

# Design of IoT based Real-Time Security System using Raspberry Pi

Saroja Kanta Panda<sup>1</sup>

(M-Tech Scholar)

Mr. sushanta kumar sahu<sup>2</sup>

Assistant Professor

College of Engineering and Technology

Bhubaneswar, India

\*\*\*

**Abstract** - *The video surveillance system of any secured places using security guards at every moment is not possible. Also, closed-circuit Television (CCTV) is extensively used CCTV in most of the security places like multi-storage buildings, banks, cinema halls, commercial buildings like shopping malls, and more. But real-time thief handling is very important to prevent theft and vandalism. This project employs an IoT based real-time video surveillance system with a password locking technique using raspberry pi. The system requires a USB webcam, Raspberry-pi 3B, 4\*4 Keypad, and PIR sensor. When any motion is detected pi activate the webcam for capturing the image if anyone enters a wrong password or tries to enter a random password, at that time processor sends an E-mail or SMS alert to register id or mobile number. When motion detected using PIR(passive infrared sensor) raspberry pi store the image in the cloud using the SMTP mail server and send them to register Email.*

**Keywords**—IoT, SMTP, Raspberry Pi, E-mail, Motion Detection, Video surveillance

## 1. INTRODUCTION

In the present day security system is the most important for many public and private sectors like the banking sector, finance sector, shopping mall, multi-storage buildings, and home security system [5]. For maintaining a social security video surveillance plays a major role in the present day. By using different methods or techniques like RFID technique [13], OTP based, GSM-based, Bluetooth based. It can decrease the crime rates, but real-time detection and capturing the theft is the vital point for the present days. Here the system proposed an IoT based door locking system [1] with password protection because it is the first step for safety. The above systems provide a security system but it is unable to provide an instant alert for any authentication. Many systems store the video and image to a memory or cloud server [1]. RFID based systems identify the person or object automatically but it is quite expensive.

IoT based video surveillance systems consume more power for continuous usage and require storage space for live streaming video. The proposed system is a PIR motion detection [6] system that activates the webcam when any living beings appear. At a particular time, an SMS send to the registered no and a alerting mail sent to the authority. The

keypad locking system [2] allows only authorized people to enter the room. If any wrong password entered then the raspberry pi send the image of the unauthorized person.

## 2. RELATED WORK

In this system, the surveillance area is covered by a Logitech C310(webcam) which is directly connected to the pi through a USB port. It captures the image when motion is detected by the PIR sensor, then the processor sends the email to the authorized address and sends an SMS to the registered mobile number. The image capture by the time of motion detection is store in the SMTP mail server. when it is offline it stores in the local raspberry pi memory. The IoT system provides a password-based door locking system [11] which is the first step of any unauthorized person. The designed system is to provide social security and other control applications. The system hardware module includes webcam, Raspberry Pi, GSM module, MAX 232IC, 4\*4 keypad and PIR sensor, 26\*2 LCD, Alarm. Fig 1. Show the block diagram of the proposed system. The Logitech C310 Webcam is connected to the Raspberry pi board through USB port directly. MAX232 is a transceiver IC that converts a hardware layer protocol known as RS-232. It has a pair of drivers and receivers which converts the TTL and CMOS voltage level to RS232 voltage level. This voltage level is used for the serial communication between the GSM module and raspberry pi.

When any human movement is detected by the PIR sensor, the system activates the webcam and activate an alarm detecting the presence of an unauthorized person in a specific interval of time and simultaneously sends an SMS alert through GSM modem to the registered no. and send the record image to the registered email of the user later recorded video sent to the cloud server that is scene in the surveillance area. Using a Raspberry pi setup or through the IoT system, more surveillance area can be covered. The raspberry pi setup will automatically deliver video data streaming to the cloud server. Here C310 HD webcam camera module is used that can be capable of 1280\*720p high definition video modes and still image, and it can connect Raspberry Pi directly with USB (Universal Serial Bus).

