# Intelligent Web based Home Automation and Security System using Raspberry PI

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**Abstract:** Home automation is a system used to control the home appliances without going to them physically. This paper emphasis on controlling home appliances through web. A security system is also included which provides images of the area under vision. The whole system is designed with Raspberry Pi which is a mini computer. Raspberry Pi has proved to be most suitable platform for home automation. Suitable sensors like motion detector are used for energy conservation.

**Keywords**: Raspberry Pi, Home Automation, GPIO, Python, Linux.

## Introduction

Home Automation(HA) include control of lighting, HVAC appliances, security locks of gates and other system to provide convenience to the user and security. Home automation has become popular in recent years due to its higher affordability and simplicity through connectivity of smart phones and tablet. Devices are connected through a home network which is controlled by a PC where internet has made remote access possible. This results in convenience, energy efficiency and safety benefits. There has been significant research in the field of home automation.

Home automation has to overcome a number of obstacles to make it easier and affordable for the users. Existing system can be classified on the basis of communication protocol like blue tooth, hand gestures, DTFM and others [1].A Java based home automation system incorporates an inbuilt security features but it requires high end computers and wired installation .This makes Java bases HA system expensive and complex. A Bluetooth based HA system has two controllers, primary and bluetooth sub-controllers to which all the peripherals are connected. This leads to access delay since all the peripherals are connected a single Bluetooth module.

Another HA [2] system is a phone based system where the control operation is done through fixed telephone lines. It suffers from the problem of flexibility as the user has to remember the access codes. The controller in a control network using hand gestures uses a glove to relay hand gestures to control the system. This system lacks security[3]. Sougata Das et.al [4] proposed a system that control Home appliances through mobile phones using GSM technology.SMS is given as control commands to the central control system which has Atmega8 as the main controller. The system lacks of the network coverage area and the user has to be aware of AT commands for controlling the devices.

M.G.Golzar et.al [5] proposed a system whose design and implementation was based on an embedded controller which is connected to a home web server that enables communication through USB ports. The system was able to save energy. However there was some limitation such as remote connection delay and actuator status feedback information. J.A.Nazabal et.al [6] designed a system for monitoring the behavior of elderly people at home by developing a low cost home automation based on sensor system. According to the data acquired by the sensors and based on certain predefined rules for a particular user, an abnormal behavior can be detected and action can be taken. The sensors used are wired which would need some kind of house reformation.

Md.Syaduset.al [7]developed a security system with ARM processor as CPU and communication system is designed by GSM technology. The system counts the number of people in the room. When the presence of human is detected an SMS is sent to the user and the video is recorded for further inspection whereas switches off the load when no movement is detected. N.Sriskanthanet.al [8] proposed a Bluetooth wireless technology to control the home appliances. The system developed, demonstrated the control of the room temperature. In this paper they use $I^2C$ to interface between the DC modules and AD's where one module of Bluetooth for each DC.

This paper proposes a HA system using Raspberry Pi, it is a mini-computer developed by the Raspberry Pi foundation in UK for stimulating the teaching computer science in schools. The system developed demonstrates an LED which glows when a movement is detected by the motion detector connected to the GPIO pins of the Rpi. It also has a Webcam that is able to take a snapshot of the area under surveillance. The snap shot can be viewed by using the Web browser in desktop PC or mobile. Figure 1 shows a RPi board. There are presently four models in the market. Model A, Model B version 1, Model B version 2 and the latest model, Model B+. Model A has RAM memory of-256 MB , one USB Port and no Ethernet Port with 26 GPIO pins. Model B v1 is same as Model A except it has 2 USB port. Model B v2 has RAM memory of 512 MB and similar

features of the previous version. Lastly the latest model, Model B+ has 512MB RAM, 4 USB ports and 40 GPIO pins. The model used in this paper is Model B +.


Fig 1. Raspberry Pi board

Figure 2 shows the pin description of RPi board.The micro USB power port is used to power the Raspberry Pi device. The Raspberry Pi has ARM1176JZF-S 700 MHz processor. The SD card slot is used for inserting the SD card which stores the operating system, programs and the data needed to run the Raspberry Pi[9].The GPIO headers are used to connect the Raspberry Pi to other hardware devises. The HDMI output is used to plug into modern television or monitor. The video output is used to connect to an older type television. The audio output can be used to plug into an external amplifier or an audio docking station. The ethernet port is used to connect the Raspberry Pi to the internet or a local network. USB 2.0 ports are used to plug in a keyboard, mouse, web cam, external hubs etc. The Camera Serial Interface (CSI) is a serial interface between digital camera module and RPi. The *Display* Serial Interface (DSI) is a serial interface between *LCD Display monitor* and RPi. Status LEDs will show the status of power, booting and network.

