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1 author:

Dr. S. Javeed Hussain
Global college of engineering and technology, muscat
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Smart Surveillance System using Thing Speak and Raspberry Pi

R.Chandana[1], Dr.S.A.K.Jilani[2], Mr.S.Javeed Hussain[3]

M.Tech student, Department of Electronics & Communication Engineering, MITS, Madanapalle, India[1]

Professor, Department of Electronics & Communication Engineering, MITS, Madanapalle, India[2]

Associate Professor, Department of Electronics & Communication Engineering, MITS, Madanapalle, India[3]

Abstract: This paper proposes the Smart Surveillance System using Thing speak and Raspberry pi. This design is a small portable monitoring system for home and office security. The model uses hardware mechanism such as Raspberry pi (model B), Gyro sensor and Raspberry pi camera. This system will monitor when motion detected, the Raspberry Pi will control the Raspberry Pi camera to take a picture and sent out an alert email with the image to the user by using Wi-Fi adaptor according to the program written in python environment. And at the same time the sensor real time data is visualized in the form of charts in Thing speak. The proposed system will works in standalone mode without the requirement of PC once programmed.

Keywords: Raspberry pi, Gyro sensor, Raspberry pi camera, python, monitoring system, Thing speak.

I.INTRODUCTION

Video surveillance systems play very vital role in various fields of our society such as in personal security, banking, business etc. Starting from small houses to huge industries, now video surveillance is essential and plays very vital role to fulfill our safety aspects in many ways. Burglary and theft have always been a problem for normal residents, particularly for those living in the big cities. Thus it is rather essential to find an efficient way to drastically reduce it. Throughout the world the usage of video surveillance system began from 20th century.Survelliance means monitoring the people's changing information like activities, behaviour for the purpose of protecting, managing and influencing. The surveillance is French word which means "watching over". Actually the surveillance means watching over from a distance by means of electronic equipment such as CCTV cameras. Surveillance is very helpful to law enforcement to investigate/prevent criminal activities, for recognizing and monitoring threats. Basically the design of a surveillance system consists of analyzing the needs of the people, reviewing the system costs based on existing hardware and technology, monitoring choices then at last planning for Installation. The design choices may vary from time to time due to advancement in technology. Surveillance system has always been playing a vital role in dealing with the burglary cases.

There are various kinds of surveillance systems available they are:

A. Hard-wired surveillance systems:
These systems use wires to connect the sensors, cameras, video displays, motion detectors, keypads, camera switchers, speakers to a central controller.

B.Wireless surveillance systems:
These systems use battery-powered radio transmitters and receivers to connect the sensors, cameras, video displays, motion detectors, keypads to central controllers.

C.Remote Access Systems:
These systems have the capability to monitor and control a security system from a location away from the surveillance area.

Though, 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. In general case we can only check the surveillance video after the burglary happened and some people will intentionally destroy the cameras.

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. The main advantages of this device are 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 use.

In this proposed system, the Raspberry Pi is used as a really powerful microcontroller and in the mean time it will act as a normal use computer. Hence this system will works in standalone mode without the necessity of PC.

II.LITERATURE SURVEY

The surveillance system has been widely used in many fields. [1]Mr.Krunal and Mr.Bharat Chaudhary had proposed a Wireless real time video surveillance system to capture the video and sent out it as quickly as possible with negligible time delay and it will send out it to the network embedded web server via ARM9 Board using mjpg streamer algorithm.[2]Fang Mei had implemented Arm based remote video surveillance system.

In this system the video is captured by using CMOS camera (OV9650) with 1.3million pixels.

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In this the video is captured continuously and by using an enhanced moving objective recognition algorithm an alarm message is sent to the user's mobile phone via e-mail.[3]Jeevanand,Keerthivasan,Mohamad, Murugan had proposed an sms altering system with real time network video capture. In this system the fire and PIR sensors are interfaced with the Raspberry Pi.The video is captured for a given period when these sensors are sensed and also the captured video is stored in the RT Raspberry Pi memory.

