# IOT BASED HOME AUTOMATION SYSTEM USING RASPBERRY PI AND TEMPARATURE & HUMIDITY SENSOR

*A Project report submitted in partial fulfilment*

*of the requirements for the degree of B. Tech in Electrical Engineering*

*By*


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# *CERTIFICATE*

## To whom it may concern

This is to certify that the project work entitled **IOT BASED HOME AUTOMATION SYSTEM USING RASPBERRY PI AND TEMPARATURE & HUMIDITY SENSOR** is the bona fide work carried out by

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_____ _____

**Signature of the Guide** **Signature of the HOD**

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**Signature of the External Examiner**

# ACKNOWLEDGEMENT

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**Place:** KOLKATA ----------

**Date:** 16/05/2019 **Full Signature of the Student**

## Acronyms and Abbreviations:

- ***LTE*** : Long Term Evolution
- ***IoT***: Internet of Things
- ***GPIO*** : General purpose input/output
- ***RPi***: Raspberry Pi
- ***IP***: Internet Protocol
- ***DHT***: Digital Humidity and Temperature
- ***IR***: Infrared sensor

## Abstract:

Availability of high speed mobile networks like 3G, 4G and LTE coupled with cheaper and accessible smart phones has seen a tremendous growth in terms of providing various services and applications at the fingertips of the citizens. This report discusses about IoT and how it can be used for realizing smart home automation using Raspberry Pi.This system consists of a smart phone along with webpage which is having panel to operate and regulate(both manual and automatic) the home appliances. Details of the real time weather conditions(Temperature and Humidity) are displayed over the web interface provided. Along with the mentioned system the proposed project provides a prototype of cheap and smart security system. The web interface on the smartphone or any computer is connected to the Raspberry Pi using the IP address of the Pi through Wi-Fi.The wireless application is user friendly which improves efficiency and lifestyle.The Internet of Things(IoT)is one of the promising technologies which can be used for connecting, controlling and managing the devices connected to the Pi. Applications ranging from smart homes, smart security etc. can use IoT for effective delivery of services automatically and intelligently.

# INTRODUCTION:

IoT is the internetworking of physical devices, vehicles (also referred to as “connected devices” and “smart devices”), buildings, and other items-embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as “the infrastructure of the information society” .. The home automation is nothing but interconnection of physical devices embedded with sensors and software. The network connectivity is used to collect and exchange the data. Home automation refers to the automatic and electronic control of household features, activity and appliances. Modern system generally consist of switches and sensors connected to a central “gateway” from which the system is controlled with a user interface that is interacted either with a wall-mounted terminal, mobile phone software, tablet computer or web interface, often via internet . Nowadays home automation system is being widely used to control devices around the home. A variety of home devices can be controlled with the help of a home automation system. All kinds of home appliances like doors, lights, fan, electric heater, surveillance systems, and consumer electronics belong to the home automation system devices. Home automation system is adopted by using the technology available for the purpose of controlling the devices as well as the systems used in the home automatically.

This project presents a prototype of an intelligent home automation to control the home appliances and electrical and electronic equipment via a web interface which can be accessed by smartphones, computers, tablets etc. having an active internet connection. It will turn ON or OFF and will regulate automatically as well as manually the home appliances and electrical equipment by using relay circuits with the concept of IoT. It will automatically regulate the fans according to the weather conditions by continuously sensing and comparing the live humidity and temperature of the house with the preset values. A software alarm will also be projected if it detects abnormally high temperature inside the house. This project also demonstrates a very basic and intelligent smart locking system which will lock or unlock the door upon manual authentication of the entity entering the house whose image will be feed to the web interface. All of these are implemented by using Raspberry Pi.

# Literatue Survey:

A. *Bluetooth based home automation system using cell phones*:
In Bluetooth based home automation system the home appliances are connected to the Arduino BT board at input output ports using relay. The program of Arduino BT board is based on high level interactive C language of microcontrollers; the connection is made via Bluetooth. The Bluetooth connection is established between Arduino BT board and phone for wireless communication. In this system the python script is used and it can install on any of the Symbian OS environment, it is portable. One circuit is designed and implemented for receiving the feedback from the phone, which indicate the status of the device. **[13]**

