

# Development and Enhancement of Motion Detection Algorithm using single board computer Raspberry Pi

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**Abstract** - Recent advances in the technology make it possible to develop a security system low cost, convenient and fast processing. It is important for all to be able to safeguard their property from destruction and thefts. Raspberry Pi is small computer, it can support on board camera module that makes it obvious choice for the cost effective security application. It has software motion which triggers Pi's camera to detect motion and save the image. The motion detection system is implemented for real time applications; frame difference method is used for detecting motion. When it detects the motion will trigger the camera to begin capturing images and indicating alarm. The algorithm is simulated using Python Script.

**Index Terms** - Raspberry Pi, Camera, Motion detection, Objects, Python

## I. INTRODUCTION

A Raspberry Pi is a credit-card sized computer originally designed for education, inspired by the 1981 BBC Micro. Creator Eben Upton's goal was to create a low-cost device that would improve programming skills and hardware understanding at the pre-university level. But thanks to its small size and accessible price, it was quickly adopted by tinkerers, makers, and electronics enthusiasts for projects that require more than a basic microcontroller (such as Arduino devices).

The Raspberry Pi is slower than a modern laptop or desktop but is still a complete Linux computer and can provide all the expected abilities that implies, at a low-power consumption level.

The Raspberry Pi gets powered via a regular 5V micro USB port and uses between 700-1000mA. For projects requiring more power than 1 Amp an externally powered USB hub is needed. The GPIO pins on the board require 16mA each, the camera module requires 250mA, HDMI requires 50mA while keyboard and mice requirements vary.

Raspberry Pi's hard drive is the SD card inserted into it. The minimum requirement for the SD card is 4 GB and it can go up to 32GB. [1]

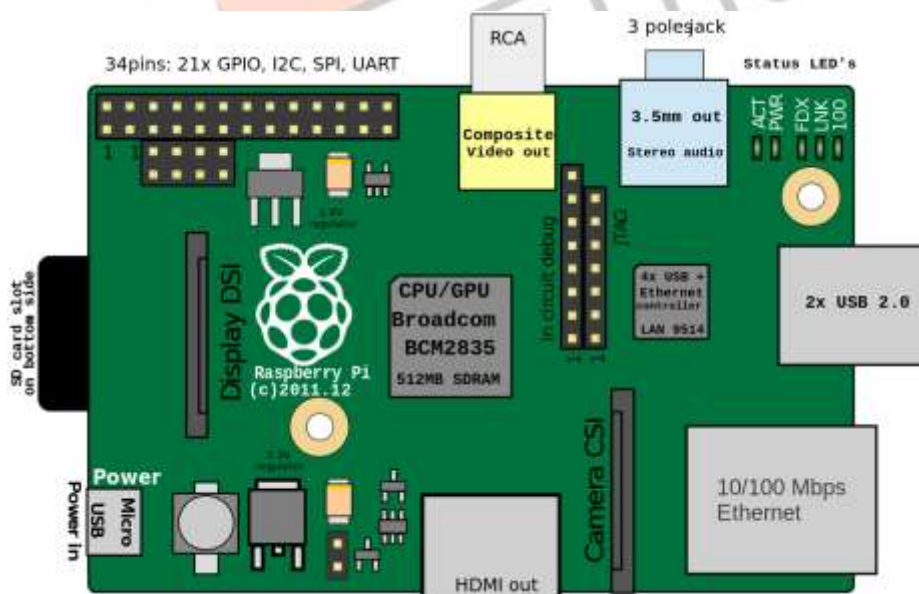


Figure. 1 Raspberry Pi top view and its connection out diagram

## II. OPERATING SYSTEM AND PROGRAMMING ENVIRONMENT

The Raspberry Pi was designed for the Linux operating system, and many Linux distributions now have a version optimized for the Raspberry Pi. Two of the most popular options are Raspbian, which is based on the Debian operating system, and Pidora, which is based on the Fedora operating system.

### *Shell*

Most of the tasks we perform on Pi are from the command line. We run commands from the command line using the LX Terminal program.

### *Python*

Python is considered one of the best First Programming languages due the ease and clarity for any beginner to start coding in the language. Python is interpreted language. Meaning we don't need to compile the code before running as the program execute directly without being compiled to a machine level language.

