

Article Info

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IoT Based Home Security System with Live Streaming

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ABSTRACT

The idea behind IoT is that, setting up of an ideal connection between the real world and the internet world, through some source. The fact that the brain or the internet has got humongous amount of information stored on it, if we could have a real time access to it, various technologies that can revolutionize our life can be developed. So, keeping this thought in mind, it is a great idea to make a device which can be controlled and monitored from anywhere. Though, security systems are already available, but they are expensive. Keeping this thought in mind, we decided to build one security system using Raspberry Pi, PIR sensor and a PI camera. This IoT based security system will not only alert the authorized person through e-mail, but also send a picture a picture of the intruder, when it detects any. The Raspberry Pi controls the whole system. This cheaper security system is easy to operate and install, and it can be installed at the main door of your home or your office. The authorized person can monitor the ongoing activity from anywhere in the world using your Email over the Internet. Along with this, using the IP address, and MJPG streamer; we can stream the video online anytime anywhere.

Keywords: Internet of Things; Home Security; PIR Sensor; PI Camera; Live Video Streaming.

1.0 Introduction

The Internet of Things(IoT), is about interconnecting devices and systems to collect and store data, gathered by embedded sensors and actuators in machines and other physical objects, intelligently and cleverly. Since the advent of 21st century, the growing use of IoT in almost the field- from education to personal use- has swept the entire world by storm. The growing use of IoT is expected to spread rapidly over the coming years and this convergence of the real world with the world of Internet, will unleash a new dimension of services that improve the quality of life of consumers and productivity of enterprises. IoT is believed to have the potential to deliver solutions that dramatically improve energy efficiency, security, health, education and many other daily aspects of life. The advancement in the knowledge of IoT, will also be a huge benefit for the enterprisers along with the

consumers as IoT can underpin solutions that improve decision-making and productivity in manufacturing, retail, agriculture and other sectors.

On a whole, IoT has helped expand many industries and technologies, and one of the best examples that shows how much IoT has expanded, is the development of smart cities. This technology has innumerable number of uses and as vast as human brain is, new and interesting ideas can be developed using this remarkable technology. This research paper is organized into VI sections: Section II deals the system model- hardware and software. Section III is about the security system design. Section IV deals with Results and the paper is concluded in section V.

2.0 System Model

The overall Home Security system can be subdivided into the software model and hardware model. The section will discuss the both models in detail.

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2.1 Hardware Model

The Raspberry Pi is a small palm sized single-board affordable computer that was developed in UK by the Raspberry PI Foundation, to develop and inculcate the ideas of Computer Science and build related projects. The authorized licensing and manufacturing is done by Newark element14 (Premier Farnell), RS Components and Ego man. All these companies sell this device online, with Ego Man producing a version for distribution solely in China and Taiwan, which can be distinguished from other Pi's by their red coloring and lack of FCC/CE marks. The hardware is the same across all manufacturers. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor (The firmware includes a number of "Turbo" modes so that the user can attempt over clocking, up to 1 GHz, without affecting the warranty), Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, with the latest version having 1 GB RAM. Though it does not come with a built-in disk or solid-state drive, but it does have an SD card slot, that is used booting and long-term storage.

Though the Raspberry PI camera module, has numerous versions, almost all of them can take full HD 1080p photo and video and can be controlled programmatically. The flex cable inserts into the connector situated between the Ethernet and HDMI ports, with the silver connectors facing the HDMI port.

The flex cable connector should be opened by pulling the tabs on the top of the connector upwards then towards the Ethernet port. The flex cable should be inserted firmly into the connector, with care taken not to bend the flex at too acute an angle. The top part of the connector should then be pushed towards the HDMI connector and down, while the flex cable is held in place.

PIR (Passive Infrared) sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason, they are commonly found in appliances and gadgets used in homes and other businesses. [1]

When the intruder comes in the range of the PIR sensor, it being a motion sensor senses a presence, then activates the Raspberry Pi, which in turn activates the PI camera.

