Raspberry Pi Based Camera Module Using Internet of Things

Sriman Nakka, B.Tech Student, CVR College of Engineering, Hyderabad-501510, Telangana, India, srimannakka410@gmail.com

Dr. Gaurav Sharma*, Asst. Prof., ECE Department, CVR College of Engineering, Hyderabad-501510, Telangana, India, ergaurav209@yahoo.co.in

***Corresponding Author**

Abstract **Surveillance from homes to huge industries plays a significant role in the fulfillment of our security. To achieve the security issues in smart way, a project is designed that is based on PIR sensor, Pi camera connected to Raspberry Pi for the generation of an alarm which send the alert messages through Internet of Things (IoT). HDMI transmits pictures and videos to a displaying screen which saves this information and sends an alert to a specified mail recipient. Detectors and video cameras, on the other hand, sense movement and give surveillance and stream live video or record occurrences for later playback. The sensor perceives Infrared Radiations (IR) emitted from humans within their field of view then provides a digital output.**

Keywords -- HDMI, Infrared rays, PIR Sensor, Pi Camera, Raspberry Pi, Video Cameras

I. INTRODUCTION

Surveillance, from homes to huge industries, plays a significant role in the fulfilment of our security. Aspects such as burglary and theft have always been a predicament. In large industries, personal safety refers to the monitoring of the people's shifting information like activities and behaviour to protect, manage, and influence personal details. Surveillance refers to observing over from a distance by use of electronic equipment like CCTV cameras [1, 2]. However, CCTV technology is expensive for average residents to install. Additionally, this kind of system does not notify the user immediately a burglary occurs. This paper includes an alarm system to overcome the shortcomings of the regular surveillance systems.

In Kenya, for example, this system can work best due to its lower consumption of power especially in remote places where electricity is a challenge. The use of a machine to machine communication offers benefits when compared to the traditional Data Acquisition System (DAS).The system allows monitoring and control to be done without human intervention [3]. The system becomes fully automatic, and the amount of error decreases with its efficiency increasing drastically.

Individuals should have the choice to live without fear and the confidence to carry out any business without fear of insecurity. The system created in this study offers security while maintaining the privacy of individuals since only one person can view it. Additionally, it uses a simple circuit. The system uses Raspbian OS for its operations, allowing the transmission of images to a smart phone [2, 4]. The traditional surveillance system is associated with various challenges and costs associated with energy use. An energy effective moveable system is preferable, and it can capture images during an occurrence of burglary.

Project implementation is simple. The homeowner/ company place a camera in a particular area that needs monitoring to ensure security. The system allows the user to access and monitor security from different locations, even remote areas [5]. The user can monitor the remote surveillance system using a smart phone with connected internet availability. The system is useful for projects targeting security setups limited to a specific location, but whose security is monitored from separate locations.

The main aim of this project is to create Raspberry Pi based Surveillance system. To fulfill this main aim the following objectives are designed:

1. Study of Raspberry Pi board and its interfacing.
2. Interfacing of Camera Module with Pi Board.
3. Interfacing of PIR Sensor with Pi Board.

II. PROJECT DESIGN

A. Working Model

The development target is to have a low-cost security system for home applications. The system uses small PIR (Pyroelectric Infrared) sensor built around a microcontroller [3, 4]. The microcontroller senses human motion by detecting infrared radiations from a human body. The block diagram for working model has been shown in Fig. 1.

 DOI : 10.18231/2454-9150.2018.1004

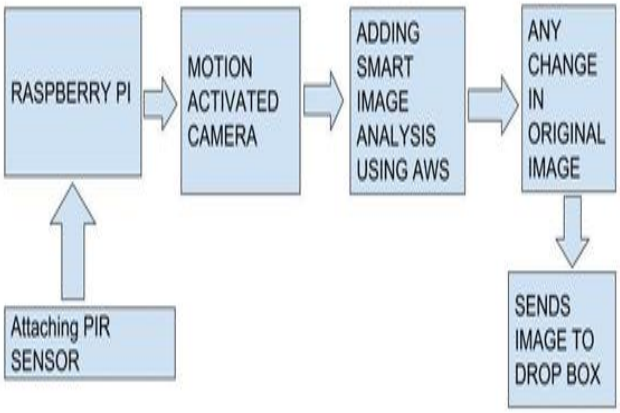

Fig. 1. Block diagram for working model

The home security system uses wires to make connections between the central controller and devices necessary for surveillance and home security. These devices include the cameras, sensors, video displays, keypads, motion detectors, camera switches and speakers.

