IOT BASED SMART HOME AUTOMATION SYSTEM WITH SMART GARDEN AND AUTOMATED HOME SECURITY

Report submitted by

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in partial fulfillment of the requirements for the course

19CCE384 – Design and Innovation Lab

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MOTIVATION:

The project aims to explore the domain of IoT-based smart home automation, coupled with smart garden systems, and automated home security. The motivation lies in the desire to enhance convenience, security, Sustainability, and efficiency in our daily lives.

With the advancement of technology, a smart home can be controlled through a user-friendly interface or GUI, users can easily interact with the system and manage their appliances., eliminating the need to manually operate each device and streamlining the control process.

Smart home systems can optimize energy consumption by adjusting LED bulb intensity and fan speeds, according to comfort requirements. The use of energy-efficient LED lights further contributes to sustainability by minimizing power consumption.

By monitoring the soil's moisture content and regulating the watering intensity correspondingly, a smart garden system may provide intelligent plant care. As a result, less water is wasted, and plant health is improved.

An automated security surveillance system adds an extra layer of protection to the home by monitoring the surroundings in real-time and sending alerts to the user.

This project combines hardware and software components and allows for hands-on experience in integrating various technologies such as Raspberry Pi, networking protocols, various sensors like PIR and soil moisture sensors, and programming languages like Python, and its different libraries, and tools.

PROBLEM STATEMENT:

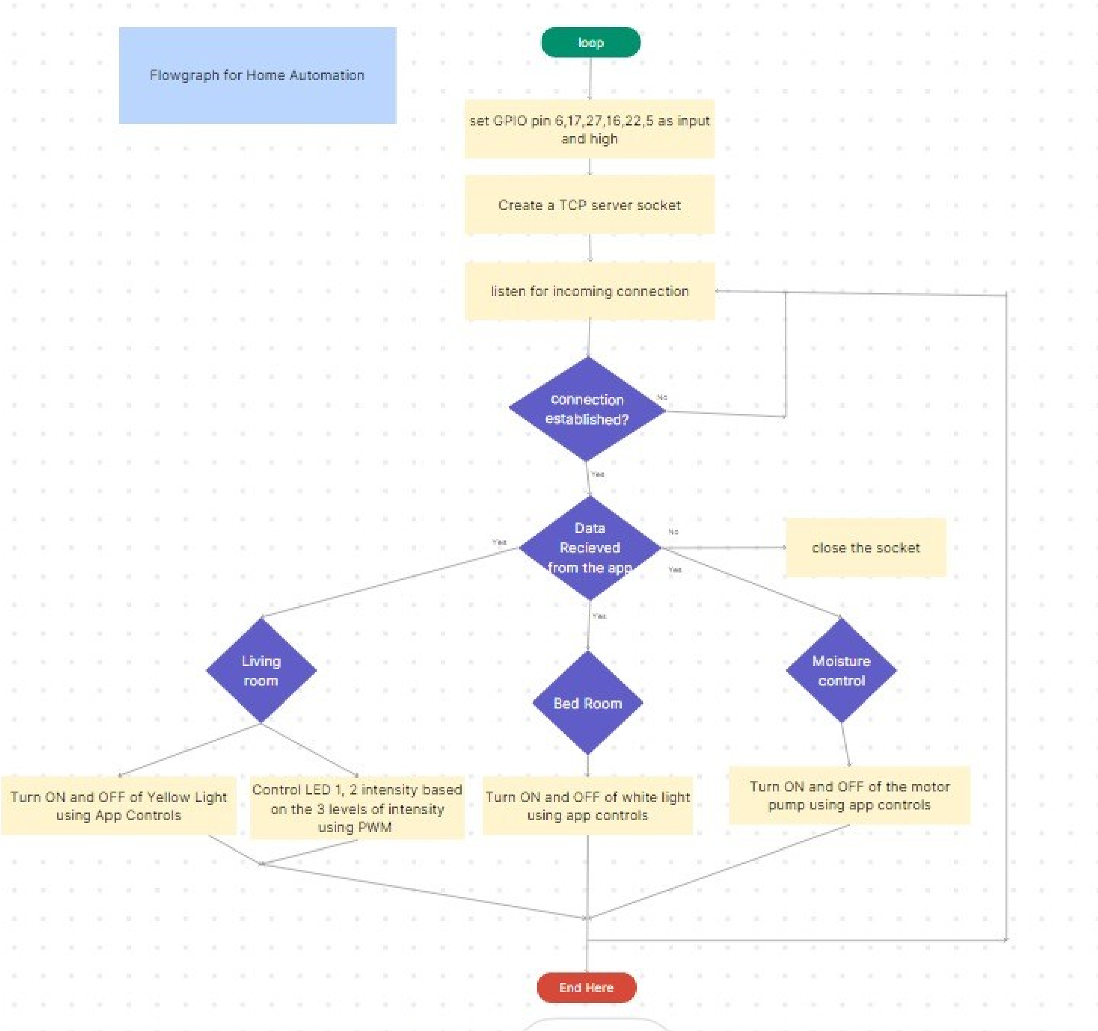
To Implement a smart home system that integrates various appliances, home surveillance, and a smart garden. Through a mobile app, users should be able to control appliances, such as LED bulbs and fans. The system should also detect motion with a PIR sensor, activate the living room camera, and send an email with a 10-second video clip to the owner if someone is detected. Additionally, the system should incorporate a smart garden feature that measures soil moisture and adjusts the water pump intensity based on the moisture level.