*B.* *Smart home based on Zigbee:*
Constructing the efficient, convenient and cozy home environment has become the current hot spot by using ZIGBEE wireless communication technology. This system uses ZIGBEE Wireless Technology to build home internal Network, and connect a variety of sensors and home appliance controller to ZIGBEE network node. Various signals collected by a few end-nodes may be delivered by this system to the main control module, which will analyze and process them. Then the main control module transfers this information to internet through the Ethernet and GSM/GPRS network to remotely and locally monitor and control family inner environment and household appliances. Furthermore, the working condition of the system can be traced into SD Cards.**[12]**

C. *Wi-Fi based home automation system using cell phones*:
Wi-Fi based home automation system mainly consist three modules, the server, the hardware interface module, and the software package. The figure shows the system model layout. Wi-Fi technology is used by server, and hardware Interface module to communicate with each other. The same technology uses to login to the server web based application. The server is connected to the internet, so remote users can access server web based application through the internet using compatible web browser. Software of the latest home automation system is split to server application software, and Microcontroller (Arduino) firmware. The Arduino software, built using C language, using IDE comes with the microcontroller itself. Arduino software is culpable for gathering events from connected sensors, then applies action to actuators and preprogramed in the server. Another job is to report the and record the history in the server DB. The server application software package for the proposed home automation system, is a web based application built using asp.net. The server application software can be accessed from internal network or from internet if the server has real IP on the internet using any internet navigator supports asp.net technology. Server application software is culpable of, maintain the whole home automation system, setup, configuration. Server use database to keep log of home automation system components, we choose to use XML files to save system log.**[14]**

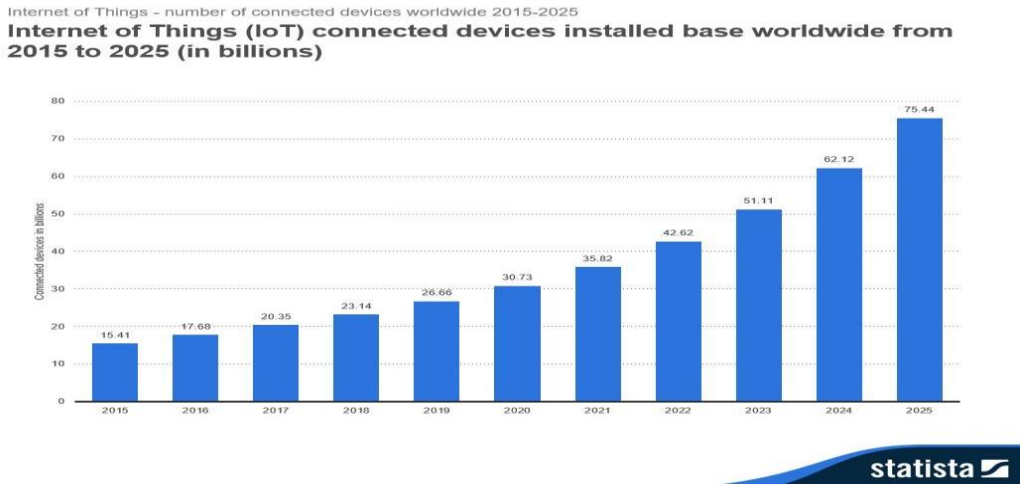


***Fig 1**: Projection of growth rate of Iot based devices installed*

# THEORY:

## Working principle of IoT:

This project works on the concept of IoT. All the devices are connected centrally to the pi.

The web interface is designed to access the dedicated IP address of the Raspberry Pi to gain remote access over the devices directly connected to the RPi. The sensors are calibrated with the Pi in order to obtain the real time data which is then fed to the interface as well as used for automatic regulation of the connected devices.The web interface having its own dedicated IP address makes it accessible from any parts of the world over the Internet.

Home automation is a network of hardware, communication, and electronic interfaces that work to integrate everyday devices with one another via the Internet. Each device has sensors and is connected through WiFi, so we can manage them from our smartphone or tablet whether you're at home, or miles away. This allows us to turn on the lights, lock the front door, or even turn down the heat, no matter where we are.

There are three main elements of a home automation system: sensors, controllers, and actuators.

Sensors can monitor changes in Humidity, temperature, or motion detection. Home automation systems can then adjust those settings to our preferences.

Controllers refer to the devices — personal computers, tablets or smartphones — used to send and receive messages about the status of automated features in your home.

Actuators may be light switches, motors, or motorized valves that control the actual mechanism, or function, of a home automation system. They are programmed to be activated by a remote command from a controller.