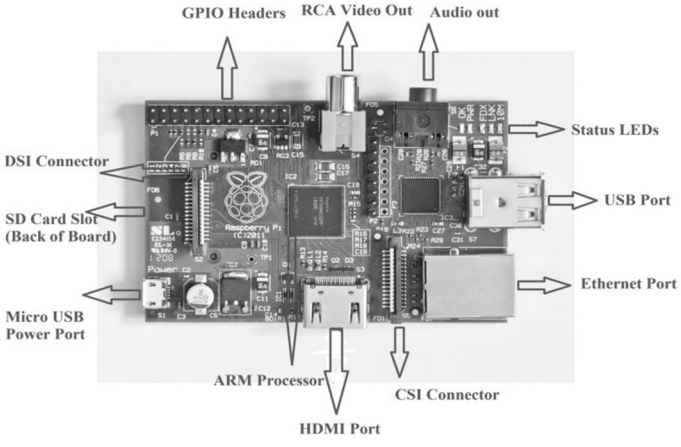


Fig 2. Pin description of RPi

## Design of the Proposed Work

Figure 3 shows the block diagram of the proposed system. The whole system is designed with Raspberry Pi which acts as the CPU and the programming language is written in python which is already incorporated in Rpi by default.

The user can access the Raspberry Pi board to control and view the status of the device through internet from PC, desktop, mobile or tablet. This is done by enabling SSH in the Rpi configuration. The RPi has a total of three connections. A 5V, 700Ma-2A rating adapter which provide the supply to the board, an HDMI connection, (the other end is connected to the monitor) and a USB hub. The USB hub has a Wi-Fi dongle (optional in case of LAN connections), a power supply since the

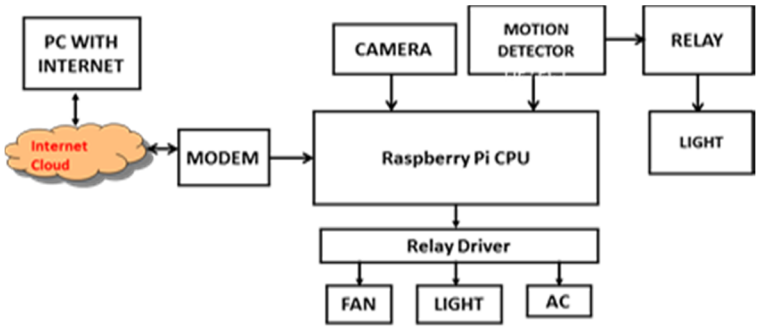


Fig 3. Block Diagram of Proposed system

Wi-Fi dongle draws more current than the board, keyboard and a mouse. The monitor, keyboard and the mouse are used only during the development of the system. The figure 4 shows the pin configuration of the Rpi GPIO used in the system.