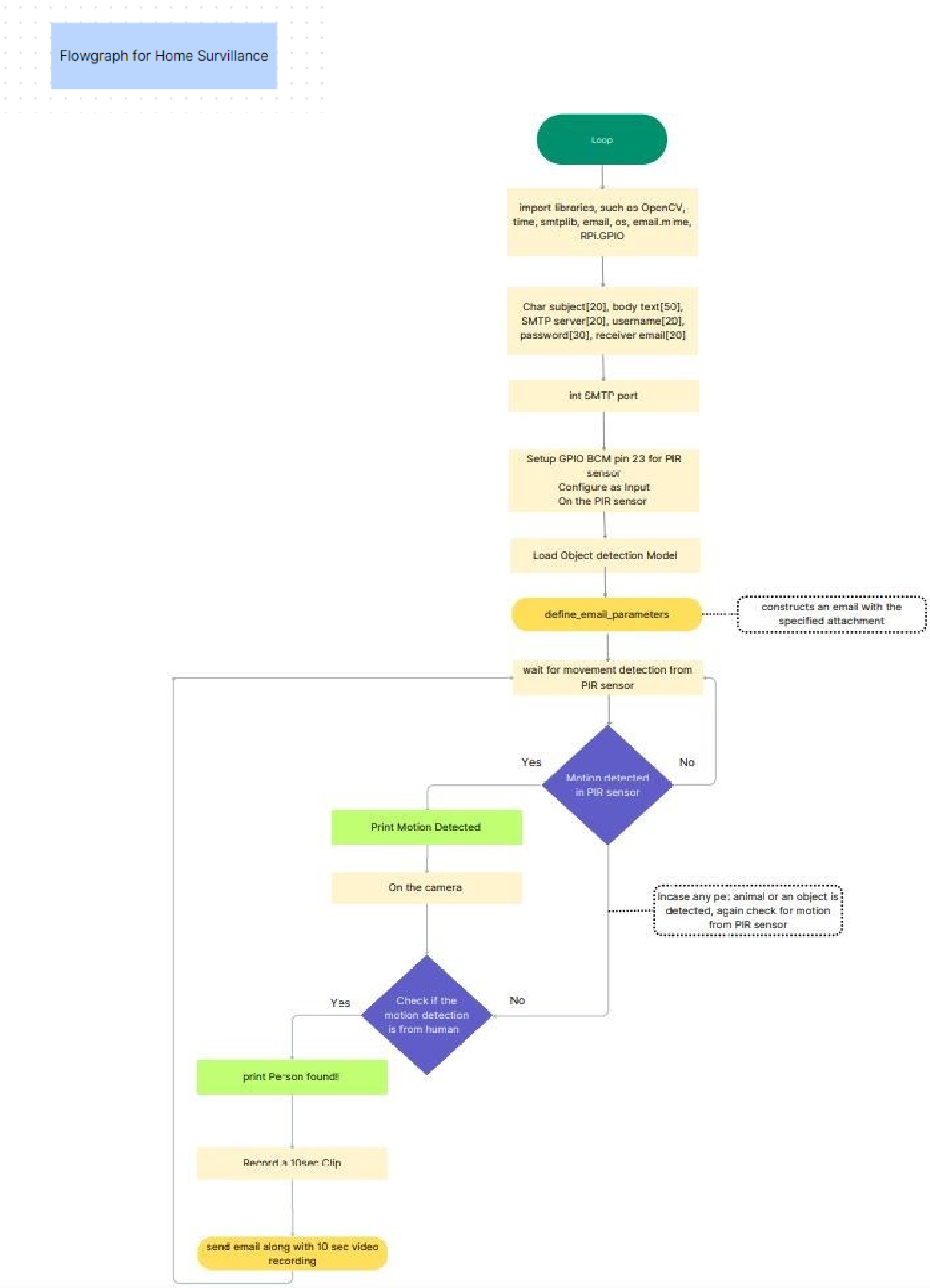
- Create a mobile app with an intuitive user interface to control smart home appliances.
- Implement functionality in the app to adjust the intensity of LED bulbs and the fan speed.
- Integrate a PIR sensor to detect motion within the house.
- Connect a camera inside the living room that activates when motion is detected by the PIR sensor.
- Integrate an algorithm to distinguish between human and non-human motion in the video feed.
- Send an alert email to the owner when a person is detected, with a 10-second video clip attached to the mail.

