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Real-Time Interface of Smart Robot Design with User Identification Application

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Abstract—Robotic vehicle will sense the presence of human motion using PIR sensor in the restricted areas and the analysis of recognized/unrecognized person will be done. Face recognition has a major impact in security measures and it has been using in many areas widely. To perform face recognition, mathematical calculations have been adopted to develop automatic recognition systems. As a face recognition system has to perform over wide range of database, dimension reduction techniques become a prime requirement to reduce time and increase accuracy. In this paper, face recognition is performed using Principal Component Analysis followed by Linear Discriminant Analysis based dimension reduction techniques. The following steps are done in this paper- preprocessing, dimension reduction of training database set by PCA, extraction of features for class separability by LDA and finally testing by nearest mean classification techniques. The transfer of message is performed by means of GSM and the further action for security purpose will be done.

***Keywords*:** Robotic Vehicle, PIR Sensor, Face Recognition, PCA, LDA and GSM.

I. INTRODUCTION

In military applications for searching terrorists in forest and to detect the presence of human motion in the restricted areas, PIR (pyroelectric infra red sensor) sensor is used currently. In traditional methodology to find the motion of human we have some devices like video camera, radar, ultrasonic sensor etc. In case of video camera another human have to continuously monitor the video. If we use radar or ultrasonic sensor, we need a transmitter and a receiver. So these are high in cost and most of the jamming techniques are there to cheat (i.e. stealth

bomber planes). PIR absorbs the infrared radiation (wave length of 9.4 micro meters) from the human body and creates a corresponding signal. As it has protection devices like lenses it is less suppose to be cheated. As this is sensitive only human body heat and frequency of radiation, this sensor can be used to find human up to 3 meter to 90 meter distance (using perfect Fresnel lenses). So it helps to find human availability beyond the barriers like walls and fire etc. It can be used as earth quake rescuer. A robotic vehicle is used and it carried the PIR sensor, which is made to move continuously in the restricted area. we can operate the robotic vehicle from anywhere in the world using mobile phone. Once the PIR sensor detects the presence of human motion warning indication will be send to the controller through GSM. The video will be captured continuously by a camera from which the image of the person in the restricted area will be segmented and the recognition of face will be done. Now-a-days the technological development in human detection by the face recognition researchers have been increased.

Face recognition biometrics is the science of programming a computer to recognize a human face. When a person is registered in a face recognition system, a video camera takes a successive snapshots of the face and then signifies it by a unique holistic code. When somebody has their face verified by the computer, it captures their current appearance and match up it with the facial codes which is already stored in the system. If the faces match, the person will receive authorization, otherwise, the person will not be identified. The existing face recognition system identifies only static face images that approximately match with one of the images piled up in the database. Hence face recognition can be used as a major factor in crime detection mainly to identify criminals. Face recognition has several applicable areas.There are several methods for face recognitions like template, wholistic, appearance and feature based. In this paper we used appearance based method. Appeareance-based methods represent a face in terms of several raw intensity images. An image is considered as a high-dimensional vector. Then satistical techiques are usually used to derive a feature space from the image distribution. The sample image is compared to the training set. Appeareance methods can be classified as linear or non-linear, while model-based methods can be 2D or 3D. Linear appeareance-based methods perform a linear dimension reduction. The face vectors are projected to the basis vectors, the projection coefficients are used as the feature representation of each face image. Examples of this approach are PCA, LDA or ICA. Non-linear appeareance methods are more complicate. In fact, linear subspace analysis is an approximation of a nonlinear manifold. KernelPCA (KPCA) is a method widely used. Here we used PCA-LDA method for dimensional reduction followed by feature extraction. The recognition part has the major role here.

II. HARDWARE SESSION/ ROBOTIC VEHICLE

A. PIR SENSOR:

Every object has a temperature above perfect zero emits thermal energy(heat) in the form of radiation. We the human being radiates at the wavelength 9-10micrometer all time of the day.PIR are tuned to detect the IR wavelength, which only emanates whwn a human being arrives in the proximity.