The system is composed of the hardware and the software parts; where both parts are interfaced to work together in response to the PIR sensor. The hardware part of the system consists of the PIR sensor, being the main component, amplifier, power supply, window detection circuit and a computer. The software portion is made up of the algorithms that make the various parts operational.

B. Raspberry Pi

The Raspberry Pi is a credit card–sized single board computer. That was developed in the United Kingdom by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science. They develop free resources to help people learn about computing and how to make things with computers [1].

There are various surveillance systems such as camera, CCTV, etc. In these types of surveillance systems, the person who is stationary is located in that particular area can only view what is happening in that place.

Whereas, here , even if the user is moving from one place to another, he/she can keep track of what is happening in that particular place [6]. The main advantage is that it offers privacy on both sides since it is being viewed by only one person.

The other major advantage is that it is a simple circuit. The operating system used here is Raspbian OS. Raspbian OS has to be installed so that the image can be transmitted to the smartphone.

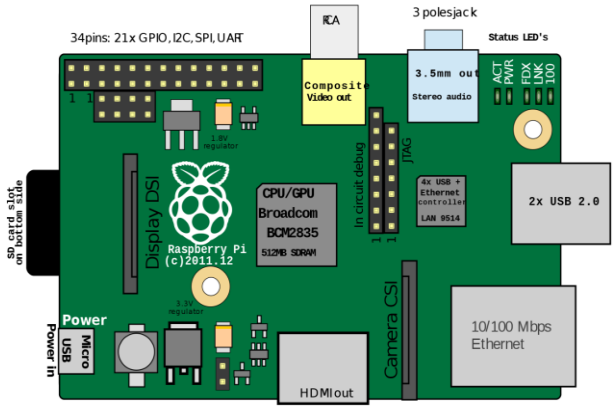

Fig. 2. Graphical representation of Raspberry pi

C. Raspberry Pi 3b+

Raspberry Pi 3b+ is a cheap single-board computer manufactured by Raspberry Pi foundation [3]. It is an improved model from the previous versions and is based on Broadcom system-on-a-chip. The model has both a higher clock speed and an onboard WiFi and with built-in Bluetooth. Raspberry pi 3b+ runs at 1.2 GHz and has an upgraded power system as well as four USB ports [1, 4]. Raspberry Pi 3b+ used in this design system and its hardware is as shown in Fig. 3.

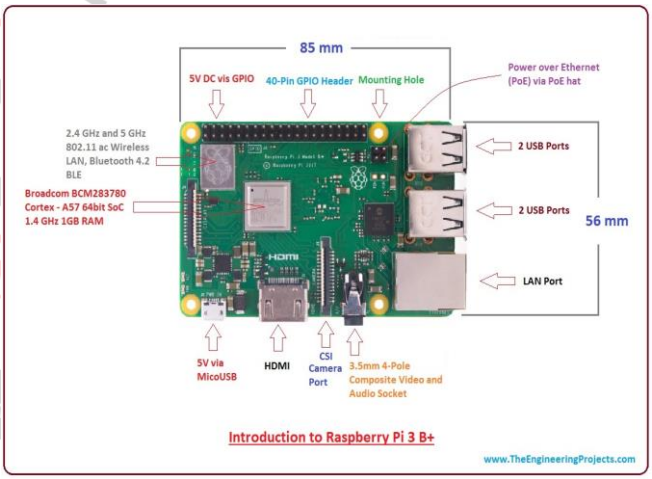

Fig. 3. Circuit board for Raspberry Pi 3b+

D. Pi Camera

The Pi Camera Module is shown in Fig. 4. The Camera Board on the Raspberry Pi is a small printed circuit board with a camera on it. The PCB is connected to a ribbon cable which connects to the Pi itself on its own port. The ribbon can be extendable. The camera on the board is very small (5MP camera). As for now it is the only Camera made specifically for the Pi therefore these specifications cannot be updated [7, 8]. Since it uses 250mA, externally powering the Pi should be sufficient enough for the camera. Specific configuration settings are required to initialize the camera plus a Python script to enable it to take pictures [9].