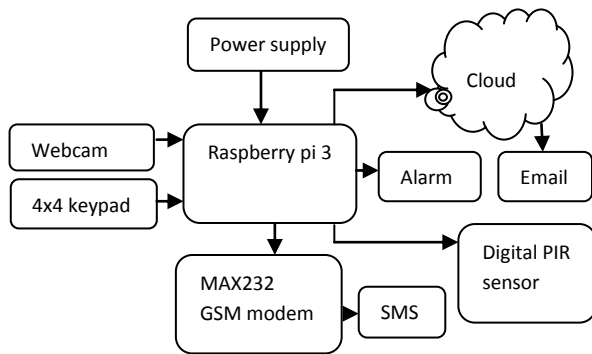


Fig.1 Architecture of Proposed System

Alternate Function	Pin	Alternate Function	Pin	
3.3V PWR	1	2	5V PWR	
I2C1 SDA	2	3	4	5V PWR
I2C1 SCL	3	4	5	GND
		6	8	UART0 TX
		7	10	UART0 RX
		8	12	GPIO 18
		9	14	GND
		10	16	GPIO 23
		11	18	GPIO 24
		12	20	GND
		13	22	GPIO 25
		14	24	GPIO 8
		15	26	GPIO 7
		16	28	Reserved
		17	30	GND
SPI0 MOSI	19	31	32	GPIO 12
SPI0 MISO	21	32	34	GND
SPI0 SCLK	23	33	36	GPIO 16
		24	38	GPIO 20
		25	40	GPIO 21
		26		SPI1 CS1
		27		
		28		
		29		
		30		
		31		
		32		
		33		
		34		
		35		
		36		
		37		
		38		
		39		
		40		

Fig -2: Pin Description of Raspberry Pi 3[source: Google]

### 2.1 Raspberry Pi 3 Model B

Raspberry Pi is a single-board credit card size computer, which is developed by the Raspberry Pi Foundation. The proposed system uses a Raspberry pi 3B model and it offers the following key features:

- Quad-core Broadcom BCM2837 64-bit ARM cortex A53 clocked at 1.2 GHz
- 400MHZ Video Core IV Multimedia
- 1GB SDRAM(i.e 900 MHz)
- 4 USB ports
- Micro SD port for loading operating system and storing data
- 10/100 Mbps Ethernet and 802.11n Wireless LAN network
- 17 GPIO channel
- Bluetooth 4.1 supported
- 5V power source via Micro USB or GPIO header
- AUDIO/VIDEO OUTPUT
- Full-size HDMI
- Onboard camera/LCD display pin

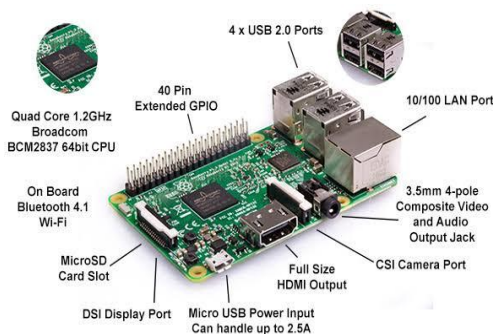


Fig -1: Raspberry Pi 3 Model B

### 2.2 Webcam

A webcam is a small camera that streams an image of real-time video through a processor or computer network. It is a low cost high flexible digital camera. It is used for broadcast video images in real-time. The USB cable supplies power to the webcam from the raspberry pi and supplies the information capture by the webcam. It is mostly used for security surveillance, computer vision, video broadcasting. The system uses the Logitech C310 webcam for capturing the image and video of an unauthorized person. Logitech C310 webcam consists of 5MP snapshots, maximum noise reduction technique, auto light correction, fix focus with a 60-degree field of vision.



Fig -3: Logitech C310 HD webcam

### 2.3 PIR Sensor

PIR sensor refers to a “Passive Infrared” electronic sensor. It is used for motion detection. It works on the principle of the amount of heat radiation emitted by the moving object is related to heat produce by it. PIR sensor detects the infrared radiation level by detecting the change in surrounding temperature for example when any person is detected by the PIR sensor it suddenly turns on the webcam and follows the instructions. Which helps in power consumption and longer life of the system.

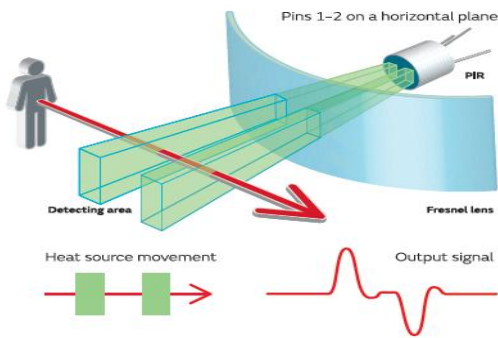


Fig -4: Working of PIR Sensor

### 2.4 Keypad 4x4

A 4\*4 matrix Keypad consists of row and column matrixes and eight terminal points. The 16 keys have number 0-9, four alphabets A to D, and two symbols \* and #. Maximum 24v for each segment. For eight terminals(4 for rows and 4 for columns) is used to connect the keypad to other devices. The system design a password-based door locking system where the password can be number or alphanumeric which allows the authenticated person.



