Smart IOT Home Security Alert System With Raspberry PI 3

Vasudha
(Assistant Professor)
Faculty of Computer Science & Technology
Lovely Professional University, Punjab, India

Rupak Kumar Ghosh
(Student)
Lovely Professional University,
Punjab, India

Jadhav Aditya Vishwanath
(Student)
Lovely Professional University,
Punjab, India

ABSTRACT:

Specific, Measurable, Achievable, Realistic and timely – these 5 words each carrying some meanings can be abbreviated as SMART. Nowadays, in the era of development of technical science presents the world with the arrival of smart cities and smart homes. Internet of Things (IOT) comes into picture to develop these smart features with the concept of arranging every system connected with Internet. This paper is based on home security and proper maintenance of home. An Internet of Thing enabled system has been designed to provide a security in front of the main door on the basis of presence of living being including human and any animal. Whenever any human intrusion is detected at the doorstep an email will be forwarded to the registered user with the picture of the person stands near the door, thus providing home security and restricting unauthorised user entry in the house. The system is also capable to decide where the movement of the person is familiar or unfamiliar according to the database and based on this notifies the owner of the house with the info of the guest and furnishes safety against the trespassers.

I.INTRODUCTION:

The speciality of the modern-day technology IOT is that the interrelated and interconnected systems over the internet controlled and scanned from anywhere in the world in anytime. The objective behind preparing this security system is to preserve family members and belongings. There are several types of home security systems available in the market like CCTV (Closed Circuit Television), microcontroller etc. This system is developed with Raspberry Pi using Camera and sensors (IR- Infrared & PIR- Passive Infrared) which overcomes the drawbacks of previous existing system in terms of expensiveness and accessibility. The entire system can be set up in the main door at a height where human beings can easily be detected. Use of this system is comparatively cost effective because it uses the components those are required to provide the detection of intruder, capturing photos and sending it to register email id. Th algorithm that is used to match the person with the database and sending email is completely hand coded and loaded to the project interface. So, the overall costing gets deducted in this case as the assembly of all the components and the software code is human made.[1]

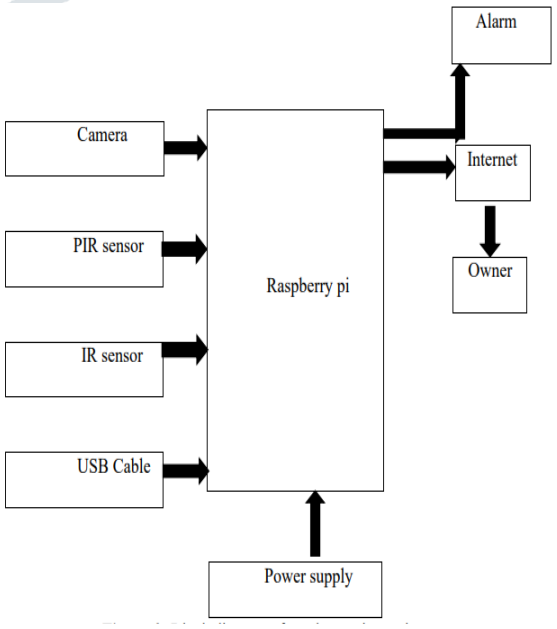

Figure 1: Block Diagram of Raspberry Pi Security System

The above block diagram depicts that the raspberry pi will be supplied power through adapter and the unauthorized person can be detected with sensors connected with Raspberry Pi machine and attached camera will act as a webcam. The USB cable connect the entire security system to the display system (Laptop, TVs etc).

II.SYSTEM INGREDIENTS:

The main building block of the entire security system is Raspberry Pi-3 because of having the advantage of less power consumption and comparatively high processing speed. The components that are used in this set up of home security system are listed below.

