

Smart Surveillance and Monitoring System using Raspberry Pi And Android

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ABSTRACT

Raspberry pi system is much cheaper, low power and advantageous over traditional CCTV camera system with standalone and atomic feature. Here Pyroelectric infrared (PIR) sensors are used instead of any algorithm for motion detection. Whenever the motion is detected through PIR sensor inside the room, the image is captured through camera and temporarily stored in the raspberry pi module. Internet of things based application can be used to control the Pi remotely even if user is not connected with same local server. After successful authentication in device, user is allowed to select difference application in which he can control raspberry pi in different ways and monitor the activity captured by camera. After motion detection user get push up message on android without any delay .If more attention is needed for security, user can also view the live streaming data. Stored image inside the SD card is then backed up in the Google drive account.

Keywords: Raspberry Pi, PIR sensor, USB camera, Python

1. INTRODUCTION

The Surveillance means to monitor something. Security in residential complexes is restricted to limited geographical locations due to the traditional devices and process used for securing any apartment or complexes. High Definition Surveillance Camera using raspberry pi is set up in the areas which need to be monitored. This system is motivation from other papers which explains similar systems with some disadvantages which is tried to be solved. It also includes some additional feature like data backup, push alert messages instead of SMS schemes which requires additional hardware like GSM. New technologies are also included like IOT (Internet of thing) based application and use of Android device concept in place of PC. System is built in general purpose and so area is not limited for the use of system and include many application where it can be used which replace existing system. It is also user friendly as if user can access the system from remotely as well as locally as per the situation. Two different controlling android applications are provided for accessing raspberry pi through command line or GUI based.

The smart phone has remarkable power in computation as well as a very convenient operation such as camera monitoring or wireless internet access by WIFI. Various application programs are open to market or developed. With the help this powerful smart phone applications, the system becomes smarter and more intelligent. Anyone finding the need to keep a watch on security through remote location is a potential customer of the product.

Starting from small houses to huge industries, video surveillance plays very vital role to fulfil our safety aspects as Burglary and theft have always been a problem. In big industries personal security means monitoring the people's changing information like activities, behaviour for the purpose of protecting, managing and influencing confidential details. Surveillance means watching over from a distance by means of electronic equipment such as CCTV cameras, PC for monitoring and additional wiring things. But it is costly for normal residents to set up such kind of system and also it does not inform the user immediately when the burglary happens. Whereas, here ,even if the user/owner of the system is moving from one place to another ,he/she can keep track of what is happening in that particular place.

Just because all of those weak points of the surveillance system, an energy efficient portable system is proposed, that can take pictures or videos when the burglary happens and send out an alert signal at the same time is much better than the currently in use surveillance systems. In this system, Motion detection feature is also included and authentication is required on the user side in order to view the streamed video in the browser which reduces hacking of data.

Advantage:

- It offers privacy on both sides since it is being viewed by only authorized person.
- It is a simple circuit .the operating system used here is Raspbian OS. Raspbian OS has to be installed so that the image can be transmitted to the smart phone.
- It is simple to implement, small size portable stand-alone device with its own power source, energy capable with instantaneous alert, truly cheap for residential and personal use.

Internet of Things (IoT) is an ongoing development of the internet by which everyday 'things' objects have communication capabilities which allow them to send and receive data. IoT based application can be used remotely to view the activity and get notification when motion is detected.

2. EASE OF USE

A. Selecting Components

Raspberry pi: It is having a feature like Broadcom BCM2836 Arm7 Quad Core Processor powered Single Board Computer running at 900MHz, 1GB RAM, 40pin extended GPIO, 4 x USB 2 ports, 4 pole Stereo output and Composite video port, Full size HDMI, CSI camera port for connecting the Raspberry Pi camera, DSI display port for connecting the Raspberry Pi touch screen display, Micro SD port for loading your operating system and storing data, Micro USB power source.

Android device: As mentioned in the title smart surveillance word is that which means surveillance can be controlled and monitored remotely through android device which eliminate the need of LCD display.

PIR sensor: sensors are sensitive to moving objects radiating IR light, whose temperatures are above absolute zero emit infrared radiation. Pyroelectric infrared (PIR) sensors are widely used as a simple but powerful people presence triggers. It could achieve 89%–95% recognition accuracy according to machine learning algorithms, low cost and power consumption, small form factor, and unobtrusive and privacy-preserving interaction ^[1]

USB Camera: Most have some sort of ball-head type mounting, which allows to re-position the camera as needed. Features like Longer, flexible USB cable when compared with raspberry pi camera which is having Short, fragile, and inflexible ribbon cable and camera board is best when camera will be mounted in the same box as the Raspberry Pi (or close by), ideally with everything but the lens internal to the box. Most are supported by Video4Linux, which let to use it with nice software like Motion and GStreamer. Available with different camera pixel resolution as per the application and less cost effective compared to pi camera.