## Schematic representation of Raspberry Pi:

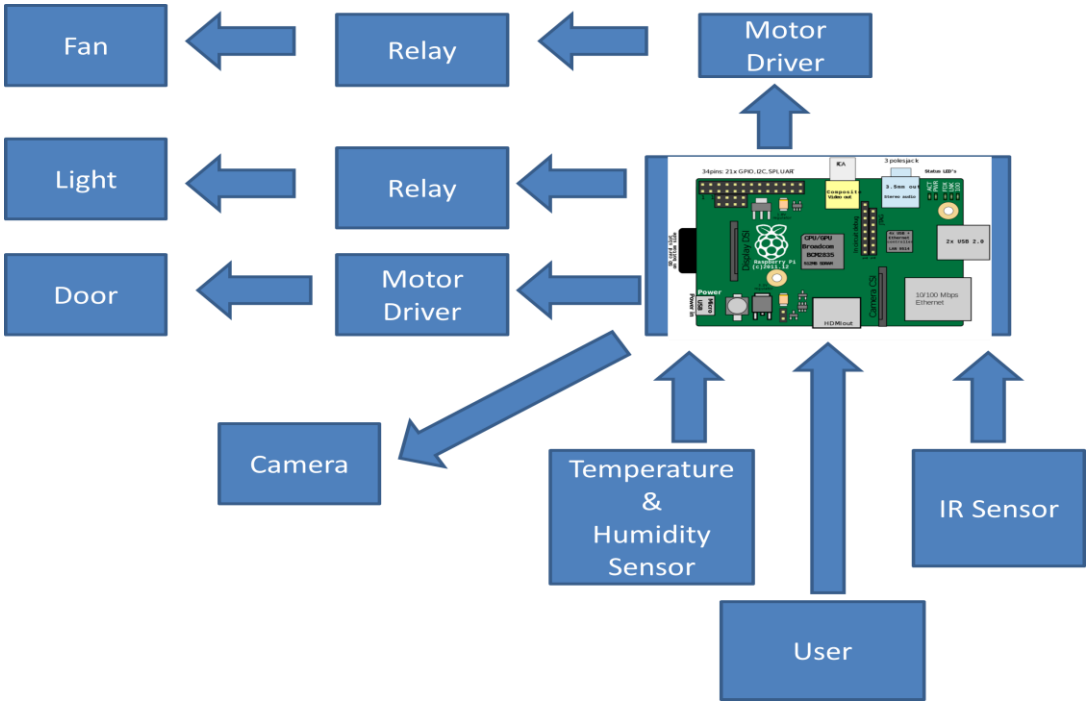


***Fig 2:*** Proposed block diagram of the project work

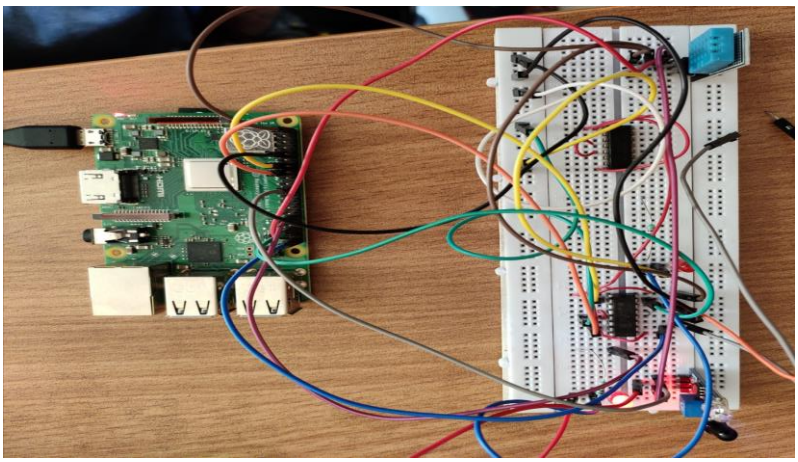

**Fig 3:** physical connection layout of Raspberry Pi with breadboard

# HARDWARE MODEL:

PROPOSED SYSTEM:

In the proposed system Raspberry Pi is used and internet connection is established for the purpose of automation using IoT by accessing the IP address.

## HARDWARE REQUIREMENTS:

A. Raspberry Pi:

Raspberry Pi is a low cost credit card size computer that plugs into a computer monitor or TV and uses a standard keyboard and mouse. Most importantly it's open source hardware. Computing Programmable Language like python and scratch under Linux platform. Raspberry Pi 2 model B has CPU 900MHZ quad-core ARM cortx-A7 processor. The Ethernet adaptor is connected to an additional USB port. In model A and A+ the USB port is connected directly to the Silicon on Chip (SoC).

