SMART SECURE DOOR LOCK SYSTEM USING IoT AND EIGENFACE APPROACH

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Abstract : In this new-fangled world crime has become an important issue to be resolved. Some of the real time incidents as of today are thefts at home, trespassers and so on. Though people have no time to look up on these things as they are held up in their daily life, they always want to ensure their safety of their beloved ones and beloved things. Sometimes they forget to look after their necessary things like keys, wallet, credit cards etc. Without these, they are unable to access their home or any place they want. Smart home security control system has become indispensable in daily life. This paper explains about the design and development of a home security system, using remotely monitoring technology and human face recognition technology, to confirm the identity of the visitor and to control door accessibility using Internet of Things (raspberry pi) and also the implementation and deployment of wireless control system and accessibility to a home environment for only authenticated people

IndexTerms **- Raspberry pi, IoT, Wi-Fi modem, relay, python, Eigenface.**

I. INTRODUCTION

The most important of feature of any home security control system is to detect the people who enter or leave the house. Instead of monitoring that through passwords or pins unique faces can be made use of as they are one's biometric trait. These are innate and cannot be modified or stolen easily. The level of security can be raised by using face detection.

Thus a new hardware system for human face detection using Raspberry pie has been developed. The Raspberry Pi is a series of small single-board computers. It is like a fully functional CPU and its functionality is similar to a desktop computer.

The flow of the face recognition system is that first an image is captured by camera. The snippet code detects the features of an individual. After the detection, using Raspberry pi the captured image is checked against the images in the database. Then it is decided if the faces match or not. After that SIM300 GSM module sends a security alert to the authorized person if an intruder tries to enter into the premises. The equipment used is easily available and used in a wide sense. Python programming language has been used for the algorithm which works on a LINUX operating system. Access is given only to the members of that particular family whose faces would be stored in the database. In case of guests (unrecognized face, not specifically an intruder) an alert is sent to the authorized person and authentication is provided by them.

The system which was proposed has been designed to eliminate the drawbacks of the previously mentioned security system and to improve the security, flexibility, efficiency of the forth coming system. The security camera system may sometimes be impossible due to the exhaustive costs incurred during installation. The other implementations of this system are in banks, attendance, authentication networks.

II. LITERATURE SURVEY:

Chen [4].This paper is concerned the major features of the face detection algorithms are designed in the software domain and it has a very high detection rate, but they often require several extra seconds to detect faces in a single image, a processing speed that is insufficient for real-time application. According to this paper by using enhanced features of independent component analysis approach for face recognition are to be used.

J. Nagi [2]. This paper has presented a technique called as novel face recognition in which features are derived from DCT coefficients, along with a classifier called, SOM-based classifier. The estimation process was done in MATLAB using 25 facial images as a image database, in which five different subjects are considered and each subject having 5 images with varying facial expressions. According to this paper efficient High-speed face recognition system has designed.

L. Ma, Y. Xiao, and K. Khorasani [9]. In this paper researcher has proposed a new technique for facial expressions, which uses the technique of two-dimensional (2D) discrete cosine transform (DCT) over the entire full face image as a feature detector and a constructive one hidden-layer feed forward neural network which is used as facial expression classifier. According to this paper by using constructive feed forward neural network facial expression recognition has been done.

Keun-Kwak and W. Pedrycz, [10]. This paper is concerned with an advanced independent component analysis (ICA) and its application is used for face recognition. Typically, face representations obtained by ICA is based on unsupervised learning and high-order statistics. In this paper, we can develop an enhancement of the generic ICA is done. Augmentation of this method is done by using the Fisher linear discriminate analysis.

Dhiraj Sunehra, Ayesha Bano [6]. This paper is concerned about the home security, activities and the behaviour of the surveillance system. During natural, accidental and human dangers, safety features are provided by alarming the residents. Zigbee and Bluetooth with cloud networking is applied to implement this system.

III. ARCHITECTURE:

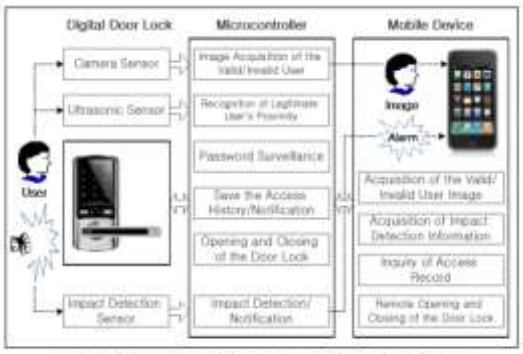


Figure 1. Structure of the Proposed Door Lock System Using EigenFaces

A) INPUT UNIT:

- Any webcam can be used for face detection. Here, Microsoft LifeCam HD-3000 has been used.
- It has the following specifications:
- Widescreen with 720p HD video chat and recording
- Noise reducing microphone
- TrueColor Technology for bright and colourful video
- Universal attachment base works on your desktop, laptop, or notebook.