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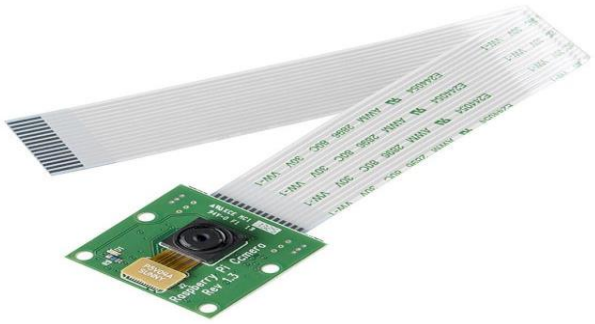

Fig. 4. Pi Camera

E. PIR Sensor

An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor [7]. When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection. Objects of similar temperature but different surface characteristics may also have a different infrared emission pattern, and thus moving them with respect to the background may trigger the detector as well.

F. Connecting Pi to PIR Sensor

Raspberry pi is a minicomputer, hence has ports which necessitate the wiring of the project. Power source comes from the PIR sensor, that is, only the sensor is powered, and it relays the power to the other devices in the connections like the raspberry module and pi camera [2, 8, 10].

Starting from the PIR sensor, positive terminal is connected to pin 2 of raspberry pi, ground to pin 6, and the third terminal to pin 11 as shown in Fig. 5. The project responds positively when powered on. Several pins of the raspberry pi module make it possible to integrate several devices according to the objective. Fig. 5 has been used for illustration. It registers a 1 and 0 when there is an intruder and not respectively. The PIR sensor used is a wired sensor of 5V DC.

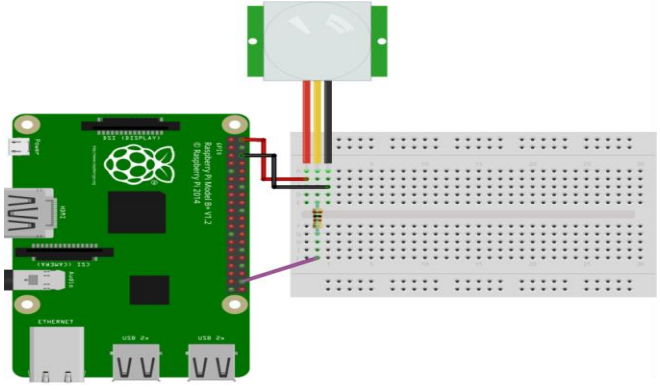

Fig. 5. Connecting Sensor to Pi

III. RASPBERRY PI DESKTOP

A. Download the Stretch Image

After opening the raspberry pi website and there are some downloads option same as shown in Fig. 6. A Raspbian image is a file that can be downloaded onto an SD card which in turn can be used to boot the Raspberry **Pi** and via APC into the Raspbian operating system. Using a Raspbian image is the easiest way for a new user to get started with Raspbian [1, 2].

Raspbian is the Foundation's official supported operating system. It can be installed with NOOBS or download the *image* below. Raspbian comes pre-installed with plenty of software for education, programming and general use. It has Python, Scratch, Sonic *Pi*, Java, Mathematica, and more [5].

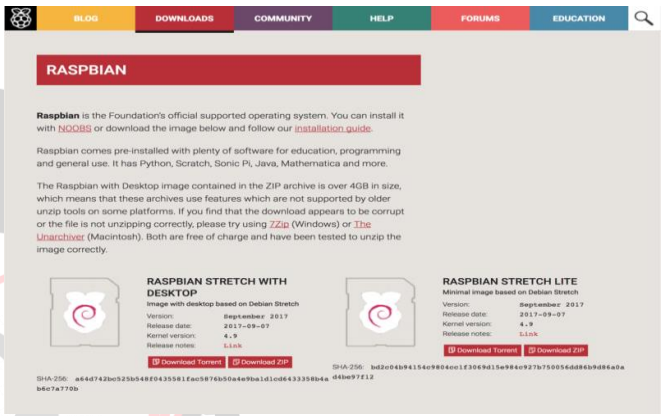

Fig. 6. Webpage of Raspberry pi

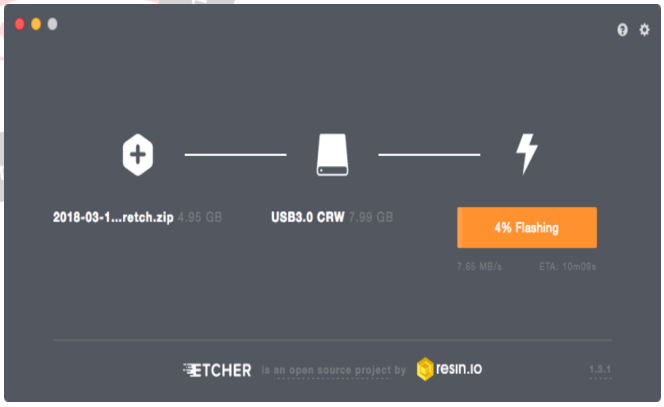

Fig. 7. Etcher Application

B. Use Etcher

The easiest way to flash Raspbian Stretch to SD card is to download and install ETCHER. After opening Etcher, select the Raspbian disk image, as shown in Fig. 7, and SD card, and then click Flash.