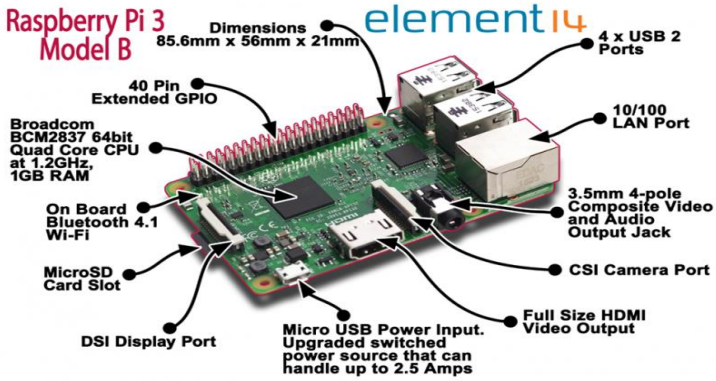


***Fig 4:*** *Schematic representation of RPI 3*

**B.** DC motor:

A DC motor is any class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in the part of DC motor. DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances

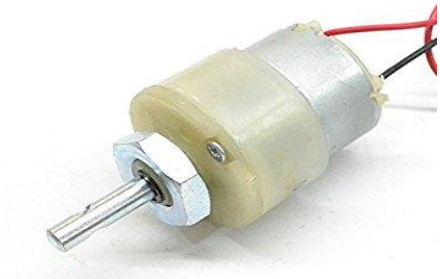

***Fig 5:*** *Pictorial view of DC motor*

**C.** Motor driver circuit:

L293D is a typical Motor driver or Motor driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC

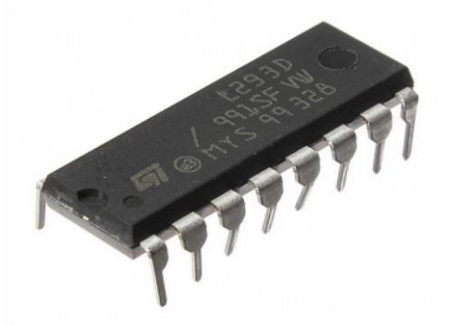


***Fig 6:*** *Schematic view of motor driver*

**D.** IR Sensor**:**

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion.These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor.The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, The resistances and these output voltages, change in proportion to the magnitude of the IR light received.

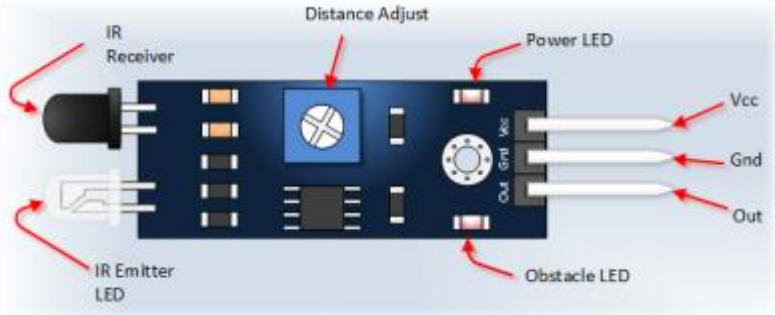


***Fig 7:*** *schematic representation of IR sensor*

**E.** Relay circuit:

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contact in another circuit. When a relay contact is Normally Closed (NC), there is a closed contact when the relay is not energized. It is an electromagnetic switch operated by relatively small electric current that can turn on or off much larger electric current the heart of a relay is an electromagnet.Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated

operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults. Two channel relay diagram is shown in the figure.This is a 5V, 10A 2-Channel Relay interface board. It can be controlled various appliances, and other equipment with large current. It can be controlled directly with 3.3V or 5V logic signals from a microcontroller (ARM, 8051, PIC).


***Fig 8:*** *Schematic representation of two channel relay*

## Software Requirements:

A. Python:
Python is a widely used high-level programming language for general-purpose programming first released in 1991. An interpreted language, Python has a design philosophy which emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly braces or keywords), and a syntax which allows programmers to express concepts in fewer lines of code than possible in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale.