Fig 1: Software Model



Now, that the Pi-Camera has been captivated; as per the settings initiated in the coding of the security system, the PI-Camera will capture 3 images (the number can be changed); and then send them to the designated person's email address, with the time and date. [2, 3] The software runs a Python command line. Using the requisite code for the software one can:

- Use the PIR sensor, to make the raspberry pi as soon as there's an activity or movement around it.
- Use the PI-camera to capture the image and then send an image of the intruder via an e-mail to the designated e-mail id.
- Using MPMEG streamer to get the live feed anytime anywhere.

2.2 SMTP

The SMTP - Simple Mail Transfer Protocol (SMTP) is an Internet standard for electronic mail (email) transmission. First defined by RFC 821 in 1982, it was last updated in 2008 with Extended SMTP additions by RFC 5321, which is the protocol in widespread use today. SMTP is a connection-oriented, text-based protocol in which a mail sender communicates with a mail receiver by issuing command strings and supplying necessary data over a reliable ordered data stream channel, typically a Transmission Control Protocol (TCP) connection. An SMTP session consists of commands originated by an SMTP client (the initiating agent, sender, or transmitter) and corresponding responses from the SMTP server (the listening agent, or receiver) so that the session is opened, and session parameters are exchanged. SMTP.com is an independent service provider exclusively focused upon the execution of outbound email delivery for marketing, enterprise and personal applications.

Registering an account at SMTP.com gives you access to relay quota which is being reset every month on a date of registration. All email traffic can be split into streams - senders. Each sender has a unique pair of login and password for accessing SMTP.com outbound email servers (ServiceName.smtp.com, plain/tls ports: 25, 2525, 25025 and ssl port 465).

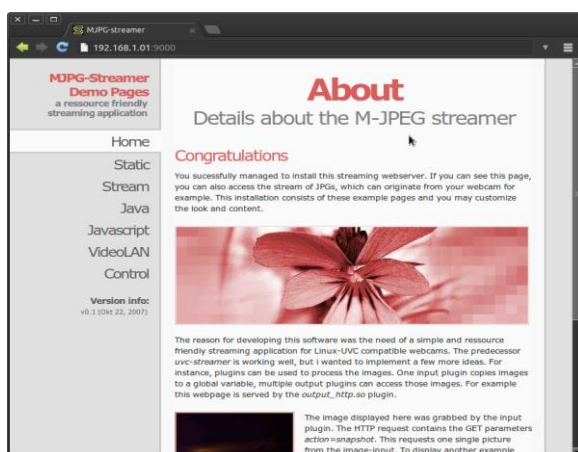
2.3 MJPG streamer on raspberry Pi

MJPEG-streamer is a command line application that copies JPEG frames from one or more input plugins to multiple output plugins.

It can be used to stream JPEG files over an IP-based network from a webcam to various types of viewers such as Chrome, Firefox, Cambozola, VLC, mplayer, and other software capable of receiving MJPG streams.

It was originally written for embedded devices with very limited resources in terms of RAM and CPU. Its predecessor "uvc_streamer" was created because Linux-UVC compatible cameras directly produce JPEG-data, allowing fast and performant M-JPEG streams even from an embedded device running OpenWRT. The input module "input_uvc.so" captures such JPG frames from a connected webcam. mjpg-streamer now supports a variety of different input devices. Below is the image of M-JPEG Streamer on Raspberry Pi.

Fig 2: MJPG Streamer on Raspberry Pi



3.0 Security System Design

The main objectives are to design and to execute a cost effective and open source home automation system that's capable of leading most of the home and sustain the house automation system.

The projected system can make use of wireless Wi-Fi HotSpot connections between various sensor, hardware modules and server, and various communication protocols between users and server.