B. Proposed work

Smart surveillance system operated via android device by owner remotely as well as locally. IOT application for remote controlling is used, system will send the push notification to android device when an intrusion is detected inside the room. It is required to develop and implement and affordable low cost web-camera based surveillance system for remote security monitoring. Authorized user can access to their monitoring system remotely via internet with the use a mobile phone and monitor the situation on application. This entire work is done on raspberry pi with Raspbian operating system ported on it. If more attention is required additional live video streaming is also included.

System Monitoring: This system has the capability to monitor a location away from the surveillance area through android device. It also consist two parts:

1. Local Access: If person is connected with local server same as the system, he can control the raspberry pi and monitor the area in form of image/ video through android application.
2. Remote Access: Even if user with android device is away from the system but connected with the separate internet plan then controlling of raspberry pi is possible with the IOT application named “Dataplicity”.

C. Block Diagram

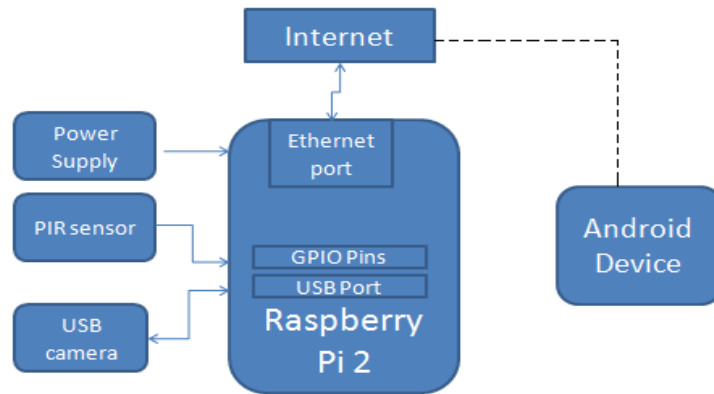


Figure 1. System block diagram

The block diagram shows that the project is divided into two sections. The raspberry pi will be placed in surveillance area, spying the activities connected with components like PIR sensor, power supply, USB camera and internet through LAN. And the controlling and monitoring the area can be done from any part of the world through android application. The system consists of an USB camera to capture the image from the crime scene, and transmit the same to the application. The owner can view the image/video with secured login and password. We are using internet to control the system as well as sending notification on user mobile as popup message when an intrusion is detected.

