

# AN IoT APPROACH FOR MOTION ACTIVATED SECURITY CAMERA AND SURVEILLANCE SYSTEM

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**Abstract:** In this paper, we are providing a home security for the theft by implementing surveillance system using RP and PIR sensor. Now-a-days, the IoT plays a major role in many fields by automating the application. For example: If an Intruder or unauthorized persons enter into our zone the PIR Sensor detects the person activity then the security system capture the image of the unauthorized person and also give real time alert SMS to the authorized person. The image is captured using camera module which is attached to RP. The captured image is sent to authorized user via g-mail by using inbuilt WIFI module in RP. If the captured image matches with the images present in the database the door is opened automatically.

**Index Terms - Raspberry Pi (RP), Passive Infrared (PIR) sensor, Internet of Things (IOT), Face Recognition, Motion Detection, Smart Door Unlock, Haar Classifier.**

## I. INTRODUCTION

The technology has made lots of changes in the world. The next century will come become more comfortable base on the bright rise in technologies. The recently emerging technology in real world is the IoT. This technology has bright growth to make the complete system a smart one. The development was the surveillance system. There were lots of inventions developed in the field of IoT and the most recognized one was the surveillance system development. There were lots of advancements in the wireless technologies such as domain, cloud and many other technologies which were included in the system to show something new. IoT will include many devices such as electronic, electrical and IT related works.

Surveillance system consists of many systems that has to be monitored properly and must be handled carefully so that the system does not fail for any improper handling of the devices. The issue that people faced after many days is that the problem of connectivity. Among many IoT applications the smart surveillance system plays a vital role in realizing the smart cities. The Government of India has proposed to develop many smart cities across the country which will create a huge demand for smart home automation solutions in near future. In smart surveillance the word "smart" means context aware this can be realized using IT and IOT.

Every individual dreams to have a Safe and cheap security system. A security progression over a highly arcane area at a very low cost and which can it provide a security is appreciable. This project serves to be beneficial to any person who can incur a secure and cheap product which could provide alert features to any device that carries an active SIM (Subscribers Information Module). Developments in information technology have made automation very easy in many applications like biometrics. Recent technologies have made the concepts of smart homes very popular. Home security systems are becoming popular along with prominent features on mobile devices.

Here the embedded system used is Raspberry Pi which is operated by an Open CV. The locker room is continuously monitored through a webcam, which starts recording when it senses change in motion. This system aims to reduce the unwanted storage hence it records when there is motion detected in the image. It works by comparing the image frame that is captured onto a webcam following which it relates the previous frame with current frame and the same procedure is repeated as a loop. If there is an intruder in the surveillance area the Raspberry Pi sends alert information to the authority by mail along with the intruder image which is obtained by the video that captures the image continuously. Even simulations can be executed using Raspberry Pi boards.

## II. LITERATURE SURVEY

Neha Gaba et al, Identification and Tracking of object is an important factor in analysis of video in a surveillance system. A series of techniques for detection of motion have been design and developed in the past decade. One of the most recent and relevant high precision technique being temporal differencing, which is considered to be most advanced of all. The temporal differencing technique employs pixel-by-pixel difference between consecutively incremental frames, thereafter the threshold is decided based on averaging of differences to establish the foreground object. The presented paper describes an advanced algorithm based framework which is capable of producing background with almost null noise pixels. It also overcomes the trails of artificial "ghost". [3]

K.N Karthick Kumar et al, To improve the calculation of the project, it is isolated into two sections motion detection and motion recognition Raspberry Pi camera catches the picture and uses foundation subtraction calculation to recognize movement. The principle of PIR sensors is based on the fact that everything emits a small amount of infrared radiation. The system is also equipped with a remote monitoring facility. To enable remote monitoring, we must configure the Wi-Fi router. In conclusion, PIR motion sensors and camera modules are cost-effective surveillance mechanism. [4]

Shakthi Murugan.K.H et al, The security automation system works by a custom made Raspberry Pi will be fixed at the surveillance area which controls for the video camera. The system consist of a monitor, Raspberry Pi, GSM Modem, HD camera, VGA converter, connectors, key board, mouse and connectors. The GSM modem is connected to the system by means of a USB port present in the Raspberry Pi. The USB port acts as our alert system. Open Computer Vision is a library function that enables real time video and image processing enabling the computer to see. By using the intelligent surveillance system we can reduce the

video storage system for a huge extent since it will store the video only if it detects any motion and also it reduces the cost of the entire system. [5]