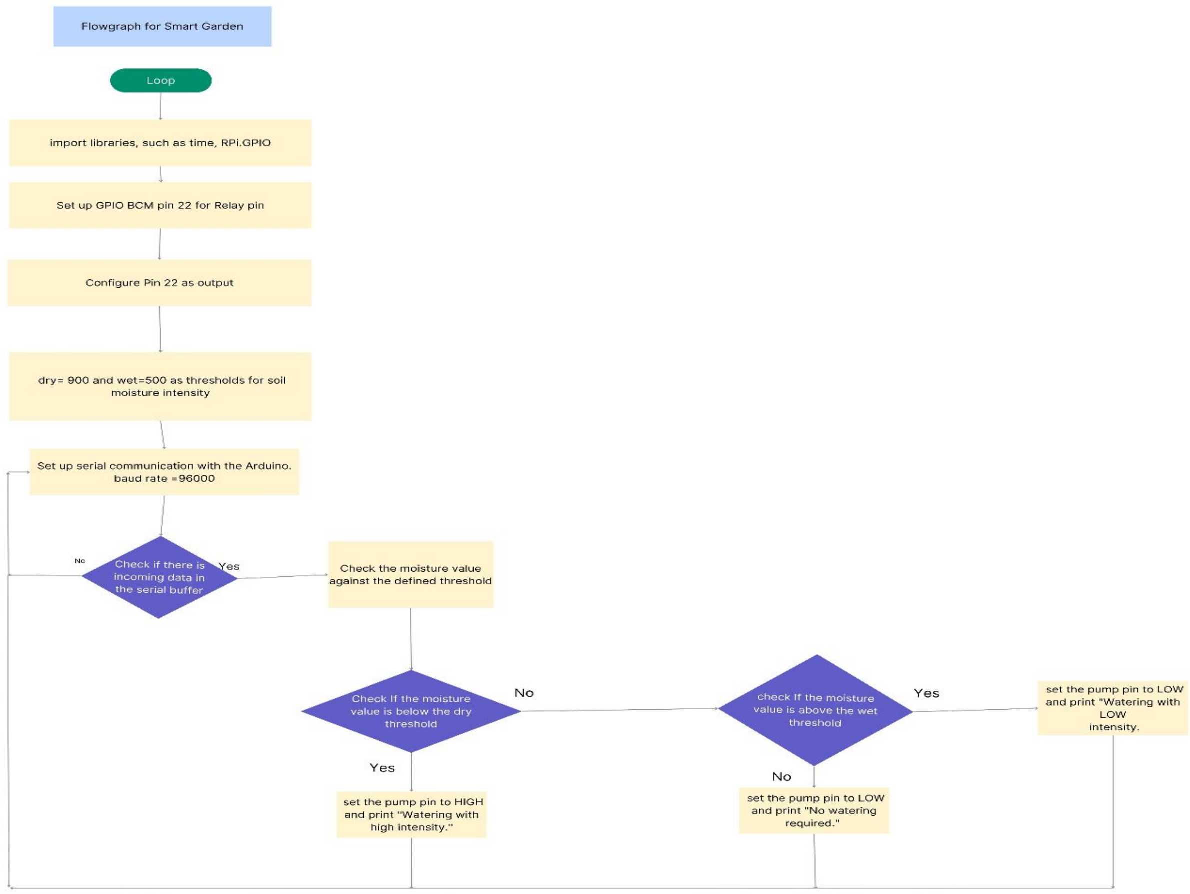
- Integrate a smart garden system that measures soil moisture levels using soil moisture sensor.
- Implement a water pump control mechanism that adjusts the intensity or level of water based on the measured moisture level.

