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IoT BASED HOME SECURITY MANAGEMENT SYSTEM

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Abstract -In recent years, home automation has received a lot of interest, and hence its security has been the prime concern. Our project is an outline for an automatic system to control and secure the home, based on digital image processing with IoT. The system consists of a sensor, a camera, and a web application. If the person at the door turns out to be unauthorized then the owner of the house is notified through the web application and also an SMS. Necessary actions can be taken remotely with the help of a web application. The system is self-sufficient for its own safety.

Key Words:Face recognition, home automation, Image analysis, Sensors, Web application

1. INTRODUCTION

Home security becomes one of the crucial things that must be contemplated by the community as well as in the smart home systems. A home security system currently used, is a conventional home security system, which is a security system with a mechanical system that requires users to always use the key to unlock or lock the door. This makes the home security level low due to several factors, namely: the ease of duplication of keys, the probability of lost key or changing hands, and others. The Indian smart home market is driven by factors such as a significantly growing IoT market, cost reduction measures enabled by home automation systems, manufacturers improving their product portfolios, and the increasing dignity of home monitoring from remote locations. With the increasing demand for smart home devices, security and privacy invading are also increasing. The issues about privacy and security breach are preventing the growth of the smart home market. Our proposed system delivers an expense and energy-efficient solution for home security by using IoT and face recognition. IoT will enable sensing and trigger a system of motion detection using sensors such as Ultrasonic sensors for motion detection and distance measurement used to calculate the position of the person in front of the camera.
We are going to use the detect Multiscale module from OpenCV which creates a rectangle with coordinates (x,y,w,h) around the face detected in the image. The recognition system has 80% of accuracy when it is tested using real-time images. A person should stand in frontof a camera. a camera will identify the face and compare it with the faces stored in the home member database stored in raspberry pi. If the face matches found, the door will be automatically unlocked else it will remain locked.

2.LITERATURE SURVEY

In [5], the author has proposed a Face Detection and Recognition System for Smart Home Security which captures the image and performs image processing using MyRIO 1900 is the main controller which contains the software of image acquisition, face detection, and face recognition. A personal computer (PC) is applied as a user interface, image display, and monitoring. Both MyRIO and PC are programmed using LabVIEW which a graphical programming language is called. The major disadvantage here is the cost of MYRIO is very high as compared to the raspberry pi.

In[6], it is explained how Raspberry pi and pi camera work with OpenCV for a face recognition system. The efficiency of the system was analyzed in terms of the face recognition rate. If the face is recognized it implies that an authorized person is trying for the door access and hence, the door lock is opened. if the face is not recognized, then the remote user can check the mail for the image of the person trying to access the door and allow or deny access to the door through an android application-Telegram. The analysis revealed that the present system shows excellent performance efficiency but the camera live status and the action tabs are not present at the same place making it a little tedious.

In[4], Face Recognition System Using IoT by authors Sandesh Kulkarni, et al., the proposed system is very well presented, and the methodology is quite well, explain in detail working of door lock-unlock on face recognition but, use of wifi limits its area covered as the system can not be accessed remotely by the homeowner.

In[3], Smart home security using IoT and Face recognition by authors *Suraj Pawar, Vipul Kithani,* the proposed system is very well presented, and the methodology is quite well, explained in detail, the system has the battery backup in case of power failure,
working of door lock-unlock on face recognition but, the system itself has no security features.

3. REQUIREMENT ANALYSIS

3.1. Software

The software system consists of a flask-based web app developed in python, it has a user login and user dashboard to view status and analyze actions taken by the hardware system. For face detection, a haar cascade face detection module is used and for face recognition, face net-based architecture is used.
users can monitor the activities detected by the camera and the raspberry pi system.

3.2. Hardware

Hardware system consists of raspberry pi, ultrasonic sensor, Vibration sensor, camera, and dc motors
The ultrasonic sensor detects the motion of humans and gives a signal to the raspberry pi system, a camera connected to the raspberry pi detects and recognizes the face of a person if a

person is unknown(unauthorized) it sends message to the owner of the house.
If a person is authorized it will open the door automatically, for that the raspberry pi will rotate the motor connected to the door.

