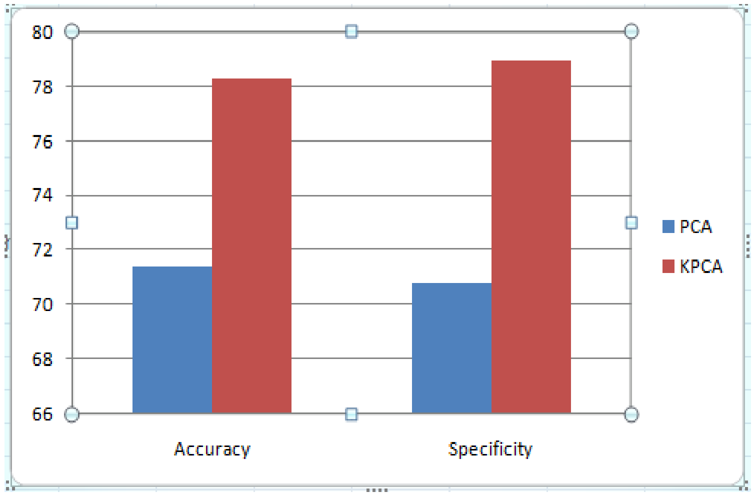

Figure 7 comparison between PCA and KPCA

Accuracy and specificity shows the performance measure of SVM and KSVM. Figure 8 shows Accuracy and Specificity between of SVM and KSVM.

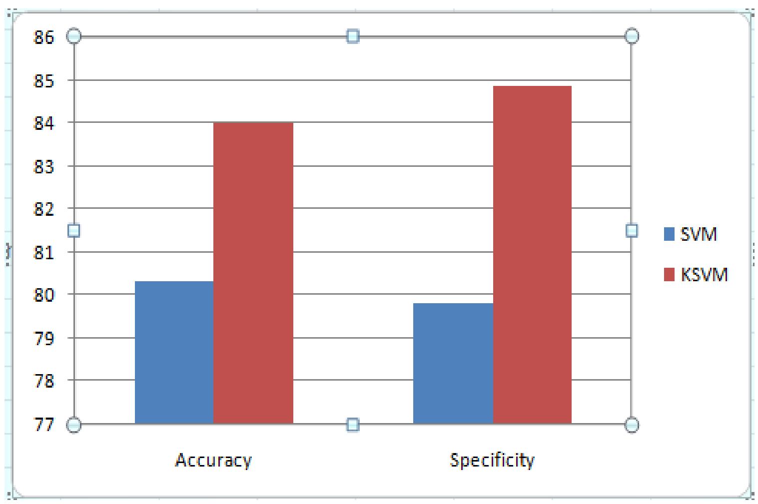

Figure 8 comparison between SVM and KSVM

V. Conclusion

Biometric technique has been successfully used for the purpose of human identification. The ear has a structure that does not change much with individual age. The Proposed System implements with automatic ear measurements and design with Kernel Principal Component Analysis method for extract the features without noise. Kernel Support Vector Machine (KSVM) is used to determine the extracted ear images into training and testing. From the results, it shall be seen that Kernel method has given better performance accuracy than the traditional methods and is sufficient to reduce the false positive and improve accuracy. In future, The Optimization technique such as ACO, PSO can be used to get better optimized solution.

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