

# Smart Home System using Raspberry Pi

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**Abstract**— In this project, a computerized way of controlling home appliances and home security via a smart phone is demonstrated. The user can be anywhere around the world and can still supervise the house's devices. When the user is out, the Raspberry Pi will notify him on the smart phone through the internet if anyone requires access and the same can be taken care of by the user. The project also helps the differently abled user to open the front door without even moving. With this system, we try providing a complete solution of home automation to all.

**Keywords**— Home Automation System, Smart Home System, Remote control via mobile apps, PIR sensor, SMS, Detection of Thief/Intruder, IR Sensors, Raspberry Pi.

## I. INTRODUCTION

This project, Smart Home System using Raspberry Pi” is based on a raspberry pi processor. It is supported by 1 GB RAM and 1.2 GHz CPU. A PIR sensor will be placed at the front door of the house it will detect every person coming in front of the doorstep of the house and it will raise an alert and tell the user that “Someone is at the door” by a voice message using a text to speech plugin Espeak, after listening to the voice message the user will check who is at the door with the help of the webcam installed on the door and connected to the Raspberry Pi, and then the person activates the program to open the door lock at his will right from his smart phone.

The user can also control a lot of house-related activities from his smart phone like security, surveillance, lighting, power management, entertainment services and access control all possible by the GPIO pins of the raspberry pi board. There is an increasing need for home security and automation due to increased rate of thefts in India today. The need of surveillance and monitoring is essential in today's lifestyle. Energy management provides increased cut down on costs of energy, in a few years energy savings will be as much as the funding needed to setup home devices such as laptop computers, mobiles etc. This shows that users prefer a ubiquitous access to a system rather than to go physically to the nearest control point. Remote control saves time of the users and it also provides the users with increased security and flexibility.

For example, In this project when the user is not at home he will activate a program for the PIR sensor to say “there is no one in the house”. If it is someone the user knows, they will either go back or call the user but if it is an intruder he will try to enter the house forcefully which will activate the IR sensors and activate the alarm of this smart home system as well as send the user an SMS saying that “Intruder is Detected”. He/She can then check the

surveillance video to see who it is and then contact the police or a person in their neighbourhood to see what is happening in the house. As a matter of the fact, security of family members is a priority in all families.

The user is informed of all issues occurring in the house and he/she is informed regarding them via his/her smartphone. This gives the possibility to deal with the intruder problem using different ways of control like instant messaging (SMS) since many users are already familiar with it using different existing protocols for making a remotely controlled house.

## II. IMPLEMENTATION

In this system there is a PIR sensor which is connected to the front door of the house. This sensor has a 180° range up to 1 to 2 meter approximately[5]. This sensor is more useful than the normal IR sensor which have a range in a straight line so this sensor is able to detect people even if they come from the side.

When a person comes in range of the sensor it sends a trigger pulse which activates an LED array and the camera (in video mode). The led array provides a good light environment for the camera to take a good video so that there is no problem of a bad video in which the person's face cannot be seen.

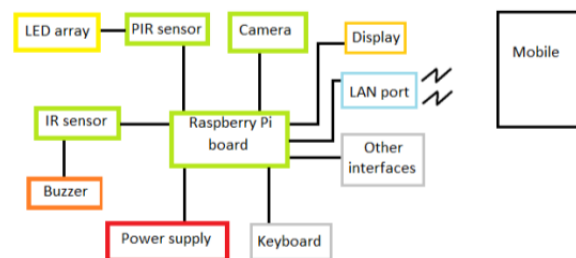


Fig. 1 Block Diagram of the Proposed System

After the camera is activated it starts the live streamed video of the person present in front of the door and the Raspberry Pi sends a message to the user to check the video. The video is transmitted to the user's phone via the web which he/she views in his/her mobile phone's web browser to check who is the person at the front door. Two IR sensors are connected in the house at the front door and window of the house for safety i.e. if some person tries to break in the house through the front door or window then the sensor will detect that intrusion and send a trigger pulse to the buzzer and activate it also a message is sent to the user's phone so that he/she can take action accordingly, this calamitous situation is also taken care of in this project.

Once the person is recognized by the user then he/she will allow him to enter the house by executing a command in his/her phone. This is how the project flows.

### III. HARDWARE DESCRIPTION

#### A. Raspberry Pi Board



Fig. 2 Raspberry Pi Board

The Raspberry pi board used in this project has a processor of 900 MHz CPU and 1GB RAM which almost acts like a minimized computer. We installed NOOBS in the memory card used for the board and then with the help of NOOBS we can boot the raspberry pi with various operating systems. We have booted it with a LINUX based operating system called Raspbian OS which is mostly recommended . There are also 40 GPIO pins which can be used as both digital input, digital output pins and pins to control and interface with various devices in the real world, 4 USB ports, 1 HDMI port, 1 Ethernet port, 1 3.5mm Audio jack and a micro USB power supply port. This board also has ports for connecting a camera and a display to it which really makes it a multipurpose and multiuse board.

