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# Smart Locking in Home Automation using Internet of Things

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**Abstract:** *The Internet of Things (IoT) can be described as connecting everyday objects like sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves. Home automation can be described as the introduction of technology within the home environment to provide convenience, comfort, security and energy efficiency to its occupants. Adding intelligence to home environment can provide increased quality of life. This paper presents an IoT based Smart security surveillance system and a Smart door locking system using Raspberry Pi. The intent is to build a low-cost Raspberry Pi based Security system which includes a PIR (Passive Infrared) sensor placed alongside the Pi-camera activates the camera to take pictures upon detecting the presence of a person. This system is further branched into two sub categories, the first being the image taken by the Pi-camera sent through mail as an attachment and also including the IP address for live streaming. The second part consists of a Facial recognition system done using Microsoft Azure API and using Twilio platform to send the image captured via MMS (Multimedia Messaging Service). The smart door lock is built using a metal geared servo motor and a door latch on the hardware side and the software implementation is done by programming in JavaScript and also using an android mobile application 'Blynk' which is configured according to the need and is being used to remotely lock and unlock the latch. The user also receives a notification about the status of the door lock after it has been locked or unlocked to confirm its position.*

**Keywords:** *Internet of Things, Smart Lock, Home Automation, Security, Face Recognition, MMS*

## I. INTRODUCTION

The Internet of Things (IoT) can be described as connecting everyday objects like sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves. Building IoT has advanced significantly in the last couple of years since it has added a new dimension to the world of information and communication technologies. The Internet has come a long way over the last 30 years. Old-fashioned IPv4 is giving way to IPv6 so that every device on the Internet can have its own IP address which enables for IoT to play a larger role in daily human life. Home automation can be described as introduction of technology within the home environment to provide convenience, comfort, security and energy efficiency to its occupants. Adding intelligence to home environment can provide increased quality of life. With the introduction of the IoT, the research and implementation of home automation is getting more popular. IoT brought about the idea of remotely monitoring objects through the Internet. When it comes to an individual's home, security has become a crucial issue to the general public. This paper presents a low cost and flexible smart lock monitoring and control system using a Raspberry Pi which has onboard Wi-Fi capability for easy accessing and controlling devices wirelessly.

## II. RELATED WORK

Aruni Singh, Sanjay Kumar Singh, Shrikant Tiwari [1] have implemented comparison of various face recognition algorithms including eigenfaces, fisherfaces, Principal Component Analysis, Local binary Pattern. In holistic based algorithms PCA has range of accuracy from (51-72) %, LDA (48.50-76.50) %, iSVM (63.5-79) % while texture-based algorithm LBP shows the identification accuracy (60-94.5) % and feature based algorithm SIFT demonstrates the accuracy range (61-94) % at various image compression levels. Jeevanand, Keerthivasan, Mohamad, Murugan [2] had proposed an SMS altering system with real time network video capture. The video is captured for a given period when these sensors are sensed and also the captured video is stored in the RT Raspberry Pi memory. A digital door lock system is equipment that uses the digital information such as a secret code, semiconductors, smart card, and fingerprints as the method for authentication instead of the long-standing lock and key system. Smart locks won't really make home any safer, but they will allow for more control so that one can lock and unlock the doors remotely and even extend 'digital keys' to friends, family, caregivers and anyone else who are regularly admitted into the house. Y. Poria, A. Reichel, Y. Brandt [3] found that people with disabilities have difficulty in accessing lock system for door either using technology or conventional way because it is a bit hard for them to reach the lock in which case a Smart lock can be of extreme help in locking and unlocking the doors to them.

### III. SMART DOOR LOCK

Most of the current smart home systems use digital door locks to secure their homes. Often, the digital door lock has an interface (keypad or touch screen) for the user to input PIN (Personal Identification Number). Thus, home residents can relieve the burden of carrying a large set of keys, and no more worries about the key will be lost or stolen. However, when the keypad has been used too many times, the coatings of buttons may begin to fade or the mucky fingerprints may remain on the touch screen. As a result, it can reveal the clues for malevolent. To avoid being hacked, the PIN should be changed every few months. Sometimes, the new PIN is forgetful, especially when one is in a rush to enter the home. So in order to avoid the above mentioned circumstances, a new method to lock and unlock the door by using a mobile application which can only be accessed by members of the home has been developed in this paper.

#### A. Hardware

The system consists of a Raspberry Pi-3B+, PIR sensor, Pi-camera, MG996R metal gear servo motor.

