Chapter-3

Requirement Engineering

3.1 The Raspberry Pi

The Raspberry Pi is a Linux based microcomputer based on ARM architecture. It was built mainly to aid in developing open source game. The device is estimated to cost about $35 (Rs. 3000) depending on the model.

3.1.1 The Raspberry Pi Models

This section describes the models of Raspberry Pi available. This report will not attempt to provide full specifications but an overview in order to help in making a decision as to which device it is required to accomplish the objectives in question. Currently, five Raspberry Pi models do exist. They are: Model B+, Model A+, Model B, Model A and the Compute Module (currently only available as part of the Compute Module development kit). All these models use the same SoC (System on Chip - combined CPU & GPU), the BCM2835, but other hardware features differ.

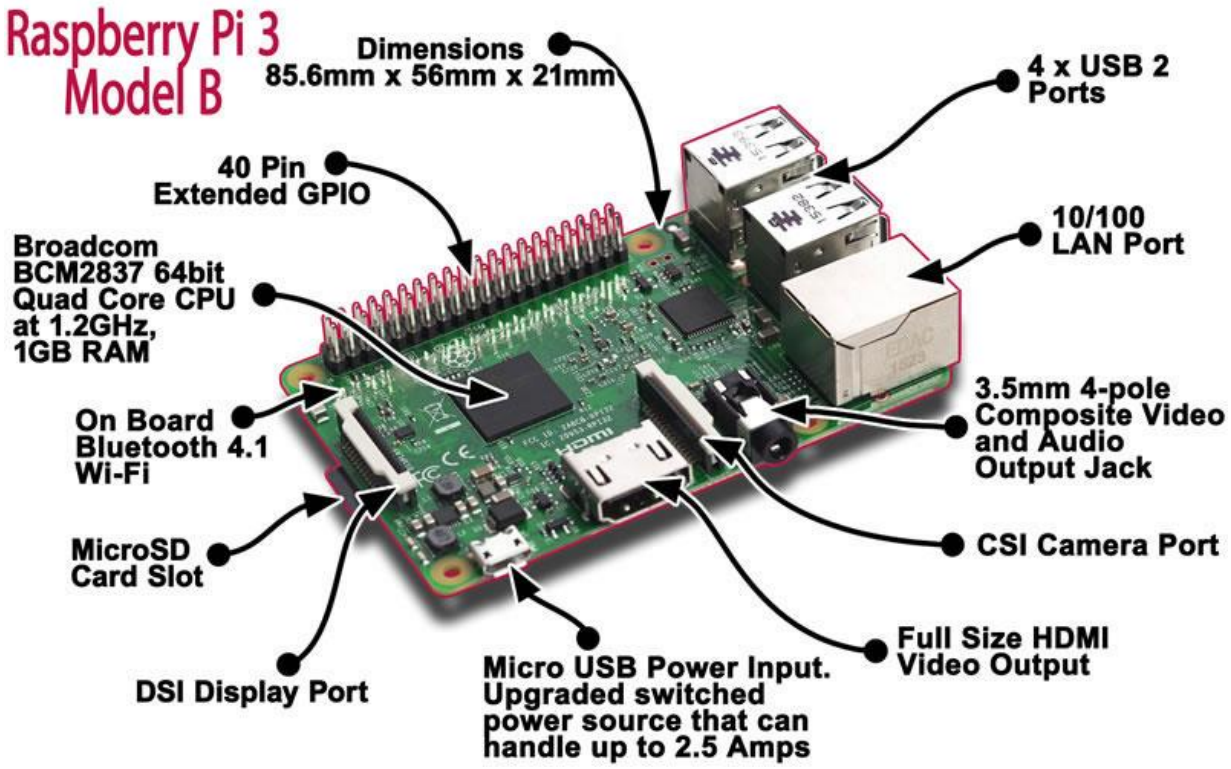

Figure 3.1: Raspberry Pi 3 Model B

a) Model B+/B

First release was made in July 2014. This Model is an upgrade of the Model B. It has the following characteristics: 4 USB ports, 40 pins on the GPIO header , Improved power circuitry which allows higher powered USB devices to be attached and now hot-plugged. The full size composite video connector of Model B has been removed and the functionality moved to the 3.5mm audio/video jack and the full size SD card slot of Model B has also been replaced with a much more robust micro SD slot. The following details some of the improvements over the Model B:

- Current monitors on the USB ports mean the B+ now supports hot-plugging
- Current limiter on the 5V for HDMI means HDMI cable-powered VGA converters work in all cases.
- 14 more GPIO pins
- Higher drive capacity for analog audio out, from a separate regulator, which means a better audio DAC quality
- No more back powering problems, due to the USB current limiters which also inhibit back flow, together with the "ideal power diode"
- Composite output moved to 3.5mm jack 15
- Connectors now moved to two sides of the board rather than the four of the original device
- Ethernet LEDs moved to the Ethernet connector

b) Model A/A+

This is the basic device, with a single USB port and 256MB of SDRAM. Onboard ports include: Full size SD card, HDMI output port, Composite video output, One USB port, 26 pin expansion header exposing GPIO, 3.5mm audio jack, Camera interface port (CSI-2), LCD display interface port (DSI) and One micro USB power connector for powering the device.

3.1.2 Programming the Raspberry Pi

To enable communication with the outside world, the Raspberry Pi has to be programmed with a suitable programming language. These languages include Java, FOTRAN, Pascal, Python, C, C++ etc. Each language has its own syntax and semantics. RPI can be programmed using any of these languages but for purposes of this project, Python will be of great importance to study.

3.1.3 Raspberry Pi Operating Systems

An operating system makes Raspberry Pi run. Raspberry Pi is a small boxed-sized computer that is based on Linux, optimum performance of RPI can be achieved if it is therefore operated in this environment. A pure OS Raspbian often provides: it comes with over 40,000 packages; pre-compiled software integrated in a compatible format for easy installation on Raspberry PI. Important to note is that the Windows environment is not supported by Raspberry Pi .To get access to Pi from windows we require VNC Viewer Software. VNC Viewer is an SSH and Telnet client.

3.2 The Pi Camera Module

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). Till now it is the only Camera available specifically for the Raspberry Pi therefore these specifications cannot be updated. Since it uses 250mA, externally powering the Pi should be sufficient enough for the camera to initialize the camera specific configuration settings are required. And a Python script to make the camera enable to capture images.

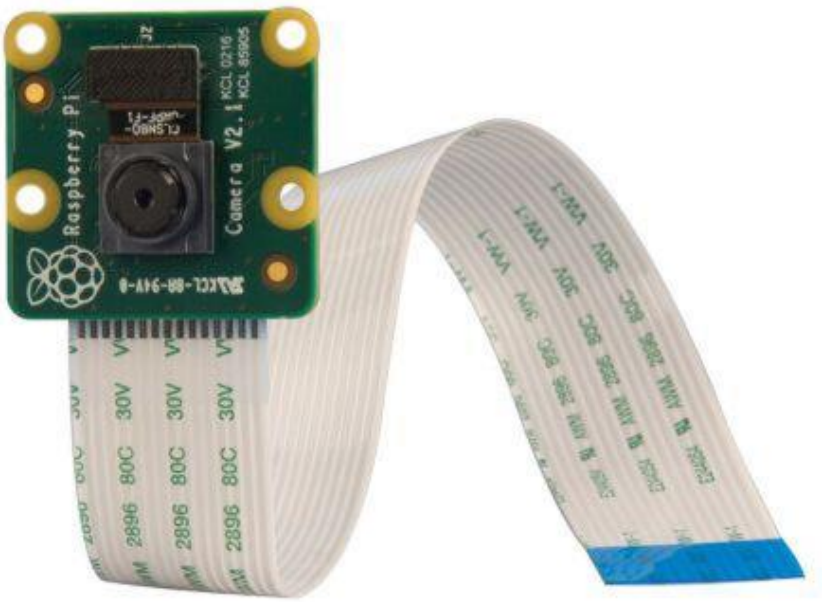

Figure 3.2 Pi Camera Module

3.3 Passive Infrared Sensor

3.3.1 Principle of operation of a 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. When any object, such as a human being, 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 plus the body temperature of the human, and then back again.

