Surveillance Camera using IoT and Raspberry Pi

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Abstract—Security remains as one of the most important aspects of smart cities. At present, due to the increased population and urbanization there is a huge demand for smart security system. But, existing CCTV and IP cameras are inefficient interms of image quality and these systems require large amount of storage space. Hence, this paper proposed a surveillance camera by employing Raspberry Pi and IoT. It will make use of raspicam camera for capturing the images. The proposed surveillance system requires less storage space as it records the video and captures the images only when the motion is detected in the monitored area. Motion detection can be done by using PIR sensor. The implementation of the proposed surveillance camera is simple, where the captured data is encrypted at the transmitter side and decrypted at the receiver side. Hence, the proposed system provides a secured data transmission. The live feeding is deployed by using Raspicam Remote App. The proposed model can be easily configured, where it allows us to test the image filters of the camera. Hence, the proposed surveillance camera using raspberry pi and IoT appears to be more superior to the conventional IP cameras.

Keywords—*Security; PIR sensor; motion detector; raspicam remote app.*

I. INTRODUCTION

It is not always possible to keep an eye on our home or businesswhen we are away from them [1-2]. Then, we can make a surveillance world to watch whenever important things happen using a low-cost solution. This is done by a surveillance camera. Conventional CCTV cameras are inexpensive, but anyone can observe our signal and video feed using wireless receivers. A surveillance camera can be defined as security technology that records the activities of people such as detecting, preventing or investigating the threats to public or crime. It prevents public from threats and useful in crime investigation. It safety for public.

Surveillance cameras are video cameras which are used for continuous monitoring of a particular area. Recording equipment and cameras are expensive and require manpower for continuous monitoring of video footage. This has been made easier by some automatic software [3]. This software organizes the camera footage using a database. The main responsibility of city authorities is security. It is a networked and digitalized version of CCTV (Closed Circuit Television).

It will encode the signal at the camera and it will send the signal to the video recorder (in this project it is a mobile phone) through the internet protocol. It requires the connection to the same network to which the recorder connected. It will make use of alocal network to view images and for video streaming.
By using mobile App or Software, we can watch the live video through IOS or tablet or android phone [4].

The proposed system has more advanced and successful features and functions over conventional CCTV cameras. Its applications are preventing theft, weather monitoring and vandalism to property [5-6]. Due to low power absorption, small form factor and affordable price, we can easily integrate raspberry into the camera circuit. In this circuit, firstly we should connect raspicam to raspberry pi and stream the live video from the android device and we can save photographs and videos with different aspects [7]. The surveillance camera works within a local area network. The raspberry pi is acredit-card-sized computer which is capable of becoming a surveillance camera along with raspicam and wireless data connectivity (Internet of Things). Surveillance can be defined as monitoring of changing information or behavior to protect or influence the people. This can be done by using electronic equipment. In this project, electronic equipment is a raspberry pi and pi camera.

A. Role of Surveillance Cameras in Public Areas

If there is any crime happens in public places, for higher authorities it is a good chance for identifying the criminals through the video footage [8]. If a person got to know about those security cameras, which are existing in the public area, then he may not willing to commit illegal activity. Security cameras are the primary evidence for the judiciary system, as it captures images and also provides video footage. Saved images and footage helps in solving the case in a faster manner [9]. The arrangement of security cameras in public places is illustrated in fig1. Surveillance can be defined as the monitoring of changing information or behavior activities. It creates a sense of security.

B. Imporatance of Surveillance Cameras at Work Place

At workplace surveillance of video protects the company and employees as well. Installing a surveillance system inside or outside the work helps to record the criminals who steal or vandalize the company properties. The video footage will help them in the investigation and identifying the criminal [10].

Fig.1 Security Cameras at Public Places

For the protection of our privacy and secure of our assets, there is a huge demand for user-friendly security systems. It acts as a crime detector. The object of this paper is to design and implementation of surveillance camera using raspberry pi3, pi camera, PIR sensor and Raspicam Remote app. It is used to record HD video, only if it detects the motion in the monitored area and motion is detected by using PIR sensor.PIR sensor is used to detect the motion in the monitored area. The proposed surveillance camera reduces the storage space significantly compared to the existing conventional surveillance cameras

II. SYSTEM DESIGN AND HARDAWARE ARCHITECTURE

The system design of the surveillance camera is shown in fig.2 [11]. In the design, the camera can be directly plugged into the CSI connector of raspberry pi and it delivers a clear 5MP image or HD video recording of 1080p. The camera module attaches to the ribbon cable of 15 pin to the dedicated camera serial interface (CSI). It was designed especially for interfacing with the camera module. The data transfer capacity of CSI is very high and exclusively it carries pixels to the BCM 2835 processor. Raspberry pi is USB powered. In the figure, raspicamera module is connected to the raspberry pi through the CSI (Communication Serial Interface) connector of a raspberry pi.