#### B. Raspberry Pi Camera



Fig. 3 Raspberry Pi camera

The Raspberry Pi camera module is used in this system to capture a live video of the person standing outside the front door of the house. It is a 5 Megapixel fixed-focus CMOS camera which can be used to take High-definition videos. Any other camera/webcam can be used for the above purpose in this project.

#### C. Motor Driver Circuit

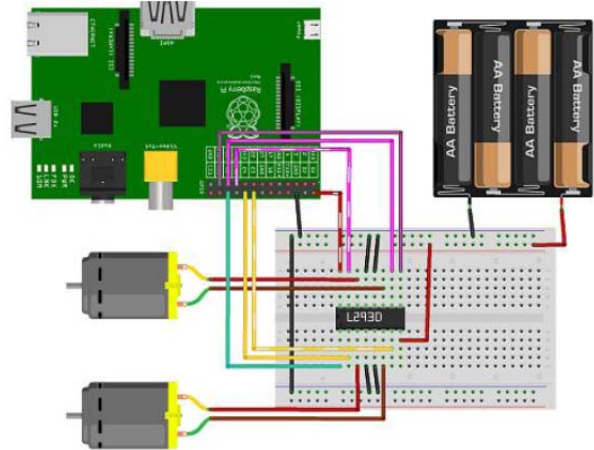


Fig. 4 Motor Driver Circuit

The L293D is a Motor driver IC which allows the DC motor to be driven in either directions, according to the way it is programmed. It is a 16 pin IC which can control two DC motors simultaneously in any direction with the help of the code. The IC uses an input of 5 volt at pin 8 and 16 as well as pin 1 and 9 which is enable, the other pins 4,5,12 and 13 are grounded[6].

#### D. PIR Sensor



Fig. 5 PIR Sensor

The PIR sensor is used to sense motion, they are used to detect if a person or object has moved in or out of the sensor's range accordingly they send a trigger pulse to the Raspberry Pi. They are often referred to as PIR, Passive Infrared sensors. PIR sensors can detect infrared radiation from human beings. Due to a person's body heat, every person emits some low level radiation. This conceot is used to detect a person standing at the front door of the house of the user[5].

**Input:** Input can be given to the PIR Sensor in the range of 3 to 9 Volts, but 5 Volts is ideal.

**Output:** The PIR Sensor output is a 3 Volt pulse, when it detects motion.

**Sensitivity:** It can range up to 10 to 12 feet (3 meters) and about 110° x 70° detecting range.

E. IR Sensor



Fig.6 Infrared Proximity Sensor

An Infrared sensor has a set of transmitter and receiver i.e. an IR led and a photo diode. It has a detection range about 3-80cm and depending on the potentiometer value set by the engineer, the sensor’s detection range may vary[7]. The IR sensor operates at an input voltage of 5V. When the sensor detects an object it sends a trigger pulse to the Raspberry Pi, and this trigger pulse persists till the object is removed from the sensor’s detection range.

F. Relay Switch



Fig. 7 Relay Board

In this project, the relay module is used to switch the lights, fans and various other appliances ON and OFF[9]. Here, a relay module can be triggered from the Raspberry Pi and the relay can be connected to 230-250V AC supply that runs the appliances. These relays are triggered from the GPIO pins of the Raspberry Pi and they are controlled from the “GPIO tool for Raspberry Pi” Android Application[10]. The remaining basic working of the relay remains the same in this project[8].

IV. PRODUCT DESCRIPTION

A. PIR Sensor Module

In this module we have the PIR sensor as shown in figure 5. It senses if a person comes in its range and then it activates the camera[4]. As shown in the above figure 7 when we run the program in the terminal the sensor activates and checks for any chances, so in the beginning it displays Ready in the terminal and when the sensor detects something it displays Motion detected![5].

B. Motor Control Module

When we run the program of controlling the motors in the terminal as shown in the figure 8 it displays Going forward and the motors run in one direction after a particular time it displays Going backward and it rotates in the other direction and finally it stops. According to the user’s need, you can modify the rotation of the motors which is controlled by the IC shown in figure 4.

C. Raspberry Pi

Used to control security of the house and control appliances of the house. It is the main processing unit of our product and accepts commands from the users android smartphone.

D. Relay Board

It is used for appliance control like fans and lights in the house, It accepts commands from smartphone to switch ON OR OFF the appliance.

E. IR Sensor module

It is used to prevent an unauthorized person to enter the house from the window or the front door.To achieve this we have programmed two IR Sensors-One at the front door and the other at the window.It is basically used for security of the house in our product.



Fig. 8 Product View

## V. CONCLUSIONS

The user can monitor the house's security and control the household appliances directly from his smartphone through this project. Today there are many smart home systems available in the market but our proposed project achieves the above goal at a lower cost compared to the former smart home systems. In the future, we plan to link our project to the police stations for direct action against theft like in the USA. This would give the users from our country a complete smart home system like the citizens of USA.

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