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Intelligent Surveillance System for Smart Security

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Abstract

Objective: To provide a smart surveillance security system to identify the human intrusion. **Methods**: We propose a system that provides smart surveillance security where it identifies the human intrusion and makes an alert to the user or authorized person. Whenever the motion of the human is detected, images taken by the camera are processed using the control unit by face recognition. Viola Jones and PCA algorithm is used for face detection and face recognition. Face of the human is compared with the faces available in the database images. **Findings**: When there is no match with the database images, an alert is sent to the authorized user to intimate that there is an emergency in the place and also a buzzer alert is given from outside. Additionally, in order to avoid the intruder from escaping from the place, chloroform is sprayed at the place which will make the intruder unconscious for some time. Through this system theft can be avoided and the unauthorized person cannot escape. **Applications**: The areas of object detection and monitoring systems are implemented and transmitted to the rescue person; it is suitable for houses and bank lockers of any assets.

Keywords: Camera, GSM, PCA, PIC Microcontroller, Viola Jones

1. Introduction

Security is the first and foremost requirement for the entire place especially in busy traffic area. Nowadays in every place CCTV cameras are fixed to track the activities that are happening in a particular area. Surveillance is nothing but monitoring an area where security is required. Surveillance can be done with/without human support such as security system in which human closely monitors the visuals captured by CCTV cameras and systems which are standalone. In order to effectively develop a system with the help of CCTV surveillance, object detection and face recognition technique is added for validating the person in gateways. Validation is done using image processing by comparing the face captured in the image with the faces available in the database. Based on the validation result, required action will be taken by the control system.

2. Literature Survey

In[1] has proposed a smart theft detector system using a PIR (Passive Infra-red) sensor. Abstract - Security is a major concern in today's life as the crime rates are increasing day by day. Emergence of new which identifies human intrusion, camera for monitoring the actions in home such as intruder existence and gas leakage by live streaming through emails. Using this system, user can

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access the video from anywhere as it is using IoT (Internet of Things). This system confirms whether the person identified through video is authorized and if the person is unauthorized the system sprays chloroform in order to avoid the unauthorized person from escaping

In[2] proposed a surveillance system in home in order to monitor parameters such as gas leakage, fire detection. This system uses Raspberry Pi board along with USB camera integrated. User has an access to a webpage which will require a username and password to login into it. User will be able to control the door movements from the login page. Once the user is logged in webpage, he/she can view the live streaming video of the place and give door commands such as open, close, capture image.

In[3] has proposed surveillance and monitoring system which uses PIR sensor to indentify human intrusion. This system uses Arduino Mega 2560 board which has an attached Ardu-CAM module. This uses a Firebase API to send a push message to Android and it is further used for communication through Internet of Things. This is an energy efficient system and reduces the installation cost.

In[4] have implemented a face detection system using MATLAB. In this paper the author proposed algorithm is Viola–Jones algorithm which determines the HAAR features of the face. MATLAB implementation is done by using a function vision - Cascade Object Detector in computer vision toolbox. Faces in picture are detected by identifying the face features like nose, eyes using input string Classification Model. Cascade training is done with positive and negative samples. In order to achieve more accuracy, layer based cascade training is performed.

In[5] has proposed a new algorithm called 2 dimensional Principal Component Analysis (PCA). It is using multi angle dimensional analysis and images are trained to compare with the test images.

In[6] has proposed a smart home security system as a real time monitoring. This system uses wireless sensor network along using IoT. It is an efficient system to monitor and detect any intruder presence and alerts the user/owner through a notification sent to the mobile.