The hardware system also consists of a vibration sensor and alert mechanism, if someone is trying to damage the system and no one is at home the vibration sensor will send a message to raspberry pi and it will give an alert notification to the admin as well as a security guard.

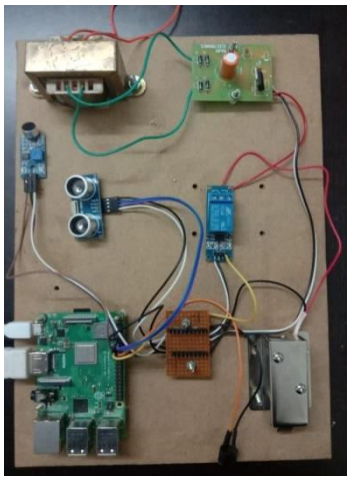

Figure-1: Hardware Connection

4. PROPOSED WORK

Our proposed system delivers a cost and energy-efficient solution for home security by using IoT and face recognition. IoT will enable sensing and trigger systems on motion detection using sensors such as ultrasonic for the motion detection of a person in front of the camera. A person should stand in front of a camera. As soon as the person arrives in front of the camera, the PIR sensor detects the person and the camera starts working. The camera will take the picture and videos of the person and it will search images in the database and will see if the person is authorized or unauthorized. If the person is classified as authorized then the door will automatically open. On the other hand, if the person is classified as unauthorized then the application will send the administrator the notification stating "an unknown person at door". The owner can see the live status of the camera and the person arrived. Further, the action tab will be provided to the administrator so as to take the necessary action remotely. The administrator also has the power to alter the list of authorized users. Furthermore, the logs of the visitors alongside their arrival time are also stored within the application for future references.
If someone tries to hamper this security system then the vibration sensor placed on to the system detects the stimuli and the buzzer starts ringing and the owner is also notified with the red alert about the damage.

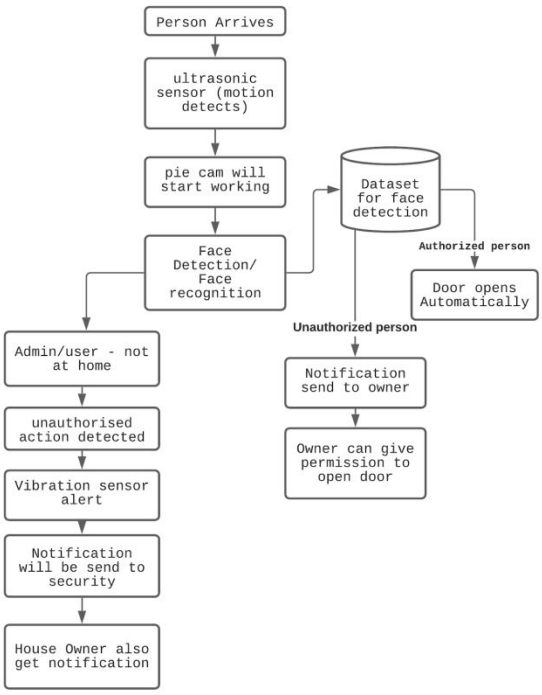

Figure-2 : Flowchart of the proposed work

5. ALGORITHM

5.1 Face detection: Haar Cascade

It is a machine learning-based approach where an algorithm is trained from a lot of positive and negative images. It is used to detect objects in images.
Initially, the algorithm needs multiple sets of positive images of faces and negative images which do not contain face picture faces to train the classifier.
This algorithm is classified into the following four stages:
Calculating Haar Features.: Figure 2 consists of some of the Haar features which are responsible for finding out one particular feature in the image(Figure 1). An edge, a line, or any structure in the image is detected wherever there is a sudden change of intensities.

