# IOT Based Embedded Door Access and Home Security System

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*Abstract* - **The application of the smart phone is growing day by day. The smart phones are used in controlling the other devices and systems now a days in addition with the normal functioning of the phone. This paper describes the design and the operation of the door lock controller based on the user command. The specific webpage is developed to view the image of the person near the door and to control the door. The prototype is developed using the raspberry pi 3 model B. The IOT based embedded door access and home security system is implemented and tested successfully.**

**Keywords:** door control, raspberry pi 3, GSM, web page, IP.

## I. INTRODUCTION

The technologies today has become integrated part of the human life. It has major and continuous influence in many aspects of the day to day life. These allow better social interaction, ease of transportation, developed medicine distribution, enhanced entertainment etc,. After the introduction of the computers and the smart phones the people started depending on the technology to communicate with other person and to store information such as documents, images, videos, audios etc,. the internet have become a major platform used in devices which can simplify the daily life of the people.

The efficient and accurate embedded control system is very important for the wide range of commercial and security application. Many countries are gradually adopting smart doors for enhanced security and easier access. The major part of the home security is to identify the visitor who enter and leave through the door. The door controller can be guarded using the sensors, finger prints, key cards, passwords, face recognition etc,. Face recognition is the most natural way for the biometric authentication between humans. The second most popular biometric reference is finger prints and next comes the iris prints.

Only few researchers have implemented the home security system based on the image verification techniques in embedded system for real time application. The next advanced concept in home security is the facial recognition. Any one of the application of these two techniques have the ability to transform any normal application into efficient systems.

The proposed system is the digital door lock system is developed for the efficient smart home environment. The paper proposed raspberry pi 3 based digital lock security system controlled through web page. The system identifies the presence of the visitor, captures the image and transmits the image to the created webpage and an alert SMS is sent to the user Via GSM network automatically to recognize the visitor. The system provides access through the internet, where the user receives the image of the visitor through the webpage as the developed algorithm is fed into raspberry pi 3 and the system responds to the corresponding instruction with high security. The user can directly view the image in the website and control the access through smart phone without any need for separate server.

It has various features such as low cost, portability, energy efficient system, intelligent and high performance. The article is organized as follows. The system architecture is discussed in section II, followed by system description in section III. The embedded web page implementation and the experimental results are discussed in section IV and section V respectively. Finally the enhancements which can be implemented and the conclusion are discussed in section VI and section VII.

## II. SYSTEM ARCHITECTURE

The door access control system consist of two parts namely wireless control unit and wireless information unit supported through internet that allow the transfer of control information. The WIU has GPRS module to transmit the data through public mobile network. The processing unit of WIU is raspberry pi 3 which is a single board computer developed by Cambridge university. The raspberry pi is extremely popular among the

high performance prototyping at low cost. The model B version 2 of the pi ships with 64 bit quad core processor running at 1.2GHz and it has 1GB RAM, 4 USB ports and 1 Ethernet port. It packs ARM Cortex-A53, 400 MHz Video Core IV GPU into Broadcom BCM2837 system which is cheap powerful and also on low power. The pi 3 has HDMI support and has an SD card slot for booting up during the lack of permanent memory. The python coded algorithm has been fed into the pi 3 and it is connected to the internet to access and send image to the user.



Fig1: raspberry pi 3 model B version 2

The embedded web server refers to import web server at the mobile screen and control equipment , in support of the corresponding hardware platforms and software systems, transfer traditional mobile screen into control equipment with internet base, possessed with TCP/IP protocol as the underlying communication protocol and web server technology as its core.
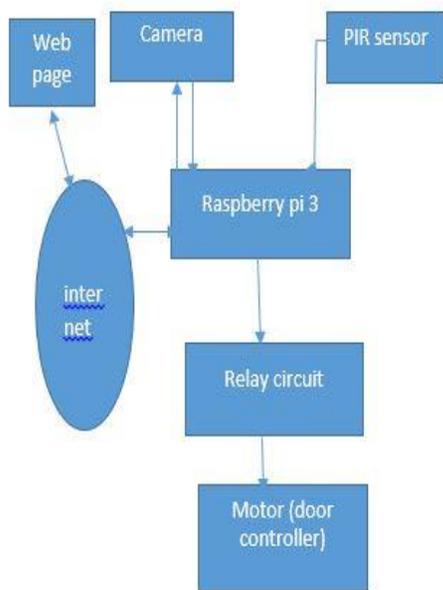


Fig2: layout of the proposed system

## III.  SYSTEM DESCRIPTION

The remote monitoring and the controlling of the embedded systems over the internet can be mechanized by certain network architectural design plans and applying various communication standards. The data transmission of the captured image from the smart camera over internet can be done by integrating internet gateway and the communication module in the pi 3.