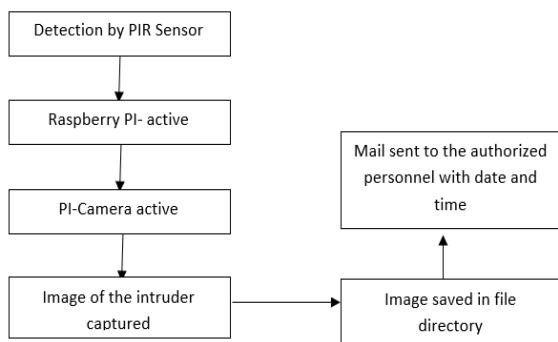
- After successfully installing Raspbian OS on Raspberry Pi, the user needs to **install Pi camera library files** for run this project in Raspberry pi.
- **Enable Raspberry Pi Camera** by using Raspberry Pi Software Configuration Tool (raspi-config).
- Then select Enable Camera to enable it.
- Then **reboot Raspberry Pi**, by issuing `sudo reboot`, so that new setting can take. Now the Pi camera is ready to use.
- Now the user will have to install software for sending the mail, using `ssmtp` which is an easy and good solution for **sending mail using command line or using Python Script**. When done, the two libraries have to installed in order to get smpt command to start working.
- The Python Program of this project plays an instrumental role to perform all the operations. First, the user will have to include required libraries for email, initialize variables and define pins for PIR, LED and other components. For sending simple email, smtplib is enough but to send mail in cleaner way with subject line, attachment etc. then we will have to use MIME (Multipurpose Internet Mail Extensions).
- Having done so, now initialize Mail and define mail address and messages.
- The function `def capture_image ()` is used to **capture the image of intruder** with time and date.
- When PIR senses movement, the data is recorded, the Raspberry Pi calls the `capture_image ()` function to capture the image of intruder and send an alert message with the picture of intruder as an attachment.
- The `send mail` inside `capture_image ()` functions have been used for sending the mail. [4-7]

So, this how this Raspberry Pi Security System works, and instead of a PIR sensor, we can also use Ultrasonic sensor or IR sensor to detect the presence of burglar or intruder.

- Working of this Project is very simple. A PIR sensor is used to detect the presence of any person and a Pi Camera is used to capture the images when the presence it detected.

- Whenever anyone or intruder comes in range of PIR sensor, PIR Sensor triggers the Pi Camera through Raspberry Pi.
- Raspberry pi sends commands to Pi camera to click the picture and save it. After it, Raspberry Pi creates a mail and sends it to the defined mail address with recently clicked images. The mail contains a message and picture of intruder as attachment.
- Here the pictures are saved in Raspberry Pi with the name which itself contains the time and date of entry. So that we can check the time and date of intruder entry by just looking at the Picture name [8].

Fig 3: Flowchart shoeing Home Security System Process



4.0 Results

When the intruder comes within the vicinity of PIR sensor range, his presence gets detected, which further activates the Raspberry Pi. Then a command is sent to the Pi Camera, to click the picture of the intruder at that instant. The number of pictures can be set, by coding in Python. Now, that the picture has been clicked, using the SMTP, a mail containing the date, time and picture of the intruder will be sent to the authorized e-mail address. Following are the results captured: Now, that an intruder has been sensed around, the Raspberry Pi will send an alert/email to the designated email id.

5.0 Conclusions

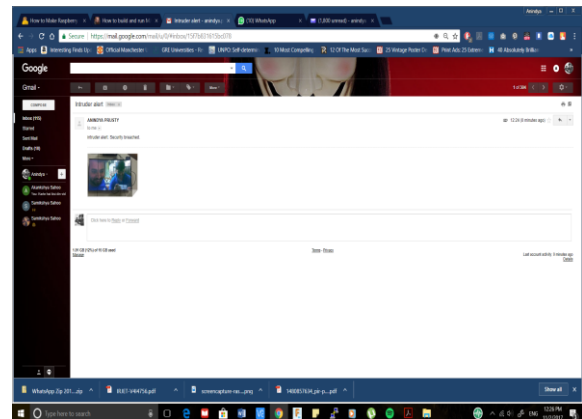
In this paper, an IoT Based Home Security System with Live Streaming over Raspberry PI 3 platform was presented. The system is based on a Raspberry Pi platform, a hardware which has evolved through several versions and feature variations in

CPU capabilities, memory capacity and peripheral-device support.

Fig 4: Input image by the PI-Camera



Fig 5: Image input to Email



The system operates on image frames acquired with a Pi Noir camera board, along with a PIR sensor, which is used to detect motion. The camera has no Infrared IR filters, providing thus great capabilities also for low light conditions. The performances of the system are more than enough for the application itself required in matter of response time and compensation of low image resolution by considering the classification results of subsequent frames. Considering the complete integration on an embedded device, the system operates autonomously, reporting only the finals classification results to the control module for the barrier control.

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