3. Proposed Methodology

Based on the literature study, this system is designed to identify human intrusion using image comparison. When human intrusion is identified, the camera takes the

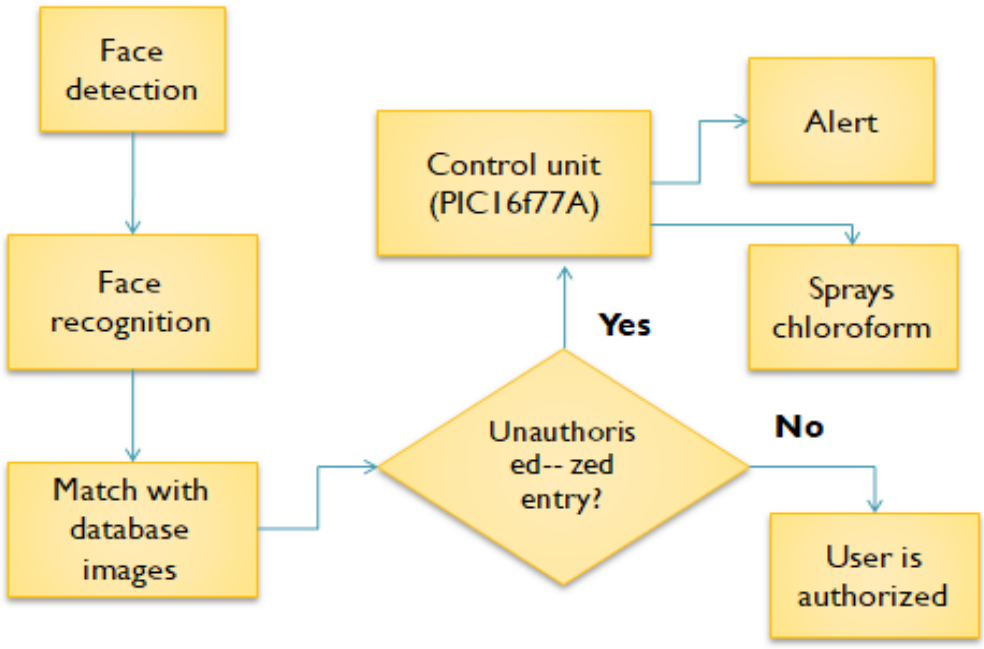

Figure 1. System architecture

picture and detects whether it has a face using Viola Jones algorithm and verifies the face in the image using PCA face recognition technique by Image processing.

If the face in the image is matched with the face in the database, the person is authorized. If the person is unknown, then message is sent as an alert to the owner/ user. Also the motor is driven to automatically spray the chloroform gas in order to avoid the user from escaping from the exit. The below Figure 1 provides clear understanding of system architecture.

4. Algorithms

Algorithms are set of defined rules which are written based on the image analysis. Input for an algorithm is an image and the output is the features extracted using it. In digital image processing, the captured images are modified by enhancing colors, noise removal, compression and binarization, segmentation and extract semantic information. All these are achieved through the algorithms which define them.

4.1 Viola Jones

Viola Jones algorithm developed by Paul Viola and Michael Jones has made a trademark revolution in Image processing due to its capability of detecting the faces with high accuracy and efficiency. This algorithm uses a real time face detector which is used to detect faces in real time surveillance and track the person of the face. It is also used in many devices such as mobile phones and DSLR. This algorithm is fast and robust is more than 10 times faster than other techniques with 95% accuracy.

This technique uses simple HAAR features available in the face which are quite easy to compute as it deals with the rectangular features.

In this, instead of statistical pixel based system, rectangular features are used since it represents statistical face information and sparsely related background. HAAR features are chosen first by horizontal division, second by vertical division, third by two vertical division and last by two horizontal and vertical division.