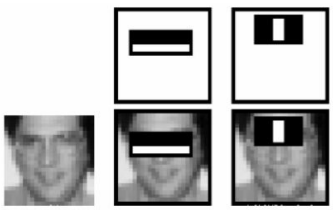

Figure-3: Calculating haar features

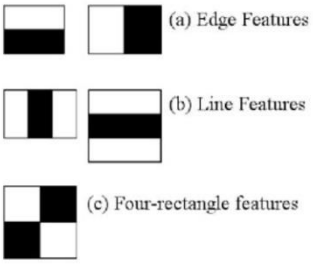

Figure-4: Some of the haar features

2. Creating Integral Images: Now after traversing the whole image, there will be tons of mathematics auditions, so to simplify this Integral Images came into existence.Integral image is calculated as: each pixel of the Integral Image is the sum of all the pixels lying in left and above in the Original Image. This reduces the time complexity of addition on the whole.

3. Using Adaboost: This technique selects subsets of features from the huge set which would not only select features performing better than the others but also will eliminate the irrelevant ones. This will cut down 18,000 features to at least 6000 main features.

4. Implementing cascading classifiers: Features are applied to the images in stages.In the beginning, the stages contain simpler features, and in later stages the features are complex. The concept here is that not all the features need to run on each and every window. If the initial stage does not detect anything on the window, then that window itself is discarded from the remaining process, and moves on to the next window. Due to this, a lot of processing time will be saved.

Figure -5: Calculating Haar features of Sample image

5.2 Face recognition: Face Net

Facenet uses a convolutional algorithm to learn representations of the image directly from the pixels of the face. This network was trained on a large dataset to achieve unvarying to light, angle, and other variable conditions. This system was trained by the Labelled Faces in the wild(LFW) Dataset. Facenet builds a 128-dimensional embedding from the input images and inserts them into a feature space, in such a way that the squared distance between all faces, of the same identity, is small, whereas the square of distance between a pair of face images of different people is large.

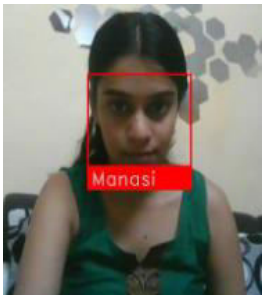

Figure-6: Detection of known user

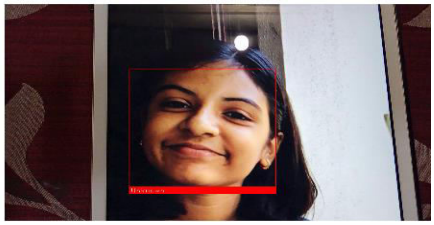

Figure-7: Detection of Unknown face

6. NOTIFICATION

Notification is being sent via text message on the owner's mobile number. This is implemented using SMTP Mobile Messaging. It is the type of messaging method of using a phone number to send messages to another person's phone number. To do so, you send a normal short email message via SMTP but send to an address with the following pattern: phoneNumber@carrierDomain.com like xxxxxxxxxx@vmobl.com.

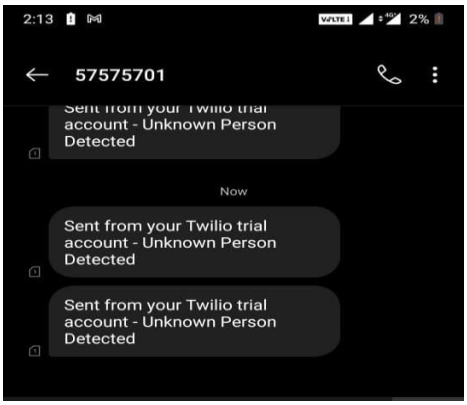

Figure-6: Notification sent as message

7. TESTING RESULTS

Sr. no	Recognition Result	Owner's permission	Door status
1.	Authorized user	yes/no	Open
2.	Unauthorized User	No	Closed

3.	Unauthorized User	yes	Open(remotely controlled by owner)

Table-1: Test cases

8. CONCLUSIONS

We have proposed a home security system with IoT and face recognition with less expense and increased security. Our system is useful for identifying authorized and unauthorized people. If the person at the door turns out to be unauthorized, the homeowner will be notified via a web application and also via SMS. If someone tries to harm the system, Buzzer will issue an alert. The efficiency of the system was verified in terms of face recognition rate.

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