D. System Flow

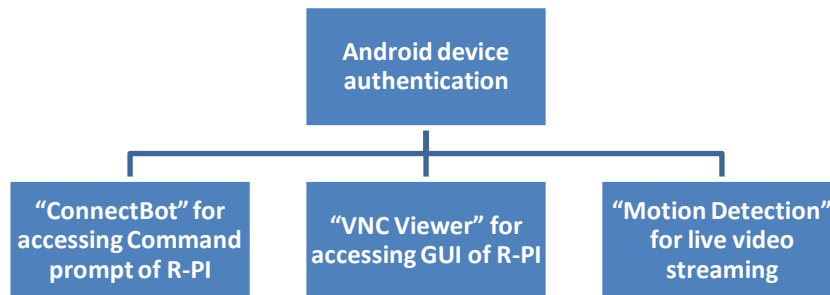


Figure 2. Application selection for different local access control

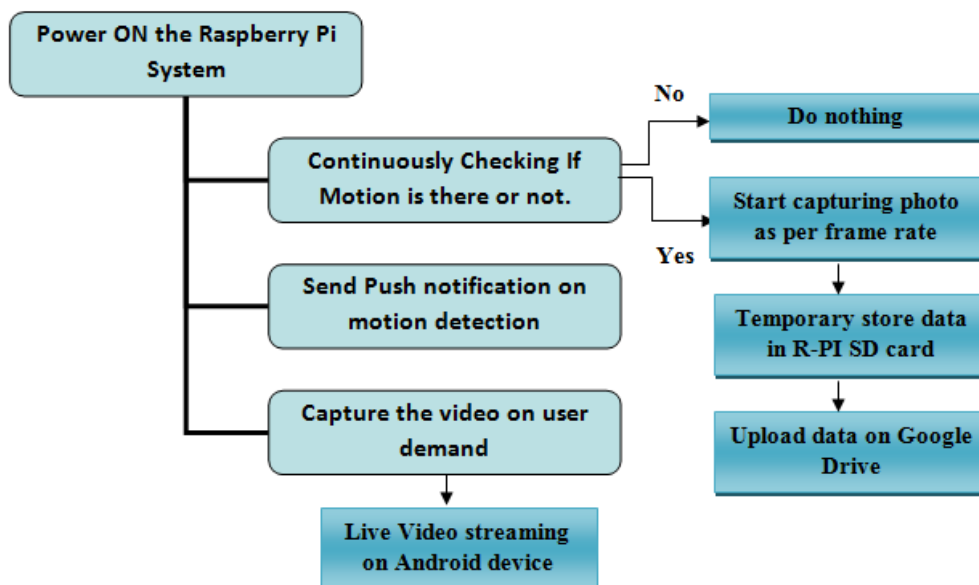


Figure 3. System Flow diagram

System is operated through android application. As shown in the figure 2, Various application are used based on the user controlling requirement. First of all user having a android device require authentication password to access android device. After login into the device, he needs to select the android application.

1. Connectbot if access of command prompt of raspberry pi is required.
2. VNC Viewer if access of GUI of raspberry pi is required.
3. Motion Detection if live streaming monitoring is required

Figure 3 shows the basic system flow diagram of system. Whenever R-pi get the power supply it continuously check motion inside the room is there or not. And send the push notification on motion detection to the android device. If motion is there it captures the image and store temporarily on system. Later on Image data is backed up on the Google drive. We can control when to back up the system remotely. Everyday auto back up feature is also included. If user is connected with the same network he can monitor the live streaming video data in his android device.

PuTTY works by sending typed commands and receiving text responses over a tcp/ip socket like a traditional terminal (TTY), but it uses secure socket (SSH) with public key encryption wrapping the packet payloads. Pu (Public Encryption) + TTY (Teletype). System local access can be performed through PuTTY even if raspberry pi is not connected with any LCD display.

Pushetta provide push notification from cloud after getting registered on Pushetta website. After registering it requires System requires 650 mA@5v power supply and internet. System works on Raspbian Os and image is captured through Opencv and programming is done in python scripting language.

3. IMPLEMENTATION

Main aim of this paper is to control the system through android device. System contains a word like smart monitoring and surveillance which is fulfilled here. “Smart” itself suggests that system can be operated remotely via internet. At the raspberry system side, it is connected via RJ-45 Ethernet cable to the internet. To control raspberry pi via android it should also be in the same network. Through router, one WiFi connection is provided to the android device.

Raspberry pi is connected with the USB camera, PIR sensor, power supply and internet via RJ-45. One android device is there which is not connected with any other wires but using WiFi facility, connected with router having own IP address and one android application is running inside looks like command window of raspberry pi.

Android application named “Fing” is used to find the IP address of raspberry pi, shown in figure 4. Right side image is the application named “connectbot” is running on android device which is controlling raspberry pi with its IP address and port number. It is used to run command locally.



Fig.4 android application to operate command line of android

Android app “VNCViewer” is running in next image that enables user to remotely access and control raspberry pi from Android device. User can see the desktop, run applications, change settings, and access data exactly as though you were sitting in front of a computer. One software “tightvncserver” needs to be installed in raspberry pi.

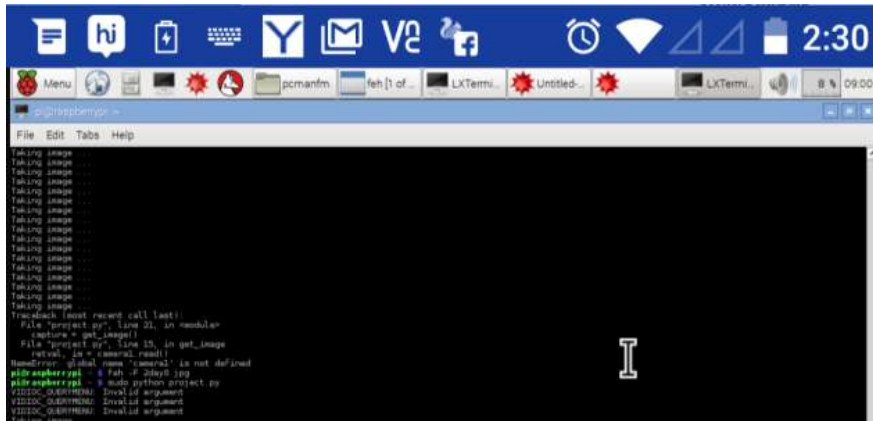


Fig.5 android application to operate GUI of android

To log in to Raspberry Pi remotely, we need the IP of the Raspberry Pi – this is basically like house address and tells the host device where to look for it on the network. By default, the Raspberry Pi will be given an IP automatically by the router (called Dynamic IP and denoted by DHCP) when we connect to a network. However, this can change whenever we remove the Pi from the network e.g. turn it off. Here one android application is used to find out the dynamic IP address of raspberry pi but as if system need to be real time, it is beneficial if set static IP for the Raspberry pi. `$sudo nano /etc/network/interfaces` is used to make changes in interface file related to IP settings.