This system is a real time system based on RT Raspbian.For altering the controlling person GSM module is interfaced from the client. And At the same time Live video can also be viewed in the sharing network by using the IP of the pi:8080.[4] Kumar,Murthi Sharma,Sridevi and Pravin had implemented an sms altering system with real time video capture based on ARM9.In this system the Ethernet interfaces for wired and wireless internet accesses is used. In this system the real time video is captured and also alerts the controlling person by using Global system for mobile communication module.

This system is a real time system based on RT Linux. And also the Captured video is displayed both on the display at the client and in the sharing network.[5]Ying wen,Zong Han,Li sih shen had proposed an Embedded surveillance system to enhance the sensing reliability by using ultrasonic signal coding and PIR sensors.

The ultrasonic sensor and multiple PIR sensors will interface to Arm 7 microcontroller.The sensors group detects an intruder by using majority voting mechanism and captures the image by using web camera and uploads it through internet.

III.PROPOSED METHOD

The proposed system is Smart Surveillance System using Thing speak and Raspberry Pi. The objective is to design and implement the portable monitoring device for home and office security. In this device the MPU 6050 sensor is used to sense the door movement.MPU6050 consists of 3-axis accelerometer and 3-axis gyroscope.

When a normalised movement signal is detected, the Raspberry Pi captures the picture using Raspberry Pi camera and then send out an alert email along with the image to the user by using Wi-Fi adaptor as per the program written in python environment in software implementation.

Hence, they can handle the emergency immediately. The sensor 6-axis real-time data is visualized in the form of charts in Thing speak.

The proposed work is implemented in two steps i.e., in Hard ware implementation and soft ware implementation which is discussed below.

IV.HARDWARE IMPLEMENTATION

The system consists of Raspberry Pi, Gyro sensor, Raspberry Pi camera, power supply and Wi-Fi adaptor.

The Block diagram of the proposed work is shown Fig.1.

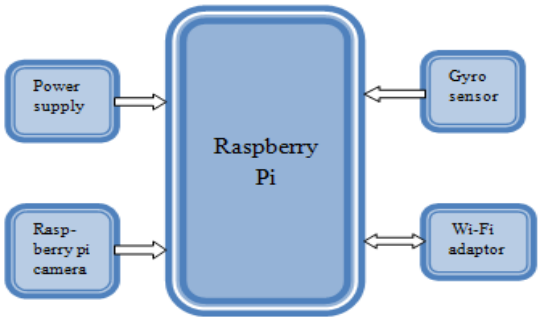

Fig.1.Block diagram

A. Raspberry Pi (model B)

The Raspberry pi is used in our model. Raspberry Pi is a single board computer with Linux or other small operating systems. It was developed by Raspberry Pi foundation in UK for the use of computer science education. The second version of the Raspberry Pi is used in this project. It consists of an ARM 1176JZF-S processor, which runs at 700MHz clock speed, 512MB SDRAM shared with GPU, a Video Core IV GPU, 2 USB port, 1 100 M bit/s Ethernet port, one video and audio output, one HDMI output. It also has 26 pins including 8 General purpose Input/output (GPIO), one SPI bus, one I2C bus, one UART bus and 3.3V, GND and 5V.The Raspberry Pi needs an external Secure Digital(SD) card to store its operating system and also all the user data.

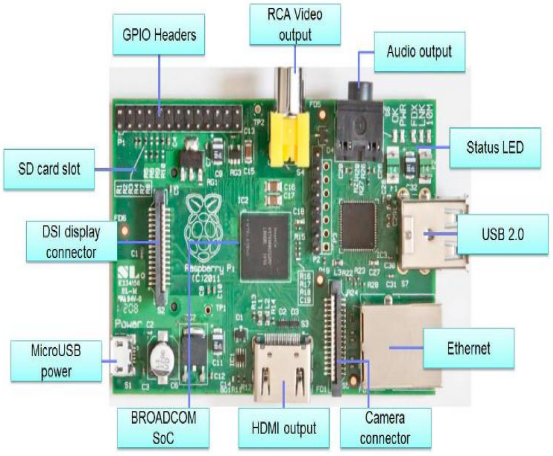

Fig2.Raspberry Pi model B

Hence the Raspberry pi can be used as a really powerful microcontroller which can accomplish almost any functions, and also it can act as a normal use computer with keyboard, mouse and monitor connected.