PIC 16F877A:

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It is programmable interface controller. This is programmed using the software Microcode Studio. The needed pins are taken as input and outputs. It has flash memory. So it is reprogrammable. This microcontroller has 40 pins. These microcontrollers have the capability ofoperating at 20MHz. The input for the microcontroller is DTMF signal and PIR sensor signal. As this microcontroller has interrupt functions, it is able to find no of humans in any room or opposite to PIR sensor.

B. Gsm(Global System For Mobile Communication):

It is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM is a TDMA based wirelss network technology. GSM phines make use of SIM card to identify the user account.

C. Mechanical Design:

In this car we use two 12V dc motors for their motion. These motors are fixed with back wheels each with one. Front wheel is free to rotate. Let's see the actions for the car.

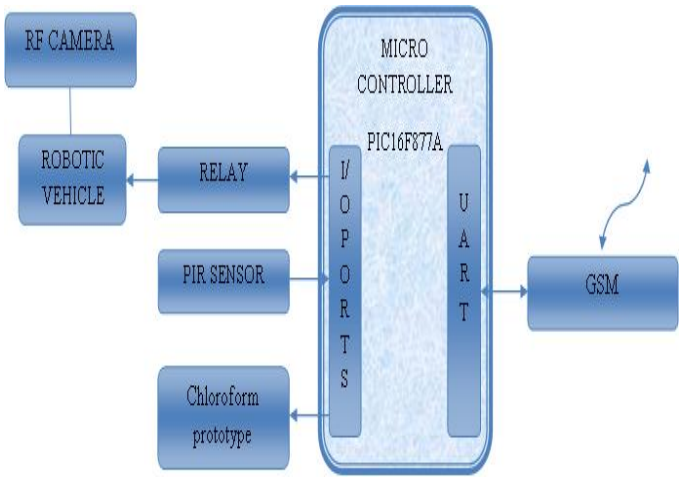


Figure 1: Block Diagram of Robotic Vehicle Setup

1. Forward

In this motion both the motors are rotate to move the car forward direction.

2. Backward

In this motion both the motors are rotate to move the car in backward direction.

3. Turn Left

In this motion right motor is moved toward forward and left motor is moved towards backward.

4. Turn Right

In this motion left motor is moved toward forward and right motor is moved towards backward.

5. Search& Result

Using a DC motor the robotic vehicle will be moved in the path and the identification of human will be done. The transfer of message will be done using GSM.

III. SOFTWARE SESSION/FEATURE EXTRACTION ALGORITHM AND CLASSIFICATION TECHNIQUE

Recognition of Face:

A face recognition system is a computer application for automatically identifying or verifying a person from a digital image from the source. One of the ways to do this is by comparing selected facial features from the image and a facial database. Two types of comparison in face recognition

- Verification- The system compares the given individual with who that individual says they are.
- Identification- The system compares the given individual to all other individuals in

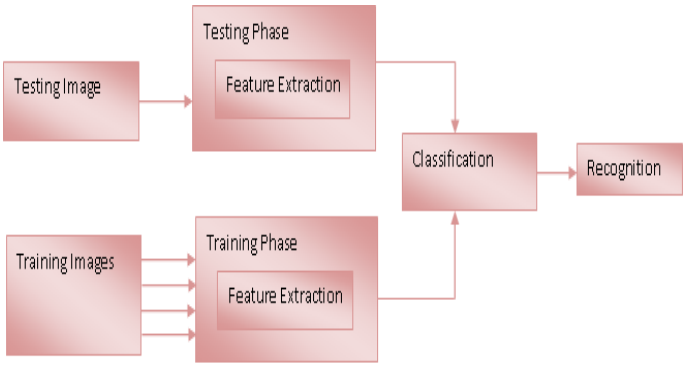


Figure 2: Block Diagram of Face Recognition Process

Using PCA-LDA method the recognition rate can be increased and the computational cost can be reduced the database and gives a ranked list of matches.

Facial recognition software:

It is an application that can be used to automatically identify or verify individuals from video frame or digital images. Some facial recognition software uses algorithms that analyze specific facial features, such as the relative position, size and shape of a person's nose, eyes, jaws and cheekbones. Unlike finger printing and voice recognition, facial recognition software yields nearly instant results because subject consent is not required. Facial recognition software is primarily used as a protective security measure and for verifying personnel activities like attendance, computer access or traffic in secure work environments.