A. **Raspberry Pi Model B:**

It is capable of doing computing works at a low cost. It has the compatibility of communicating with the outer world. Raspberry Pi is known as general purpose computer having functionalities in media centre, learning program and electronics, capturing photos (as Webcam), robotics, network storage and in weather station to upload readings to internet and accessing those from anywhere. If we dive into the history of Raspberry Pi, then it is found that it was invented and developed by a Foundation named Raspberry Pi of United Kingdom charity with the motto to make computing access easier. Beside running Linux, Raspberry Pi also provides General Purpose I/O pins which allows to explore the world of IoT by taking command over electronic elements for computing.

The 3rd generation of raspberry pi model is used in this project because it has an upgraded Broadcom of BCM2837 processor and having cost under 4000/- Rs. This model can run very efficiently compared to the previous generations and easily available tool for the projects, developments, experiments, private systems etc. Among many models available in the market Model is preferred in this scenario because of its features and compatibility with the parts required for the completion of this process. [2]

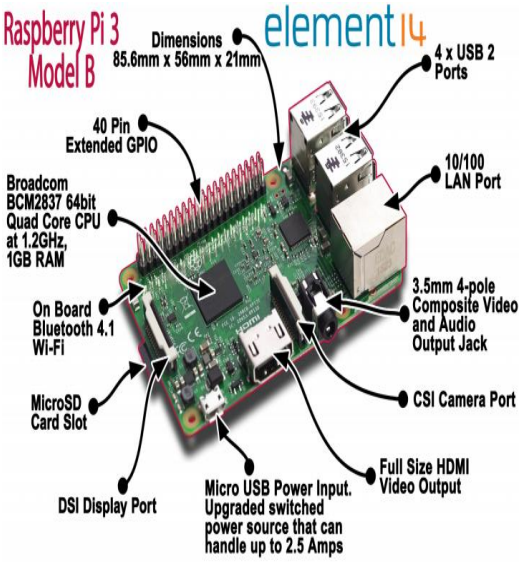

Figure 2: Model B of Raspberry Pi (3rd generation)

Specifications:

Processor – BCM2837
Architecture – Quad-core
Storage - Micro SD
GPIO – 40 pins with 2.5mm expansion header
GPU – Dual Core with Video core Iv
Memory – 900 MHz (1 Gb)
Network – 10/100 Ethernet, 2.4 GHz
Bluetooth- 4.1
Operating System - Linux OS
Power – micro-USB (socket 5 V)
Video Output – High Definition Multimedia Interface[3]

B. **Power Supply:**

The power to the raspberry pi security system is supplied by the adapter with USB cable. 2.0A smart USB power supply adapter with high quality micro USB cable is used in this scenario. The adapter can be plugged into the power supply source or a efficient battery. The adapter will supply power to the security system efficiently with safe charge nullifying the chance of the power overload or the system failure. The USB cable and the adapter can be attached and detached based on the necessity.

Figure 3: USB cable

C. **Memory:**

For the storage purpose the system uses 16GB memory card that is used to store programs, software and required code for the process. This 16GB micro SD memory card of SanDisk group have higher transfer rate in comparison to the other memory card.

Specifications:

Capacity – 16GB
Speed – 10mbps
Wireless Type – 802.1 a
Dimensions – 1.5*.1*1.1 cm
Weight – 9g

Figure 4: Memory Card

D. **Camera:**

The camera module holds the most important functionality of the project as it is responsible to capture images of the intruder in front of the house door and records the captured stuff into memory card. Mega pixel camera is being used that is released in 2013. It has a very nice image capturing feature with high clarity and it is attached to the hardware of raspberry pi with cable.

Figure 5: Camera module attached with cable

Specifications:

Sensor: Omni vision OV5647

Resolution: 2592*1744 pixels

Size of the pixel: 1.4mu*1.4mu

Focal Length: 3.6mm+/-0.01

Dark Current: 116mVps

Video Modes: 1080p30, 720p60, 640*480p

Fixed Focus: 1m to infinity

E. **IR sensors:**

The sensor detects and select light wavelength of the Infra-Red spectrum in surrounding environment. The wavelength is longer than the visible light, so it is not visible to the human eye. Two types of IR sensors are available – active InfraRed sensors that emits and detects radiation. It has 2 parts – LED (Light Emitting Diode) and a receiver. LED is capable of producing the light at a particular wavelength. When an object comes closer to the sensor, the light will bounce off the object into the light sensor. This incident results into a larger change in the intensity that is known as threshold.