For a face detection to be efficient, the two key factors considered is speed and accuracy. In order to attain this, integral images are used. They are constructed by taking the sum of luminance above and left of the image. They speed up the feature extraction. MATLAB can process large set of images in less than 2 seconds

4.2 Principal Component Analysis

Principal Component Analysis (PCA) is used to discriminate input images into several persons. PCA has a better recognition rate with a high accuracy of around 90%. The images are converted into a 2D matrix and Eigen vector and Eigen values are found. Following are the steps in PCA,

- Reshape all the images into 1D column vectors from which 2D matrix are constructed.
- Mean of the training images is calculated.
- Eigen values are calculated by finding the covariance matrix.
- Mean image vector is calculated.
- Eigen vectors are calculated from the non zero Eigen values of covariance matrix which represents the best feature set.
- Eigen faces are calculated with the Eigen vectors.
- The same is done for the test images and Euclidean distance is calculated from database images with the test image to compare and check whether the features of test image matches with features of any of the database images.

5. Hardware and Software System

5.1 PIC Microcontroller – PIC16f877a

Microcontrollers are the controlling units of an embedded system which is used to send signals to sensors and devices integrated with it. PIC stands for Peripheral Interface Controller contains 40 pins architecture. It is a low power consumption controller with high performance ability. PIC is capable of supporting hardware and software

such as compilers, debuggers and simulators easily. On comparing with other microcontrollers, they are reliable and malfunctioning of PIC is very less

5.2 L293D Driver

L293D driver is a 16 pin IC which is typically used to drive a DC motor on the direction whichever is required. L293D is capable of controlling two DC motors at a time. Using a L293D driver, physical operations can be controlling such as opening/closing the door, etc. In this project, L293D is used to drive a DC motor to spray gas on intruder in restricted area

5.3 Camera

Camera is the input source for the entire system and it is used to capture the videos and images of a particular area. They are placed in required places for monitoring and provide live feed of what is happening in the place. There are cameras which rotate in 360 degrees and capture visuals. High definition cameras are used to capture images with clarity. In some places a night vision camera is used to take pictures in dark area. Even web cameras are used in some places which can record live stream videos for indefinite time and it can be viewed from any place in a webpage with the help of internet. With the help of visuals taken by camera, the system can process the images and send signals based on the decision.

5.4 GSM SIM 800

Figure 2 shows that GSM SIM 800 module. It is used to send a notification message with the help of a SIM card inserted into it. It is easily adapted to accept any network SIM card and has a unique phone number to send message. It has RS232 port which is used to interface it with embedded applications. Module is interfaced with controller through serial communication. It is capable of sending/receiving SMS messages, make a voice call, receive a voice call and reject a voice call.

5.5 RS232 Cable

RS232 cable is used to connect the computer system with the embedded hardware. All the signals from computer systems are sent to processor/controller via the RS232 cable. It acts as an interface between the computer systems and the external embedded application. In case of image processing, the images are processed through MATLAB software and results of that are sent to hardware through RS232 cable.

Figure 2. GSM module.

5.6 MATLAB

MATLAB is an image processing tool which has a lot of computer vision processing options useful to process the captured images. It is a fourth generation programming language with high performance.

- It is a high level language used for computer vision programming.
- It is used to create graphical user interfaces where user can interact.
- It is used in signal and communication processing.
- It is used in control systems.

5.7 PROTEUS

It is a software tool containing simulation, schematic and PCB designing. It is used to create schematic diagrams by designing a circuit in real time and also develop 2D drawings. The circuit can be simulated and output can be seen virtually in the system after which it can be programmed to the device. This helps in avoiding damaging of devices due to wrong circuits.

5.8 Simulation Output

Face detection and recognition is implemented using MATLAB and the recognition output is given to the PIC microcontroller which further decides the control action. Motor circuit is simulated using Proteus and then programmed to PIC micro controller Figure 3 shows the simulation output for unauthorized user and Figure 4 shows the simulation output for authorized user.

