Advanced Door Level Security For Theft Detection

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Abstract— Now a day's many door access control systems are available in market but still the theft rates are increased. Protecting highly secured areas with single level biometric system for access control is not efficient. So in this paper we proposed a system with two level security checks. This system uses password with face recognition technique for theft detection. First system acquires password from user. If that password matched with authorized password, then current captured image will get compared with authorized image stored along with that password. This two level security reduces the number of comparisons required to match the image with authorized person. If any unauthorized person tries to get access of area, then system raises alarm and sends message to registered mobile number using GSM (Global System for Mobile Communication) module. If any unauthorized person tries to harm the system, vibration sensor sends signal to microcontroller 89E51RD2 which in turns raises alarm. This system helps users for improvement of the door security of sensitive locations by using face detection and recognition. This system uses sensor, namely passive infrared receiver (PIR) which detects presence of human in front of door, Vibration sensors for detecting vibrations at door or window area, Microcontroller 89E51RD2 for sending signals to computer, Camera for capturing images, GSM module for sending messages and a buzzer for alerting authorized persons.

Keywords- *Face recognition, GSM (Global system for mobile communication),PIR(passive infrared receiver), Microcontroller 89E51RD2*

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I. INTRODUCTION

For reducing robbery rates many security systems available in market have been using different biometric techniques for theft detection. Our system is mainly based on two level securities as password checking along with face recognition. Password checking method simply decreases the number of comparisons required for authenticating person. The system gives maximum three chances for entering password to user. If password is matched then the next process of face detection and recognition will get continued, otherwise access is denied. If all three attempts failed then it raises the alarms. If any unauthorized person wants to access the door, then system will raises the alarm and sends message to registered mobile number to alert the authorized person that someone is present at door. This system also uses vibration sensor to continuously observe the area around a place for any illegal activity. It raises alarm if someone tries to enter the place through backdoor or window. It also sends message to mobile number.

II. METHODOLOGY

Face recognition has become an important field of research area because of its usefulness in numerous applications. Such a recognition system can be used to allow access to computers, to control entry into restrained areas and to search for a face in databases for testimony. There are three phases of face recognition system: face detection, feature extraction, face recognition (Refer fig. 1). Face detection can be defined as the process that applies to input image to detect whether it is a face or not[1]. The feature extraction phase extracts data of some features in the face such as mouth, nose and eyes to build unique data set for each person and then this data is classified and stored in database for further face recognition process [2].

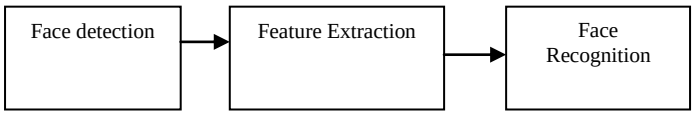

Fig. 1 Three stages of face recognition system

A.Viola Jones Face Detection Method

The Viola–Jones object detection framework is the first object detection framework to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones[12]. Although it can be experienced to detect a diversity of object classes, it was motivated primarily by the problem of face detection. The problem to be solved is exposing of faces in an image. A human can do this easily, but a computer requires precise instructions and constraints. To make the task

more manageable, Viola–Jones requires full outline frontal upright faces. Thus in order to be find, the entire face must point towards the camera and should not be tilted to either side. While it seems these constraints could decline the algorithm's utility somewhat, because the detection step is most usually followed by a recognition step, in practice these limits on pose are quite acceptable.

1) Feature types and evaluation

The attribute of Viola–Jones algorithm which make it a best detection algorithm are:

- Robust – very high detection rate (true-positive rate) & very low false-positive rate regularly.
- Real time – For practical utilization at least 2 frames per second must be processed.
- Face detection only (not recognition) - The goal is to distinguish faces from non-faces (detection is the first step in the recognition process).

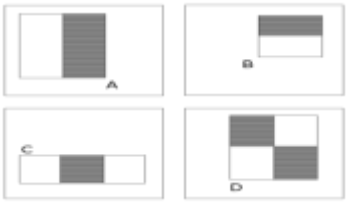

Fig. 2. Feature types used by Viola and Jones

The algorithm has four stages:

1. Haar Feature Selection
2. Creating an Integral Image
3. Adaboost Training
4. Cascading Classifiers

The appearance sought by the exposure framework astronomically involves the sums of image pixels within rectangular areas. As such, they bear some resemblance to Haar basis functions, which have been used previously in the domain of image-based object detection .However,since the features used by Viola and Jones all rely on more than one rectangular area, they are generally more complicated. The figure on the right emphasize the four different types of features used in the framework[12]. The value of any given feature is the sum of the pixels within clear rectangles replace from the sum of the pixels within shadowed rectangles. Rectangular features of this sort are primitive when compared to alternatives such as steerable filters.