C. Configure File

1. It is required to insert and configure file into the SD card.

2. In that it needs to enter the wi-fi name & password as shown in Fig. 8.

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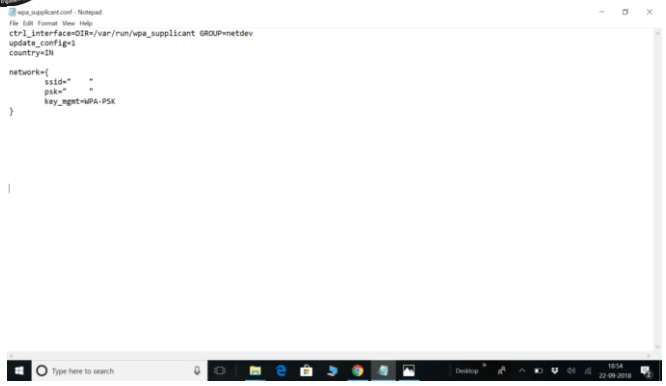

Fig. 8. Program for configuring file

D. Add ssh File

Do the addition of file in the BOOT folder as shown in Fig. 9.

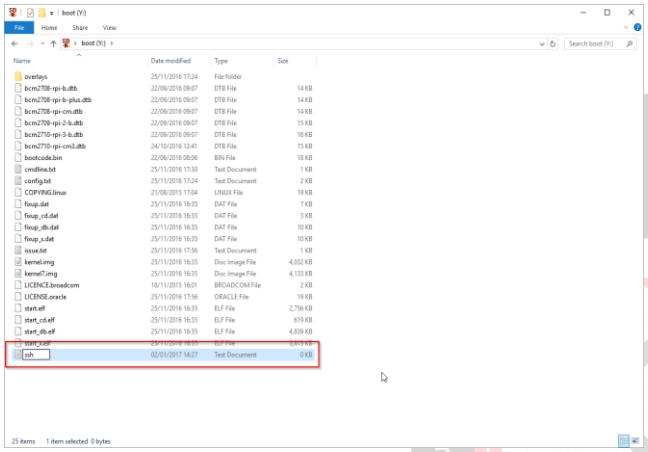

Fig. 9. Boot Folder

E. Advanced IP Scanner

1. After downloading the advanced IP scanner from internet, open it, it is shown in Fig. 10.

2. In the search box below type the IP address where the laptop and pi is connected to the same hotspot.

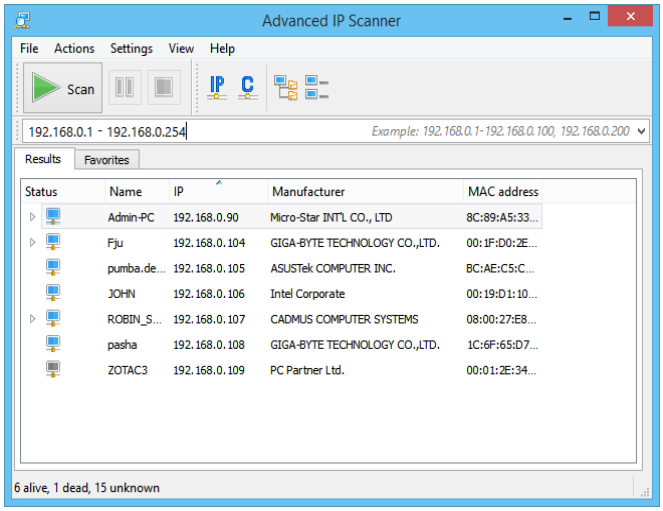

Fig. 10. Advance IP scanner application

F. Putty Configuration

1. Obtain a copy of PuTTY from the PuTTY download page.
2. Save the installer file. An important note is that exit all applications before the installation process.
3. Double-click on the file PuTTY-install.exe to begin the installation.
4. At the Choose Destination screen, Click Next to accept the recommended default destination location for installing PuTTY.
5. Click next on the Select Program Folder screen to select PuTTY as the recommended Program Folder name (PuTTY should already be displayed in the Program Folders text box).
6. Click Finish on the final screen to complete the installation.
7. Finally after downloading, a PuTTY application page is displayed as shown in Fig. 11.