Fig -5: keypad of structure 4\*4

### 2.5 SMTP Server

The Simple Mail Transfer Protocol(SMTP) is a communication protocol for electronic mail transmission. The SMTP server is used for the application purpose is to send, receive, and/or relay outgoing mail between email senders and receivers. SMTP sendS data to another server after processing the data and also receiving, sending, and relaying of email. It sends the outgoing email from an activated account and protects the account from unauthorized accounts .it also checks the email is delivered or not.

### 2.6 GSM Module

The GSM module communicates between a mobile device and a GPRS or GSM system module. The microcontroller of the GSM module allows wireless

communication with more devices and modules. Such wireless connectivity of microcontrollers open it up to a extensive verity of applications like Home Automation, Disaster Management, Medical Assistance, automobile Tracking, Online Banking, E-Commerce, etc.

LCD 16\*2

Liquid Crystal Display is an electronic display module used for various circuits & devices like computers, mobile phone calculators, etc. It is a low power consumption multi-segment light-emitting diodes. The system uses a 16\*2 LCD which has 16 columns and two rows. It is an alphanumeric display which displays the numbers, symbols, and alphabets. It requires 4.7v to 5.3v and 1mA current with no backlight. Two modes of work(4 bits and 8 bits) and 5\*8 pixel boxes are built for each character. It guides the user by displaying the message.

### 3. MOTION DETECTION

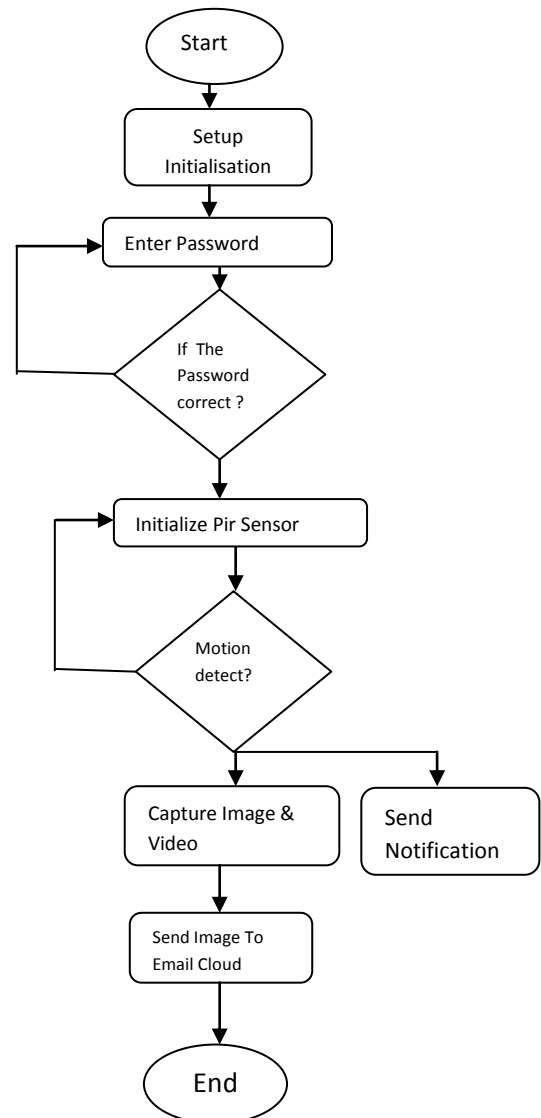


Fig -6: Motion Detection Flowchart

The system used a PIR sensor for Motion Detection at the entry point of the door which detects the change by the infrared signal. The change depends on the temperature and surface behaviour of the objects which move to the in front of the sensor. The voltage generates a change in environmental infrared rays triggers an object or motion detection. The motion detection algorithm is written by the python. The image captured is saved to raspberry pi memory. The system connects by the internet to send the image to register email.

#### 4. IMPLEMENTATION

The system implement the motion detection Algorithm written in python. Here the system use openCV for capturing the image object or person with the help of webcam. Raspberry pi control all the hardware and software in the single platform. It send the SMS through GSM modem and email through SMTP mail server to the register mail id.