III. HARDWARE ASPECTS

A. Raspberry Pi-3

Raspberry pi is a computer of credit card size and it is designed for Linux based operating system. Raspberry pi 3 is built-in with Wi-Fi and Bluetooth for the first time. It is surely positioned as a less cost hub for IoT (Internet of Things). Raspberry pi is a Linux based computer and is shown in fig. 3 [12].
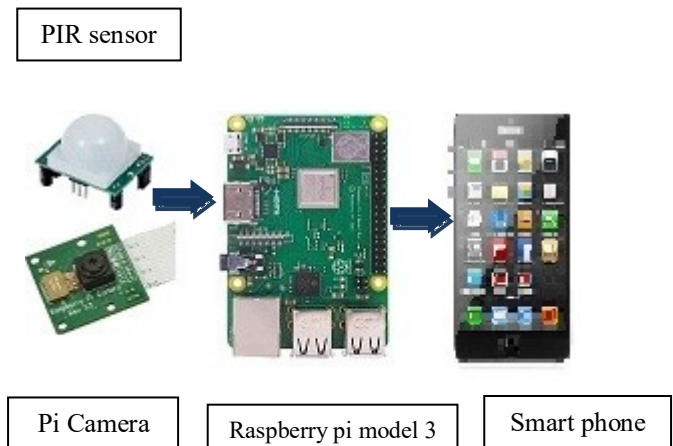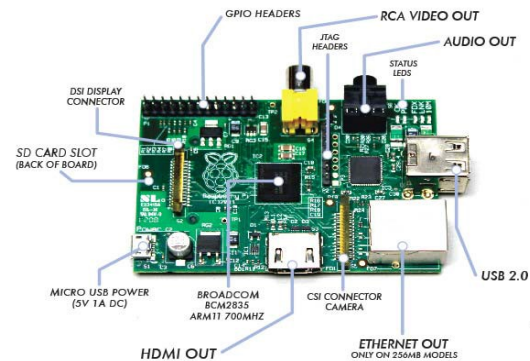

Fig. 2 System Design

Fig. 3 Raspberry Pi-3

The specification parameters and values are shown in the table1 [13].

Table 1

Specification parameter	Values
CPU	QUAD core ARM cortex A53 cortex
Clock frequency	1.2 GHz
Network	10/100 Mbps Ethernet and 802.11ln Wireless LAN
Memory	1GB LPDDR2-900 SDRAM
USB	4

ports	
Video outputs	HDMI and Composite video
GPIO pins	40
Power source	5V via micro USB
Bluetooth	4.1

B. RaspiCamera Module

The Raspicamera plays a key role in the designed architecture, as it is used to capture images and also used for recording videos. The camera supports the latest rasbian version and operating system of the raspberry pi. It used to capture images and high definition (HD) Video [14]. It supports all models of raspberry pi. It is applicable in home security and camera traps of wildlife. It supports different modes such VGA90, 720p60, 1080p30. The raspberry pi camera module is shown in fig 4.
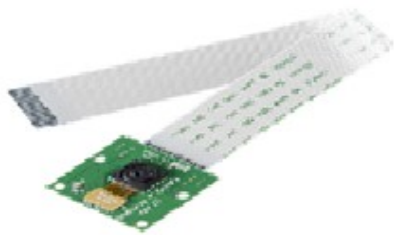

Fig. 4 Camera Module

C. PIR Sensor

PIR sensor basically a motion detector sensor capable of sensing the motion in the monitored area. PIR sensors are inexpensive, small, easy to use, and the PIR sensor is shown in fig. 5.