G. Installation of VNC Viewer

1. Open LX terminal.
2. In LX terminal type in "sudo apt-get update" to update the operating system to the latest version
3. When prompted to update type in "y" and press enter.
4. After updating is complete type in "sudo install tight VNC server". Press "y" and hit enter when prompted.
5. Once tight VNC server has completed installation it can be started by typing in "vncserver:1"
6. It will prompt to create a password. Keep in mind passwords can be at MOST 8 characters long.
7. Enter a password. The VNC server is now running in the background of Raspberry Pi's operating system. Any computer can be used on network with a VNC client to remotely access the Raspberry Pi as shown in Fig. 12.

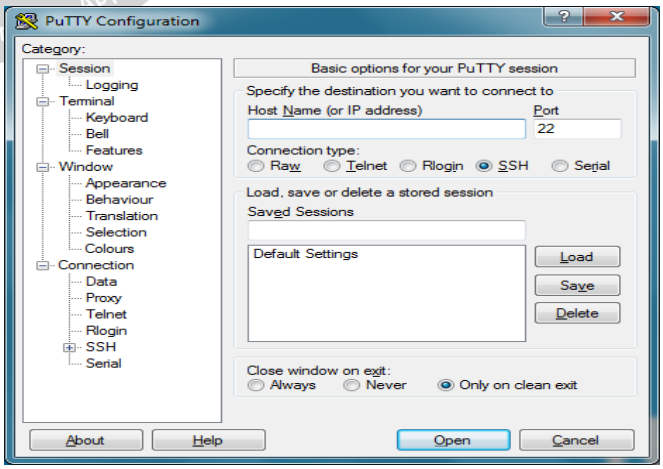

Fig. 11. PuTTY Application

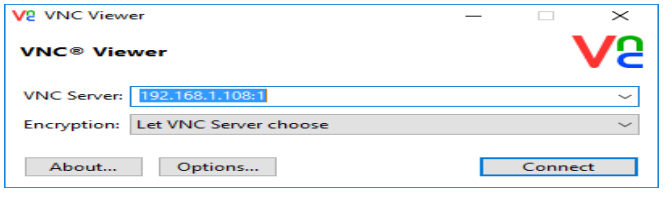

Fig. 12. VNC application window

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VNC is a graphical desktop sharing system that frames buffers of protocol for control of other computers or mobile phones remotely. VNC Viewer is installed on the homeowner's device, personal computer, and mobile phone. VNC's inputs which include mouse, keyboard, or touch are then decoded and send to VNC Server installed on Raspberry Pi module to instruct and ensure control of the actual node device remotely [4, 6, 11]

After entering the server & encryption, the required Raspberry pi desktop is obtained as shown in Fig. 13.

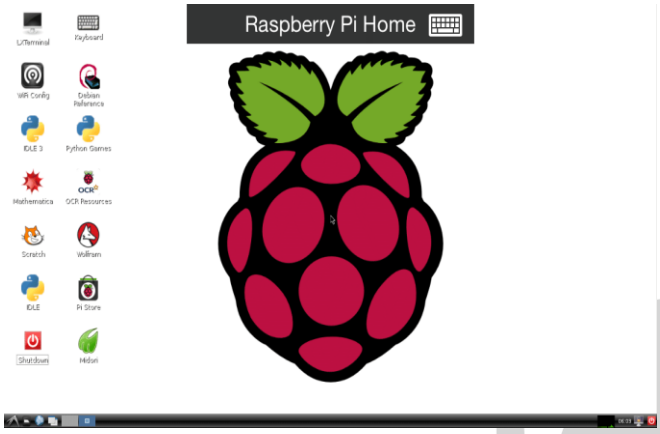

Fig. 13. Raspberry Pi Homepage

IV. Conclusion

In this paper, an efficient raspberry pi based camera module is designed, which is capable of taking picture and videos of any suspected thing. The main thing is that, this camera is also capable of sending these picture and videos to the user at a remote location through IoT. With an improved awareness of the importance of home security, homeowners are on the lookout for an efficient surveillance system which is cost-friendly. This design covers all the vital areas of a home security system. Detection of intrusion into the home is made possible using passive infrared sensors. The sensor uses the infrared radiations changes as a result of human motion across its field of movement. When movement is detected, the pi camera, with the capabilities for taking pictures and recording videos, is enabled. The picture attachment alongside the recorded video is then sent to a specified mail recipient, who is the homeowner. With having such capabilities, this project can be used as an efficient product for surveillance.

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