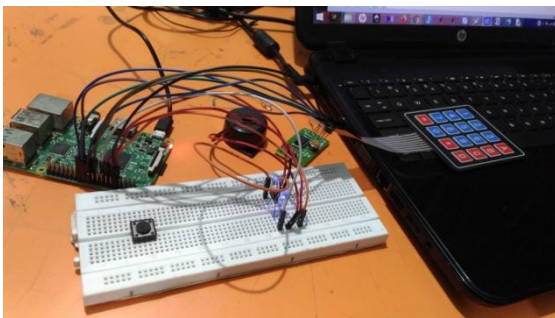


Fig -7 Experimental Setup for Password Protection

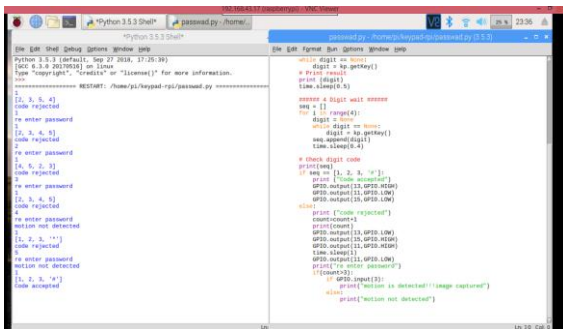


Fig -8: Screenshot of Wrong Password Detection

Image captured by webcam send to the SMTP cloud server when any wrong password enter by any unauthorized person. Motion detection helps to save power consumption and require less amount of memory space. It is also a low cost IoT system for implementing all security places

#### 5. EXPERIMENTAL RESULTS

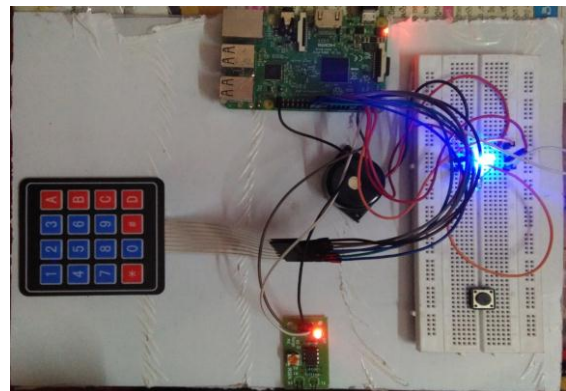


Fig -9: Assembly Of Motion Detection Integration

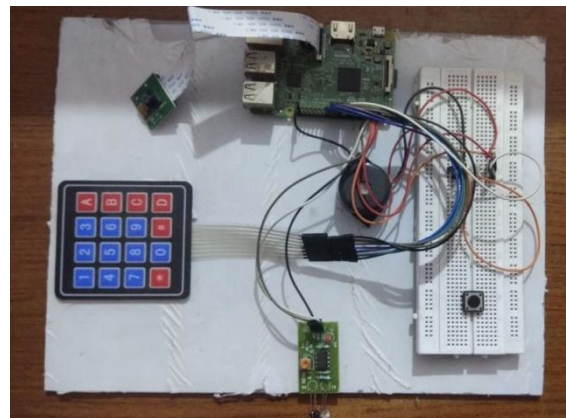


Fig -10: Camera interface with raspberry pi



Fig -11: Motion detected when password incorrect

Experimental result shows the motion detection, image capture at the time of entering wrong password. The system works over internet to send the email and sms alert which controlled by the IoT processor raspberry pi. There is no human being is needed for any operations so it is fully automatic real-time operating system. Process of operation and monitoring allow the only authorized person whose email and mobile no is register over this platform. Figure 8 and 10 shows wrong password detection and photo captured by using computer vision.

## 6. CONCLUSION & FUTURE WORK

By using the IoT based smart door lock with a video surveillance system is a consumer-oriented device. It is a smart flexible system that replaces a lot of conventional types of locking systems nowadays. The system is a powerful monitoring tool that unfolds the invader's behaviours. It is a less power utilization device that ON the camera if any triggers occur. The raspberry pi provides for embedding more sensors and hardware with the system. The processor has much computation power to connect multiple devices and sensors. All the operation is fully automatic and it reduces manpower. It also uses various security places like the locker room of the bank, ATM centres, and storerooms, etc. it stores and sends the data to the SMTP server which not allow hacking the system. The real-time monitoring system build is a fully constructive system to build a fully constructive system for practical implementation.

In future plan to use Open CV for in better way to improve detection algorithm, because it mainly depends on the threshold value. Its mean the algorithm developed the performance of absolute conditions and to known about the person is authenticated or not.