DESIGN PROCEDURE:

FLOW CHART:




Flowgraph for Home Survillance
Loop
import libraries, such as OpenCV, time, smtplib, email, os, email.mime, RPi.GPIO
Char subject[20], body text[50], SMTP server[20], username[20], password[30], receiver email[20]
int SMTP port
Setup GPIO BCM pin 23 for PIR sensor
Configure as Input
On the PIR sensor
Load Object detection Model
define_email_parameters
constructs an email with the specified attachment
wait for movement detection from PIR sensor
Yes
No
Motion detected in PIR sensor
Print Motion Detected
On the camera
Incase any pet animal or an object is detected, again check for motion from PIR sensor
Yes
No
Check if the motion detection is from human
print Person found!
Record a 10sec Clip
send email along with 10 sec video recording



ALGORITHM:

HOME AUTOMATION:

1.Initialize the state variables for each component:

- Initialize bulbState1 to OFF (state of the first bulb in Room 1).
- Initialize bulbState2 to OFF (state of the bulb in Room 2).
- Initialize ledBrightness1 to 0 (brightness of the first LED in Room 1).
- Initialize ledBrightness2 to 0 (brightness of the second LED in Room 1).

2.Establish a connection between the app and the home automation system (controlled by raspberry pi).

- Receive user input from the app:
- Read the desired state for bulbState1 and bulbState2 from the app.
- Read the desired brightness values for ledBrightness1 and ledBrightness2 from the app.

4.Control the components in house:

- If bulbState1 is ON, turn on the first bulb in Room 1; otherwise, turn it off.
- If bulbState2 is ON, turn on the bulb in Room 2; otherwise, turn it off.

- Set the brightness of LED 1 in Room 1 to ledBrightness1.
- Set the brightness of LED 2 in Room 1 to ledBrightness2.
- Repeat steps 3 and 4 if the app is connected.

HOME SURVEILLANCE:

1.Initialize the PIR sensor, Pi camera, and email settings.

2.Set up the PIR sensor to detect motion:

3.Continuously monitor the PIR sensor:

- In an infinite loop read the output of the PIR sensor.
- If motion is detected, proceed to the next step. Otherwise, continue monitoring.

4.Capture a video using the Pi camera:

- Turn on the Pi camera module if motion is detected in the PIR sensor.
- Start recording a video for 10 seconds.
- Save the video file in a local storage device

5.Send the captured video to the user's email:

- Compose an email with the captured video as an attachment.
- Set the recipient's email address.
- Set the email subject and body as desired.
- Send the email with the video attachment.

6.Delete the temporary video file.

7.Return to step 3 and continue monitoring for motion.

SMART GARDEN:

1.Import the necessary libraries: serial and RPi.GPIO.

2.Set up the GPIO pins with respect to BCM numbering scheme.

3.Define the pump pin as GPIO pin 22 and set it as an output pin.

4.Set up serial communication with the Arduino, providing the appropriate port, baud rate=9600, and timeout values.

5.Reset the input buffer of the serial connection.

6.Define the dry= 900 and wet=500 as thresholds for soil moisture intensity.

7.Enter an infinite loop:

- Check if there is incoming data in the serial buffer.
- Read the data from the serial buffer and convert it to an integer representing the Set up serial communication with the Arduino moisture value.
- Check the moisture value against the defined thresholds:

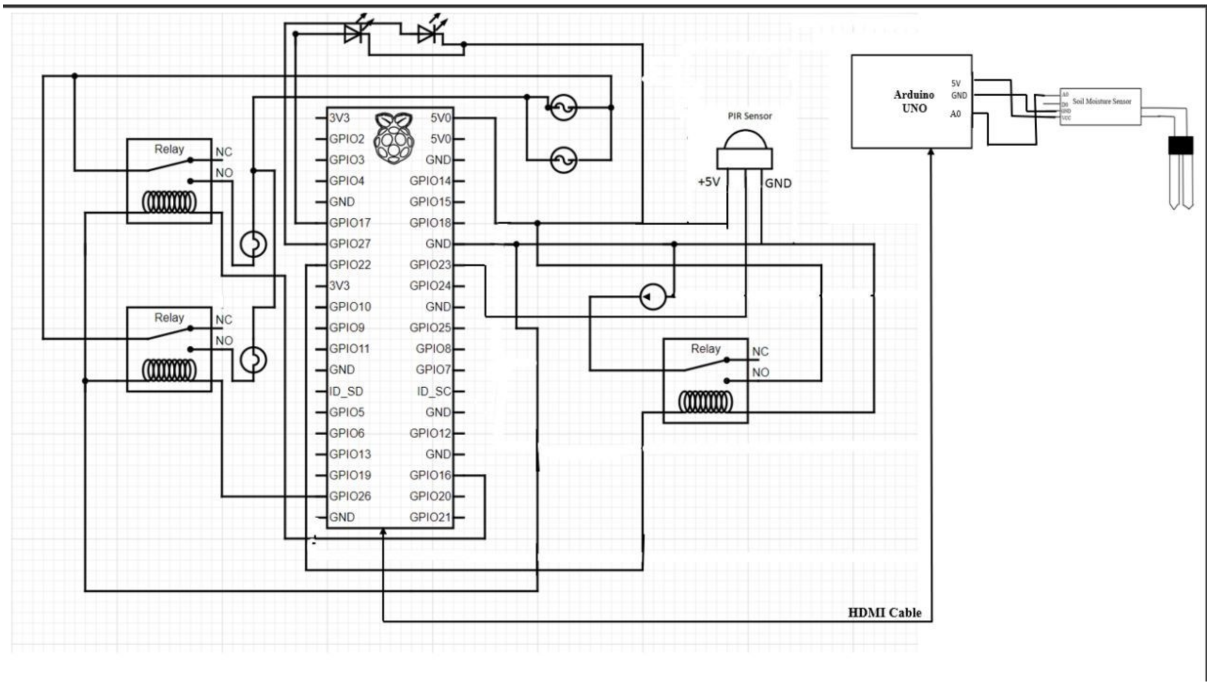
- If the moisture value is below the dry threshold, set the pump pin to HIGH and print "Watering with high intensity."
- If the moisture value is above the wet threshold, set the pump pin to LOW and print "Watering with low intensity."
- Otherwise, set the pump pin to LOW and print "No watering required."