- 1) *Raspberry Pi*: It is a low cost, credit card sized computer that performs various applications. Some of its main features of the version which are being used include 1GB RAM, General Purpose Input Output pins, Linux support. These features give programmers a wide range for diverse applications.
- 2) *Pi Camera*: The Raspberry Pi Camera Module is a 5 Mega Pixel CMOS camera with a fixed focus lens that is capable of capturing still images as well as high-definition video. Stills are captured at a resolution of 2592 x 1944, while video is supported up to full-HD 1080p at 30 FPS. The camera is supported in the latest version of Raspbian, Raspberry Pi's preferred operating system. The Raspberry Pi has a Camera Serial Interface Type 2 (CSI-2) which uses a 15-pin Zero Insertion Force (ZIF) connector for camera. The pi camera is connected using a ribbon cable (Fig.1).



Fig 1. Raspberry Pi with Pi Camera Attached.

### IV. SMART SECURITY SURVEILLANCE SYSTEM

#### A. Intruder Alert System using Mail

The Intruder alert system is shown in Fig. 2. This system is largely based on the python programming to perform all the operations from detecting the motion to generating an alert. Various python libraries are used to control the PIR sensor for detecting the motion. There is also a specific library 'picamera' in python which is needed in order to operate the Pi-camera which is connected to the Pi-3. There are also other libraries which are needed to include required libraries for email, initialize variables, and define pins for PIR and other components.

For sending simple email, smtplib is enough but if images need to be attached with the mail then MIME (Multipurpose Internet Mail Extensions) needs to be used. MIME is a kind of an add on or a supplementary protocol which allows non-ASCII data to be sent through SMTP (Simple Mail Transfer protocol). It allows the users to exchange different kinds of data files on the Internet: audio, video, images, application programs as well.

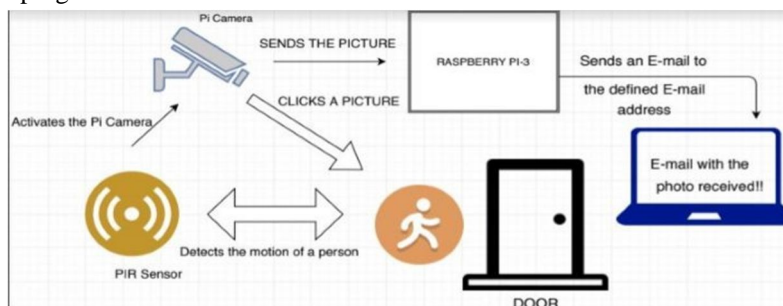


Fig 2. Intruder Alert System



### B. Intruder Alert Using face Recognition and MMS

As IoT is also advancing and smart gadgets are getting more available to the end consumers, the need for a system which connects facial recognition with smart gadgets and low-budget hardware arises. There are numerous use cases where IoT systems with facial recognition in private or commercial use would be usable. For example, as a control mechanism to check if children have reached home safely after school. Moreover, it would also be possible to implement a system which automatically checks if students came to class, or it could be used as a simple door mechanism which would replace keys. The aim of this paper was to implement a system using facial recognition for IoT with lower budget hardware.

### C. Smart Door Locking System

In the proposed system, a servo motor module has been attached to the bolt of the door latch which would lock or unlock the bolt upon receiving the command from the blynk app ( Fig.3). A Door lock has been designed, which can be remotely controlled by a smart phone. Lock works in such a way that whenever the user wants to enter his/her house, he can just open the blynk mobile application which has been configured with a button which upon pressing will lock or unlock the door. The blynk application needs to be installed in the smart phone and signed in with the same Gmail account which is used at the time of making the project. The Blynk application can be installed in multiple devices of residents of the home but needs to be signed in with the same account as every blynk account registered is allotted a unique blynk authentication token. Upon unlocking or locking the door the application notifies you about the state of the door lock. This Blynk application is used on IoT platform to connect devices to the cloud, design apps to control them, and manage the deployed products at scale. To operate the bolt on the door lock latch, a high torque, metal gear servo called MG996R made by Tower Pro has been used.



Fig.3 Smart Door Locking System

## V. RESULTS

An email is received to the designated Gmail account of the user with the known member image as an attachment along with an IP address for video streaming (Fig.4).