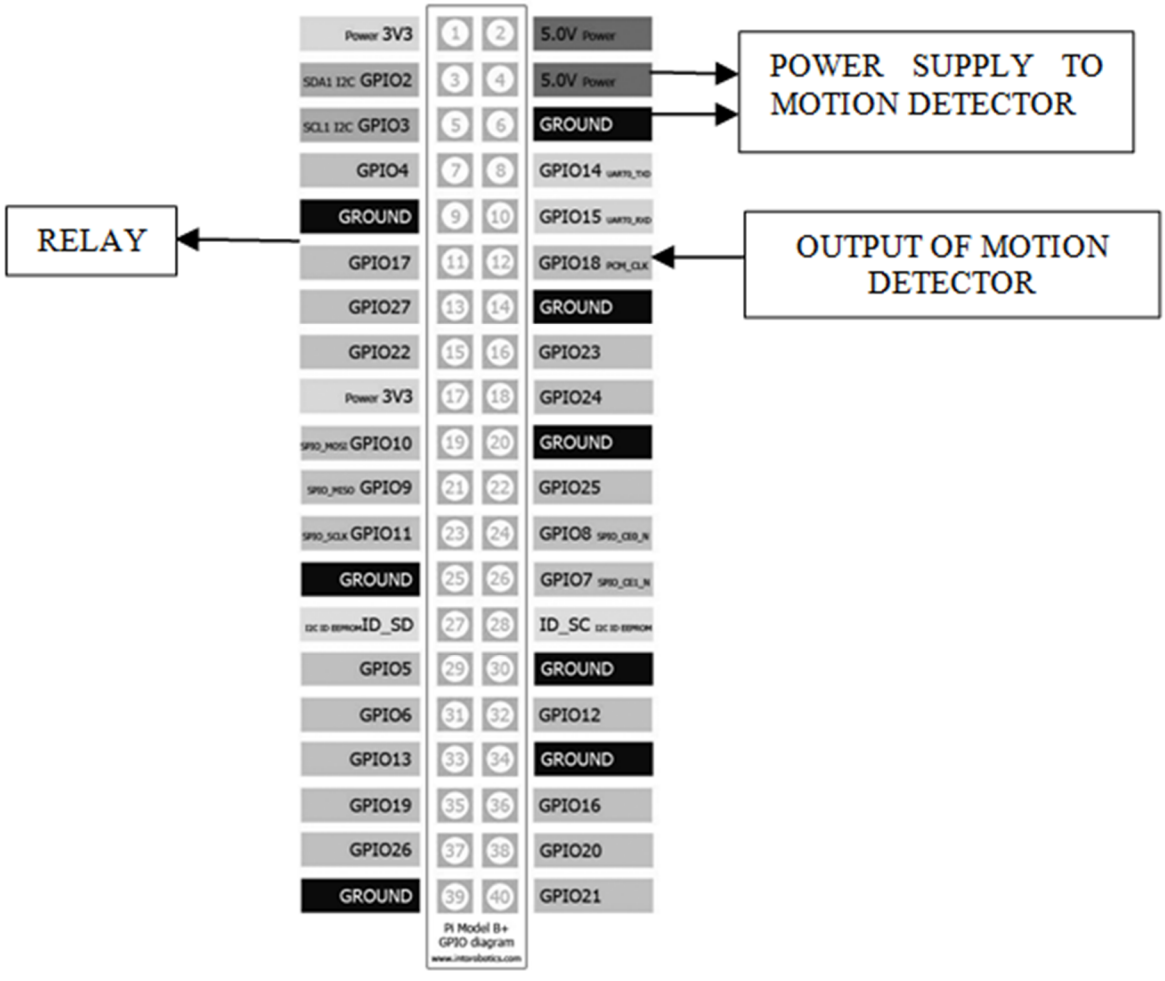


Fig 4. Pin configuration of RPi GPIO

**Camera Interfacing**

A web cam is used for capturing images for the area under observation. It is connected to RPi through the USB port. The RPi does not come up with the software for the web cam so firstly it has to be installed by using the Linux command.

**Sudo apt-get installfswebcam**
The python program is written in such a way it takes images after every one second and the previous image is refreshed after every two seconds. To use the file having the program at startup is done by using the Linux command

**Sudo update-rc.dpiWebCamserve defaults**
piWebCam is the file in which the python script for the operation is saved. An HTML script is written to view the images taken from the web through PC, desktop, etc

**Motion Detector Interfacing**
A PIR sensor is used for detecting motion in the vicinity. It is a 5v passive infrared sensor. Since the rating of IR sensor is as same as that of Rpi, it can be directly interfaced with the GPIO pins. The PIR is a 3 pin module consisting of a 5Vsupply pin, ground pin and an output pin. The Figure 5 shows the interfacing of PIR module with the RPi. When a motion is detected the output pin goes high with +3V for a duration ranging from few second to 200 seconds. The default setting is only for few seconds. When there is no motion detected the out pin goes low. Depending on the status of the output pin a relay is operated to switch ON/OFF the device connected to it by using suitable level shifters.

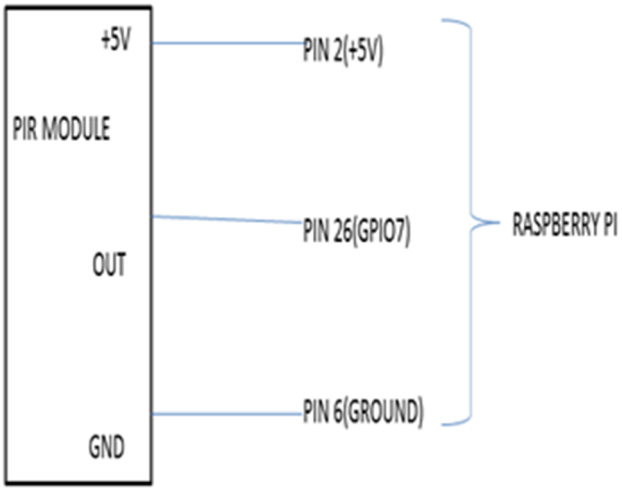


Fig 5. Interfacing of PIR module

**Interfacing Home Appliances To Be Controlled**
Home appliances such as lighting, HVAC devices are connected to RPi GPIO pins directly via relays. Home appliances are switched ON/OFF by the user depending upon the status. The user controls the appliances through the web page created for HA. The web page is accessed by using the unique IP address for the system. The webpage shows the status of the device and provide controlling operation. The controlling signal is send to the board by the internet cloud. The relay operates which in turn controls appliances.
The proposed setup has the raspberry pi, motion detector and the webcam. The control of home appliances is shown with the help of an LED which is turned ON/OFF depending upon whether there is any human motion or not.