After capturing images, temporarily all are stored in SD card and if user want to view the images there are two methods

1. Local access :Using GUI android application VNC Viewer
2. Remote access :Google Drive

It's useful even necessary as SD card is having very limited space. And images can be viewed remotely and user can keep eye remotely on surveillance area. For that Raspbian Os require some packages to be installed which supports Google drive account upload data in raspberry pi like `libcrypt11-dev libjson0-dev libcurl4-openssl-dev libexpat1-dev libboost-filesystem-dev libboost-program-options-dev binutils-dev libboost-test-dev libqt4-dev libyajl-dev`. If user is having a Google drive account, he can use the grive program to sync a folder on Pi with Google drive.

After installing `tighttpd` in the raspberry pi, PHP script is also needed to be installed to support through command: `sudo apt-get -y install php5-common php5-cgi php5`. After setup, default webpage is generated.

To start live streaming command below is needed to be run then only user can able to watch the video on these created webpage. Secure network is created, only authenticate person having username and password is able to watch live stream data on his device locally.

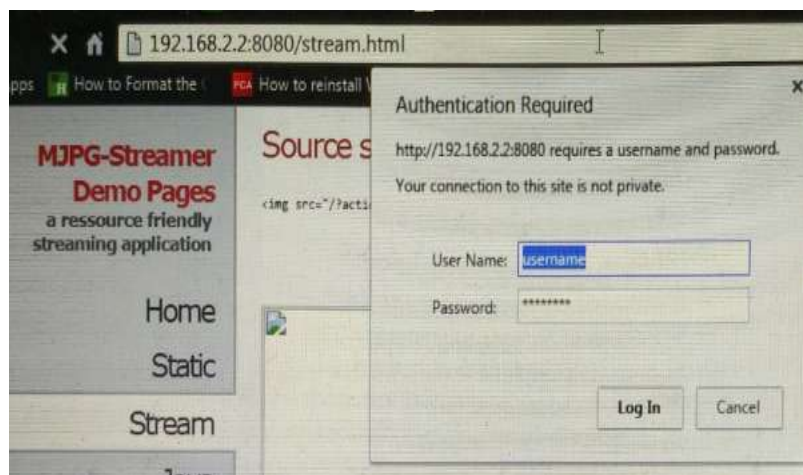


Fig. 6 Authentication page for live streaming

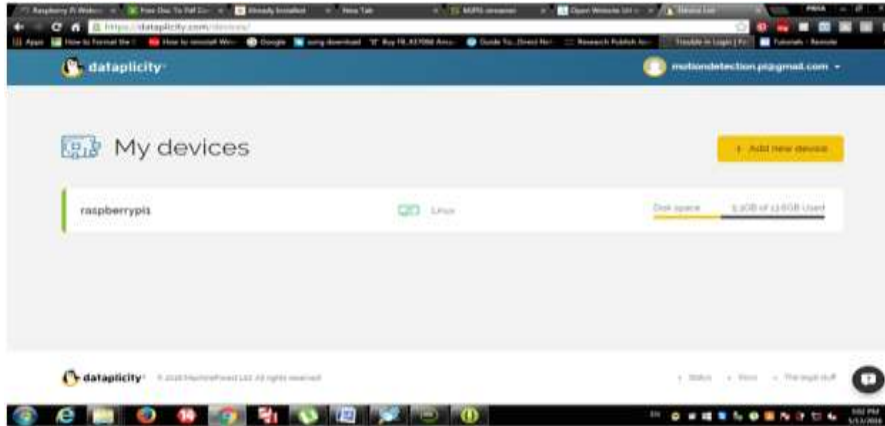


Fig. 7 Dataplicity page for remote access

Android application is created on eclipse to control the raspberry pi remotely. IOT application is running on android to access raspberry pi remotely when user is not connected on same network. As shown in figure android emulator is running on eclipse software, checking the working of newly created android application named “Motion Detection”.

