

Motion Detecting Camera Security System with Email Notifications and Live Streaming Using Raspberry Pi

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Abstract - Even when needed, having a security camera system may sometimes be impossible due to the extensive costs for installation. The Raspberry Pi is a credit card sized computer that has the capability to become a camera security system when its own camera board is used. It contains the software motion which enables the Pi's camera to detect motion and save the image as well as view live streaming from the camera. A python script, then directs the Pi to send email notifications every time motion is detected. With these components, a cost effective and efficient security camera system is made and reported here.

Keywords: *Raspberry Pi, Motion Detecting, Email, Notifications, Python, Live Streaming.*

I. INTRODUCTION

New innovative technology revolves around how much a product is capable of implementing along with its price. The Raspberry Pi crosses off both criteria because it is a cheap effective computer which is capable of much more. What makes it so convenient is that so much can be done with it from a security system to a VPN server. The possibilities are endless! Like any other computer it can accept several programming languages including Python.

Most importantly, security can be a necessity today and the Pi has the ability to become a camera security system with a cost under 80dollars. Regular security systems lead

up to prices within the range of thousands. Who would want to buy a single camera for over 100 dollars just to setup on their front door, when they can buy a 29 dollar camera which even notifies them via email?



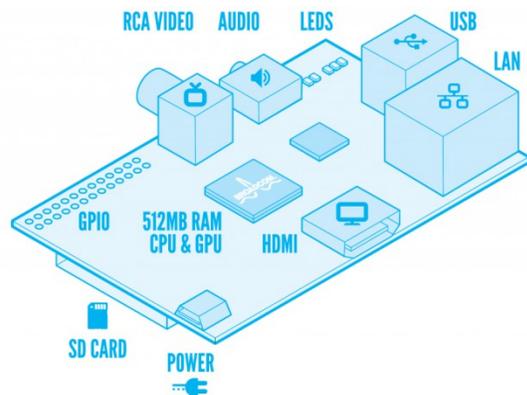
You would never have to worry about looking back through recordings because the Pi Security System would send you an email whenever someone comes by your home. Most of all the Pi Security Camera system is very user friendly. Anyone who has the required materials can do it with a few additional installations of files and save themselves a great amount of money. Not to mention, they would gain an efficient security system.

II. RASPBERRY PI

A Raspberry Pi is a thirty five dollar, credit card sized computer board which when plugged into an LCD and attachment of a keyboard and a mouse, it is able to complete the functions of any regular PC can. Like a PC, it has RAM, Hard Drive (SD Card), Audio and Video ports, USB port, HDMI port, and

Ethernet port. With the Pi, users can create spread sheets, word-processing, browse the internet, play high definition video and much more. It was designed to be a cost friendly computer for users who needed one. There are two models, Model A and B. Model B is the faster containing 512MB of RAM as well as the ability to over clock [1].

RASPBERRY PI MODEL B



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. Powering the Raspberry Pi using batteries is possible however it is not recommended because batteries do not provide stable power which can harm the system [1].

As mentioned above the 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. Pi is also Linux based and the OS is stored on the SD card. There are several distributions that can be installed and are specifically created for the Raspberry Pi. There is an OS named NOOBS specifically for individuals who are new to the Pi. Other OS's include Raspbian, Pidora, RaspBMC, ARC and OpenELEC. In order to install the OS onto the SD card the raw image has to be first downloaded from the Pi's

website [1]. Once it is downloaded, the SD card has to be formatted using the software SDFormatter. Once it is formatted, the software Win32DiskImager has to be used to write the image onto the SD card. The SD card can then be inserted into the Raspberry Pi and booted up using an LCD display and a keyboard. The power source, SD card and keyboard are necessary components for setting up the Raspberry Pi.

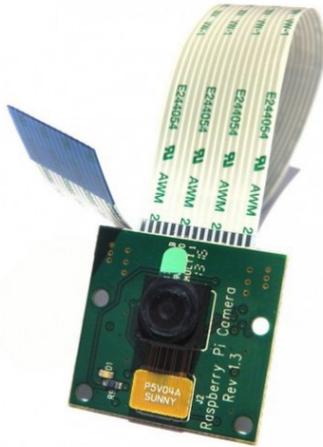
The Pi does not contain its own Wi-Fi connection yet it does have an Ethernet port. It can also support certain models of Wi-Fi dongles such as the Edimax Nano Adapter. Plugging in an Ethernet cable to a router will automatically enable the internet, however, with a Wi-Fi dongle there are various steps that are need to be followed to properly make it function. With these methods, the browser can be used and also access to the Internet is needed to install various packages through the terminal.