B) COMMUNICATION INTERFACE:

SIM300 GSM Modem/ Module can be used to send and receive SMS or make/receive voice calls. It can also be used in GPRS mode to connect to internet and do many applications for data logging and control.

In this system, it is used as an interface to alert the authorized person in case of intruder invasion.

C) INTRUDER DETECTION MODULE:

We use Raspberry Pi 3 which is the third generation Raspberry Pi. It has

• A 1.2GHz 64-bit quad-core ARMv8 CPU
• 802.11n Wireless LAN
• Bluetooth 4.1
• 1GB RAM
• 4 USB ports
• 40 GPIO pins
• Full HDMI port
• Ethernet port
Combined 3.5mm audio jack and composite video.

Power Supply:

- The power input of DVP-SS2 is DC.
- The power is connected across two terminals

This module in particular makes use of the algorithm that is input to Raspberry Pi using python. Based on the decision making parameter ,that is, recognizing whether the face a family member and passing on the results to the communication interface.

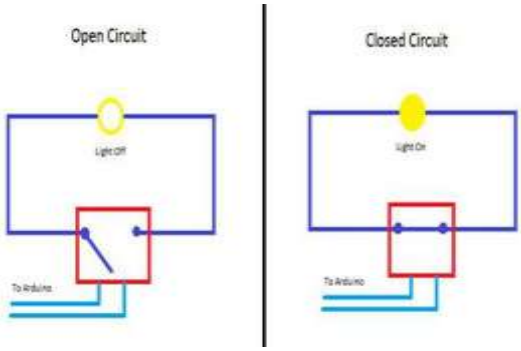
D) DOORLOCK SYSTEM MODULE:

A database is provided in which the images of known faces are stored. On each house entry, if the match is found, access to the place is possible. Access is denied in case the face is not recognized.

The Authentication phase relates to the face extraction where the images from database and captured image are cross checked and the results are sent to the Application Specific Unit.

E) APPLICATION SPECIFIC UNIT:

A relay does this same exact thing as switch except that the switch is powered not by hand but by a low-power signal. There are different kinds of relays and they differ by the throws and poles, has been explained in the diagram given below



This Relay used is to lock the system, if the face is not recognized. The relay circuit used is SainSmart 2-Channel Relay Module. The features are:

- It has Relay channel-2 interface board, 5 volts and each channel needs 15-20mA current.
- High-current relay, AC250V and DC30V with both 10A
- Microcontroller is controlled by standard interface.
- LED indication is used to known the output of the Relay status.

Pseudo Code:

```
1.  foreach user
2.    input action
3.    switch action
4.      case "password":
5.        if password is request number then take and send image
6.        else if password is valid then open the door lock
7.        else if number of mismatch >=3 then take and send image
8.                else go to step 2
9.      case "impact":
10.       impact sensor operation
11.       if impact value >= threshold value then camera sensor operation
12.     else go to step 2
13.   case "proximity":
14.     if distance >= threshold value then mobile device synchronization
15.       If valid user then send password, door open
16.       else go to step 2
17.     else go to step 2
18. End
```

Figure 2. Pseudo Code for the Operation of the Door Lock Controller

IV. METHODOLOGY:

The aim is to provide a high security face detection system on Raspberry Pi board and send an alert to the authorized person via GSM (Global System for Mobile) module. The flow is as follows:

- Interfacing of input unit to capture live Face image.
- Create a database of authorized house members and relatives.
- Capture the face at the doorstep and compare with data base image.
- Interface GSM (SIM300 GSM) module to send an alert to the person in authorization.
- Interface relay to the lock system.

Camera module is Pi camera interfacing to the raspberry pi module. It is used for captures an image and send captured image to the Raspberry pi module.

If any visitors arrive, the Raspberry pi sends an appropriate text alert which is done by a separate python code which is running in background. The server then sends to the home owner the name and photo of visitors for further action. Webiopi GUI webpage is used, through which the owner can directly login and interact with the real time embedded devices without the need of an additional server.

A) EIGENFACE APPROACH

One of the most effective PCA (Principal Component Analysis) approaches which are used in face recognition modules is the Eigenface approach.

Creation of Eigenfaces is done by using facial recognition. System's speed and efficiency are the main advantage of using Eigenfaces. The method used in Eigenface is dimension reduction method, in which each system represents many subjects which will be using a small data set.

For large reduction in image sizing, the face recognition system is invariant. Since the difference between the images seen and probe images is large, the system will fail considerably.

The gallery images are used to recognise faces, which are seen by the system and it is stored as collection of weights. Each weight describes the contribution of every Eigenface to that image. Now if a new face is represented to the system then its weight of the new face was found by projecting all new images on to the Eigenfaces gallery collection. Thus we can obtain the set of weights that describes the probe face. The classification of weights is done by finding the closest match in the gallery set. Here, the nearest neighbour method is imposed where, the Euclidean distance between two vectors, in which minimum values are assumed as the closest subject and classified accordingly.