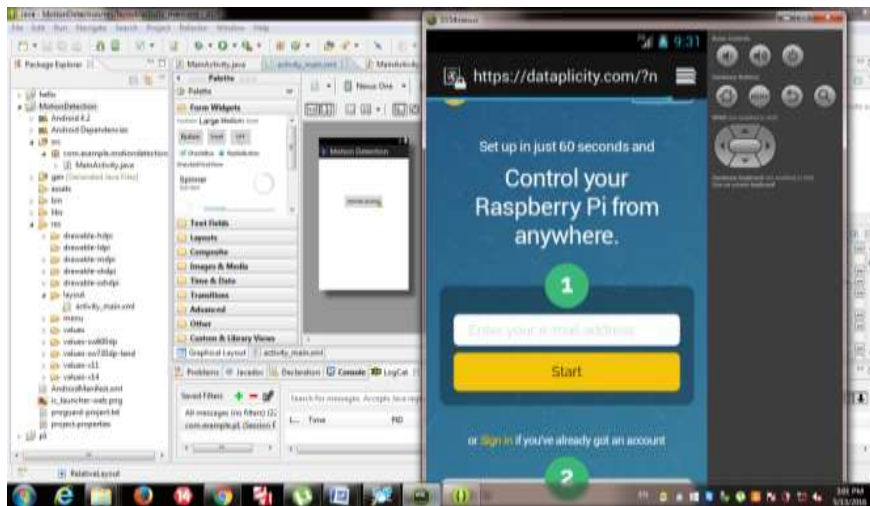


Fig. 8 Emulator running in eclipse for Motion Detection App creation

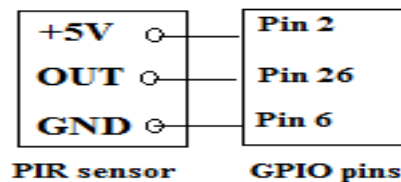


Fig. 9 Interfacing of Raspberry pi with PIR sensor

In part of interfacing PIR sensor is connected with the GPIO Pins as shown in above figure., USB camera with the USB port of PI and one python script is written inside the raspberry pi which captures the image on motion detection.



Fig.10 Image captured via USB camera

As mentioned earlier on motion detection one push notification is sent if any motion is detected via PIR sensor. For that channel is created on Pushetta application which receives the message on motion detection. SVIT named channel is created on application.

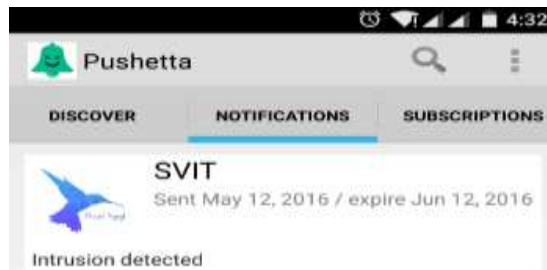


Fig.11: Push notification on motion detection

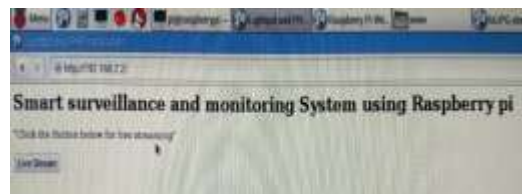


Fig.12: Webpage for video streaming

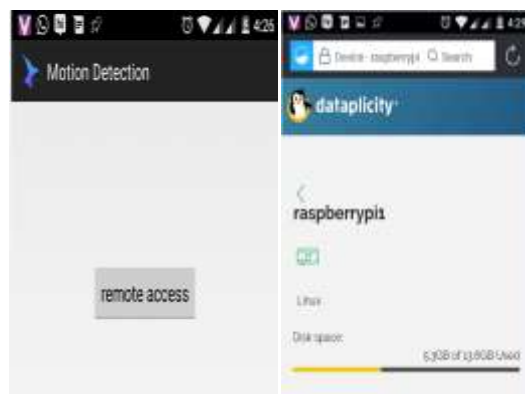


Fig.13: Android application for remote access controlling of R-pi

3. CONCLUSION

The smart surveillance system has been aimed to design in such a way that it can fulfil the needs of the user for particular surveillance area. It has countless applications and can be used in different environments and scenarios. For instance, at one scenario it can be used by any person working in industry to be aware of the activity being happened at their own working places, in their absence, while at another instance it can be used for spy purposes at bank lockers, storage houses. If user is near to the system, local access is available through android device and if he is at some remote location “motion Detection” named android application is developed for remote access. With additional feature of video monitoring on user requirement system becomes smarter.

4. FUTURE EXPANSION

One application should be developed which include remote controlling as well as video monitoring when user is away from the surveillance site. User can also view captured image remotely on this application. It will be beneficial if all the application used here is merged on same application so it can be user friendly application.

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