B. PUTTY :
Used to connect devices over ip address

C. Advance IP scanner:
Used to scan the ip address of the devices.

D. Vnc viewer:
Used to remotely control the pi over a GUI.

E. Raspbian Jessie :
The OS through which we interact with the Pi.

F. IP Webcam:
An android app through which we are able to use camera of our android phone.

## Flow Chart of the proposed system:

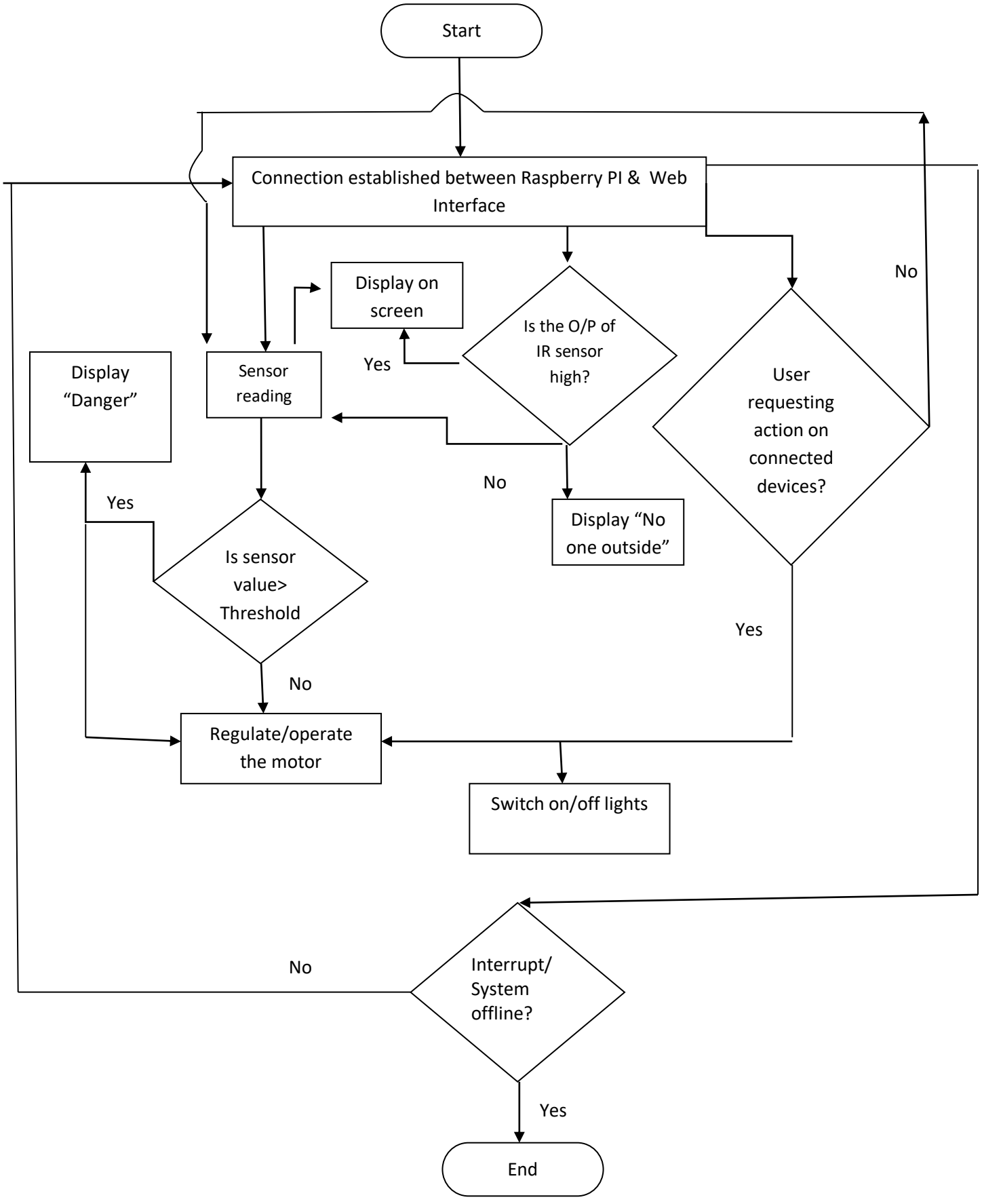


***Fig 9:*** *Flow chart of the proposed system*

# Software program developed for the proposed project:

## Master code:

```
from flask import Flask,render_template,request
import RPi.GPIO as gpio
import time
import Adafruit_DHT
import urllib.request
from PIL import Image
url='http://192.168.0.100:8080/shot.jpg'
gpio.setmode(gpio.BCM)
gpio.setwarnings(False)
gpio.setup(13,gpio.OUT)
gpio.setup(27,gpio.OUT)
gpio.setup(22,gpio.OUT)
gpio.setup(21,gpio.OUT)
gpio.setup(16,gpio.OUT)
gpio.setup(12,gpio.OUT)
gpio.setup(18,gpio.OUT)
gpio.setup(23,gpio.OUT)
gpio.output(12,gpio.HIGH)
ir=25
gpio.setup(ir,gpio.IN)
a=0
x=[0]
def temphumi():
h,t=Adafruit_DHT.read_retry(11,26)
return h,t;
def increment(a):
a=a+1
return a;
def click():
if((gpio.input(ir))==0):
a=x[0]
i=increment(a)
img= Image.open(urllib.request.urlopen(url))
filepath='/home/pi/Project/static/image'+str(i)+'.jpg'
name='image'+str(i)+'.jpg'
img.save(filepath)
img1= Image.open(filepath,)
x[0]=i
return name;
p=gpio.PWM(27,100)
p.start(0)
q=gpio.PWM(21,100)
q.start(0)
app = Flask(__name__)
@app.route('/')
def index():
h,t=temphumi()
name=click()
if(t>25):
s='Danger'
else :
s='Normal'
templateData={
'Temp':t,
'Humidity':h,
'filename':name,
'status':s
}return render_template('project.html', **templateData)
```

```
@app.route('/<device>/<action>')
def action(device,action):
try:
h,t=temphumi()
if device == 'light1' and action =='on':
gpio.output(13,1)
elif device == 'light2' and action =='on':
gpio.output(5,1)
elif device == 'light1' and action=='off':
gpio.output(13,0)