8.Clean up the GPIO pins on program exit.

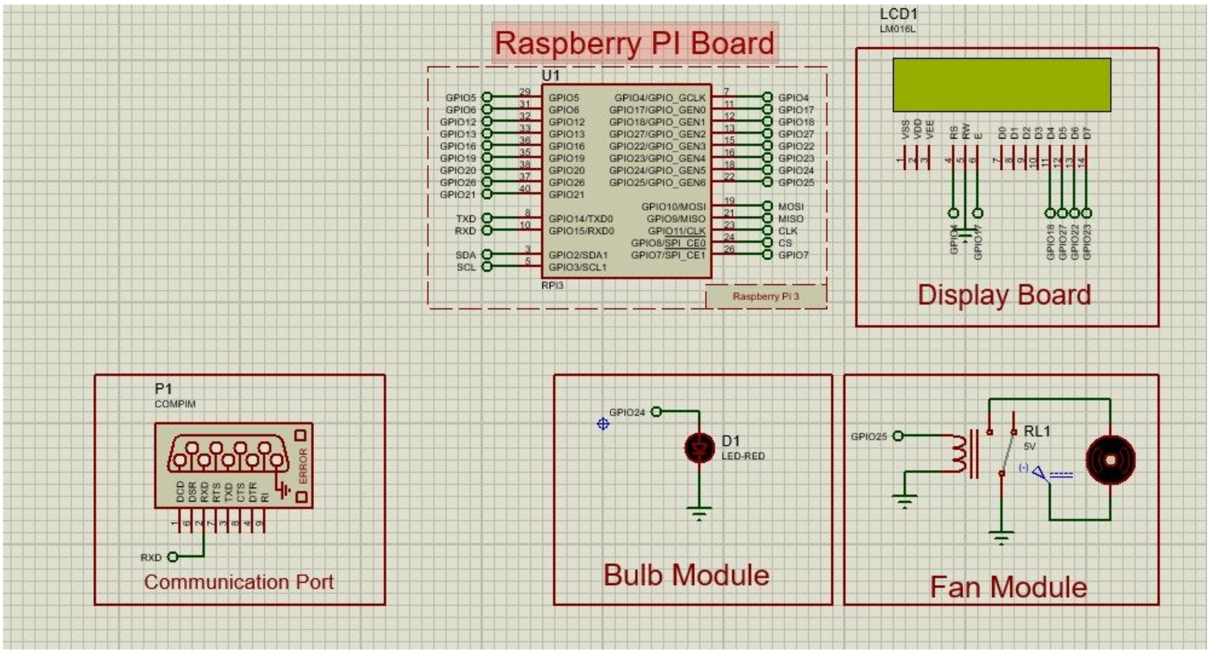
BUDGET:

S.No	Product Description	Quantity	Price (in Rs.)
1	Raspberry Pi 4B	1	8300
2	Raspberry Pi camera module	1	370
3	PIR sensor	1	125
4	Soil moisture sensor	1	180
5	Mini water pump	1	100
6	Mini water pipe	0.5 meter	20
7	Printed Circuit Board (PCB)	6x8 cm	50
8	AC Bulb with holder	2	190
9	LED	2	10
10	Arduino Uno	1	650
11	Jumper wire	As required	200
12	5V 4 channel Relay	1	280