D. Power Supply and MicroSD Card

We can use any type of power supply that should have a micro USB and it should supply a minimum current 1A. Raspberry pi doesn't have any storage space, hence a microSD card should be used for installing and running the operating system
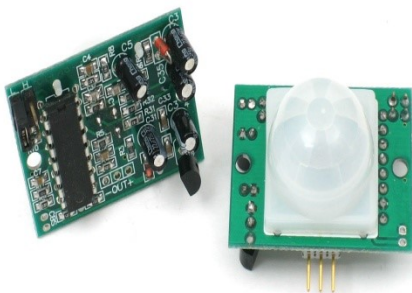

Fig. 5 PIR Sensor

IV. SOFTWARE ASPECTS

A. Rasbian OS

It is a Debian optimized free operating system for raspberry pi. This operating system makes raspberry pi to run successfully. It is a set of utilities and basic program. The installed rasbian OS is shown in fig. 6.
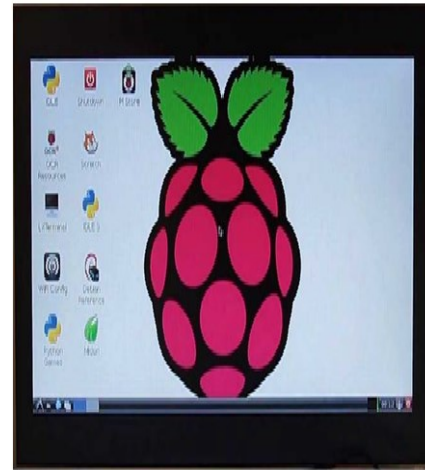

Fig. 6 Raspbian OS

B. VNC Viewer

Virtual Network Computing is a client-server model. It is a remote control software. Any PC can be used with our connected network for accessing the raspberry pi remotely. The IP address of the raspberry pi should be entered for connecting purposes. The installed VNC viewer is shown in fig 7.
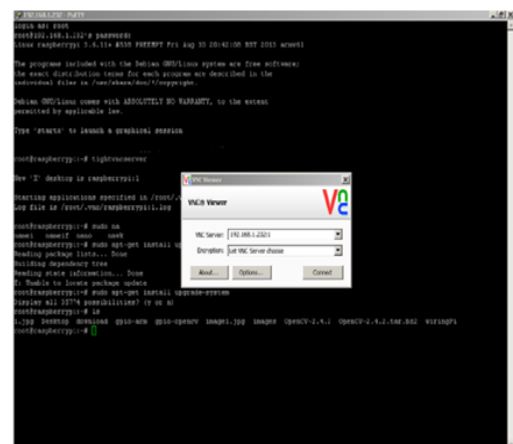

Fig. 7 VNC viewer

C. Raspicam Remote APP

The designed surveillance camera architecture improves the capability of searching. It has the capacity of recording and playing simultaneously. It has the ability of compressing the content for efficient memory usage, provides quality images with less degradation of content and installation, maintenance are simple.

V. ADVANTAGES

The designed surveillance camera architecture improves the capability of searching (linkhttp://whatis.techtarget.com/definition/IP-surveillance), it has the capacity of recording and playing simultaneously. It has the ability of compressing the content for efficient memory usage, provides quality images with less degradation of content and installation, maintenance are simple.

VI. IMPLEMENTATION AND RESULTS

The implementation of the designed Surveillance is simple, as it uses standard NOOBS setup. Hence, it doesn't require any software for installation. To start the project, we need the raspberry pi with an internet connection. Get Software Ready: we have to update the raspberry pi to ensure that it should have all the latest drivers and software. This can be done by executing the following commands in the terminal for updating as well as upgrading the raspberry pi. The prototype of the proposed surveillance camera is shown in fig. 8.

sudo apt-get update
sudo apt-get upgrade

raspi-config is a raspberry pi configuration tool. It was written and maintained by the raspbian operating system. For the first time, we will be shown that raspi-config is booting into the raspbian.

For using the raspi camera module for surveillance purposes, we should enable the enable camera option. This enabling camera option will ensure the allocation of 128 MB of RAM to the GPU (Graphic Processing Unit). The raspi-config tool provides a way of performing the initial configuration.

The rebooting of the system can be done by executing the following command.

sudo apt-get reboot

For checking the system installation and enabling the raspi camera module to take photographs, the following command is used.

sudoraspistill o image.jpg

In the above command image is the name given for the captured image. The command rapspistill is an application of the command line. Raspicamera Remote app uses default login details. The user name is pi and the password is raspberry. The camera module can be accessed by enabling port 22 for port forwarding over the internet and is shown fig. 10.

Fig. 8 Prototype of Surveillance camera

Fig. 9 Captured image

The IP address generated by Wi-Fi enabled Raspberry pi can be viewed by executing the following command.

sudo ifconfig

If raspberry pi connected to the network, it will generate the IP address. By typing the IP address in the mobile it will be connected to the network and the mobile will show the

captured images by the camera module and the image is shown in the fig. 9.