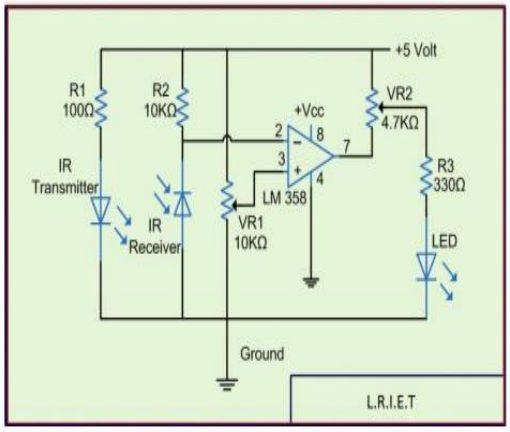

Figure 6: IR sensor Circuit Diagram

The above circuit of infrared sensor is comprising of LM358 IC2 IR transmitter with resistors and variable resistors for controlling purpose. The LED is connected to 330-ohm resistor in serial fashion.

Working of IR sensors:

Two phases exists- a) When no object is there in front of the sensor, the transmitted light from the LED will have no reflection-

so no object presence detected; b) If object is there, then The reflection of LED light will be detected by the sensor, the colour of the object can be determined by the reflection as the light objects reflect more light and relatively dark objects reflect less light.[4]

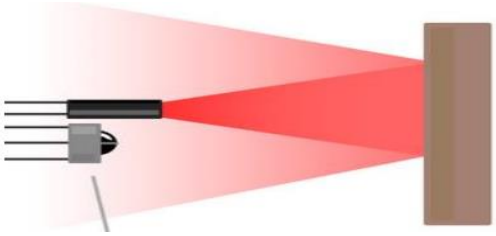

Figure 7: IR sensor

F. **PIR (Passive InfraRed sensors):**

This is basically used to detect the movement of the object with the help of transmission of infrared lights. It does not emit anything, detects IR radiations. The radiation energy from the intruder near the door is detected by PIR sensors all objects have heat above absolute zero. The reflected IR radiation is detected by PIR sensors which has 3 pins – one in the ground followed by a signal and final pin will be power.

After detection of the presence and movement of the person in front of the door in the defined time, the camera will be responsible for capturing the image and sending the email.

Figure 8: PIR sensor

G. **HDMI:**

The HDMI - High Definition Multimedia Interface cable fills the gap between the security system and the digital display system. This cable makes possible for the owner of the house to monitor his house front door surroundings with the help of laptop, television or any other security screen.

H. **Bread Board:**

It is a solder less device used for testing the circuit design and check whether the LED, sensor works as per the estimation and the circuit is designed correctly or not.[5]

I. **LED:**

It is a diode that emits light after activation. The meeting of electrons with hole generates lower energy level and releases photon formed energy. It is small and used for the shape of radiation pattern

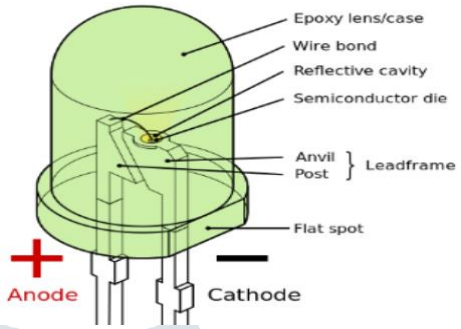

Figure 9: LED

III.ARCHITECTURE:

There are 5 types of circuit diagram or interfacing exists in the entire system-

A) Power supply to raspberry pi:

Power adapter with USB cable supplies power to raspberry pi.