The virtual home security system is developed in python. All the instruction and the communication is checked for better safety and security, in virtual environment, before implementation in real time home environment. The raspberry pi 3 and camera are installed in home through serial port interface. If any visitor arrives, the raspberry pi 3 sends the alert SMS and the image of the visitor to the web server link in the authenticated user's phone. The owner can directly open the webpage, can see the image sent by the pi 3 and can grant to the visitor. The owner can interact with the embedded device in the real time through webpage without the need to maintain an additional server.

### A.  CAMERA MODULE

The principal component in effective monitoring and the analysis in the security system is the camera module. This is used to capture the image of the visitor when the PIR sensor pulls the pin 26(BCM) HIGH. The picture resolution is 1280x720. This reduces the data dimensionally by performing various image processing techniques. The image is loaded into the pi 3 through the USB port available in the prototyping model. The resolution of the camera module used is about 20MP with the video resolution of 320x240 30 FPS, 640*480 15 FPS. The camera is enabled with automatic white balance with LED light for night version. Here CMOS type image sensor is used. This component can also be used in windows XP/VISTA/7/8.

### B.  SENSOR NETWORK

The PIR sensor module is easy for operation. The term PIR sensor stands for Passive Infra Red sensor, which means that the output terminal of the PIR sensor is normally LOW. When an obstacle is placed in front and within the range of the sensor the output terminal of the PIR sensor is triggered HIGH. The obstacle in our proposed system is visitor.

The implementation of the PIR sensor is used to detect the presence of the visitor and to trigger the camera accordingly. The implementation of this sensor with the system improves the performance of the system as the actions near the door are

totally automated and no manual operation is needed on the hardware side.

### C.  LOCK MODULE

The lock module here is the actual door control system. Here the motor is used to demonstrate the action of the proposed system , the control remains the same but the only change when this system on implementation with the real time environment is the lock module. The actions of the lock module are controlled based on the instructions given by the authorized user after viewing the image of the visitor in the embedded webpage.

The lock module should be properly designed such that it must not allow any other access other than the commands from the embedded web page. The more sophisticated the lock, the more security it can offer.



Fig3: common automated locks

The fig 3 shows the lock modules which are commonly employed in the real time environment

### D.  RASPBERRY PI 3 MODEL B VERSION 2

Raspberry pi 3 is a low cost small sized single board computer developed by raspberry pi foundation. Raspberry pi is controlled by the modified version of  Debian Linux optimized for the ARM architecture. It has Broadcom BCM2837 64bit Quad Core Processor powered Single Board Computer running at 1.2GHz with 1GB RAM. It is packed with BCM43143 WiFi on board, Bluetooth Low Energy (BLE), 40pin extended GPIO, 4 x USB 2 ports, 4 pole Stereo output and Composite video port. It also has CSI camera port for connecting raspberry pi camera easily.



Fig 4: raspberry pi 3 model B version 2

### E.SMS MODULE

The SIM900A is a GSM/GPRS module which works on various frequencies such as 8S0MHz, 900 MHz, 1800 MHz and 1900 MHz to send SMS. The modem is designed with RS232 level converter circuitry which allows it to be connected to the microcontroller serial interface. It also has TCP/IP stack which enables the microcontroller to connect with internet via GPRS. An SMS activation system is implemented to communicate the home owner. The SMS module consists of GSM modem and a control program. The control program, GSM-dial up and communication protocol are stored in the embedded gateway and the GSM modem is connected to the Raspberry pi via serial interface to the switching module. The SMS module acts as an interface between the embedded processor and the GSM network, making the system login to the network and ready to make any data transfer and communication. The module takes the AT command from remote terminal or mobile devices and sends them to switching module via the GSM network.
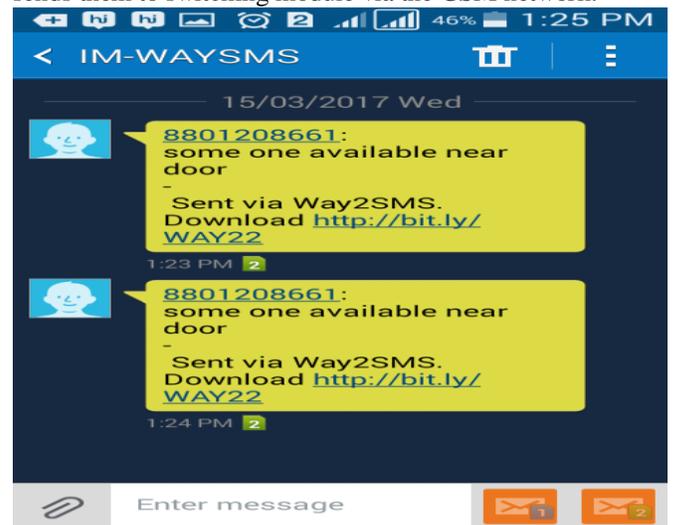


Fig5: SMS sent to the authorized user

The fig 5 shows the SMS which is sent as an alert to the user when a visitor approaches the door. This is to notify the user to check the webpage in order to identify the person and to grant access to the door control system accordingly.