The default programming language provided by Raspberry Pi is Python. Other languages such as Java, C, and C++ can also be installed and used if the programs are installed on the system. It is important to note that installing programs that use these languages might take up a large amount of space on the SD card. This can also cause the system to slow down. Over clocking is possible, however, it is important to note that the proper methods have to be followed or else this may harm the Pi.

III. CAMERA BOARD AND MOTION DETECTION

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); and is comparable to the ones used on cell phones today. As for now it is the only Camera made specifically for the Pi therefore these

specifications can not be updated. Since it uses 250mA, externally powering the Pi should be sufficient enough for the camera. If more items are connected, however, once again an externally powered USB hub is needed [1]. A USB powered webcam can be used along with a PIR sensor to be able to achieve motion detection. For this case only a camera board is needed.



In order for the camera to be enabled it is necessary to go to the raspberry pi configuration settings and selecting Enable Camera. The camera can be used as a regular camera as well as a motion detecting camera. In that case it is not necessary to download the configuration file. Commands in the terminal such as

```
raspistill -o imagename.jpg
```

take snapshots while other commands such as the one below can make a video [2].

```
raspivid -o videoname.h264
```

Raspberry Pi contains a software titled Motion that allows the Pi Camera to turn into a motion detecting camera. A specific configuration file is used to make any adjustments regarding the behavior of the camera. It allows the adjustment of the picture taking settings, streaming settings, image settings, motion detecting settings and much more [4]. This file is to be obtained from online due to the fact

that it does not come with the installation of Motion. When the camera board is turned on the command used, runs the configuration file.

IV. EXPERIMENT

The method to create the security system starts off with downloading the proper OS within the SD card. The directions are mentioned above within the Raspberry Pi section or for more information see reference [1]. Once the system is booted up the camera has to be enabled under raspberry pi configurations. The boot method of GUI also has to be selected. Once these configurations are made the system will have to reboot.

After reboot, the system has to have its latest packages installed to make sure Motion works properly for that it is necessary to update and upgrade.

```
sudo apt-get update  
sudo apt-get upgrade
```

In order to allow for email notifications to send, the OS needs a program that allows for emails to be sent. SSMTP is a program that allows a system to deliver an email from a local computer to a mailhost. It does not receive mail but can send out mail. SSMTP is ideal for situations where alerts are needed to be sent therefore it was useful when sending notifications. SSMTP was then installed using the command below.

```
sudo apt-get install ssmtp
```

Next, the Motion is the main program which allows the camera to take a snapshot when it detects movement. Along with motion, special packages also have to be installed which allow the program to function properly [5].

```
sudo apt-get install motion  
sudo apt-get install -y libjpeg62 libjpeg62-dev  
libavformat53 libavformat-dev libavcodec53 libavcodec-  
dev libavutil51 libavutil-dev libcb6-dev zlib1g-dev  
libmysqlclient18 libmysqlclient-dev libpq5 libpq-dev
```

Most programs come with a configuration file which allows the user to make any adjustments to adjust or advance the program. Motion is no different; however, for convenience is that the proper configuration file can be downloaded from a dropbox. This file has been available to the public by a user who has worked with the Motion program. Once the tar file is downloaded it has to be extracted. The actual configuration file is titled *motion-mmalcam.conf*.

```
wget
https://www.dropbox.com/s/xdfcxm5hu71s97d/
motion-mmalcam.tar.gz

tar zxvf motion-mmalcam.tar.gz
```

From there the configuration file has to be edited in certain aspects. It is the file that contains the snapshot settings, motion detection settings, streaming settings, etc. There is a section for each setting making it easy to make desired modifications. For this case it is important to make sure that

```
daemon on
threshold 3000
target_dir /home/pi/SecurityShots
```

Threshold is the amount of pixels that need to be changed in order to detect movement. If the threshold is really low then a picture will be taken even with the slightest movement. Increasing it to 3000 makes sure a picture is taken once proper movement is detected. Target directory is the location where the picture gets saved. In the location above the pictures are stored in a file titled SecurityShots. If space is a concern, it is also possible to direct the images to be saved onto a USB. The proper path of the file the images are being stored in just has to be written next to target_dir.

