



Home Based Security Control System using Raspberry Pi and GSM

Akash V. Bhatkule¹, Ulhas B. Shinde², Shrinivas R. Zanwar³

PG student, Dept. of E&TC, CSMSSChh. Shahu College of Engineering, Aurangabad (MS), India¹

Professor & Principal, CSMSSChh. Shahu College of Engineering, Aurangabad (MS), India²

Assistant Professor, Dept. of E&TC, CSMSSChh. Shahu College of Engineering, Aurangabad (MS), India³

ABSTRACT: Home security and automation are becoming increasingly prominent features on mobile devices. The aim of this paper is to design and implement affordable, flexible and fast monitoring home security system using Raspberry pi with GSM technology. The system is designed to detect burglary, the image of person is captured by camera and sends to mobile and email as well as alarm gets on; and leaking in harmful gas, the smoke caused by fire as such suspicious activity is detected. Also the user can activate all the alarm system while going outside through the mobile. The messenger has the feasibility of activating and deactivating the alarm system with the additional control for some home appliances switching using relays. For controlling, raspberry pi module, GSM technology is used along with camera, PIR sensor, Vibration sensor, air quality sensor. It is only applicable for magnetic door lock system.

KEYWORDS: Home Security and appliances, Remote monitoring, Raspberry pi, GSM.

I. INTRODUCTION

Today security and safety is becoming more and more popular day by day due to its numerous advantages, and with such advancement happening, the security of one's home must also not be left behind. Nowadays theft is on rise. So there is an endeavour to build a security system which will effectively manage this issue keeping user away from fear about home security in all cases. The system considered to be best only if it offers protection and monitoring that guard against a number of threats, protecting home against the element as well as break-in and home invasions. Whenever the user is away from his home for some reason, it happens sometimes that he is left unconnected with people who visit his place. These visitors may be known or unknown to user. For this the proposed system consists of different sensors such as PIR, Vibration, Air quality and magnetic door lock sensors.

The PIR sensor which detects the presence of human appearance which will notify the user using message through GSM and image captured by camera through email using internet. After checking the email and image user decides upon whether or not to enter to the visitor to his house. If known, the visitor must be allowed to enter the home using send the message through GSM to the Raspberry pi that is open door. There are only two entry points of our home that is doors and windows. Entry from windows is illegal and for this windows entry point protection system uses vibration sensor that is installed at the windows glass. Whenever the glass break or open and close by someone then vibration occurred this vibrations above threshold value then we use alarm message to the user and buzzer is for neighbour's attention for fast response. Air quality sensor to sense the different types of pollution gases in the home like wood smoke, tobacco smoke, gas burning appliances, and mosquito coils that is harmful for family members. Anyone can control the pollution in the home remotely in this system using alert message to the user.

II. RELATED WORK

The Java based technology produces a secure solution. However the system requires an intrusive and expensive wired installation and use of high end personal computers [1]. Earlier system was depending on telephone line using phone based remote controller [2]. The remote controlling and monitoring of a house using internet requires a laptop or a computer which is large in size and heavy to carry around all day long. So an alternate can be mobile phones with operating system on it for remote controlling and monitoring of a house. The system uses the wireless technology for communication between the devices. The embedded Bluetooth technology, they form a network in which appliances

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can communicate with each other. There are certain issues involved in the design of a home automation system. The system should be scalable, so that new device can easily be integrated into it [3][4]. There are two divisions of security system; commercial and home security system. Since commercial security system usually needed too much cost to meet the expenditure of ordinary family, So as to cost down the expenditure DIY home security system developed and interfaced with Bluetooth modules [5].

In literature researches, suggest a number of security systems based on new technologies like Ubiquitous Sensor Network, Field Programmable Gate Array, Digital Signal Processor, and Microcontroller [6]. The wireless technology has some remarkable benefits comparing with non-wireless technology. For example, it makes the installation and maintenance easier. Bluetooth [7], ZigBee [8], 802.11[9], and wireless USB [10] are the most popular technologies in the field of home wireless network. Internet of Things is technology to improve home security and network of physical objects, devices, buildings, vehicles and other items embedded sensors and network connectivity that enables using with electronics, software these objects to collect and exchange data and the physical world could be connected to the internet by sensors [11]. The key difference between Wireless sensor network and GSM is its wide covering area which facilitates very long distance communication. The Raspberry pi board drives the relay circuit to control fan and light and capture the image using camera and also this system consist of GSM modem to send message along with the link of the image[12]. The PIR and Vibration sensor are attached and that is connected to the Arduino microcontroller and the password coder is fixed at the door, if known person comes they will type the password and get inside the house[13]. Robot has temperature sensor where if the temperature increases there will be buzzer indication alerting the owners of the house and it is on and left in the house [14].

III. SYSTEM ARCHITECTURE

A. SYSTEM OVERVIEW

There are some different features that are available in GSM communication which is comfortable for the proposed system like low cost, small size, user friendly interface, emergency alarm generated, very short response time and main feature is that wide area coverage. So the user can interact with the system even from a very remote place far from urban areas.

