REVIEW PAPER ON AUTOMATIC DOOR ACCESS

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***Abstract**: as we know there are different techniques like keypad input, face recognition, gesture recognition, voice recognition etc. are available for operation of home appliances and door opening and closing in today's world. This paper is basically related with the review of two different techniques of door access i.e., face recognition and voice recognition. First technique is face recognition which is based on mainly three subsystem namely face detection, face recognition and automation door access. While the other technique is based on voice recognition method and door access according to voice input. Process of detecting region of face in an image is a face detection by using a viola jones algorithm and recognition of face with algorithm of principle component analysis. Recognition of face by principle component analysis is referred to as an Eigen faces. If face is recognized either it is known face or unknown. The door will open automatically foe known person with command of microcontroller and alarm will ring for unknown person. On the other hand same concept is used with voice recognition method, voice is recognized if person is known otherwise an unknown person and door will be open for known person.*

***IndexTerms** - Viola jones algorithm, Principle component analysis, PIC microcontroller, Arduino, Bluetooth, Voice module, etc.*

I. INTRODUCTION

In the system of Door access with face recognition, viola jones algorithm is used to detect the face. This detector is using a so called integral image and some simple rectangular feature like a haar wavelets. Face recognition is included with feature extraction, feature reduction, recognition or a classification. For effective feature extraction principle component analysis (PCA) method is used which is based on face as a global feature.it reduces the dimension of image effectively and hold the primary information. Classification is done by measure the Euclidean distance which is used to classify the feature of image present in database and test image.in this system, MATLAB which is installed on pc is used for face detection and recognition. USB to RS232 converter is used as the interface between PC and 16F887 converter. To switch off the motor if door reaches to one of its end position Edge sensor is used. Also the same application is studied which is operated on voice recognition. Voice recognition module is used for voice recognition. This system is working with the Arduino microcontroller Bluetooth module is used for communication between voice module and microcontroller. Operation of door is done with the dc motor.

II. PROPOSED METHODOLOGY OF AUTOMATIC DOOR ACCESS BY FACE RECOGNITION

Firstly explain the methodology and whatever techniques which is used in the system of automatic door access by face recognition.

2.1. VIOLA JONES FACE DETECTION METHOD

This system is basically work in three steps. First step is to convert the input image into new image representation called integral image which allows a fast feature evaluation. The Viola-Jones method analyses a sub-window using features consisting of two or more rectangles. Each feature results in a single value which is calculated by subtracting the sum of the white rectangles from the sum of black rectangles. Adaboost is a machine learning boosting algorithm capable of constructing a strong classifier through a weighted combination of weak classifiers [4]. A weak classifier is calculated by the following equation $h(x, f, p, \theta) = 1$ if $pf\ x < p\theta$ and 0 otherwise where x is a 24*24 pixel sub-window of an image, f is an applied feature, p indicates the direction of inequality and θ is a threshold that decides whether x should be classified as a positive (a face) or a negative (a non-face).The final strong classifier is obtained after applying the adaboost algorithm detailed in [1]. In the third step, Determination of face whether a given sub-window classifier is definitely not a face or maybe a face by using a cascade classifier. The cascaded classifier is composed of various stages in which each consists of a strong classifier.

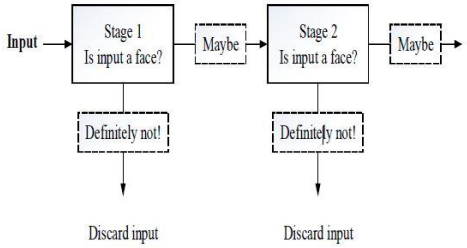

Figure I: Cascaded classifier

2.2. PRINCIPAL COMPONENT ANALYSIS (PCA)

Principle component analysis method is used for extraction of various parameters of image. The technique used for Face Recognition which is based on PCA is generally referred to as the use of Eigen faces. Eigen faces are Principal Components of the distribution of faces, or equivalently, the Eigen vectors of the covariance matrix of the set of the training images, where an image with N by N pixels is considered as a point in N2dimensional space. The PCA algorithm is working in five steps.