The main algorithm for the email notifications is that since a picture is taken whenever motion is detected, we need a command that sends an email to start once that

occurs. There is a specific part of the configuration file called "on_picture_save" where the user can enter a command to be performed once a picture is saved.

```
on_picture_save python camera.py
```

The "on_picture_save" configuration is set to python camera.py because once a picture is saved this python script will run. The script camera.py is designed to use SSMTP and send an email notification every time a picture is saved. Since it uses SSMTP it is necessary to enter the email address and password of the account the notifications are to be sent to [3]. The content text can also be adjusted within the program. In this specific script the user is alerted that there is motion detected, the IP address and port of the location is also given. The context of the script is shown below for clarity.

```
import subprocess
import smtplib
import socket
from email.mime.text import MIMEText
import datetime
import os
#Destination email
to = 'Type your email address'
#user gmail account
gmail_user = 'type your email address'
#gmail password
gmail_password = 'type your password'
#everything is verbatim from this line on down
smtpserver = smtplib.SMTP('smtp.gmail.com', 587)
smtpserver.ehlo()
smtpserver.starttls()
smtpserver.ehlo()
smtpserver.login(gmail_user, gmail_password)
today = datetime.date.today()
arg = 'ip route list'
proc = subprocess.Popen(arg, shell=True,
stdout=subprocess.PIPE)
data = proc.communicate()
split_data = data[0].split()
local_ip = split_data[split_data.index('src') + 1]
public_ip = os.system('wget http://ipecho.net/plain -o - -q >
test.txt; echo')
public_ip = open('test.txt', 'r').read()
msg_content = 'Alarm detected. Public ip is %s:8081, local ip is
%s' % (public_ip, local_ip)
msg = MIMEText(msg_content)
msg['Subject'] = 'Raspberry Pi Alarm on %s' % today
msg['From'] = gmail_user
msg['To'] = to
smtpserver.sendmail(gmail_user, [to], msg.as_string())
smtpserver.quit()
```

It is vital to know that after any adjustments that are made to the configuration file the system should be rebooted. If the system isn't rebooted, the changes will not be fully taken into affect

Once the system is rebooted the final step is to start the camera and run the configuration file so that it can detect motion. The command below runs the camera and the configuration file.

```
./motion -n -c motion-mmcam.conf
```

The live streaming can be viewed within Mozilla Firefox. The following form has to be entered within the address bar. The IP address that needs to be entered is of the PI and the port is started within the configuration file. The standard port number is 8081.

```
IPADDRESS:PORT NUMBER
```

Firefox was mentioned because for many users using Google Chrome or Internet Explorer did not work. For most uses Firefox did display the live streaming. If both streaming and notifications are working properly then the security system is complete

V. CONCLUSION

Raspberry Pi opens up a whole new chapter when it comes to technology today. Not simply because of its size but because of its capabilities. The fact that it is so portable allows it to be used for anything. Even though it is Linux based and many individuals are not familiar with terminal commands, the online community for Pi is growing. There has been so much input from different users along with tutorials online making everyone's life simple when it comes to Pi projects. This can be seen from this security camera project. The system can be made by anyone who follows these steps. The steps basically focus mainly on installations which are done directly from the

terminal. The program Motion and its configuration file perform 90% of the task required for the pictures to be taken and sent to the email. There is also minor programming involved to send email. To even simplify the aspect of the script, the user can find a single command that would send an email directly from the configuration file using programs such as "sendMail" or Postfix.

These steps allow anyone's home to be secure and the size of the camera allows it to be discrete as well. It can be placed anywhere! If the user gets a notification they need to simply go to a Firefox browser and enter their IP address along with the stream port number. They'll be able to see what is going on at that time. A cost effective system which is user friendly and convenient, what more would you need?

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