S.W.A.T – Motion Based Intrusion Detection System

Mehek Male[1], Sahil Colvalkar[2], Ajay Pandey[3], Sarvesh Pandey[4]

[1,2,3,4] Computer, Thakur Polytechnic.

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Abstract - *This paper presents a wise indoor security system using general electronic components and networking technology which are easy to use and cost effective. This system uses a Raspberry Pi, Sensor, Camera, Mutt (email client) and Python & Shell Script. The camera records a video, when sensor detects any motion and by using mutt email client, the recorded video is emailed to the user on the spot by using date and time as a filename. This system works as a Motion Based Intrusion Detection System (IDS). It can be used wisely in homes and offices where, entries of people are strictly prohibited and will provide quite efficient safety from intuders. Raspberry Pi is employed as main a part of the sensible home system. The Raspberry Pi supports various languages i.e. C, C++, python etc. Python is the default language of Raspberry Pi. Python language programming is integrated with the shell script. Shell Script is used to send instant notification on owners smartphone when intrusion is detected (notifications are received on messenger, named Telegram).*

Key Words: **Raspberry Pi, Python, Email, Smartphone, Sensor, Mutt, Camera.**

1. INTRODUCTION

This is a standalone project which contains a Raspberry Pi. This project ensures security by preventing thefts, by monitoring its surrounding using some specialized sensors and camera footage. It works in a different way as compared to existing IDS. As when some motion is detected in a restricted area, camera records a video. This recorded video will be mailed to the user on the spot. So, there is no need for user to maintain a database of whole day recordings etc. User will receive notification along with video attachment whenever intrusion is detected. Additionally, Owner will also receive notification on telegram. Programming is completed with the help of python and shell script.

2. OBJECTIVE

The main objective of this project is to ensure security of a room or a premise, by monitoring the activities happening when a trusted person is not present in the room and alerting the trusted person when required. The principle of this project can be used in environments where important data is to be secured.

Example: Military, Banks, etc.

3. PROPOSED SYSTEM

In this project we will mainly focus on three modules i.e. Camera, Raspberry Pi and sensor.

It uses Hardware such as

- Raspberry Pi
- Camera Module
- Jumper Cables
- Motion Sensor

And software such as

- Python Scripts
- Mutt email client
- Raspberry PiCamera Interfacing
- GPIO Pins Programming

The core of this project is Raspberry Pi that is a minicomputer which runs the backend process of intrusion detection on the Raspberry Pi. All the programs that we run are coded in python and shell script.
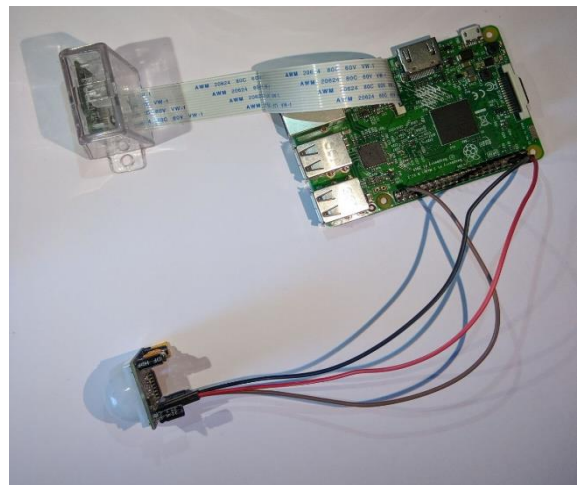

Fig 3.1 Proposed System containing all the functional units

Raspberry Pi has been chosen because of the processing unit for the system due to its user-friendly options and economic edges. Further, the python coded algorithmic rule has been fed into the Raspberry Pi. It is programmed in such a way that it will first set all the GPIO Pins to make a proper interface between all the connected devices and Raspberry Pi, then all connected modules will perform their functions accordingly.

4. WORKING

4.1 Sensor

We have used a passive infrared motion sensor.