B.Gyro sensor

The Gyro sensor used in this project is MPU 6050. It is the first integrated world's 6 axis motion sensor, it combines one 3 axis gyroscope and one 3 axis accelerometer, and it has its own digital motion processor (DMP) with its inside algorithm, in DMP it can process the motion data.

It can output 6 axis raw data as well as 6 axis data which pass through the Kalman filter or processed by the Quaternion algorithm. However, access to the filtered data

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as well as the DMP need specific permission. Through the I2C bus this sensor can also attach a 3 axis compass which makes it a 9 axis inertial motion sensor. The output data of this sensor is 16 bit digital values because the chip itself has a 16 bit analog to digital converter (ADC) internally. Thus it requires two registers to hold the value for one axis data. The detection range of the gyroscope is +250,500, 1000, 2000º/s and the accelerometer is +2g, 4g, 8g, 16g and we can select the range by setting the corresponding registers. Through the I2C data bus at the clock frequency of 100 kHz the MPU6050 is communicated with Raspberry Pi.

C.Power supply

The power supply system on the Raspberry Pi is quite simple. It uses a Micro USB connection to power itself. The power source used for the device is a 5200mAh external battery for smart phones and tablets.

D.Raspberry Pi Camera

Raspberry pi camera board plugs directly into the CSI connector on the Raspberry pi.The Raspberry pi camera module attaches to Raspberry pi by way of a 15 pin Ribbon cable to the dedicated 15-pin MIPI camera serial Interface (CSI) which was designed especially for interfacing to cameras. It's able to deliver clear 5 mega pixel resolution image or 1080p HD video recording at 30frames/sec.

E.Steps to Install Raspbian os

i. First step is to download Raspberry pi Supported Raspbain os.
ii. Install 'Win32Disk Imager' application on your windows system.
iii.Insert SD card adapter into your system.
iv. Burn os into SD card using Win32 Disk Imager.

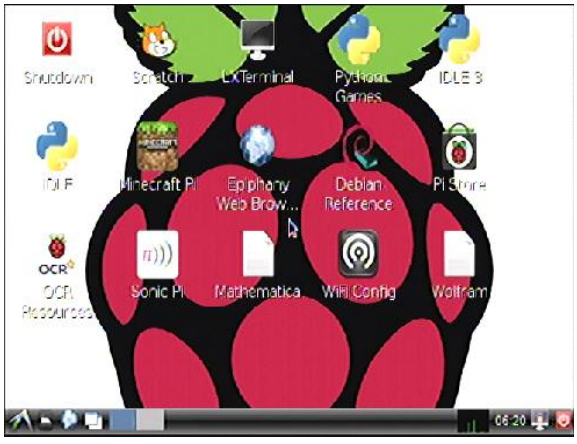

Fig.3.Installed Raspbian os

V.SOFTWARE IMPLEMENTATION

Software implementation of this work uses Raspberry Pi and Python programming language. The total programming is developed in Python which includes some python packages, the program includes capturing the image when motion detects, saving the image and send it to the user and also sending the data to Thing speak. The Python packages include configuring GPIO, I2c set up, and installing python smbus, smtplib which describes below:

A.Installation of Rpi.GPIO:

To do this enters the following command into LX Terminal:

"sudo apt-get install python-rpi.gpio"

B.Installation of I2C-tools:

Then enter the following command in LX terminal

"sudo apt-get install i2c-tools"

The fig.4 shows the installation of I2C tools

Fig.4.I2c tools installed

C. Installation of python-smbus module:

Then enter the following command in LX terminal

"sudo apt-get install python-smbus"