elif device == 'light2' and action=='off':
gpio.output(5,0)
elif device == 'fan1' and action=='on':
h,t=temphumi()
if((t>25 and t<=30)  or(h>30 and h<=50)):
p.ChangeDutyCycle(100)
gpio.output(22,False)
elif(t<25 or h<=30):
p.ChangeDutyCycle(0)
gpio.output(22,False)
elif(t>30 and h>60):
p.ChangeDutyCycle(100)
gpio.output(22,False)
elif device == 'fan2' and action=='25':
q.ChangeDutyCycle(25)
gpio.output(16,False)
elif device == 'fan2' and action=='50':
q.ChangeDutyCycle(50)
gpio.output(16,False)
elif device == 'fan2' and action=='100':
q.ChangeDutyCycle(100)
gpio.output(16,False)
elif device == 'fan1' and action =='off':
gpio.output(22,0)
p.ChangeDutyCycle(0)
elif device == 'fan2' and action =='0':
gpio.output(21,0)
q.ChangeDutyCycle(0)
elif device == 'door' and action =='on':
gpio.output(18,0)
gpio.output(23,1)
elif device == 'door' and action =='off':
gpio.output(18,1)
gpio.output(23,0)
except:
return render_template('project.html', **templateData)
name=click()
h,t=temphumi()
if(t>25):
s='Danger'
else :
s='Normal'
templateData={
'Temp':t,
'Humidity':h,
'filename':name,
'status':s
}
return render_template('project.html', **templateData)
if __name__ == '__main__':
app.run(debug=True,port=5000, host='0.0.0.0')
```

## **Web interface source code:**

```
<!DOCTYPE html>
<html>
<head>
<meta http-equiv="refresh" content="5"  name="viewport" content="width=device-width,
initial-scale=1">
<style>
* {
box-sizing: border-box;
}
body {
font-family: Arial;
font-size: 17px;
}
.container {
position: relative;
max-width: 1200px;
margin: 0 auto;
}
.container img {vertical-align: middle;}
.container .content {
position: absolute;
bottom: 0;
background: rgb(0, 0, 0); /* Fallback color */
background: rgba(0, 0, 0, 0.5); /* Black background with 0.5 opacity */
color: #f1f1f1;
width: 100%;
padding: 20px;
}
a:link {
color:#FF9;
}
#leftcon{
float:left;
}
#rightcon{
float:right;
}
#photo{
float:right;
}
</style>
</head>
<title>RaspPi</title>
<meta charset="utf-8">
```

