ABSTRACT
Home security is growing field. To provide security to home, face recognition system can be implemented. A standard Pi camera captures the image to identify the person. It’s a prototype that identifies the visitor. If the door recognize the visitor, the door will be unlocked and opened. If they are not identified the door will be firmly locked. The system will perform the detection and recognition rapidly in real time. This project utilizes the basic Pi cam, and the internet connection to create a door that unlocks itself via facial recognition. Firstly the system needs a face authentication for the user to be able to enter the home (locked/unlocked). When an unauthenticated tries to log in, this face will be captured and would be sent to gmail as an attachment. The system should also support remote home control.

Keywords: Face Recognition, IoT, Raspberry Pi 3, OpenCV

INTRODUCTION
We want to provide high level security to home by using IoT technology. IoT is new technology which has made an enormous impact on the modern world. The IoT can be defined as the system of interconnected mechanical, electrical and computing devices and other objects like animals, humans which are given an unique identifier and this system has an ability to transfer data over a wide network of such interrelated systems without requiring human-to-human or human-to-computer interaction. In short, the IoT has an ability to make things self-instructed. Hence it can make significant impact on modern security technologies [2][10].

IoT will enable sensing, actuating and communication in the system. System can be made automated easily. So we can go on developing a smart home by extending this security system. To develop this we will use a Raspberry Pi micro-controller board for system development, a pi camera module for face recognition and a programmable servo motor to open door lock. We will install appropriate linux based Raspberry pi operating system on raspberry pi micro-controller board. For the door unlocking system, we will place a servo motor at door latch. This motor will be programmed in such a way that when the system authenticates the person in front of the camera, the motor will rotate to open latch.

We will use image processing technology to authenticate the person to enter in home. For image processing, we will use pi camera module. Pi camera module is attached to Raspberry pi, and it aids to store various faces in the databases. When someone wants to enter in home, he should stand in front of the camera. Camera will recognize the face and compares with the faces stored in the LFW database [8]. If the face matches, the door will be automatically unlocked [3], otherwise a warning call will be sent to the owner of the house.

Motivation
Nowadays the security has become main issue in the society. Nobody’s home is safe, and the technologies which are developed for security purpose till now can be easily tackled by the intruders. Therefore, we are trying to develop a home security system using IoT [5].

Till date, Face recognition [1][4] technology has not been developed using IoT [2] and we will develop an IoT based automated door lock system using face recognition. Development of the system in IoT will make significant change in modern security technologies. The use of micro-controller board will establish simplicity and flexibility in the system.
The use of IoT will aid in controlling and monitoring the system remotely. We will also develop a new face recognition algorithm which will take over the disadvantages of algorithms like PCA (principle component analysis) and LDA (linear discriminant analysis) [6].

REQUIREMENTS

Hardware Requirements:
- Raspberry Pi

![Raspberry Pi Image]

Fig 1: Raspberry PI

Raspberry pi is very powerful board which has provided us programming environment.

- Camera Module

![Camera Module Image]

Fig 2: Camera Module

It is 5 mega pixel camera module, which is compatible to raspberry pi.

- Servo Motor

The servo motor that we have used, has a rotational angle between 0 to 180 degree. We have used it at latch to the door. It will help us in order to open the door when particular face is being detected.

- DTMF Module

Dual Tone Multiple Frequency Based Module which uses IC MT8870. We are using this to control the door locking system remotely. It will give us very easy interface for controlling the project remotely control.

Software Requirements
- Opencv

Opencv is python based computer vision library which aids in image processing.

- Raspbian Jessie

It is linux based operating system installed in Raspberry pi 3. It is successor raspian of Wizzy. It provides programming environment for various languages.
**Yaleface Database**

It is a file containing several faces. These faces are stored as per the expressions such as sad, happy, etc. An image of human wearing glasses is also stored.

**Architecture**

We store the faces in the Yale face database. In Yale face database, the faces are stored in particular naming system. Example: If the face to be stored is sad, the face should be stored as subject.sad. If the person wears spectacles, then the face should be stored as subject.glasses. Hence the Yale database follows a particular naming system. If the face of person in front of the camera is in database, then it will get matched and the door will get opened. For opening the door, we have used servo motor as a latch of the door. When particular face gets detected, the motor rotates in a particular angle in order to open the door.

![Fig 3: System architecture](image)

In case of face not being detected, an email will be sent to the owner of the house attaching the image of the person in front of the camera. At the same time, a call is being transferred to the owner of the house, notifying him that there is a person in front of the camera. If owner knows the person, owner can simply open the door remotely using DTMF module.

Above, we showed the working of the system. We are using an internet for sending an email by using Raspberry pi. Hence this becomes IoT module. Therefore, Face Recognition using IoT can be achieved easily.

**ALGORITHM**

```python
# Call the get_images_and_labels function and get the face images and the corresponding labels
images, labels = get_images_and_labels(path)

# Path to the Yale Dataset
path = './yalefaces'

#defining Predicted and actual faces.
nbr_predicted, conf = recognizer.predict(predict_image[y: y + 130, x: x + 130])
	nbr_actual = int(os.path.split(image_path)[1].split('.')[0].replace("subject", ")
```

#
if nbr_actual == nbr_predicted:
    # rotates a motor in 90 degrees
    setAngle(90)
    Time.sleep(1)

else:
    # sending email
    msg['From'] = gmail_user
    msg['To'] = to
    smtpserver.sendmail(gmail_user, [to], msg.as_string())

    # calling function
    ATD**********;<ENTER>

ADVANTAGES
- Low Cost
- Remote Monitoring.
- IoT Based [12].
- Scalable and flexible.
- Low power consumption.
- New embedded technologies can be easily inserted into this development, due to the use of raspberry pi.
- Along with Online, system works in offline mode too.

FUTURE SCOPE
This security system is a combination of face recognition system and IoT. These two technologies are growing technologies and with the help of them, much advancement can be done. There are many face recognition algorithms developed till date but none of them are proper and hence each one has its disadvantages. Hence in the future a proper designing in the face recognition algorithm can be done and a new algorithm can be introduced.

The technology is scalable therefore new modifications can be easily done. New hardware can be easily attached hence new smart home concept can be implemented. Everything in that home will be smart. That means we don’t need to give command to hardwares every time. Hardware itself will know do’s and don’ts.

CONCLUSION
The security system, proposed, is low cost, low power consuming system. This system can easily provide high level of security as it combines two modern technologies together i.e. Face recognition and IoT. These are rapidly growing technologies in industries and scientists are still researching on them. Therefore these two have made a significant impact on security system development. Due to these, the security will almost double. Remote controlling and monitoring is possible because of using IoT and Face recognition has made it almost impossible to hack.
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