The fig.5 shows the python smbus installation

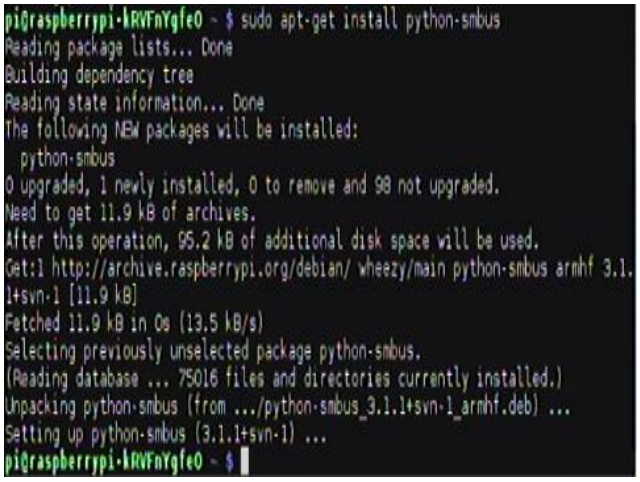

Fig.5.Python smbus installed

D. Installation of python-picamera:

For installation of picamera the following command is used.

"sudo apt-get install python-picamera"

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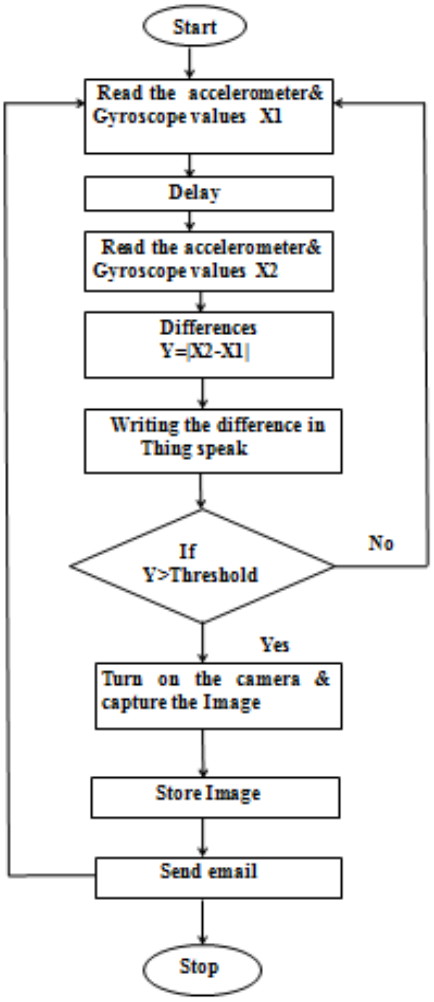
E. For sending email:

For sending email we want to "import smtplib".
SMTP is a protocol, which handles sending e-mail and routing e-mail between mail servers.

F. Thing speak:

Thing speak is a platform providing various services exclusively targeted for building IOT applications. The Gyro sensor 6-axis real-time data is visualized in the form of charts in Thing speak .The 'Thing speak channel' is the core element of Thing speak. It wills stores the data that we send to Thing speak.

G.Flow Chart of proposed method:



VI.EXPERIMENTAL RESULTS

Lots of experiments have been done to determine the threshold value.
Number of trails has been done to note the Gyroscope and Accelerometer x-axis, y-axis and z-axis readings in different directions like hitting in x, y and z directions. Thus a door movement can be detected by setting a threshold value.