## 7. REFERENCES

- [1] S. N. Jyothi and K. V. Vardhan, "Design and implementation of real time security surveillance system using IoT," 2016 International Conference on Communication and Electronics Systems (ICES), Coimbatore, 2016, pp. 1-5, doi: 10.1109/CESYS.2016.7890003.
- [2] J. Kumar, S. Kumar, A. Kumar and B. Behera, "Real-Time Monitoring Security System integrated with Raspberry Pi and e-mail communication link," 2019 9th International Conference on Cloud Computing, Data Science & Engineering (Confluence), Noida, India, 2019, pp. 79-84, doi: 10.1109/CONFLUENCE.2019.8776971.
- [3] K. H. S. Murugan, V. Jacintha and S. A. Shifani, "Security system using raspberry Pi," 2017 Third International Conference on Science Technology Engineering & Management (ICONSTEM), Chennai, 2017, pp. 863-864, doi: 10.1109/ICONSTEM.2017.8261326.
- [4] Huu-Quoc Nguyen, Ton Thi Kim Loan, Bui Dinh Mao and Eui-Nam Huh, "Low cost real-time system monitoring using Raspberry Pi," 2015 Seventh International Conference on Ubiquitous and Future Networks, Sapporo, 2015, pp. 857-859, doi: 10.1109/ICUFN.2015.7182665.
- [5] Bhatkule, A.V., Shinde, U.B. and Zanwar, S.R., 2016. Home Based Security Control System using Raspberry Pi and GSM. *International Journal of Innovative Research in Computer and Communication Engineering*, 4(9), pp.16259-16264.
- [6] F. Aman and C. Anitha, "Motion sensing and image capturing based smart door system on android platform," 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS), Chennai, 2017, pp. 2346-2350, doi: 10.1109/ICECDS.2017.8389871.
- [7] K. N. K. Kumar, H. Natraj and T. P. Jacob, "Motion activated security camera using raspberry Pi," 2017 International Conference on Communication and Signal Processing (ICCSP), Chennai, 2017, pp. 1598-1601, doi: 10.1109/ICCSP.2017.8286658.
- [8] N. Patil, S. Ambatkar and S. Kakde, "IoT based smart surveillance security system using raspberry Pi," 2017 International Conference on Communication and Signal Processing (ICCSP), Chennai, 2017, pp. 0344-0348, doi: 10.1109/ICCSP.2017.8286374.
- [9] A. Y. Z, D. K. R, A. S and H. K. G, "Border Surveillance System using Computer Vision," 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2020, pp. 623-628, doi: 10.1109/ICACCS48705.2020.9074171.
- [10] R. M. Patil, R. Srinivas, Y. Rohith, N. R. Vinay and D. Pratiba, "IoT Enabled Video Surveillance System Using Raspberry Pi," 2017 2nd International Conference on Computational Systems and Information Technology for Sustainable Solution (CSITSS), Bangalore, 2017, pp. 1-7, doi: 10.1109/CSITSS.2017.8447877.
- [11] N. A. Hussein and I. Al Mansoori, "Smart Door System for Home Security Using Raspberry pi3," 2017 International Conference on Computer and Applications (ICCA), Doha, 2017, pp. 395-399, doi: 10.1109/COMAPP.2017.8079785.
- [12] S. Sruthy and S. N. George, "WiFi enabled home security surveillance system using Raspberry Pi and IoT module," 2017 IEEE International Conference on Signal Processing, Informatics, Communication and Energy Systems (SPICES), Kollam, 2017, pp. 1-6, doi: 10.1109/SPICES.2017.8091320.
- [13] A. Juels, "RFID security and privacy: a research survey," in *IEEE Journal on Selected Areas in Communications*, vol. 24, no. 2, pp. 381-394, Feb. 2006, doi: 10.1109/JSAC.2005.861395.
- [14] Yongxiang Wu, "Research on bank intelligent video image processing and monitoring control system based on OpenCV," 2009 3rd International Conference on Anti-counterfeiting, Security, and Identification in Communication, Hong Kong, 2009, pp. 211-214, doi: 10.1109/ICASID.2009.5276928.
- [15] V. Mande and M. Lakhe, "Automatic Video Processing Based on IoT Using Raspberry Pi," 2018 3rd International Conference for Convergence in Technology (I2CT), Pune, 2018, pp. 1-6, doi: 10.1109/I2CT.2018.8529534.
- [16] C. Lin and Y. Tang, "Research and design of the intelligent surveillance system based on DirectShow and OpenCV," 2011 International Conference on Consumer Electronics, Communications and Networks (CECNet), XianNing, 2011, pp. 4307-4310, doi: 10.1109/CECNET.2011.5768334.
- [17] Raspberry pi 3 model B, [online].available: <http://www.raspberrypi.org>. [Accessed: 20-june-2018].

## BIOGRAPHIES



**Saroja kanta panda**  
(M-Tech Scholar)  
College of Engineering and  
Technology  
Bhubaneswar, India