*In the first step, The image matrix Im having size of M*M pixels gets converted into into the image vector Γ of size (P x1) where P = (M x M). Training Set**:** Γ = [Γ1Γ2 … ΓN

* In the second step Average face image is calculated by the formula

$$\Psi = \frac{1}{M}\sum_{i=1}^{M} \Gamma_i$$

Each face will be different as compared to the average face by $\Phi i = \Gamma i -$ Difference Matrix will be A = [$\Phi 1 \Phi 2 \ldots \Phi N$]

* In the third step A covariance matrix is constructed as:

C= $A * AT$, where size of C is (P×P). This covariance matrix is very difficult to work with because of its huge dimension that causes computational complexity. The covariance matrix with reduced dimensionality is L = AT*A, where size of L is (M×M).

$A\ Xi = \lambda i\ Xi$ This equation is used for obtaining the eigen vector of original covariance matrix. By multiplying both sides of the above equation with A, $AATA\ Xi = A\ \lambda i\ Xi$ $(A\ Xi) = (A\ Xi)\ .\ A\ Xi$are the Eigenvectors of the covariance matrix which is denoted by and eigen values are the same for the two covariance matrix.

*In the fourth step A face image can be projected into this face space by $\Omega k = Uk\ T\Phi i$.

*in the final step Test image vector is Γt and Mean subtracted image vector will be $\Phi t = \Gamma t - \Psi$. The test image is projected into the face space to obtain a vector by eqn. $\Omega = Uk\ T\Phi t$.

2.3. CLASSIFICATION OR FACE RECOGNITION

Classification is a method by which the minimum distance between the test image and the trained image is find out. The face having minimum Euclidian distance shows the similarity to test image. The distance of test image **Ω** to each training image is called Euclidean distance and is defined by, $Ek^2 = \| \Omega - \Omega k \|^2$. a threshold value Θ is the maximum acceptable value for known images and comparing it with the minimum **εk ,** test image can be recognized as known or unknown face image., the test image is recognized an unknown face for a condition like If εk(min) ≥ Θ. And for the condition εk(min) < Θ , the test image is a known face.

2.4. USB TO RS232 CONVERTER

Figure II. USB to RS232 converter

Adjustment of the voltage level between PC and the microcontroller by using this converter. The driver had already installed on PC that converts the USB connection into a Virtual Communications Port, which makes the USB connection that looks like a serial port on the PC.

2.5. PIC MICROCONTROLLER

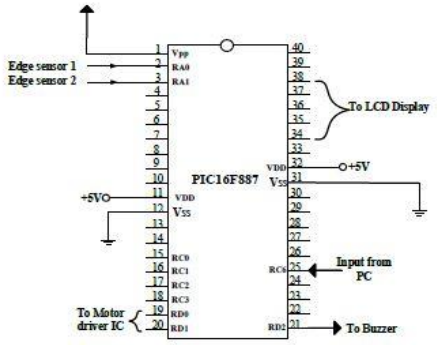

Figure III. PIC microcontroller

Because of its good features and integrated peripherals, PIC 16F887 microcontroller is used in this system. PC sends the signal to microcontroller and it send a command either to the door motor circuit or to the alarm circuit.

2.6. OPTO ISOLATOR

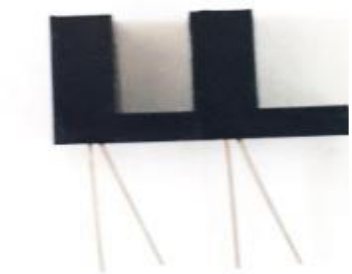

Figure IV. optoisolator

For automatic door opening and closing system, the two opto-isolators are used as the edge sensors. An opto-coupler involves a 6 LED and a phototransistor. When an electrical signal is applied to the input of the opto-isolator, its LED lights & light sensor activate, and the output is low. The output is high If an obstacle is placed between its LED and its phototransistor.

2.7. L298 Driver IC

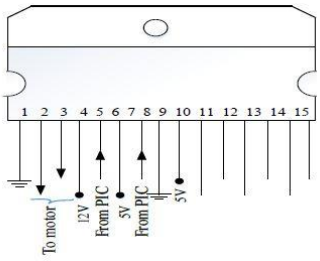

Figure V. L298 Driver IC

Each digital pin of microcontroller PIC16F887 can provide max. 25mA but the DC motor need more current. Since the microcontroller can not supply the sufficient amount of current, to give a required amout of current to operate DC motor L298 Driver circuit is used.