The main features of Eigenfaces are:

- Completely automatic training process is used. Thus it is easy to code.
- Easy and cheap way of face recognition technique.
- Eigenface minimizes statistical complexity in representation of face image.
- Face recognition in real time can be achieved if the databases of Eigenfaces are calculated.
- Large databases can be handled in Eigenfaces.

B) FACE DETECTION

The database consists of the facial images of the people who are to be permitted inside. This database is used to verify and provide access to the authorized users.

Database of training set of pre-processed images are created to perform PCA. The facial images are stored in the database after pre-processing is done. Here pre-processing is done by converting the coloured facial images in to greyscale images

On creation of the database for the first time a person's image is captured six times and stored. Later this data base is compared with the live captured image. After the comparison, the output is sent to the GSM module.

GSM module is used for sending a message to the authorized person after the comparison and the output is either positive or negative. If output is positive then "Person Recognized" message is sent to the person in charge otherwise "unknown person is trying to unlock the door" message is sent.

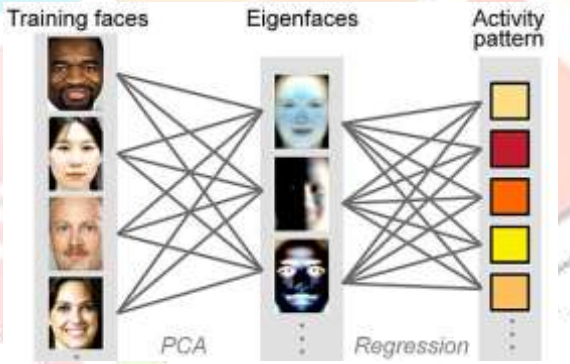


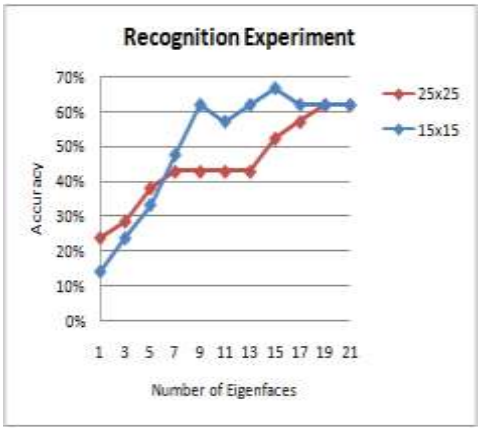
Figure 3. Eigenface Approach

C) WEB LOGIN

If the person is identified as intruder (if his face is not present in the database of authenticated persons), a mail with the intruder's image is sent from systems. The Web based monitor and control of system is forming a trend in present automation field. We can Replace PC with low-cost processors which make the administrators to get parameters of all the remote devices and to send control information to all the equipment at all the time through web. The needs of the user for that particular surveillance area are fulfilled by this smart surveillance system. Based on different scenarios and environments it can be used for many application. A person who is working in one particular industry can be aware of the activities that are happening in their own work place. Even during the person's absence, the system will be served for the purpose of spy. Another application is to provide information to the user about what is happening in surveillance area by notification. The complete system is secured through a login E-mail and Webpage password based authentication. The design is completely wireless and integrated with software to form a low cost, robust and easily operable system. Thus this will form a fully automated security system.

V. RESULT

The project was completed and is working as presented in this proposal. The system allows the authorized user to monitor and control the access to the door remotely. If the intruder is detected after the image processing is done in the raspberry pi, the image is captured and this intruder's image is sent to the authorized person's email id as an alert. If the admin wants to give access to the person through remote access, he/she can access the GPIO pins of the raspberry pi based on webIOPi and weaved IoT and so can access the door opening and closing using the web page. Face recognition experiment is conducted for the door lock system using Eigenfaces and the accuracy is much better for this system when compared to other approaches. The below image shows the accuracy is better for this system using Eigenface approach.



VI. CONCLUSION

This paper proposes the design and the development of an interactive smart home security system with the raspberry pi, Web-based control systems and using the Eigenface technology. The Web based monitor and control of system is forming a trend in present automation field. We can Replace PC with low-cost processors which make the administrators to get parameters of all the remote devices and to send control information to all the equipment at all the time through web. The surveillance system has been designed in such a way that it can fulfil the requirements of the user for particular surveillance area. It has countless applications based on different environments and scenarios. For instance, the system can be used by any individual person working in industrial sector to be aware of the activity being happened at their own working places, in their absence, and it can be used at houses and bank lockers for the purpose of spy. Another application is to provide information to the user about what is happening in surveillance area by notification. The complete system is secured through a login E-mail and Webpage password based authentication. The design is completely wireless and integrated with software to form a low cost, robust and easily operable system. Thus this will form a fully automated security system.

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