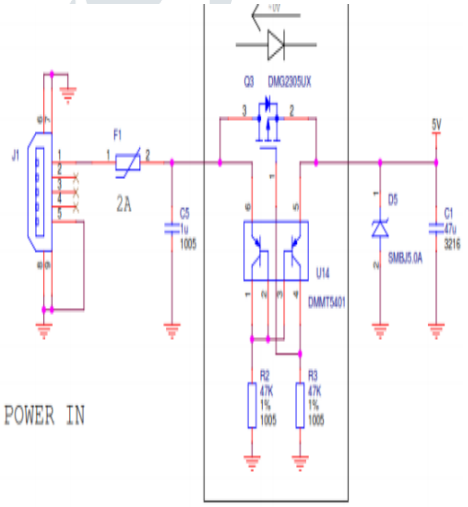

Figure 10: Power supply to Raspberry Pi

The above connection shows the power is being supplied to the circuit.

B) Interfacing Raspberry Pi with LCD:

Liquid Crystal Display is shortened as LVD is a flat display that requires liquid crystals for primary form of operation.

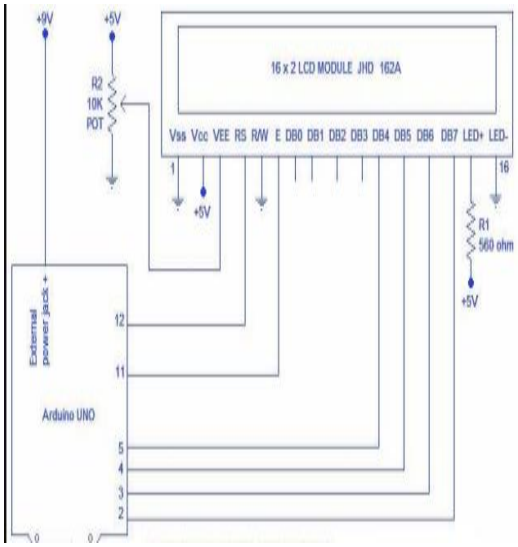

Figure 11: Interfacing LCD module to Arduino

As per the circuit diagram out of eight data pins, four data pins (DB4, DB5, DB6, DB7) are connected to 4 digital pins of raspberry pi (5, 4, 3, 2) and other 4 pins are not attached to the Arduino. Register select pina and enable pin is connected to raspberry pi. 9V of external power have been supplied to the Arduino.[6]

C) Connecting Raspberry Pi with IR sensors:

Two LEDs are joined to the GND pin of IR sensor. The other two pins of the sensor is connected to the +5V power supply of Raspberry Pi and to ground of raspberry pi. The third pin is attached with one of the digital pins of the set up.

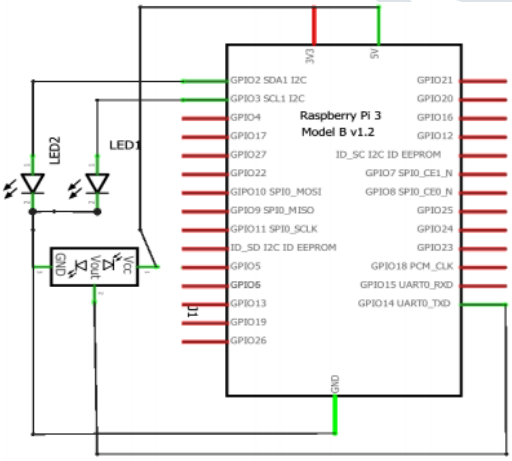

Figure 12: IR sensor circuit diagram

There are 3 pins named VCC, VOUT and GND. VCC acts as a power I/p of any device of respectively higher voltage with respect to the ground (GND). The positivity and negativity nature depend on the GND, but most common usage is in term of positive. GND is zero voltage point of a power supply.