A.Principal Component Analysis

PCA, also known as the Karhunen-Lowe transform, is a linear dimension-reduction technique. It aims to find the project directions along which the reconstructing error to the original data is minimum, and projects the original data into a lower dimensional space spanned by those directions corresponding to the top eigenvalues. In face recognition, those directions which are the eigenvectors of the covariance matrix of face images are orthogonal basis vectors. One of the

most used and cited statistical method is the Principal Component Analysis (PCA). It is a mathematical procedure that performs a dimensionality reduction by extracting the principal components of the multi-dimensional data. The first principal component is the linear combination of the original dimensions that has the highest variability. The n-th principal component is the linear combination with the maximum variability, being orthogonal to the n-1 first principal components. The greatest variance of any projection of the data lies in the first coordinate. The n-st coordinate will be the direction of the n-th maximum variance - the n-th principal component. Principal component analysis (PCA) was invented in 1901 by Karl Pearson. PCA is a variable reduction procedure and useful when obtained data have some redundancy. This will result into reduction of variables into smaller number of variables which are called Principal Components which will account for the most of the variance in the observed variable. Problems arise when we wish to perform recognition in a high-dimensional space. Goal of PCA is to reduce the dimensionality of the data by retaining as much as variation possible in our original data set. On the other hand dimensionality reduction implies information loss. The best low-dimensional space can be determined by best principal components. The major advantage of PCA is using it in eigenface approach which helps in reducing the size of the database for recognition of a test images. The images are stored as their feature vectors in the database which are found out projecting each and every trained image to the set of Eigen faces obtained. PCA is applied on Eigen face approach to reduce the dimensionality of a large data set.

B.Linear Discriminant Analysis

LDA is widely used to find linear combinations of features while preserving class separability. Unlike PCA, LDA tries to model the differences between classes. Classic LDA is designed to take into account only two classes. Specifically, it requires data points for different classes to be far from each other, while point from the same class are close. Consequently, LDA obtains differenced projection vectors for each class. Multi-class LDA algorithms which can manage more than two classes are more used. Linear Discriminant Analysis utilizes fischer space method to searches the directions for maximum discrimination ofclasses in addition to dimensionality reduction . To accomplish this goal, within-class and between-class scatter matrices are defined. Contrary to the PCA which encodes information in an orthogonal linear space, LDA encodes discriminatory information in a linear separable space the bases of which are not necessarily orthogonal. The main goal of the LDA approach is to find a base of vectors providing the best discrimination among the classes. This is achieved by maximizing the between-class scatter matrix Sb while minimizing the within-class scatter matrix Sw.

IV. FACE RECOGNITION ALGORITHM PROPOSED METHOD(PCA-LDA)

As PCA performs better than LDA when number of samples per class is small & dimension of face image is large. However performance of LDA better when database is very large and having different class datasets. To take advantages of both of these techniques, PCA is combined. Flowchart of the proposed algorithm is being shown in figure 1. Here PCA performs dimension reduction by projecting the data onto the eigenface space upon which application of LDA performs class separability by classifying the eigenface space projected data.

The method consists of four stages:-

a. Preprocessing
b. Dimensionality reduction of images of Training Database by PCA
c. Facial feature extraction for class separability by LDA
d. Nearest Mean Classification.

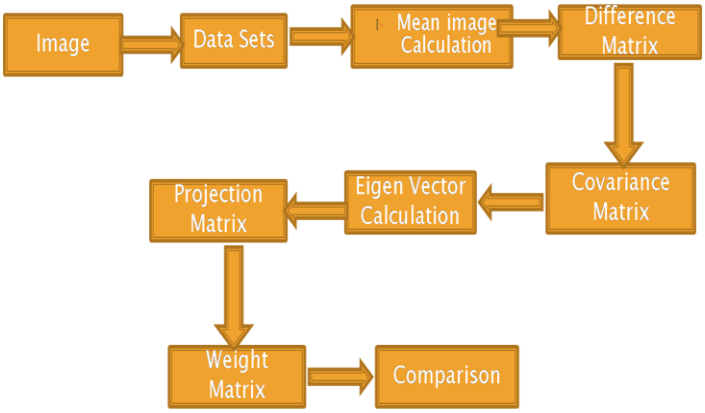


Figure 3: PCA-LDA Representation

Once the recognition of face is done using PCA-LDA method the required output will be obtained as

Simulation Results For Recognized Face:

Fig (a) Input image

Fig (b) Gray converted image

The original image is converted in to grayscale using rgb2gray command. This makes processing much simpler since then there are only a third of the pixel values present in the new image.