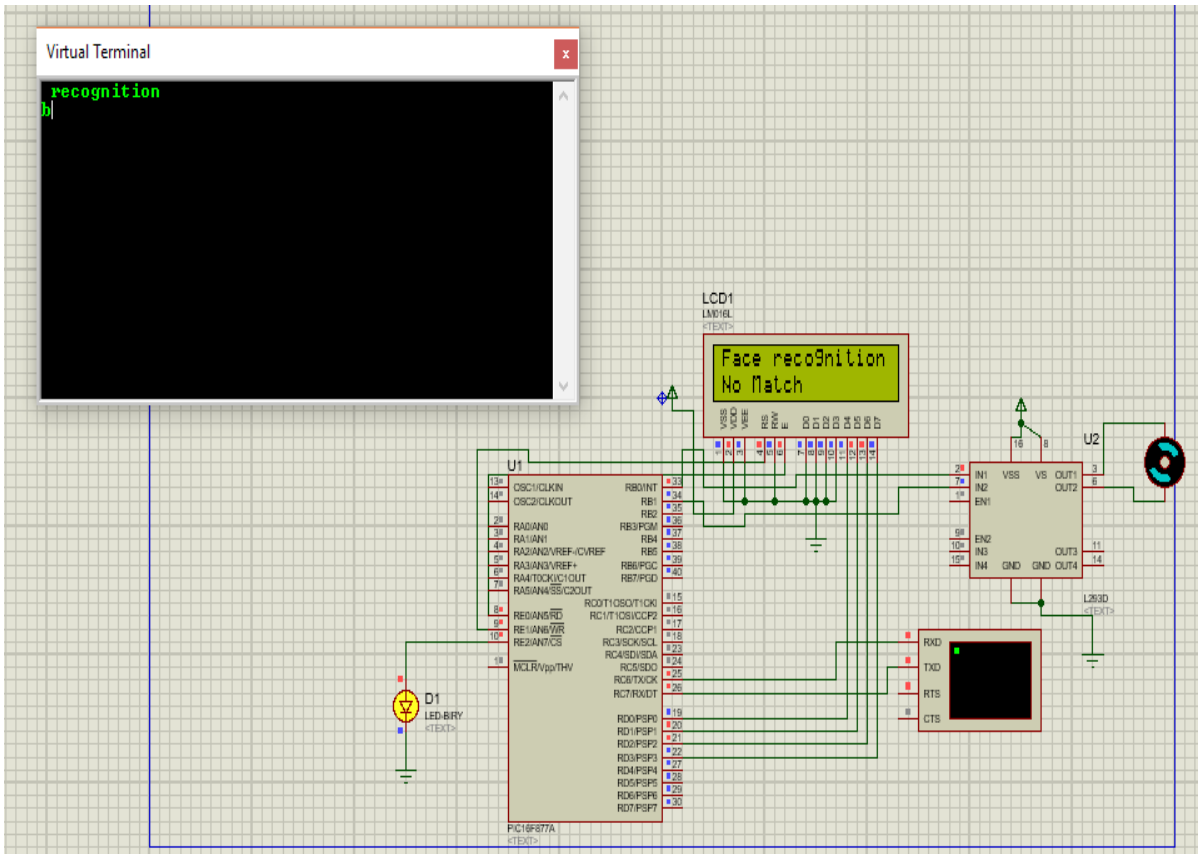

Figure 3. Proteus output for unauthorized user.