D) Connecting Raspberry Pi with PIR sensor:

There are 3 pins in PIR sensor connected with 5V of raspberry pi, GND pin and any one digital pin of raspberry pi (in this case with GPIO16 pin). One of the pins of PIR sensor is SIG that is Special Interest group. VDD plays the role of voltage supplier for the sensor.[8]

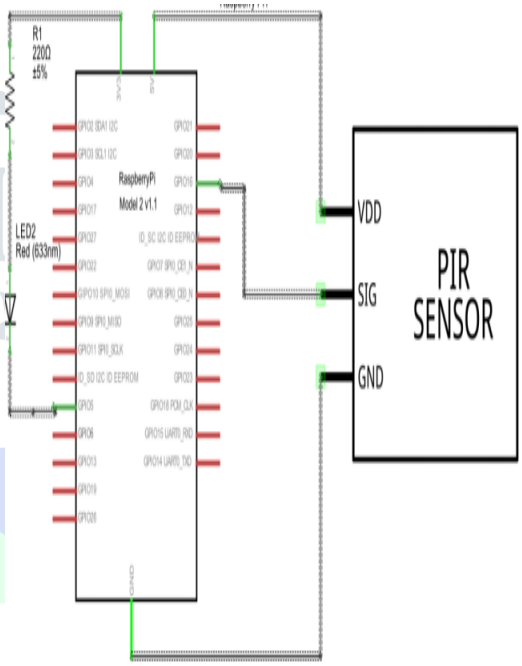

Figure 13: Circuit diagram of PIR sensor

E) Interfacing Raspberry pi with memory card:

There is a slot in Raspberry Pi system where data can easily be fitted into the card.

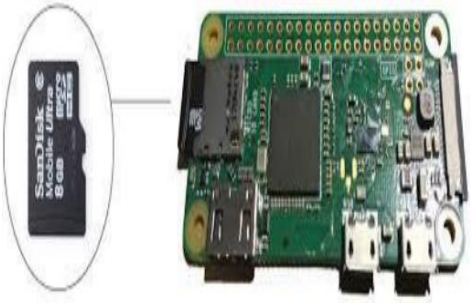

Figure 14: Insertion slot of Memory Card

Camera and PIR sensor is connected to the mother board. The PIR sensor and the LED is connected to the raspberry pi with GPIO18 and GPIO17 pin.[7]

IV.IMPLEMENTATION:

SYSTEM SOFTWARE TESTING:

To activate the hardware system the system has been tested by running a code to enable different functionalities.[9]

i.Main page in raspberry pi security system:

Following libraries have been imported -

import cv2

import sys from mail

import sendEmail from flask

import Flask, render_template, Response from camera

import VideoCamera from flask_basicauth

import BasicAuth

import time

import threading email update interval is set to 600.

An object named video_camera is created from VideoCamera library and configuration of username and password is done. If object is sensed with having comparison of last_epoch time, then the condition is applied in the way-

if found_obj and (time.time() - last_epoch) > email_update_interval:

last_epoch = time.time()

print "Sending Email"

sendEmail(frame)

print "Done!"

except print "Error sending email: "

ii.**Email Sending mode:**

The libraries those are used are following –

import smtplib (send mail to internet device)

from email.MIMEMultipart

import MIMEMultipart

from email.MIMEText

import MIMEText

from email.MIMEImage

import MIMEImage

First of all the email name is specified from which the update will be sent and the email to which the information will be sent named 'fromEmail' and 'toEmail'-

msgRoot['From'] = fromEmail

msgRoot['To'] = toEmail

Image is stored and attached and the mail containing the image description has been sent though the command-[10]

smtp.login(fromEmail, fromEmailPassword)

smtp.sendmail(fromEmail,toEmail, msgRoot.as_string())

iii.**Project interface code:**

Following libraries are imported –

import cv2

from imutils.video.pivideostream

import PiVideoStream

import imutils

import time

import numpy as np

class VideoCamera(object):

def __init__(self, flip = False):

self.vs = PiVideoStream().start()

self.flip = flip

time.sleep(2.0)

def __del__(self):

self.vs.stop()

def flip_if_needed(self, frame):

if self.flip:

return np.flip(frame, 0)

return frame

def get_frame(self):