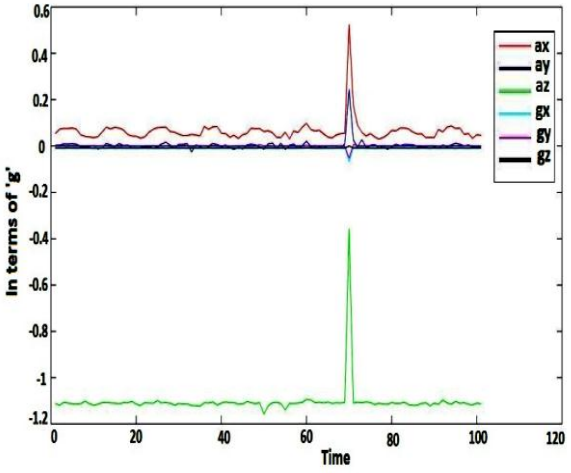


Fig.6.Hitting in X-direction

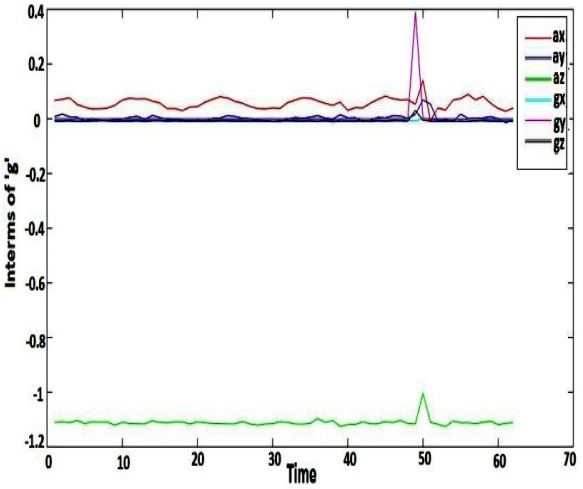


Fig.7.Hitting in Y-direction

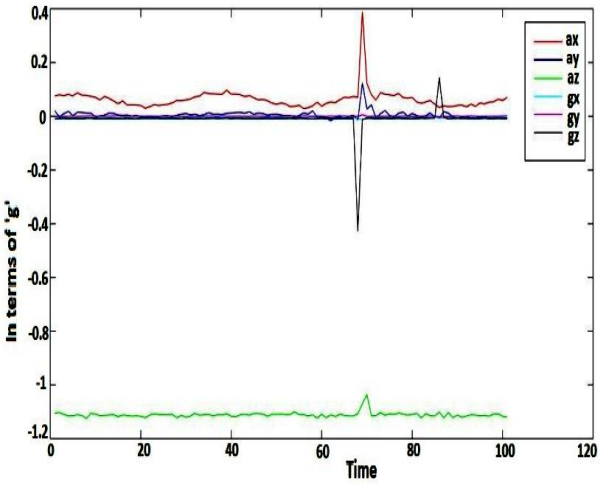


Fig.8.Hitting in Z-direction

The graphs shown in Fig.6,7,8 shows the experimental data of X,Y,Z-axis of accelerometer and gyroscope when hitting in X,Y and Z-directions.
The experimental values are shown in Table. I.

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Table I. Experimental values in different directions

Axis	In terms of 'g'		
	X-direction	Y-direction	Z-direction
Ax	0.5249	0.0527	0.3882
Ay	0.2449	0.0163	0.1243
Az	-0.3564	-1.1152	-1.0724
Gx	-0.0677	-0.0076	-0.0117
Gy	-0.0527	0.3906	0.0057
Gz	0.0006	0.0306	-0.0117

At each time, with in the 6-axis (ax, ay, az, gx, gy, gz) only few axis value will go high. By considering these values a threshold value is set to detect the door movement.Then,by implementing the whole device on the door, it can detect the motion when break in occurs in any direction and send out an alert email to the user, hence the user can handle immediately.

VII.CONCLUSION

In this research, we have designed and implemented an Smart Surveillance System using Thing speak and Raspberry Pi.The monitoring system works in standalone mode without the necessity of PC.It has small size and totally portable, it can placed on any kind of doors and detect the motion successfully. It has the feature that the Raspberry Pi camera will only work when signal is detected, hence it can save a lot of power compared to that of the previous surveillance system. For whole system it has only one break out board, hence it will be cheaper. And also the Gyro sensor 6-axis real time data is continuously visualized in the form of charts in Thing speak.

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