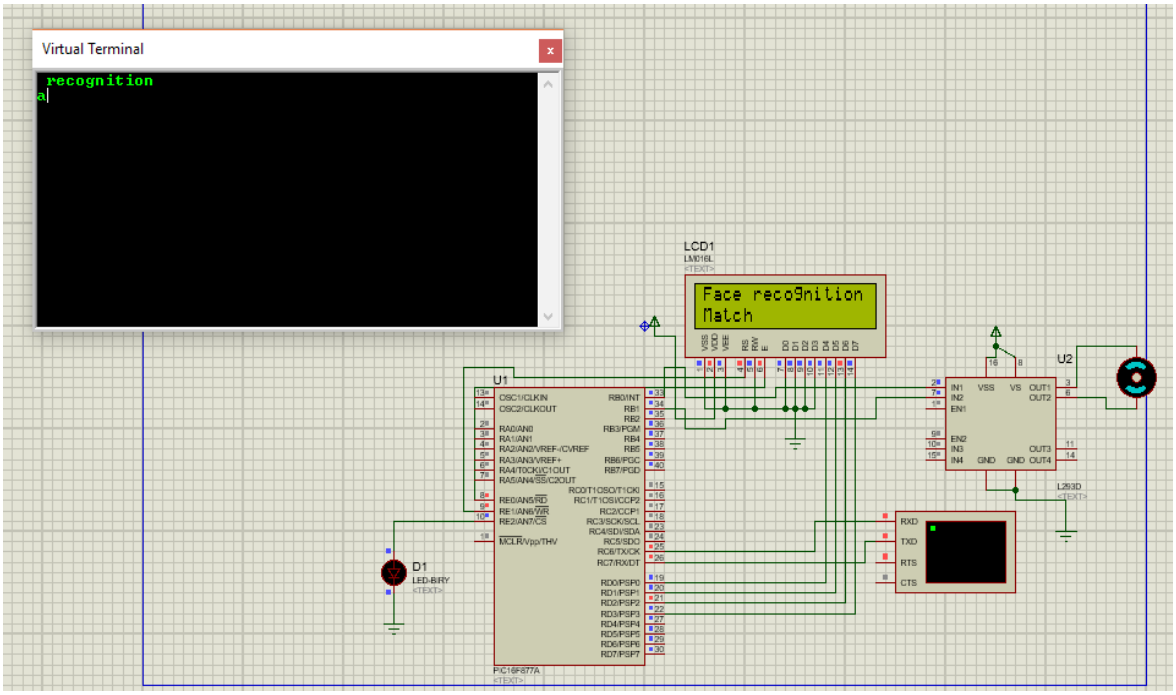

Figure 4. Proteus output for authorized user.

5.9 Face Detection and Recognition Output

Face detection is done in MATLAB using Viola Jones algorithm and the output is shown in Figure 5.

Face recognition is done in MATLAB using PCA and the output is shown in Figure 6.

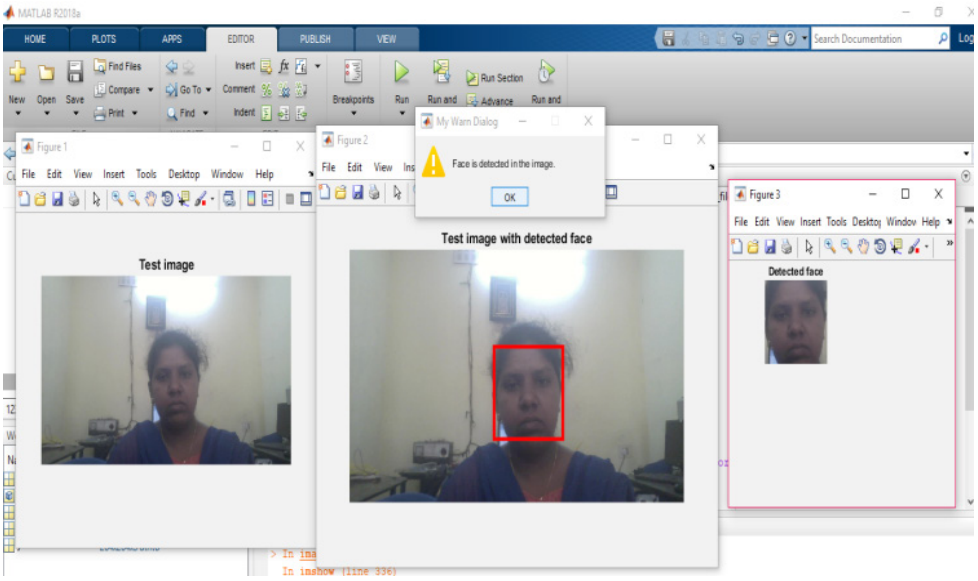

Figure 5. Face detection output.