Fig 4.1.1 Passive Infrared Sensor

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors.

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. 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.

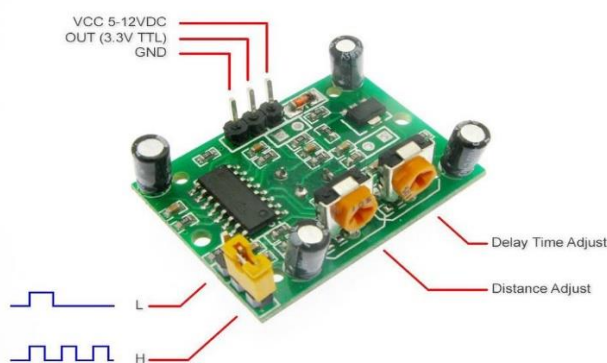This sensor has 3 pins,

- VCC
- OUT
- GND

Fig 4.1.2 Pin layout of the PIR (Passive Infrared) sensor

When there is motion activity in front of the sensor the signal on the OUT pin gets high.

This information can be transferred to the microcontroller (Raspberry Pi) to take reasonable actions.

On detection of motion a message will be sent to the owner on Telegram and also a video of the intruder will be recorded and will be mailed to the owner.

4.2 Raspberry Pi

The Raspberry Pi is a series of credit card-sized single-board computers developed in the United

Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in faculties and developing countries. Several generations of Raspberry Pi's are discontinued. The primary generation (retrospectively called the Raspberry Pi 1) was discontinued in February 2012 in basic Model A and the next specification Model B. Improved A+ and B+ models were discontinued a year later. The Raspberry Pi 2 was discontinued in February 2015 and Raspberry Pi 3 in February 2016.

We have used Raspberry Pi 3 Model B v1.2

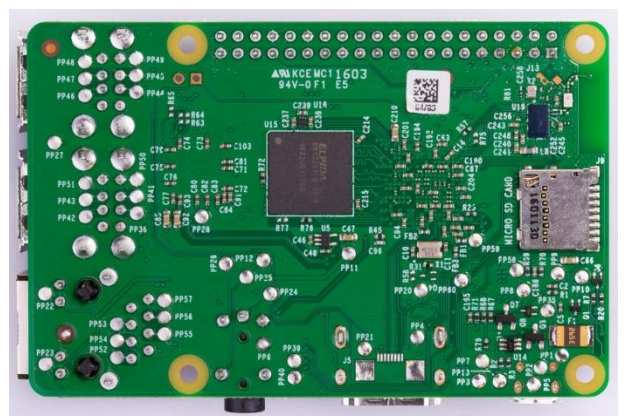**Fig 4.2.1** Raspberry Pi 3 Model B v1.2 (Front)

Fig 4.2.2 Raspberry Pi 3 Model B v1.2 (Back)

All models feature a Broadcom system on a chip (SoC), which has Associate in the Nursing ARM compatible central process unit (CPU) and an on chip graphics process unit (GPU, a VideoCore IV).

Raspberry Pi 3 include:

- CPU: Quad-core 64-bit ARM Cortex A53 clocked at 1.2 GHz
- GPU: 400MHz VideoCore IV multimedia
- Memory: 1GB LPDDR2-900 SDRAM (i.e. 900MHz)
- USB ports: 4
- Video outputs: HDMI, composite video (PAL and NTSC) via 3.5 mm jack
- Network: 10/100Mbps Ethernet and 802.11n Wireless LAN
- Peripherals: 17 GPIO plus specific functions, and HAT ID bus
- Bluetooth: 4.1
- Power source: 5 V via MicroUSB or GPIO header
- Size: 85.60mm × 56.5mm
- Weight: 45g (1.6 oz)

When the output signal from motion sensor is detected, the Raspberry Pi assumes that there is some activity going on in the premises.

Using python scripts it starts recording the information using the PiCamera module.