The resulting change in the incoming infrared radiation are converted into a change in the output voltage, and this triggers the detection. There is different infrared emission pattern for objects of similar temperature but different surface characteristics , and thus moving them with respect to the background may trigger the detector as well.

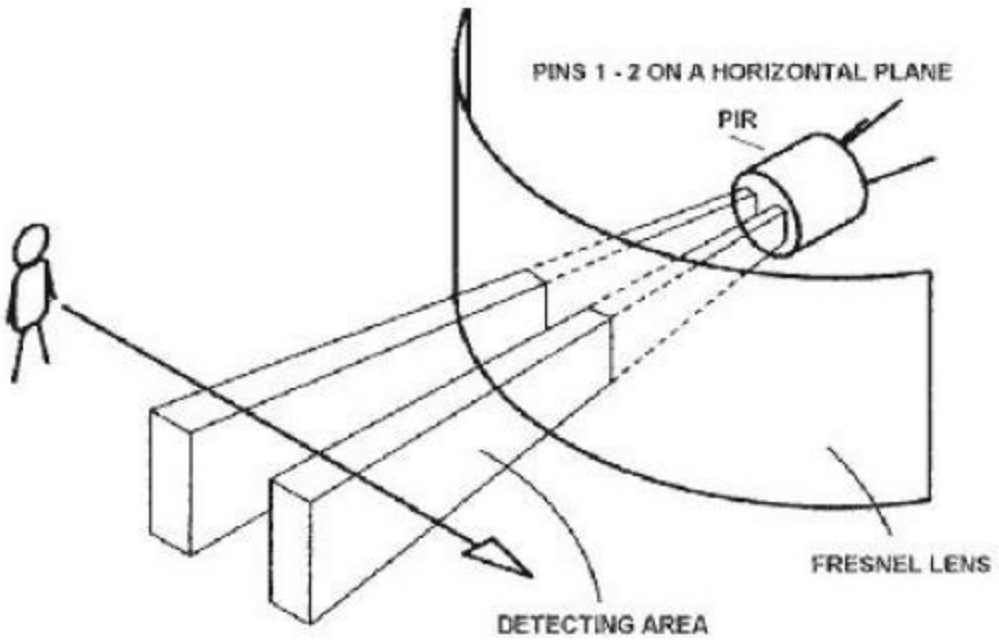

Figure 3.3 Operation of PIR Sensor

3.3.2 Reading PIR Sensors

Connecting a microcontroller to PIR sensors is very simple. Passive Infrared Sensor(PIR) behave as a digital output so all you need to do is listen for the pin to flip high (detected) or low (not detected). Retriggering must be needed in order to do so, so be sure to put the jumper in the H position! Power the PIR with 5V and connect

ground to ground. Then connect the output to a digital pin i.e. the GPIO pin of the RPI device. A C/Python code can then be used to read a channel from the PIR sensor.

3.3.3 Changing the sensitivity of the PIR sensor

There are two 'timeouts' associated with the PIR sensor:

- The “Tx” timeout: how long the LED is lit after it detects movement - this is easy to adjust on Adafruit PIR's because there's a potentiometer.
- The “Ti” timeout which is how long the LED is guaranteed to be off when there is no movement. This one is not easily changed but if you're handy with a soldering iron it is within reason.

3.3.4 Example Applications of the PIR sensor

- Remote camera triggering,
- A home-made security system using PIR sensors (which is built into a Start Trek panel!),

  PIR sensor + Arduino + Servo = automatic cat door!
- Motion detection in home surveillance/security systems.