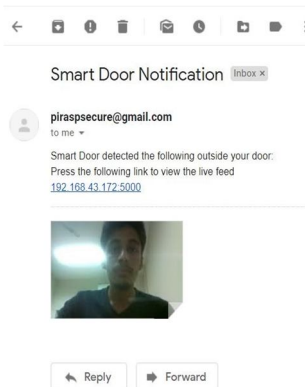


Fig.4 Email received

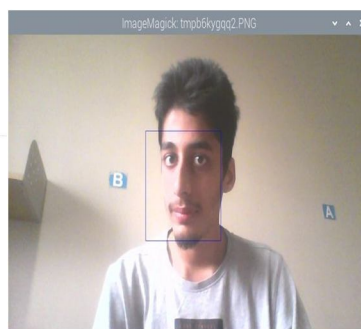


Fig.5 Recognizing a face

For the second sub part of face recognition, an MMS is received on the specified phone number through the Twilio account registered by the user with a link attached. One can follow the link to view the image captured by the Pi-camera. There is also a text message saying whether it is a known or an unknown person. If it is a known person his/her name is specified as the same name, which is fed into Azure [4][5] while training the model. If there is an unknown person detected, then the text is received as 'Motion has been detected outside the door.' (Fig. 5)

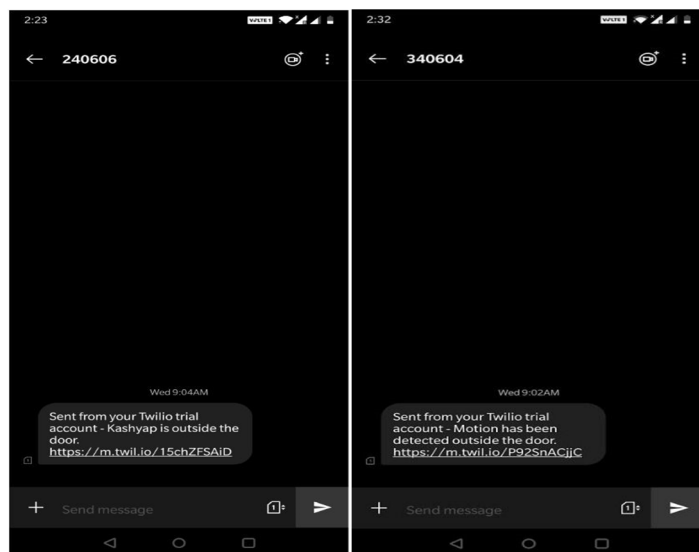


Fig 6. a) Recognized face detected

b) Unknown face detected

Fig. 6 shows a screenshot of the Blynk Android mobile application which has been configured according to the requirements of the project. It is observed that there is a button configured as L (Lock) and Un (Unlock) operation of the smart door and also a push notification of the performed operation is shown in screenshot (Fig.7).

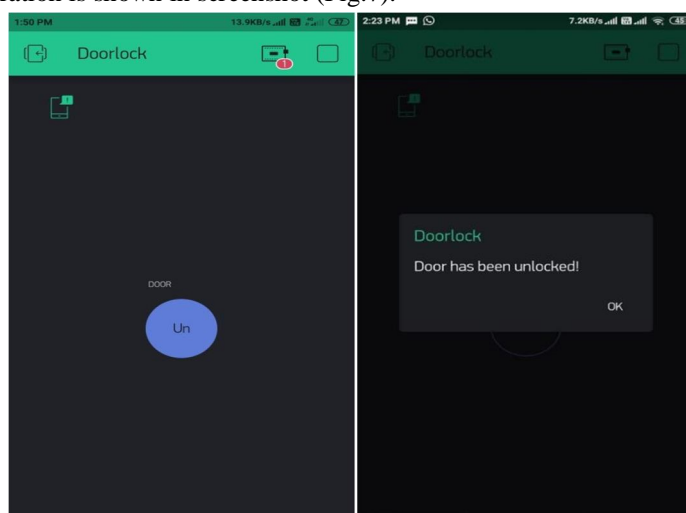


Fig.7 a) Before Unlock operation

b) After unlock operation, notification received

## VI. CONCLUSION

The system developed can help to reduce the threats faced in the society related to home theft as security is being provided with minimum human intervention using IoT. Upon detecting some suspicious activity, the owner can either take action themselves or call the Police. The proposed system presents the basic level of home security and also achieving remote monitoring and control. This low-cost home security system has minimum delay during process of email alert. There are many use cases in the growing market of IoT and facial recognition where both technologies could be used in conjunction. To summarize, a home security system using facial recognition and the Internet of Things is built using only low-budget hardware and software. IoT communication in both directions, Android to Raspberry Pi and vice versa, is coded and can be used in further development.

Improvement could be done through testing facial recognition on the Raspberry Pi using the upcoming neural networks, deep learning algorithms and also upon using a large amount of data for better face recognition. These algorithms show promising results, but are at the moment not feasible for Raspberry Pi implementations because of the missing computational power of the device. Further improvements on the recognition part will depend on the improvements of the algorithms through neural networks and deep learning.



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