## III. CAMERA MODULE

The camera board in Raspberry pi is a small PCB with camera on it. That is called camera module which should be connected with raspberry pi by small ribbon cable. Raspberry Pi has on board camera slot interface where camera module is connected. It is 5Mega Pixel camera consumes around 250mA.

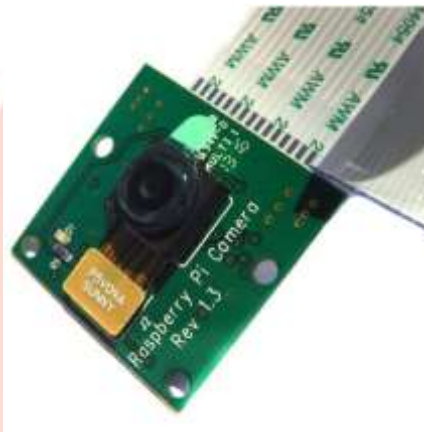


Figure.2 Camera Module

After connecting the camera module, one need to enable camera from the configuration settings. One can simply use commands to test the camera.

***Raspistill -o imagename.jpg***

the above command is used to take snapshots.

***Raspivid -o videoname.h264***

The above command is used to make video. The same camera is used for motion detection

## IV. PROJECT IMPLEMENTATION

The functions of the project are:

**Motion detection :** Here the python program is continuously analyze the frames and is there is a difference from the last frame it would positive trigger and snapshot will be taken.

**Customization:** The user has the ability to customize the settings for the frame per second, threshold level and sensitivity, etc.

**When Motion Detected:** Whenever the motion is detected camera take a snapshot of full high resolution image and saves it in disk space memory, also one can make positive trigger other things like sending images to the ftp server or stored to an external server as configured. [7]

**V. FLOWCHART**



Figure.3 Flowchart of Process

**VI. MOTION DETECTION BLOCK DIAGRAM**

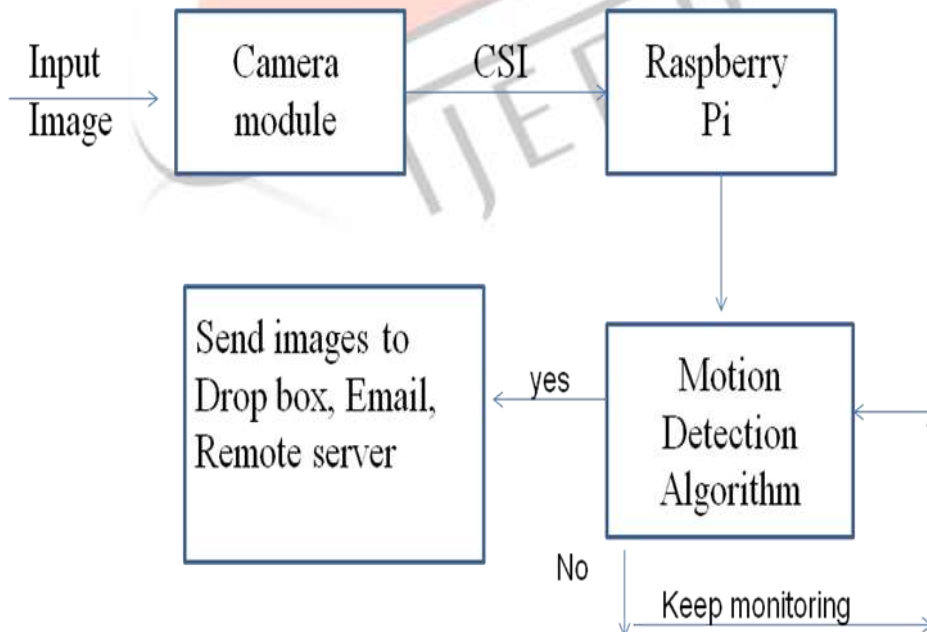


Figure.4 Motion detection block diagram

**VII. ALGORITHM**

The program algorithm written in Python language, in which camera continuously takes pictures at a rate of 1 fps, it keeps in memory, and compares quickly, once the motion is detected it again calls the command raspistill and take and save high resolution jpeg image to disk memory.