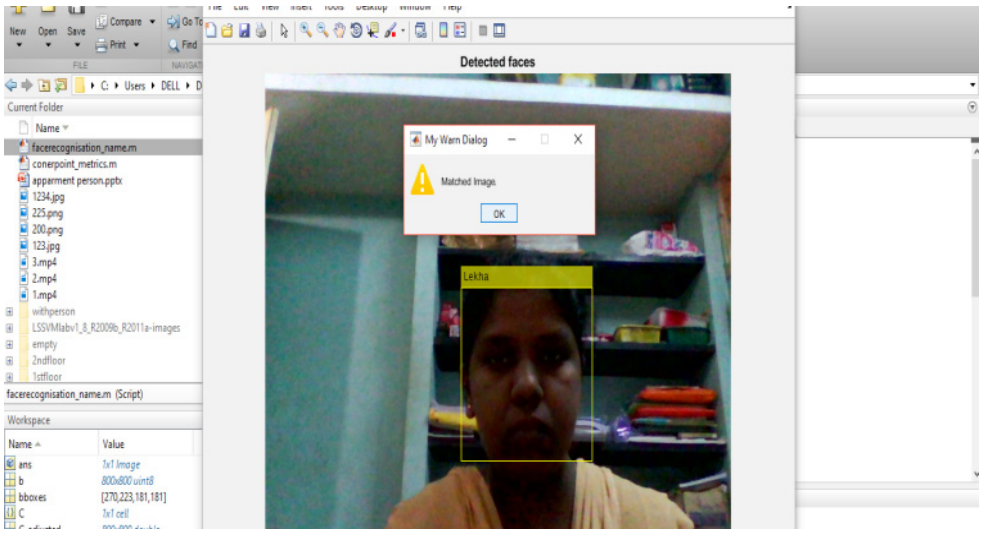

Figure 6. Face recognition output.

5.10 Prototype Hardware

User authorization is analyzed using face recognition output and if the user is unauthorized, alert SMS is sent and motor is driven to spray chloroform gas. Figure 7

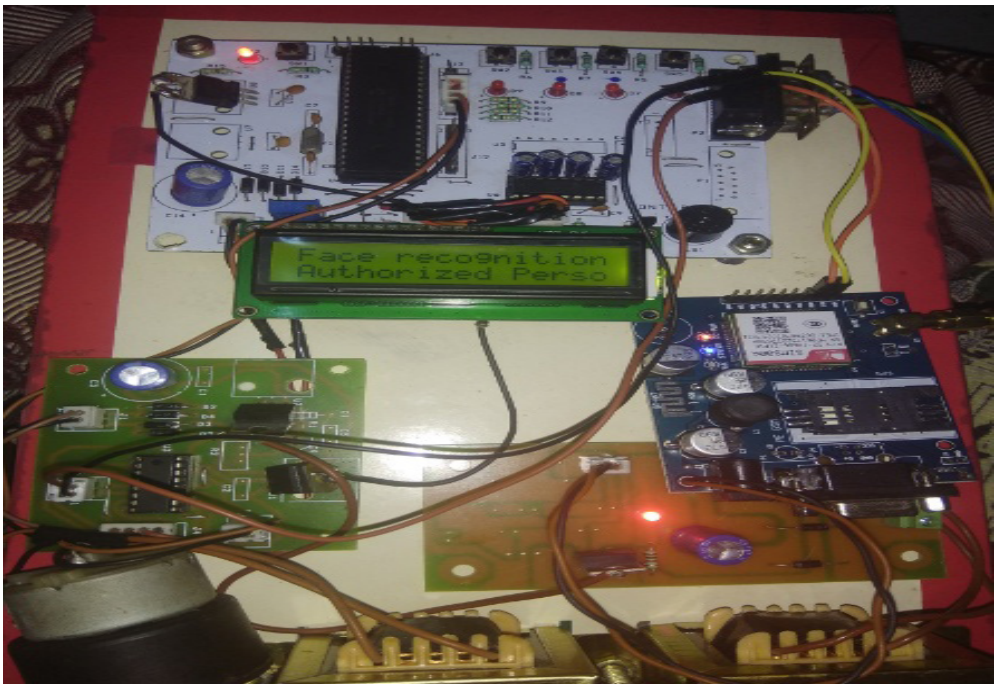

Figure 7. Authorized person output.