### IV.  EMBEDDED WEB PAGE IMPLEMENTATION

The embedded web page is the major part in order to grant access to the visitor. The webpage is developed using a simple HTML codes, where the conditions of the door are continuously upgraded in the form of text. The image saved in the memory is called using the path into the code. This has a major role in the visitor image display in the webpage. The options 'door open' and 'door close' are used for the give instruction to the door control system. When the user clicks 'door open' the pin19 is

pulled high. If the user clicks 'door close' option then there will be no trigger in pin19.

## V.        EXPERIMENTAL RESULTS

The experimental setup shown in fig is the monitoring environment for the visitor's entry, the WIU sends the image to the web server and an alert SMS to the authorized user's cell phone. The user can view the image through the web server and can control the door from anywhere.



Fig 6: execution of the main code in console

The fig 6 shows the execution command and the PIR response when a person is detected. We can see the triggering of the camera. The camera captures the image of the person standing and the image is processed and sent to the specified device's IP. The SMS is sent to the authorized user which is used to alert the user to see the image sent to the web server.
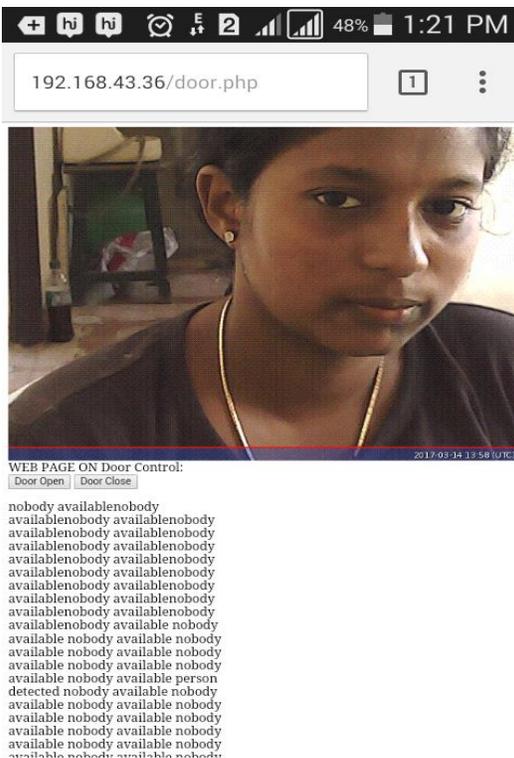


Fig 7: embedded web page

The fig7 shows the embedded web page where the image of the visitor is displayed on top. Below the image there is two buttons namely 'door open' and 'door close' to control the door .
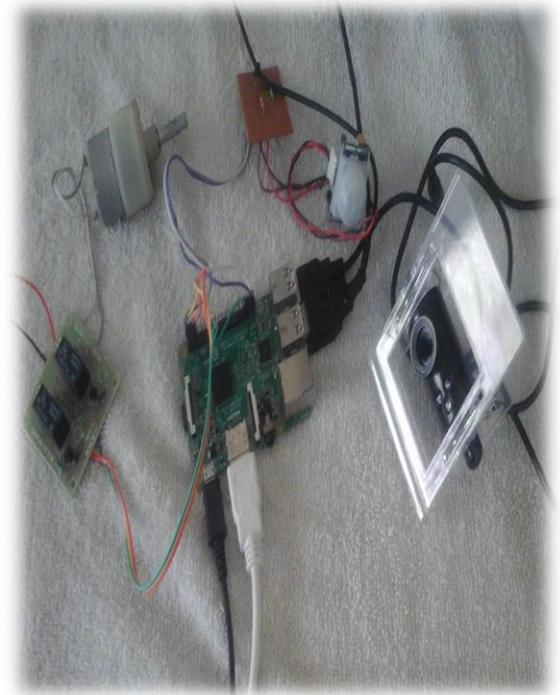


Fig 8:  developed prototype

The fig 8 shows the developed prototype which consist of pi 3, PIR sensor, camera, motor(door control), relay and power supply

## VI.        SUGGESTED ENHANCEMENTS

The various suggested enhancements that can be made on the real time implementation of the proposed system are

- The development of android application instead of web page. The application must have a cloud space for user login and password for enhanced security. This is cost effective for more units of production. When a single unit is considered this may hike the cost.
- Implementation of emergency open supported with artificial intelligence algorithms to open the door during fire crash or network malfunction
- Declaring more than one user for the grant of access to improve the performance as single personnel may not see to the access decisions all the time.

## VII. CONCLUSION

This paper presents the design and the implementation of an interactive home security system with the GSM and Web-enabled measurement and control systems. The proposed system is a trend setter in automation field. This technology is a break-through in home security as the visitor do not need a smart phone to enter into a home. The user can control the door from anywhere. When this system is implemented in real time application the need of keys to unlock the door will be history.Replacing PC with low-cost single chip processor which can make administrators to get parameters of different remote devices and send control information to field equipments at any time through Internet.

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