Sample code given below:

```

Pixdiff = abs(buffer1[x,y]1 - buffer[x,y]1)
If (Pixdiff > Threshold):
  Chnagedpixel +=1;
If (Changedpixel > sensitivity):
  Takepicture= True;
    
```

The algorithm also check s for the free disk space and delete the oldest images to making sure those new images are always get enough free space.

While running the python script code on raspberry model B 512MB RAM , it takes around 12% load on CPU and manages to save full size images in disk space every 2 second if motion is detected. [8]

**VIII. EXPERIMENTAL RESULTS**

The Motion is detected the below images show that when there is a difference in the sample image and current image the pictures are taken.



Figure.5 Frame 1 (Left) and Frame 2 (right) when motion detected

User would also get notification of motion detection, when the images are stored in local memory.

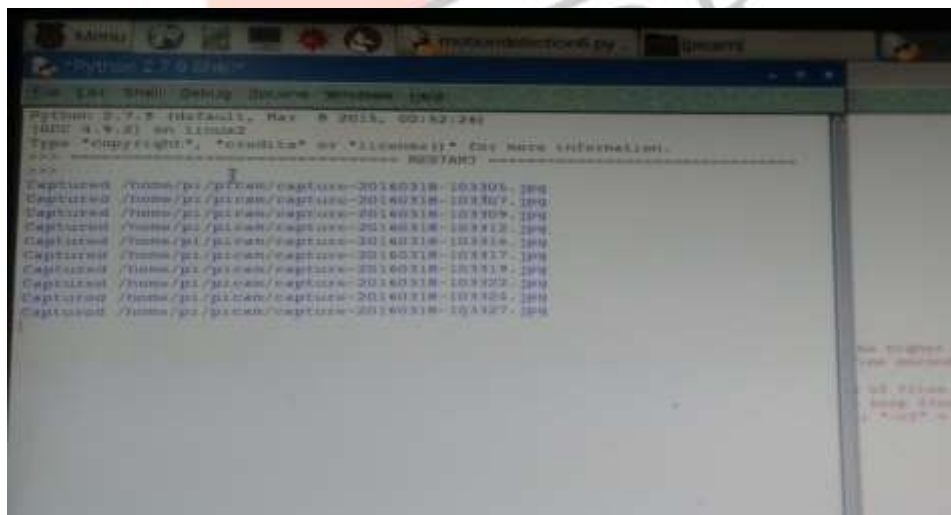


Figure.6 Images saved locally on raspberry Pi

My algorithm is based on absolute pixel difference method, where there is control over threshold level (How much pixel value change) and sensitivity level (How many pixels changed). These controls are needed to prevent the system to capture noise and false triggering the next events.

Based on the experiments the impact of Threshold on motion detection algorithm found out.

Table 1: Threshold level impact on motion detection

Threshold Level	Impact on motion detection
0	More images are clicked
10	Small objects are detected as motion detection (noise)
20	Medium variation
40	Large variation required at pixel level
60	Complete frame change required to click picture
100	Motion is not detected

Similarly, the impact of sensitivity on motion detection algorithm found out.

Table 2: Sensitivity level impact on motion detection

sensitivity Level	Impact on motion detection
0	Pictures are taken every second
10	Small objects are detected as motion detection (noise)
100	Better for objects variation detection
200	Good for motion detection (Medium size objects)
300	Large variation required (More Pixels changed) for detection
500	Motion is not detected (Almost)

From the above experiment I can conclude that Threshold level and Sensitivity should be kept at 10 and 100 respectively, for good motion detection algorithm.

## IX. FUTURE HORIZONS

After storing the images in the local disk, one can make the code to connect it live with the Google drive or Dropbox to store the images and always keep local disk empty. There are also more possibilities like email notification and live streaming of images over the remote location. In short we can extend the capability of raspberry Pi using Internet of the things approach [3].

## X. CONCLUSION

Raspberry Pi is the new thing to the world today; it is portable small in size and various capabilities, this system would be the alternative for expensive security systems being used today. The idea is to make the security system cost effective and convenient.

The algorithm developed is tested in various light conditions and by changing the different threshold level and sensitivity level. From the experiment we have made the algorithm such that it can detect the living creatures.

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