And alerts the user with the video clip via email.

4.3 Camera

We have used Raspberry Pi Camera

Fig 4.3.1 PiCamera

This Camera Module can be used to take high-definition video, as well as stills photographs. It's easy to use for beginners, but has plenty to offer advanced users. There are lots of examples online of people using it for time-lapse, slow-motion, and other video cleverness. We can also use the libraries we bundle with the camera to create effects.

The camera works with all models of Raspberry Pi 1, 2, and 3. It can be accessed through the MMAL and V4L APIs, and there are numerous third-party libraries built for it, including the PiCamera Python library.

This camera module is very popular in home security applications, and in wildlife camera traps.
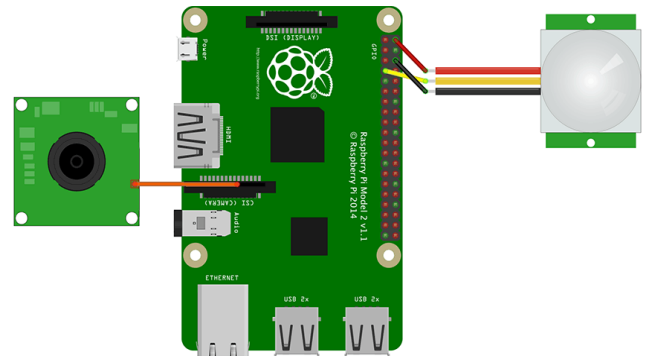

Fig 4.3.2 Connection of the PiCamera to the Raspberry Pi

The PiCamera needs some specific packages for its functioning.

The PiCamera has basic functions like:

- camera = picamera.PiCamera()
- camera.start_recording('video.h264')
- camera.stopt_recording();

These functions are used to capture videos

As motion is detected a file is generated with current time and date as a name and video is recorded into it, duration for the video can be set according to the owners wish by doing little alteration in script. As the video will is recorded it will be mailed to the owner.

4.4 Email Controller

The intrusion detection system monitors the house via pi camera and if any motion is detected, the Raspberry Pi and the camera records a video of the entrant and mails it to the owner so the owner will establish the entrant. The owner will have knowledge about the intruder and also will come to know the malicious activity which the intruder will perform. There will be an instant communication between the owner and IDS.

For this, we tend to use Mutt (email client). Mutt is a text-based email client for Unix-like systems. It was originally written by Michael Elkins in 1995 and released under the GNU General Public License version 2 or any later version. Mutt supports most mail storing formats (notably both mbox and Maildir) and protocols (POP3, IMAP, etc.). It also includes MIME support, notably full PGP/GPG and S/MIME integration.

Mutt was originally designed as a Mail User Agent (MUA) and relied on locally accessible mailbox and send mail infrastructure.

Mutt email client, is a terminal based email client.

Using this you can send emails to the desired contact with attachments.

Python scripts are used to send emails. i.e

os.system("sudo mutt –s 'Alert' alphabetathetagamapi@gmail.com –a %s <intrusion.txt" %(temp2))

5. FUTURE SCOPE

In future works, it's planned the event of latest modules to reduce the energy necessary for police work cameras. By adding an alternative energy panel, the camera is going to be capable of gathering the solar energy and be wireless. With an awfully low power Wi-Fi module, it'll be ready to transfer the recorded videos to a server. In addition, to regulate all the modules, so as to stay the performance and management the energy usage through periods of very little or no solar energy provided, there'll be an impression module. We can also add a feature, such as if intrusion is detected then automatically all doors will be locked, so the intruder wont escape. We can send emergency signal to crime department. We can add alarm systems which will alert the security guards

6. CONCLUSION

In today's generation, everything relies on computation and data either directly or indirectly. This project has hardware and software package. Hardware describes how the system was designed, what module will it use. The system is meant for unwelcomed person detection. The projected system provides digital computer primarily based home security system by use of terribly advanced low price stable software package.

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