III. BLOCK DIAGRAM OF DOOR SYSTEM BY FACE RECOGNITION

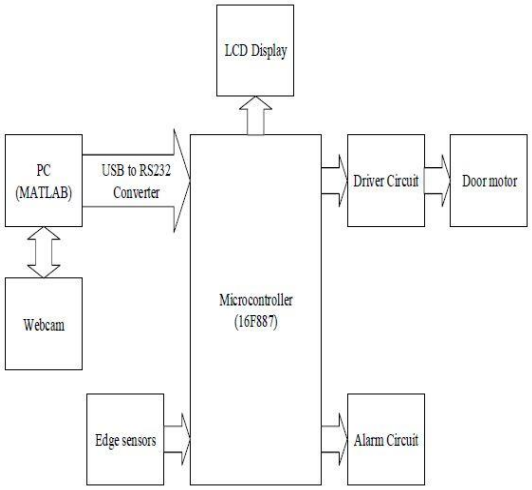

Figure VI. Block diagram of system

IV. PROPOSED METHODOLOGY OF AUTOMATIC DOOR ACCESS BY VOICE RECOGNITION

In this section, I explained the operation of door on voice recognition. Door access is performed on voice command of user. Same process as like face recognition is done with voice recognition.

4.1. VOICE MODULE

Figure VII. Voice module

This model is working in group of voice command. 15 pieces of voice instruction are stores in it. All 15 pieces of voice command is divides into three group with 5 in one group. We have to record the voice instruction group by group. Before it could recognize the 5 voice instructions within that group we should import one group by serial command. Before implementation of instructions in other groups, we should train the group first by voice command. This module is speaker independent. Operating voltage is 4.5 to 5 V. having size 30mm*47.5mm. recognition accuracy of this model is 99%.

4.2. ARDUINO UNO

Figure VIII. Arduino uno

Microcontroller ATMEGA 328 whose operating voltage is 5V. Input voltage needed is 6-20 V. it is having 14 digital I/O pin and 6 analog input pin. Required dc current is 40mA.flash memory is 32 KB and SRAM is 2 KB. Clock speed is 16 MHz

4.3. DC MOTOR

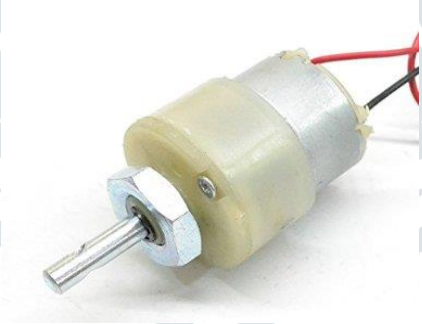

Figure IX:.DC motor

For conversion of electrical energy into mechanical energy DC motor is used. It is consisting a mainly two parts one is stator and another is a rotor. Stator is a stationary part while the rotating part is called as rotor. Basically it is used to rotate the motor of door system clockwise or anticlockwise according with the output of microcontroller.

V. BLOCK DIAGRAM OF DOOR SYSTEM BY VOICE RECOGNITION

Figure X.: block diagram of system

Voice recognizer module is trained by various voice sample of users. Then module is recognized the user voice and send the input to the Arduino board. Arduino works according to the input received by voice module. If person is known then door will be open and door will be shut for unknown voice. Dc motor and driver circuit is used for operation of door.

VI. CONCLUSION

In this paper automatic door access is done by using two different techniques like face and voice recognition. There is no need to open the door manually by going there.it is useful for a lazy or busy person. Automatic face detection and recognition is done by using the MATLAB on PC. Microcontroller is used to control the door access system depending on the data which is received from computer. Door is opened immediately after confirming the face is known. After 2 seconds, door is closed automatically. Again for a physically disable person also used this system. Automation makes our living of standard. The main challenges faced were speech recognition in noisy conditions, the training of the voice recognition module, number of commands stored in the database of the voice recognition module and the response time of the module and the device on which the code was embedded.

VII. REFERENCES

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