frame = self.flip_if_needed(self.vs.read())

```
ret, jpeg = cv2.imencode('.jpg', frame)

return jpeg.tobytes()

def get_object(self, classifier):

found_objects = False

frame = self.flip_if_needed(self.vs.read()).copy()

gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

objects = classifier.detectMultiScale( gray, scaleFactor=1.1, minNeighbors=5,

minSize=(30, 30), flags=cv2.CASCADE_SCALE_IMAGE )

if len(objects) > 0:

found_objects = True

for (x, y, w, h) in objects:

cv2.rectangle(frame, (x, y), (x + w, y + h), (0, 255, 0), 2)

ret, jpeg = cv2.imencode('.jpg', frame)

return (jpeg.tobytes(), found_objects
```

V.RESULT & DISCUSSION:

This section contains the details of the workflow of the entire home security system. The algorithm behind the working of the system and the corresponding result is as follows-

a. Ensure that the system is charged and in active state 24 hours

b.The components are attached as per the design and the software is coded

c.The object presence is sensed by IR sensor and the movement is detected by PIR sensor

d.Detection of any activity in front of the door will send the message “There is an activity detection near home”

e.After the PIR sensor sense the radiation, it uses the camera to take pictures. This function is proceeding with the help of smooth functioning of raspberry pi that is known as brain of the system.

f. Based on the image captured and the received mail, the owner of the house will decide whether the person is known or unknown, whether the door should be opened by them or not thus the system provides safety of the family members.

g.All the details of images including the timestamp will be saved in the memory card that can be monitored by the HDMI cable and can be accessed in laptop, tv and any kind of digital system.

VI.CONCLUSION:

SMART IOT SECURITY ALERT is a step to develop domestic home security with less human interventions. The suspicious movement of the trespasser is detected, and information will be passed to user’s email id. So, the designed system successfully prohibit access to unknown individual from entering the house. To avoid resource wastage and disturbance in the neighbourhood the system does alert by alarm to nullify the chance of false alarm. This system can be used in industrial usage purpose also. Depending on the requirements the system can be further developed with implementation of artificial intelligence and real time surveillance for future usage purpose.

REFERENCES

[1] Gubbi, Jayavardhana, et al. "Internet of Things (IoT): A vision, architectural elements, and future directions." *Future generation computer systems* 29.7 (2013): 1645-1660.

[2] Lee, In, and Kyoochun Lee. "The Internet of Things (IoT): Applications, investments, and challenges for enterprises." *Business Horizons* 58.4 (2015): 431-440.

[3] Khan, Minhaj Ahmad, and Khaled Salah. "IoT security: Review, blockchain solutions, and open challenges." *Future Generation Computer Systems* 82 (2018): 395-411.

[4] Chen, Shanzhi, et al. "A vision of IoT: Applications, challenges, and opportunities with china perspective." *IEEE Internet of Things journal* 1.4 (2014): 349-359.

[5] Farooq, Muhamed Umar, et al. "A review on internet of things (IoT)." *International Journal of Computer Applications* 113.1 (2015): 1-7.

[6] Ngu, Anne H., et al. "IoT middleware: A survey on issues and enabling technologies." *IEEE Internet of Things Journal* 4.1 (2016): 1-20.

[7]Xu, Boyi, et al. "Ubiquitous data accessing method in IoT-based information system for emergency medical services." *IEEE Transactions on Industrial informatics* 10.2 (2014): 1578-1586.

[8] Dorri, Ali, et al. "Blockchain for IoT security and privacy: The case study of a smart home." *2017 IEEE international conference on pervasive computing and communications workshops (PerCom workshops)*. IEEE, 2017.

[9] Mahmoud, Rwan, et al. "Internet of things (IoT) security: Current status, challenges and prospective measures." *2015 10th International Conference for Internet Technology and Secured Transactions (ICITST)*. IEEE, 2015.

[10] Zhang, Zhi-Kai, et al. "IoT security: ongoing challenges and research opportunities." *2014 IEEE 7th international conference on service-oriented computing and applications*. IEEE, 2014.