Fig (c) Enhanced image

Fig (d) Binary image

The gray converted image is then enhanced using histogram equalization. The enhancement technique is used to remove the unwanted noise thus the enhanced image will have much accuracy for further processing. Then this enhanced image is converted in to binary image in fig (d).

Fig (e) Edge detector image

Fig (f) Mean image

Edge detectors are very useful for locating objects within images. The Sobel edge detector is able to look for strong edges in the horizontal direction, vertical direction, or both directions. Then the mean of the image is calculated.

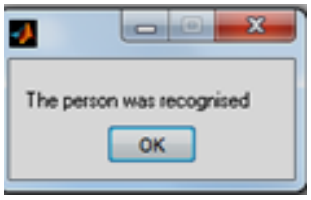


Fig (G) Recognized Person.

The message will be displayed as recognized person as shown in (g)

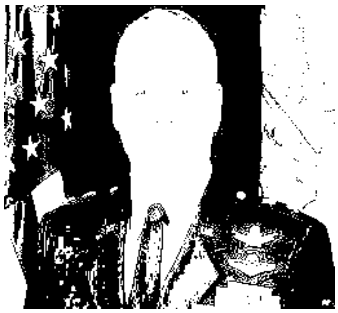
Simulation Results For Unrecognized Face:

Gray Converted Test Image

The original image is converted in to grayscale using rgb2gray command. This makes processing much simpler since then there are only a third of the pixel values present in the new image.

Enhanced Test Image

Binarized Test Image



The gray converted image is then enhanced using histogram equalization. The enhancement technique is used to remove the unwanted noise thus the enhanced image will have much accuracy for further processing. Then this enhanced image is converted in to binary image as shown in 5.2(d).

Edge detected Test Image

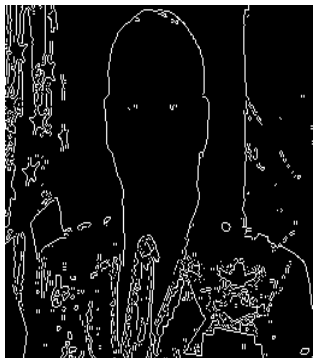


Fig (e) Edge Detector Image

Mean Image of Database

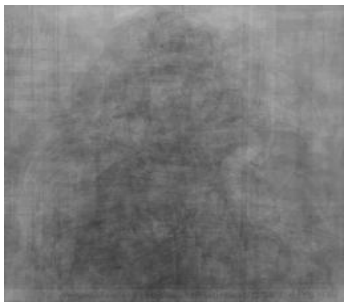


Fig (f) Mean Image

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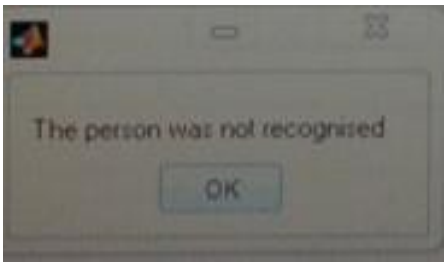

Fig (g) Un Recognized person

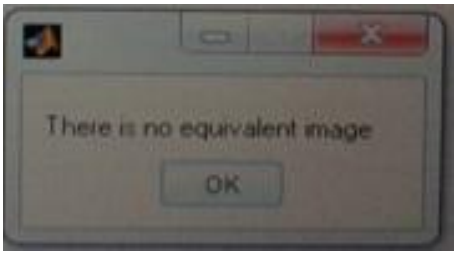

Fig (h) No Equivalent Image

Thus the image dint match with any of the images in the database hence the message will be displayed as unrecognized image.

V. CONCLUSION

Once the simulation result is transferred to the robotic vehicle through GSM the further action will be done. If the output is recognized no further action happens and for unrecognized person the action of chloroform prototype starts.

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