<body>
<h1 style="text-align:center;color:#C03;" > REMOTE ACCESS INTERFACE</h1>


IOT based Home Automation

<h3>ROOM 1</h3>
 Light       <a href="/light1/on" class="button"   </a> ON   <a </a>      <a href="/light1/off" class="button"   </a> OFF <a </a> 
 Fan       <a href="/fan1/on" class="button"   </a> ON   <a </a>      <a href="/fan1/off" class="button"   </a> OFF<a </a> 

<h3>ROOM 2</h3>
 Light       <a href="/light2/on" class="button"   </a> ON   <a </a>      <a href="/light2/off" class="button"   </a> OFF <a </a> 
 Fan       <a href="/fan2/25" class="button"</a> 25   <a </a>   <a href="/fan2/50" class="button"</a> 50 <a </a>  <a href="/fan2/100" class="button"</a> 100 <a </a> <a href="/fan2/0" class="button"</a> OFF <a </a> 

<br/><br/>Door <a href="/door/on" class="button"   </a> OPEN <a </a>   <a href="/door/off" class="button"   </a> CLOSE <a> </a> <br/><br/>
 Temperature:{{Temp}} Humidity:{{Humidity}}
 Status:{{status}}

<div id="photo"style="width:300px;height:200px;border:1px solid #000;"> 

>

</body>
</head>
</html>

# Observation and Experimental Results :

Two bulbs and 3 motors are used in this system instead of connecting home appliances. Light1, light2, Fan1&Fan2(motor)and Door lock(motor) are among the appliances that can be used in this system. Home automation system is used for controlling and monitoring the home appliances. It can be performed in several ways. In this system,concept of IoT is used in order to control the devices remotely from anywhere. Raspberry Pi is used as the board controller to connect the appliances via input and output port. Web interface (on Mobile phones,laptop,etc.) and Raspberry Pi are connected through internet. All the devices are connected with Raspberry Pi. The voltage of home appliances is 230V but the Raspberry Pi voltage is 5V. So in this system,relay circuit is used to cover the high voltage to low voltage, low voltage to high voltage which is also act as a switch. In this system, we are using two bulbs, few dc motors as home appliances. Here two way relay are used in order to connect bulbs.

For the program to execute and work automatically according to the embedded program we should keep the Rpi online i.e it should be connected to the wifi. In order to access the web interface from anywhere we need to provide IP address in the URL to open the webpage. It will establish the connection between the smart phone and the Raspberry Pi board thus to the devices connected to the RPi. On the webpage, we are having ON, OFF and regulation buttons for the connected devices. By using these buttons we can able to control the home appliances which we connected with Raspberry Pi.

Apart from manual regulation of the connected device, they have embedded code in the pi for automatic regulation depending upon the weather condition(Temperature and humidity) which is provided by the DHT11 sensor.

The door locking mechanism works on manual authentication of the entity entering the house,i.e

If any object or person comes near the IR sensor(placed on door) it will automatically click picture of the entity which will then be displayed on the webpage. After authentication the door lock will be unlocked using the “open” button provided for the door. If required, the door can be once again locked remotely via the interface.