Whenever the PIR sensor detects the motion in the monitored area then only the video will be recorded. Python programming is used for activating the raspi camera to capture the images whenever motion is detected in the monitored area.
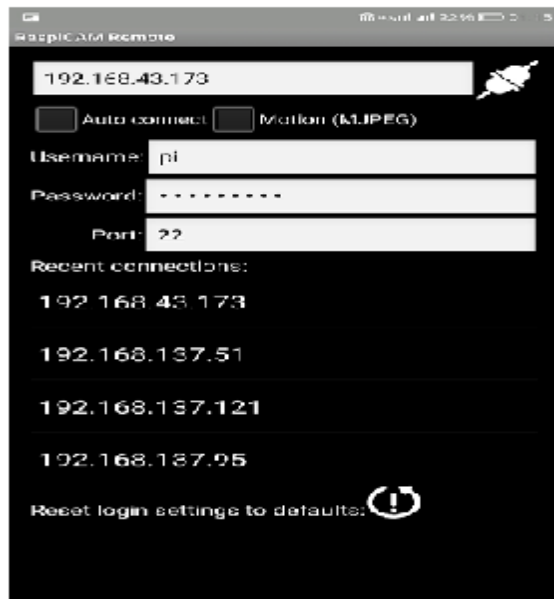

Fig. 10 IP address of raspberry pi

VII. CONCLUSION AND FUTURESCOPE

From the above-discussed points, we can conclude that every smart city should have surveillance. This can be done by creating awareness about the importance of security in the city. Hence, we designed the surveillance camera capable of capturing images, recording videos in a secure and efficient manner. We can set different features like a mirror, solarise, oil paint, flip,3D, zoom, hatch, flip, emboss, rotate, gpen, film, negative, hatch and soon. Also, we can use multiple phones for observing the video continuously. It can be extended to determine the exact position of the person. The proposed system saves significant amount of memory as it records video and captures images only when the motion is detected.

References

[1] Kosba, Ahmed E., and Moustafa Youssef."RASID demo: A robust WLAN device-free passive motion detection system." Pervasive Computing and Communications Workshops (PERCOM Workshops), 2012 IEEE International Conference on. IEEE, 2012. Sanjana Prasad et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 5 (6) , 2014, 7107-7109.

[2] Robson, Clyde, et al. "High performance web applications for secure system monitoring and control." Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC), 2012 IEEE. IEEE, 2012. Han,

Jinsoo, et al. "User-friendly home automation based on 3D virtual world." Consumer Electronics, IEEE Transactions on 56.3 (2010):1843-1847.

[3] Bajorek, Marcin, and Jedrzej Nowak. "The role of a mobile device in a home monitoring healthcare system." Computer Science and Information Systems (FedCSIS), 2011 Federated Conference on. IEEE, 2011.

[4] Karia, Deepak, et al. "Performance analysis of ZigBee based Load Control and power monitoring system." Advances in Computing, Communications and Informatics

[5] An Thanh Trung, Bui, and Nguyen Van Cuong. "Monitoring and controlling devices system by GPRS on FPGA platform." Advanced Technologies for Communications (ATC), 2013 International Conference on. IEEE, 2013.

[6] Tupakula, Udaya, Vijay Varadharajan, and Sunil Kumar Vuppala. "Security Techniques for Beyond 3G Wireless Mobile Networks." Embedded and Ubiquitous Computing (EUC), 2011 IFIP 9th International Conference on. IEEE, 2011.

[7] Luca, Gabriele, et al. "The use of NFC and Android technologies to enable a KNX-based smart home." Software, Telecommunications and Computer Networks (SoftCOM), 2013 21st International Conference on. IEEE, 2013.

[8] Luca, Gabriele, et al. "The use of NFC and Android technologies to enable a KNX-based smart home." Software, Telecommunications and Computer Networks (SoftCOM), 2013 21st International Conference on. IEEE, 2013.

[9] Acker, Robin, and Michael Massoth. "Secure ubiquitous house and facility control solution." Internet and Web Applications and Services(ICIW), 2010 Fifth International Conference on. IEEE, 2010.

[10] https://www.ifsecglobal.com/role-cctv-cameras-public-privacy-protection.

[11] Sharma, Rupam Kumar, et al. "Android interface based GSM home security system." Issues and Challenges in Intelligent Computing Techniques (ICICT), 2014NInternational Conference on. IEEE, 2014.

[12] https://www.ifsecglobal.com/role-cctv-cameras-public-privacy-protection.

[13] http://smallbusiness.chron.com/importance-video-camera-surveillanceworkplace-11657.html.

[14] https://www.raspberrypi.org/documentation/hardware/camera