Ansari et al, the project aims to simplify motion detection and the interface to be user friendly, which would send prompt notifications when motion is detected. The Raspberry Pi being small as a credit card server still has the capabilities of working as a normal computer it can play 1080p resolution without lagging. Although Raspberry Pi can perform discrete tasks, it has some limitations due to its hardware. As the user would also get a notification of the motion detection they can login remotely to the Raspberry Pi and check live output from the camera. By enhancing the capabilities of these technologies and integrating them, we hope to introduce the motion detection system and to contribute to the current security system. [6]

Li Fang et al, The task of a motion detection surveillance system is to detect a “region of interest” present in a “region of awareness”, where the region of awareness, or the field of view, is defined as the portion of environment being monitored”. Method for motion detection can be categorized into two main classes, i.e. pixel-based and region-based algorithms. Efficient and convenient motion detection surveillance is proposed in this work. The system captures images only when the motions exceed a certain threshold that is preset in the system. [7]

### III. COMPONENTS AND IMPLEMENTATION

#### 3.1 HARDWARE COMPONENTS

##### 3.1.1 Raspberry Pi

Raspberry Pi is shown in Fig. 1. It is a single board computer developed by Raspberry Pi foundation in the United Kingdom. It is the advanced form for microcontroller. Windows OS is used as an operating system. To transmit an image capture by a camera module to the mobile phone through mail, Windows OS has to be installed.



Fig. 1. Raspberry Pi

##### 3.1.2 PIR (Passive Infrared) Sensor

A PIR sensor is a motion detector that senses the heat emitted by a living organism. They are very effective in enhance in home security systems. The sensor is passive, it emits microwave energy or beam of light, and instead this sensor is sensitive to the IR energy emitted by a living thing. When an intruder walks into the detector’s field of vision, the detector views a sharp increase in IR energy. PIR sensor reacts only for the moving object and doesn’t react to the stationary objects. The camera module is to monitor the current situation.



Fig. 2. PIR Sensor

##### 3.1.3 Camera Module

The Raspberry Pi Camera Module v2 replaced the original Camera Module in April 2016. The v2 Camera Module has a Sony IMX219 8-megapixel sensor (compared to the 5-megapixel Omni Vision OV5647 sensor of the original camera). The 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 if you’re looking to expand your knowledge. There are lots of examples online of people using it for time-lapse, slow-motion, and other video cleverness. You can also use the libraries we bundle with the camera to create effects.



Fig. 3. Camera Module

### 3.2 SOFTWARE REQUIREMENTS

#### 3.2.2 Raspbian OS

Although the Raspberry Pi's operating system is closer to the Mac than Windows, it's the latter that the desktop most closely resembles. It might seem a little alien at first glance, but using Raspbian is hardly any different to using Windows (barring Windows 8 of course). There's a menu bar, a web browser, a file manager and no short age of desktop shortcuts of pre-installed applications. Raspbian is an unofficial port of Debian Wheezy arm with compilation settings adjusted to produce optimized "hard float" code that will run on the Raspberry Pi. This provides significantly faster performance for applications that make heavy use of floating point arithmetic operations. All other applications will also gain some performance through the use of advanced instructions of the ARMv6 CPU in Raspberry Pi. Although Raspbian is primarily the efforts of Mike Thompson (mthompson) and Peter Green (plugwash), it has also benefited greatly from the enthusiastic support of Raspberry Pi community members who wish to get the maximum performance from their device.

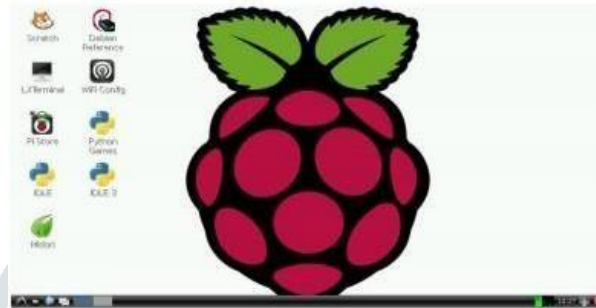


Fig. 4.Raspbian OS

#### 3.2.2 Open CV

It is a library of programming functions mainly aimed at real-time computer vision. It is developed by Intel research center and subsequently supported by Willow Garage and now maintained by itseez. It is written in C++ and its primary interface is also in C++. Its binding is in Python, Java, Matlab. Open CV runs on a variety of platform i.e. Windows, Linux, MacOS, open BSD in desktop and Android, IOS and Blackberry in mobile. It is used in diverse purpose for facial recognition, gesture recognition, object identification, mobile robotics, segmentation etc. It is a combination of Open CV C++ API and Python language. In our project we are using Open CV version2. Open CV is used to gesture control to open a camera and capture the image. It is also used in the image to text and voice conversion technique.