For a fast processing of these features, the constituent image illustration is used. This is done by making each pixel equal to the entire sum of all pixels above and to the left of the concerned pixel [3]. It is calculated by the following equation

$$ii(x , y) = \sum x' \leq x, y' \geq y \; i(x', y') \qquad [1]$$

where ii(x , y) is the integral image and i(x , y) is the authentic image. The integral image can be computed in one pass over the authentic image by using the following pair of recurrences:

$$s(x , y) = s(x , y – 1) + i(x , y)$$
$$ii (x , y) = ii(x − 1 , y) + s(x , y)$$

where s(x , y) is the cumulative row sum, s(x , −1) =0, and ii (−1 , y) =0. The second step is compose a classifier in order to select a small number of important features using AdaBoost learning algorithm. AdaBoost is a machine learning boosting algorithm capable of constructing a robust classifier through a weighted combination of fragile classifiers[4]. A fragile classifier is calculated by the following equation

$$h(x, f, p, \theta) = \begin{cases} 1 \text{ if } pf\,x < p\theta \\ 0 \text{ otherwise} \end{cases}$$

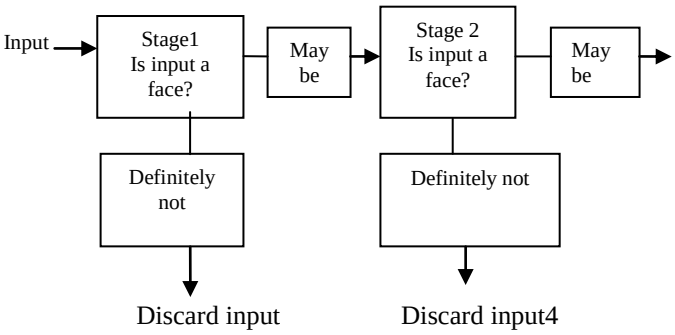

Fig. 3. Cascaded Classifier

where x is a 24*24 pixel sub-window of an image, f is the enforced feature, p point out the direction of the 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 ultimate robust classifier is retrieved after applying the adaboost algorithm detailed in [1]. In the third step, the cascaded classifier is used to resolve whether a given sub-window classifier is finally not a face or maybe a face. The cascaded classifier is composed of stages in which each consists of a strong classifier. The concept is illustrated with two stages in figure 3

B. Principal Component Analysis

To extract the relevant features of facial images, Principal Component Analysis (PCA) method is used[3]. Face Recognition established on PCA is generally indicate to as the use of Eigenfaces. Eigen faces are Principal Components of the distribution of faces, or equivalently, the Eigen vectors of the covariance matrix of the set of the practice images, where an image with N by N pixels is considered as a point in

N2dimensional space .The PCA algorithm is shown in the following steps[13]:

Step-1.Initially, the image matrix I of size (N x N) pixels is transformed to the image vector Γ of size (P x1) where P = (N x N).

Training Set: Γ = [Γ1Γ2 … Γ]

Step-2. Average face image is calculated by

$$\Psi = \frac{1}{m}\sum_{i=1}^{m} r'i$$

Each face differs from the average by $\Phi i = \Gamma i - \Psi$

Difference Matrix: A = [1Φ2 … ΦM]

Step-3. A covariance matrix is constructed as:

C= A , where size of Cis (P×P).

- This covariance matrix is very hard to work with due to its huge dimension that causes computational complexity.
- The covariance matrix with reduced dimensionality is

L = A , where size of Lis (M×M).

In order to obtain the eigenvectors of the original covariance matrix, it can be calculated by the following equations:

$$AT\ A\ Xi = \lambda i\ Xi$$

By multiplying both sides of the above equation with A,

$$AATA\ Xi = A\ \lambda i\ Xi \qquad AAT(A\ Xi) = \lambda i(A\ Xi)$$

- $A\ Xi$are the Eigenvectors of the covariance matrix which is denoted byUi and eigenvalues λi are the same for the two covariance matrix.

Step-4. A face image can be projected into this face space by

$$\Omega k = \ i$$

Step-5. Test image vector: Γt

Mean subtracted image vector:

$$\Phi t = \Gamma t - \Psi$$

The test image is projected into the face space to obtain a vector:

$$\Omega = Uk\ T\Phi t$$

III. SYSTEM DESIGN AND ARCHITECHTURE

Architecture of the proposed system is shown in following fig.4. It consist hardware components like camera, PIR sensor, vibration sensor, DC motor driver, buzzer, GSM module, microcontroller 89E51RD2, etc. First the PIR sensor detects human waiting for door access. Then it sends signal to microcontroller. Microcontroller allows person to enter password. If password is matched, then image captured by camera is sent to the PC using serial interface RS232.The face detection and recognition module is implemented in JAVA. The captured image is compared with the image stored in the database whose password is matched. If the image is matched, then microcontroller sends signal to DC motor driver L293D to open the door. Otherwise the microcontroller raises alarm and sends message to registered mobile number using GSM module.