## Result

The Raspberry pi is first booted up and updated using the command
Sudo apt-get update
The IP address of the Raspberry pi is got through the command:
ifconfig
The required operation program and the HTML script for the web page is been saved to a folder called home_monitoring. Therefore the directory should be changed to home_monitoring from the LXT terminal. This can be done by using the command:
cdhome_monitoring
With the command ***ls***all the files in home_monitoring is listed. The required program to be executed can be done using the command:
Sudo ./monitoring

This command allows the execution of the file ***monitoring*** where the program is saved. The Figure 6 shows the LXT terminal of the RPi.

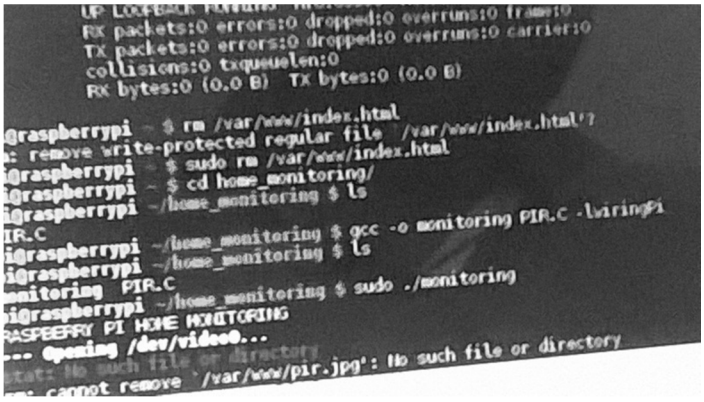


Fig 6. LXT terminal of RPi

Figure 7 shows the led output which glows when a motion is detected. The LED is turned ON for a few seconds and is turned OFF when no motion is detected.

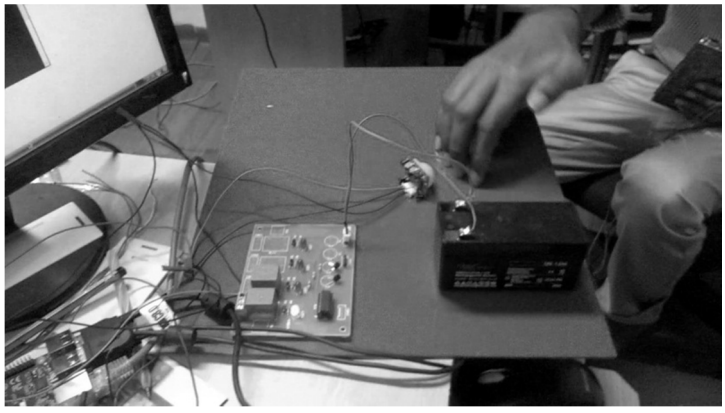

Fig 7. LED Output for motion detection

The Figure 8 shows the webpage from where the image can be viewed which is captured by the webcam. The webpage is accessed using the IP address of the Raspberry pi.

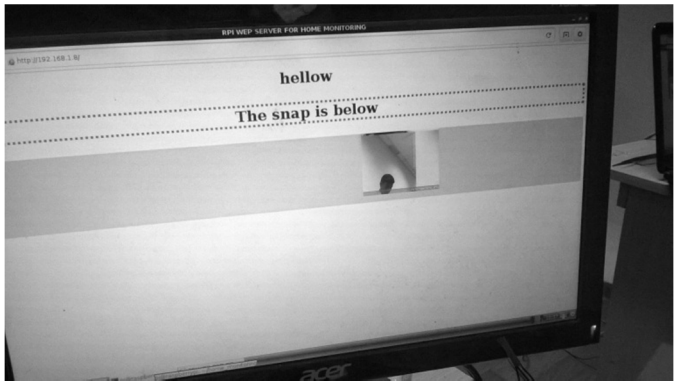


Fig 8. Webpage for webcam image

## Conclusion

The proposed system has proved to be an efficient Home Automation system in terms of flexibility, reliability and preventing wastage of energy. Additional operations can be included without changing the core features. Experimental results show how the system is user friendly and acting to its purpose. This system can allow the users to control home appliances from anywhere anytime thus it is ubiquitous. Home appliances were controlled by the user from the web page created specifically for home automation.

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