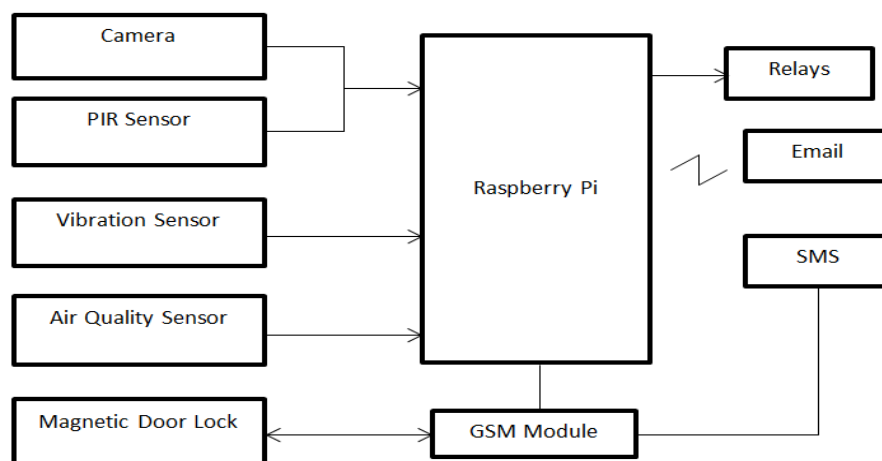


Fig.1 Block diagram of proposed system.

Overall block diagram of the proposed system as shown in fig.1. Different sensors are installed at the different location in the home. The USB camera and PIR sensor that is installed at the front door of the home interfaced with the Raspberry pi. When PIR sensor is high or USB camera on and captures the image of the visitor and sends the mail to the user id of the owner and also alert message send to the owner mobile number. Vibration sensor is installed at the windows of the home. When vibration sensors high above the threshold level then message send to the user mobile

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through GSM and buzzer is activated. Air quality sensor is installed at inside the home. When pollution increases above threshold level then message is send to the user mobile through GSM and control the pollution.

B. RASPBERRY PI

We have raspberry pi which act as a main controller of our system and small in size, is an open source and its flexible platform for experimentation. Since it is an open source, changes can be made to it as and when required. The raspberry pi runs on raspbian OS and is program using python 2.7.6, One can install various different type of software's for different purposes. We have used model B of raspberry pi which uses system on chip (Soc) BCM2835. It comes with 512 MB of RAM memory and does not have storage drive but uses SD card for booting and long term process, external storage devices can be added through the USB port, which includes an ARM11 microcontroller having clock frequency of 700 MHz fig. 2 shows the raspberry pi model B board. It is also connected to an USB camera which is used as a spy camera. First initialize the commands for the camera. Once tested in the command line the following code will capture an image and store it successfully. The sensors that have a digital output are directly connected to the board leaving them to provide the necessary data without any delay. All sensors are directly connected to the raspberry pi.



Fig.2 Raspberry pi model B board



Fig.3 GSM modem board

C. GSM COMMUNICATION

The Global System for Mobile communication is used to alert the user by sending and receiving the messages, which is controlled by AT command. Fig. 3 shows the GSM modem board. The dimension is small and reliable wireless module. It communicates with raspberry pi using RS232 serial interface. Dual frequency band operates on 900 MHz – 1800MHz. The security mechanism of GSM is implemented in three different elements. The SIM, GSM handset and GSM network The SIM (Subscriber Identity Module) contains the IMSI and The individual subscriber authentication key, the ciphering key generating algorithm, the authentication algorithm, as well as a PIN. The GSM handset contains the Ciphering algorithm. The GSM network contains encryption algorithm. In order for the authentication and security mechanism to function, all three elements are required for the system. Also system controls the magnetic door lock using GSM by sending message to the raspberry pi. It is very likely that GSM will remain the only communication network technology to be adopted by each and every country of the world.

D. PROGRAM FLOWCHART

If the value of the sensors exceeds the threshold value then the alarm message will be send by the Raspberry pi through GSM. First initialized camera, Raspberry pi, sensors and GSM after initializing system checks the sensor value, if the value is greater than the threshold then system will send message and mail to the user after that system wait for the user command using message.so As stated earlier user can also turn on or off specific sensor or appliances in the home.