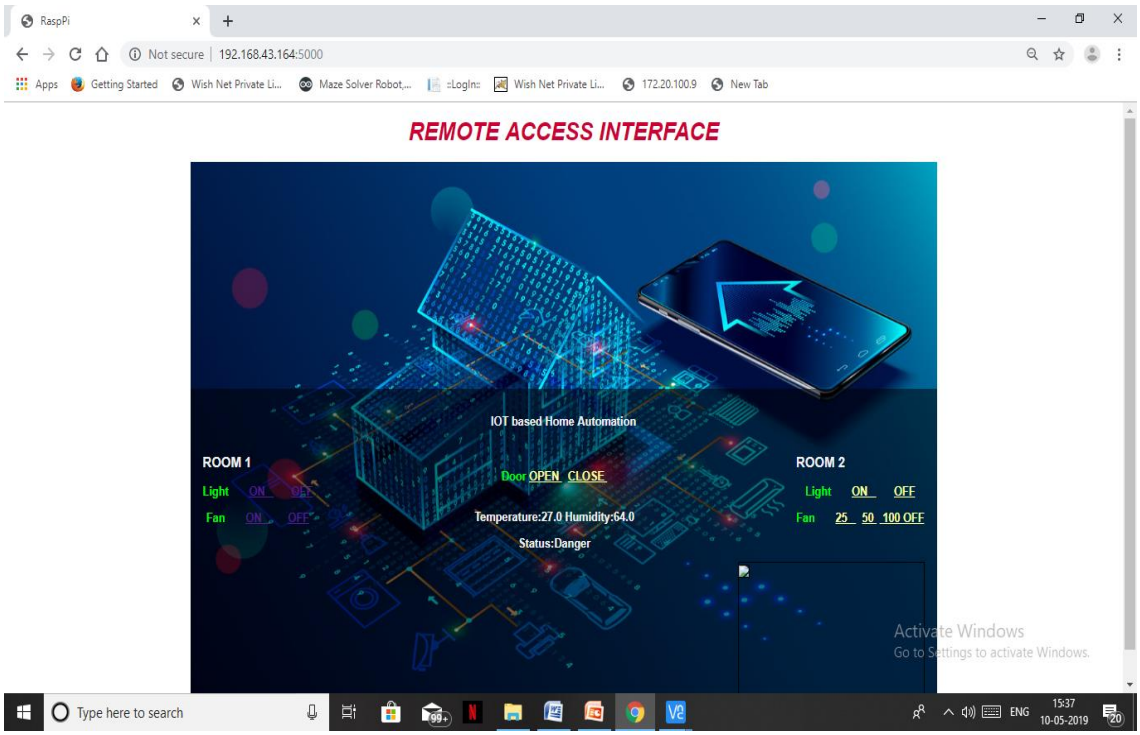


***Fig 10:*** *Web interface of the proposed project*

# Conclusion:

- In this project, a prototype smart home automation using IoT is presented by integrating relays and devices to Raspberry pi board for controlling the devices from a remote location in a real scenario.
- The proposed home automation system includes control and regulation of lights, model fans by automatically comparing the preset values of Temperature and Humidity.
- The door locking system includes manual authentication of person entering the house by automatically clicking the picture of any person or object standing near the door using IR sensors thus automatically locking and unlocking the door.
- Raspberry Pi proves to be a smart, economic and efficient platform for implementing the home automation.
- The system is Flexible and programmable and has wide range applications and supports wide Varity of peripherals and accessories
- The system can be accessed from any internet based device including handheld devices such as mobile phones.

# Specification of hardware components:

***Raspberry Pi 3B+***

- SoC: Broadcom BCM2837B0 quad-core A53 (ARMv8) 64-bit @ 1.4GHz
- GPU: Broadcom Videocore-IV
- RAM: 1GB LPDDR2 SDRAM
- Networking: Gigabit Ethernet (via USB channel), 2.4GHz and 5GHz 802.11b/g/n/ac Wi-Fi
- Bluetooth: Bluetooth 4.2, Bluetooth Low Energy (BLE)
- Storage: Micro-SD
- GPIO: 40-pin GPIO header, populated
- Ports: HDMI, 3.5mm analogue audio-video jack, 4x USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)
- Dimensions: 82mm x 56mm x 19.5mm, 50***g***

***Relay*** **:**

5V, 10A 2-Channel Relay

***DC Motor*****:**

- **Motor Type :** DC with Gear Box, Metal Gears
- **Base Motor :** DC 300 RPM
- **Shaft Type :** Center , Circular 6mm Dia with Internal Hole for coupling, 23mm shaft Length
- **Maximum Torque:** ~2.5 Kg-cm at 12V
- **RPM :** 300 RPM at 12V
- **Weight :** 145 Gms
- **Max Load Current:** ~250mA at 12V-30RPM

***IR sensor*** **:**

- 5VDC Operating voltage
- I/O pins are 5V and 3.3V compliant
- Range: Up to 20cm
- Adjustable Sensing range

- Built-in Ambient Light Sensor
- 20mA supply current
- Mounting hole

***DHT 11*** **:**

| | |
|---|---|
| • CB size | 22.0mm X 20.5mm X 1.6mm |
| • Working voltage | 3.3 or 5V DC |
| • Operating voltage | 3.3 or 5V DC |
| • Measurement range | 20-95%RH；0-50℃ |
| • Resolution | 8bit（temperature），8bit（humidity） |
| • Compatible interfaces | 2.54 3-pin interface and 4-pin Grove interface(1) |

***L293D*** **:**

- Supply Voltage Range 4.5V to 36V.
- 600-mA Output current capability per driver.
- Separate Input-logic supply.
- It can drive small DC-geared motors, bipolar stepper motor.
- Pulsed Current 1.2-A Per Driver.
- Thermal Shutdown.
- Internal ESD Protection.
- High-Noise-Immunity Inputs

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