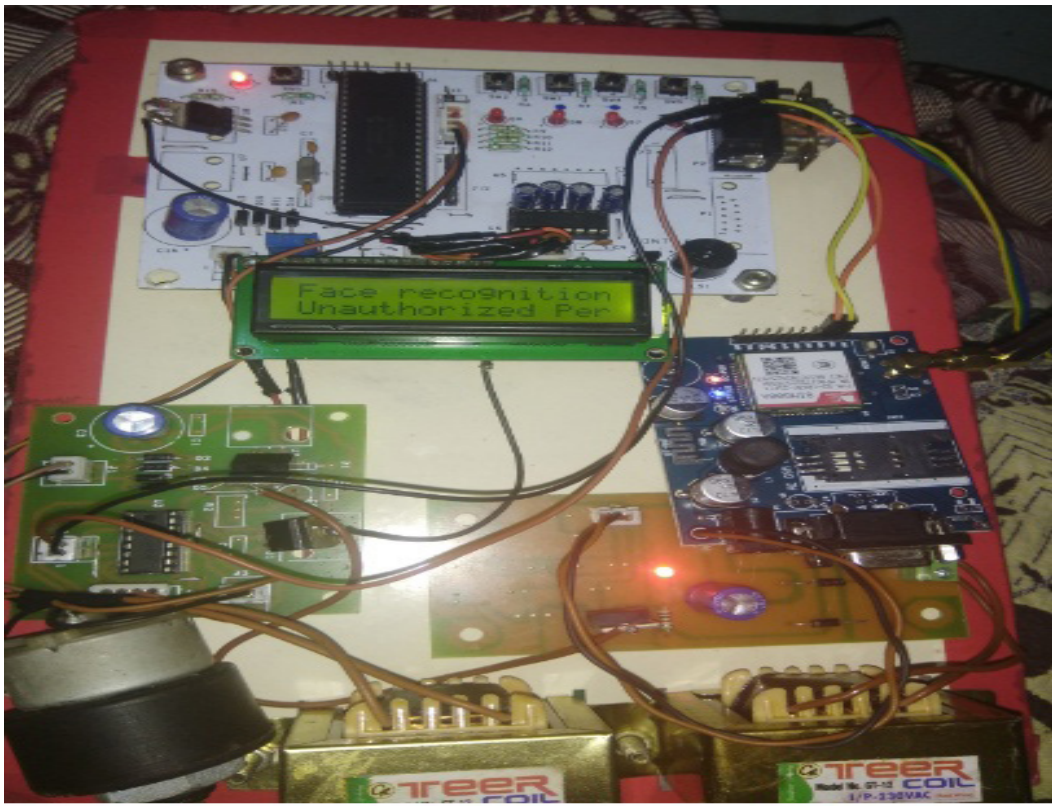

Figure 8. Unauthorized person output.

shows the display message in LCD when an authorized person is recognized. Figure 8 shows the display message in LCD when an unauthorized person is recognized.

6. Conclusion

A system is designed to provide intelligent security and it is implemented in MATLAB software. Face recognition is implemented using PCA and also histogram error comparison is done between two images to find the matching error rate. Face detection is implemented using Viola Jones algorithm and the simulation and the simulated output need to be implemented in hardware. In future, this system can also be used to provide intelligent security such as gas indication, fire detection by implementing using sensors which can be controlled from any place.

7. References

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