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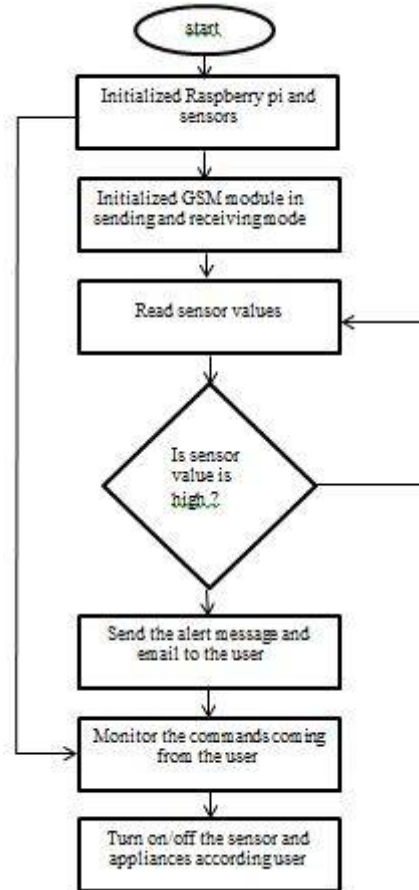


Fig.4 Program flowchart

E. **USB CAMERA**

The USB camera module used in this system which is directly plugs into the USB port of the Raspberry pi. This camera comes 16.0 megapixels with CMOS sensor. It has 30 fps frame rate and compatible with 98/2000/XP/VISTA/WINDOWS 7 operating systems and power consumption of 160 mW. Camera display on screen using `lucvview -r 640x320` command.

IV. EXPERIMENTAL SETUPS AND RESULT

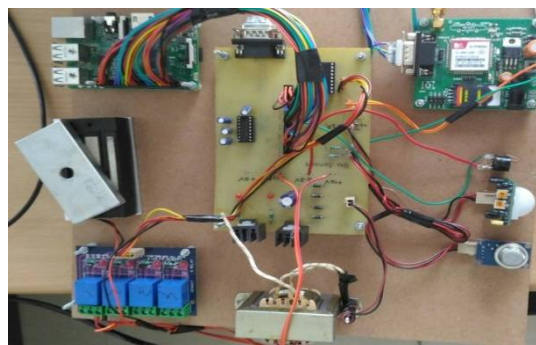


Fig.5 Experimental setup of the system

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Fig.5 shows the overall experimental setup of the system. The hardware components i.e. Raspberry pi module, PIR, Vibration, Air quality sensors, Magnetic door lock, camera, buzzer, GSM and relay driver circuit are mounted over a wooden plank. The system works quite well. The PIR sensor was accurate to detect any kind of motion. The air quality sensor was also tested by burning lighter. The appliances control process through the application was tested by using electric bulb as a load. Sensors are interface with Raspberry pi to give digital output. The data is collected by the sensors is directly send to the user through SMS and Email. When an object moves within the range of PIR sensor, a signal is sent to the controller, which initiates the webcam snaps a photo which is stored onto memory card of Raspberry pi. The stored photo is then forwarded via email to the user.



Fig.6 Result display on mobile through SMS

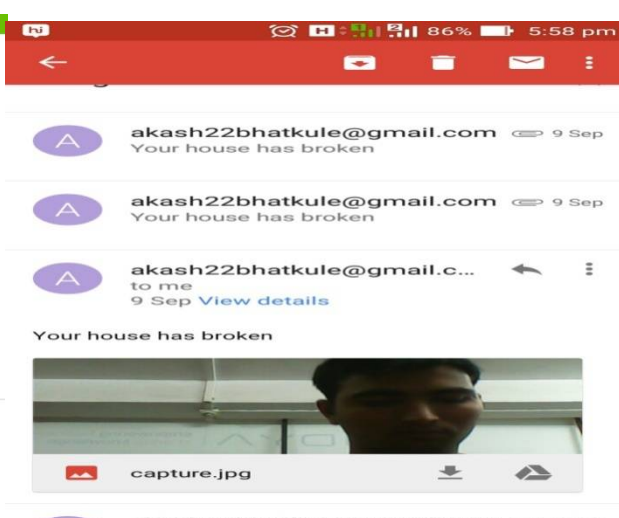


Fig.7 Result display on mobile through Email

Fig 6 shows the result on mobile through SMS; result shows the air quality sensor and PIR sensor. The alarm system detects it as a breach, which turns on the buzzer and a message “PIR sensor is high, someone is inside home” to the user. For taking a controlling action, the user can send message to magnetic door lock through Raspberry pi sending the message ‘open_door’.

Fig.7 shows the result on mobile through Email. The above snapshots was taken when there was a breach in the door, so user can easily identify where exactly there is a breach in security. Messages, notifications, recipient email ID etc. were entered into system through python scripts. The Raspberry pi is programmed to operate as an alarm system in which it detects intrusion at entry points along with motion within the home and where email alerts can be sent with pictures to allow real time monitoring of the home. Raspberry pi features include Wi-Fi wireless technologies and this is the shortcut to display images directly on email.

V. CONCLUSION

This paper presents the design and implementation of a low cost but secure home security system for general users. The security level is increased due to the usage of Raspberry pi which sends the images to the user, has in built capabilities and is easily connectible to external devices. Raspberry pi proves to be smart economic and efficient platform for implementing the home security system. Two advantages provided by the system is that, Necessary action can be taken in short span of time in the case of emergency condition and design of a PCBboard which is also small in size. Reduced size makes it more applicable for commercial manufacturing and distribution. A raspberry pi and open source applications with its ever growing community and development provides a great hope in the near future.



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