Fig. 5.Open CV

### 3.2 WORKING

When a person arrives at the door, the camera will detect the motion and capture the face of the person. The image is given to the Raspberry Pi through the USB port in the raspberry Pi. After receiving the image, that is given to the processor for further processing. Initially, the library files and the programs installed in the SD card. This SD card is paced in the SD card slot. The face recognition program will run while receiving that image. For recognizing the face, Local Binary Pattern Histogram algorithm is used. Haar feature is a wavelet-based feature that decomposes images. The function of cascade classification is to combine more features efficiently. In the beginning, the image process of Haar is only based on RGB value of each pixel, then process the image in rectangle shapes is processed and the limit level is occurred after that which shows dark and light area. These images are compared with the images which are already stored in the database .If it does not match with the images in data base, the camera starts to record the video of the event for a particular time period. That time period will be specified in the program and the video will be captured. The captured intruder image is sent to owner through email and SMS. If the captured image matches with the images in the database the door is opened automatically.

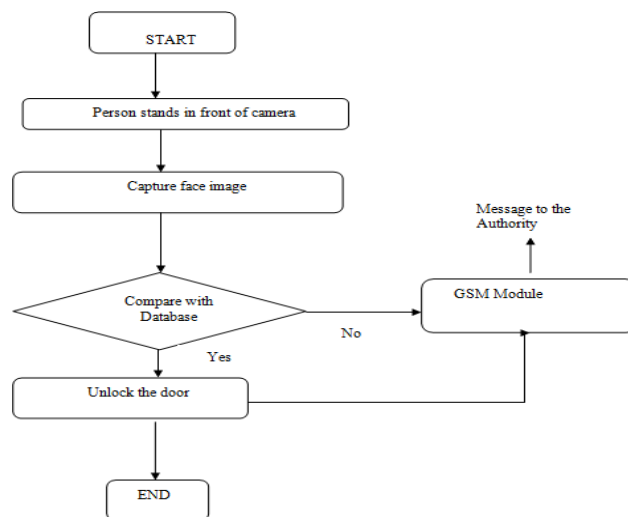


Fig. 6.Flow Chart of the complete System

#### IV. EXPERIMENTAL RESULTS

The Face Recognition system is divided into 4 modules- Dataset creation, Training the dataset, Testing and sending alert messages as an extension.

##### 1. Database creation

- a) Initialize the camera so that it captures the images for the dataset
- b) Give a unique id for every person
- c) Convert the image into gray scale, detect the face and
- d) Store it in dataset by using given input as label up to desired frames.

##### 2. Training

- a) Initialize LBPH face recognizer.
- b) Get faces and Id's from dataset folder to train the LBPH face recognizer.
- c) Save the trained data as xml or yml file.

##### 3. Testing

Load Haar classifier, LBPH face recognizer and trained data from xml or yml file.

- a) Capture the image from camera,
- b) Convert it into gray scale,
- c) Detect the face in it and
- d) Predict the face using the above recognizer.

##### 4. Sending Alert Message

- a) If the image is detected as unknown
- b) Raspberry Pi activates the Twilio API
- c) Through Twilio API owner receives a message having the body as "Unknown Person Detected"

Table 4.1 Testing Expected Output vs Results

Test case No	Input	Expected output	Actual output	Result
1	Camera module	Capture image	Person's image	Expected output matched the actual output
2	Image	Check whether the image is of known or unknown person	Known or Unknown	Expected output matched the actual output
3	Image of known person	No alert is sent and the door unlocks automatically	Door Unlock	Expected output matched the actual output
4	Image of unknown person	Alert is sent to the owner through Twilio API	Alert sent	Expected output matched the actual output



Fig. 7. Datasets



Fig.8. Image of Known Person



Fig.9. Image of Unknown Person



Fig. 10.Alert Received through Twilio API

## V. CONCLUSION

The arrangement of a facial recognition system using raspberry pi can make the system littler, lighter and work successfully utilizing lower control use, so it is more convenient than the pc- based face recognition system. It is open source software on Linux. Also, send a security alert message to the authorized person utilities. We are also providing power backup for the smooth and continuous functioning of the system in case of power failure. The power bank is used to charge the Raspberry Pi so there is less chance to slow down the system. This development scheme is cheap, fast, and highly reliable and Raspberry pi takes less power and provides enough flexibility to suit the requirement of different people. By using this intelligent surveillance system we can reduce the storage system for a huge extent since it will store the image only if it detects any motion and also it reduces the cost of the entire system. It does not need any manpower to monitor continuously and hence it also reduces the man power required for surveillance system. We can apply this to all the secured places such as bank lockers, ATM centers, etc., It's a progress of realizing embedded image capturing system and experimental prototype of the embedded image capturing system with Raspberry Pi system.

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