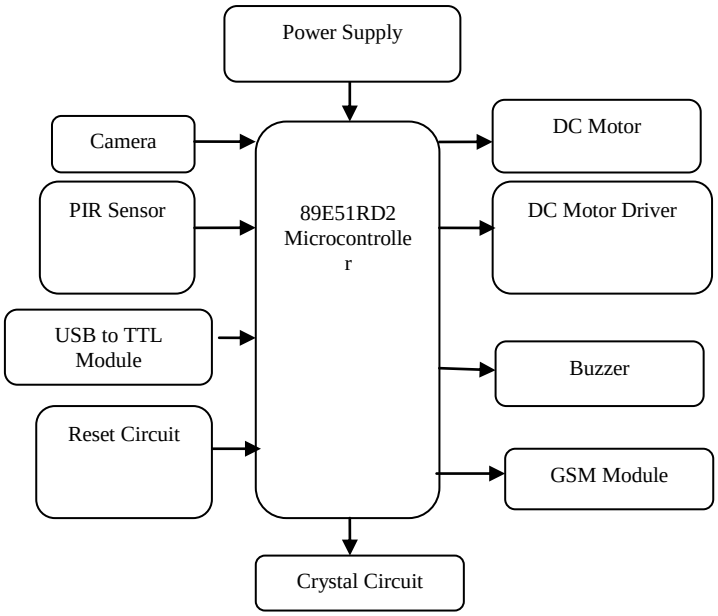

Fig.4 Block Diagram

A. *Hardware Components*

There are different types of hardware components.

1)Microcontroller 8051: The P89V51RD2 is an 8051 family microcontroller having 64 kB Flash memory and 1024 bytes of data RAM (Refer fig.5). A key feature of the P89E51RD2 is its X2 mode option. The design engineer can choose to run the operation with the traditional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency[14]. Another way to betterment from these characteristics is to keep the same achievement by reducing the clock frequency by half, thus dramatically reducing the EMI. The Flash program memory supports both parallel programming and in serial.

Fig.5 Microcontroller 89E51RD2

2)PIR Sensor : The PIR (Passive Infra-Red) Sensor as shown in fig. 6 is a pyroelectric device that detects motion by measuring changes in the infrared levels emitted by encompassing phenomenon. These fluctuations can be identified by checking for a high signal on a single I/O pin.

Fig.6 PIR Sensor

Features:

- Single bit output
- Small size makes it easy to conceal
- Compatible with all Parallax microcontrollers

3)Voltage Regulator Ic 7805: Ka78xx/Ka78xxa,: a 3 Terminal 1A Positive Voltage Regulator (Refer fig. 7). It is available with several fixed output voltage making them useful in a wide range of application (source: www.fairchildsemin.com)[16].

Features:

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Preservation
- Short Circuit Preservation
- Output Transistor Secure Performing Area Protection

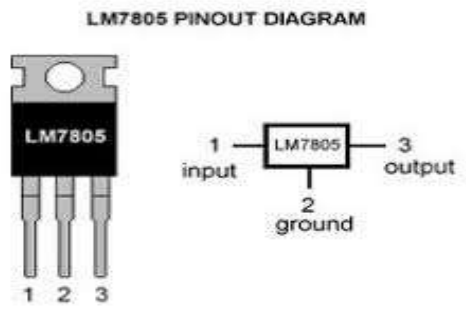

Fig.7 7805 IC

4) Dc Motor Ld293d: We have used L293/ L293D Quadruple half-H driver for rotating DC motor. DC motor automatically opens and closes door for us. L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers in consideration of they take a low-current control signal and yield a higher-current signal. This higher current signal is used to drive the motors [17].

Fig.8 LD293D IC

IV. RESULT

To automatic door access system, personal computer (PC) is connected to microcontroller using USB to RS232 converter. When no motion is detected in front of door using PIR sensor, any signal is not sent to microcontroller. The door remains closed as microcontroller is not receiving any indication from PC.

When user enters correct password his face is detected and compared with image stored in database. If face is recognized, then door is opened for that person.

If the face is not matched with authorized images in database, this person is recognized as unauthorized and door remains closed. Also buzzer rang and SMS is sent to registered mobile number.

CONCLUSION

In this paper, advanced door level security system with two level security checks is proposed: password and face recognition is used. Password recognition and automatic face detection and recognition is done by Java program on computer. The External sub system can sense motion near the door, acquires passwords, compares the password with database, capture image of the person, process the image and can grant or deny access to pass through the door (Face Recognition).Microcontroller sends signals to various components of system depending on the data input from computer. DC Motor is used for opening and closing of door. Door is opened immediately after recognizing authorized persons. For face recognition, Principal Component Analysis method is used to extract the significant appearance of facial images. PCA method trim the size of database, this system can diagnose and identify an image in one second. Therefore, this system can be used to upgrade door security for strangers without needing security guards and wasting too many time.

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