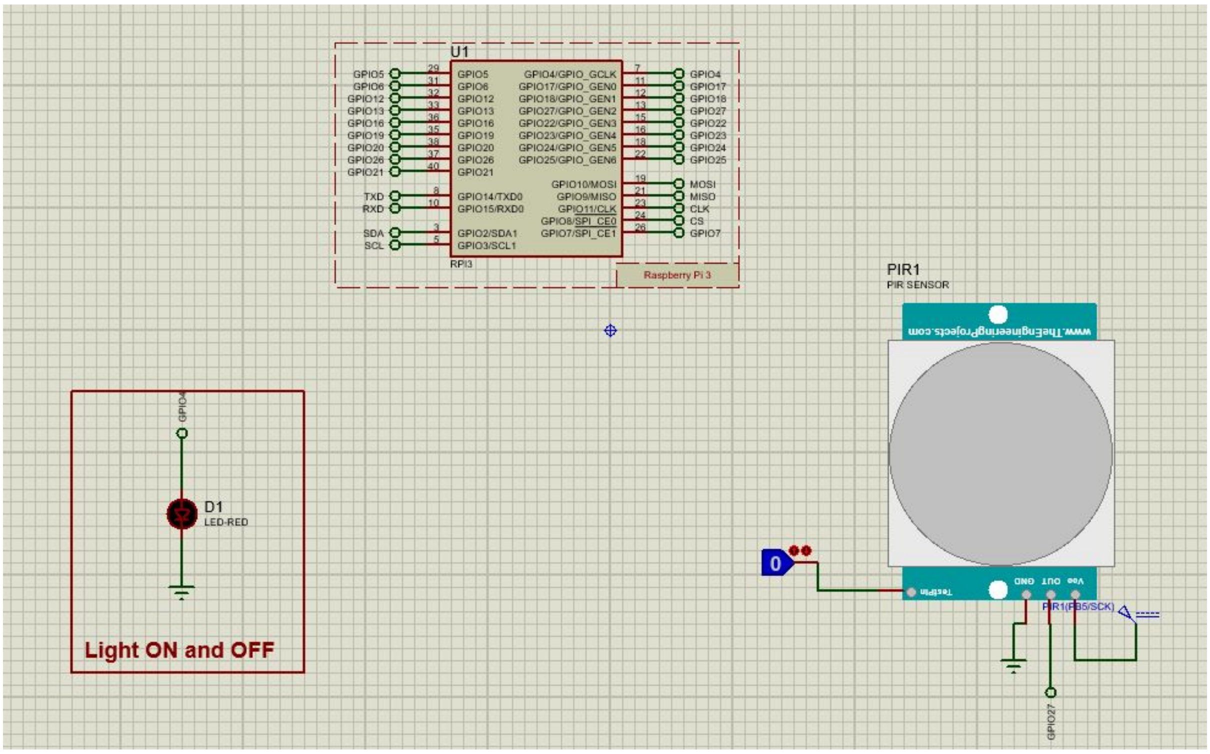
CIRCUIT DIAGRAM / BOARD LAYOUT / SCHEMATIC:



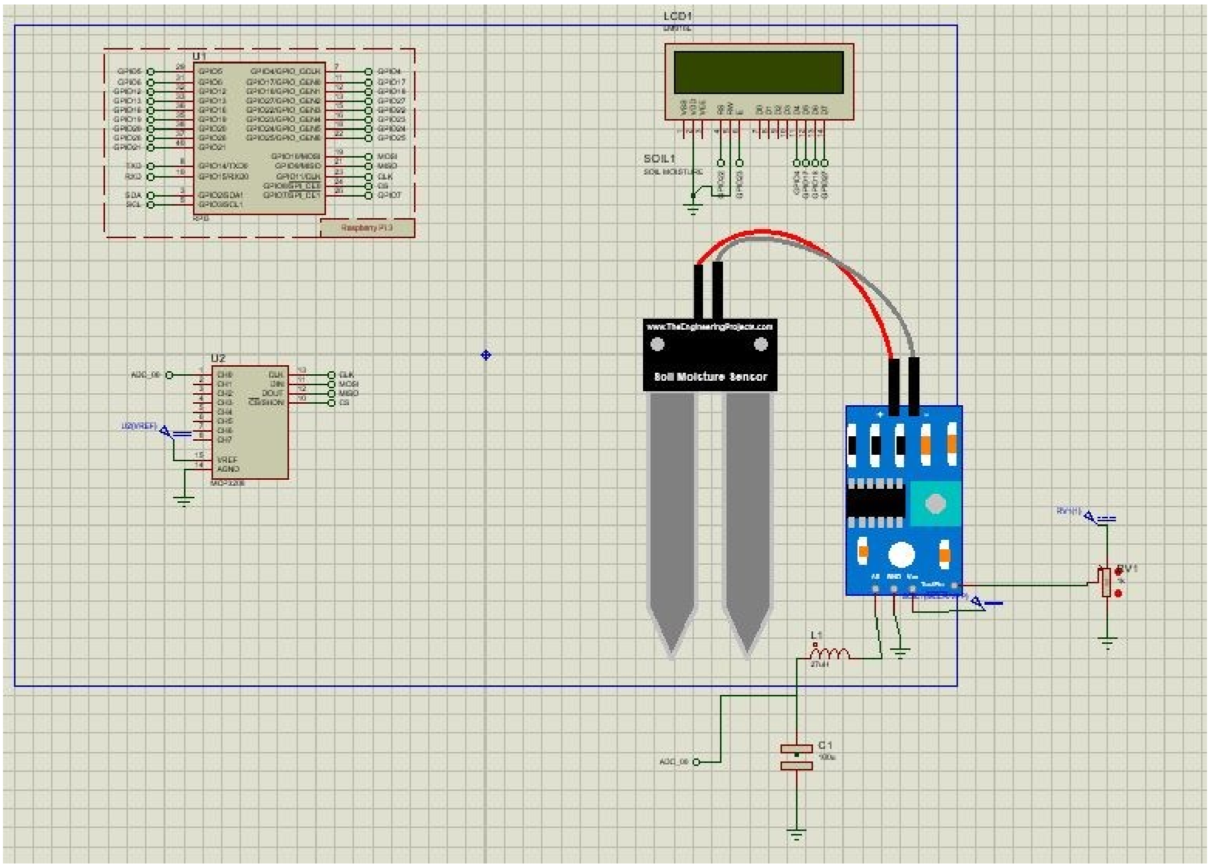
SIMULATION RESULTS/ DISCUSSION:



SIMULATION OF HOME SURVEILLENCE IN PROTEUS 8



SIMULATION OF HOME SECURITY IN PROTEUS 8



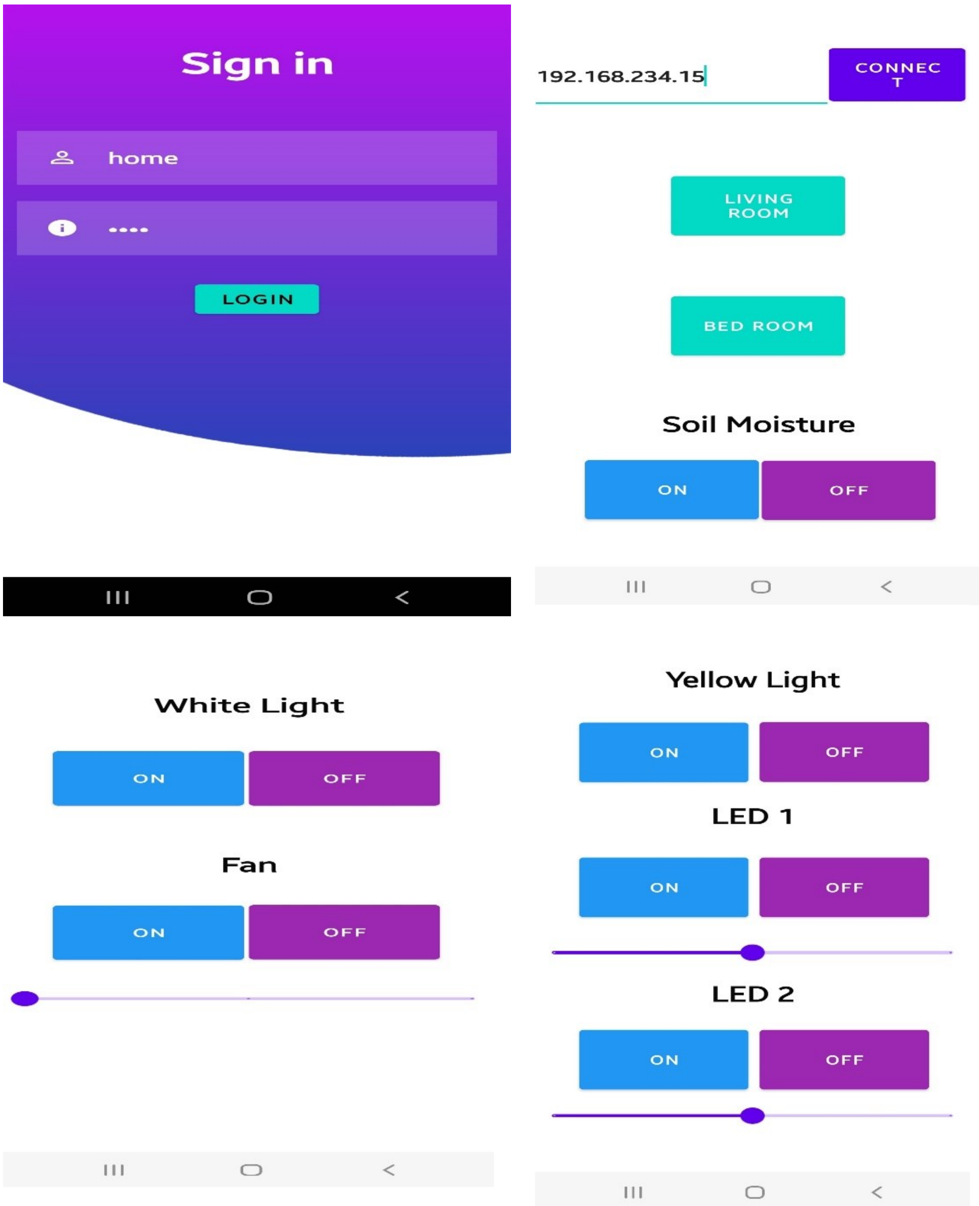
SIMULATION OF SMART GARDEN IN PROTEUS 8

After calibration of the soil moisture sensor based on we have arrived at the following conclusion for the range of the moisture content and are classified as follows:

S.No	Calibrated Value Range	Moisture Content in soil
1	300 - 500	More moisture content
2	500 -800	Modurate moisture content
3	800 - 1023	Low or no moisture content

IMPLEMENTATION / PROTOTYPING RESULTS:

APP design for controlling Bulb, LED, Motor.



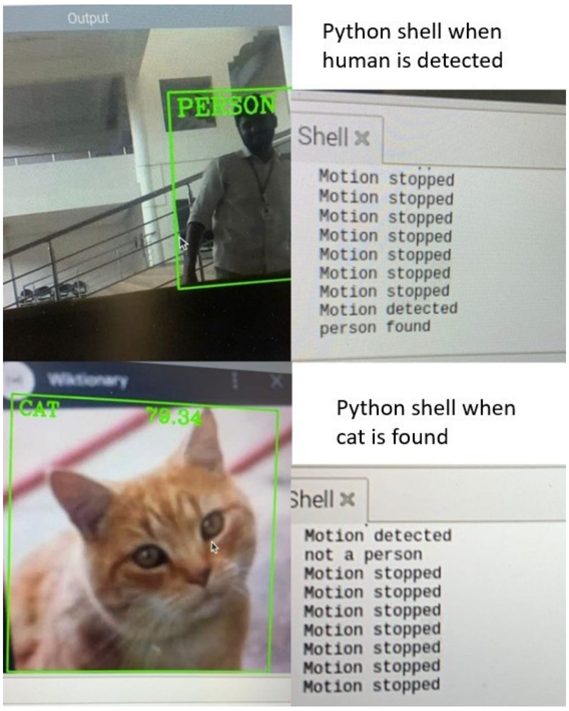
Hardware Simulation for Home Automation:

White light ON Yellow light ON

Led control with Intensity:

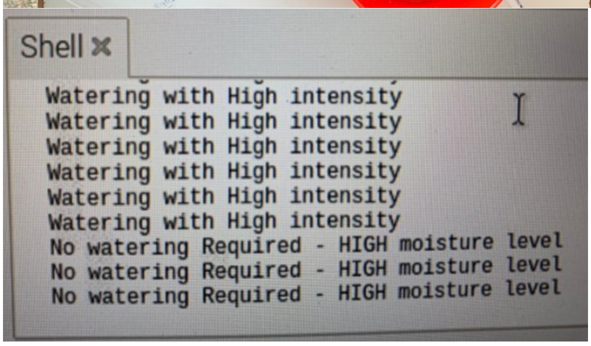
Level3 Level2 Level1

Home Security Intrusion Detection:



Smart Garden:

Watering plants when moisture level is low:



DISCUSSION /CONCLUSION:

The design flow presented outlines a comprehensive approach for developing a smart home system that incorporates app-controlled appliances, home surveillance, and a smart garden. By utilizing a mobile app as the control interface, users gain convenience and seamless access to monitor and manage various aspects of their home remotely.

The chosen components, including the PIR sensor, soil moisture sensor, Raspberry Pi, Pi camera module, 4-channel relay, and Arduino UNO, have been carefully selected to ensure compatibility and optimal performance. The PIR sensor enables motion detection, triggering the activation of the living room camera, while the soil moisture sensor accurately measures the moisture level in the smart garden, enabling precise control of the water pump The Raspberry Pi serves as the primary controller, facilitating communication between the mobile app, appliances, and surveillance system. The Arduino UNO acts as a secondary controller responsible for interfacing with the relay and managing appliance control.

In conclusion, by adopting these strategies, developers can create a smart home system that delivers seamless control of appliances, robust home surveillance, and efficient management of the smart garden, ultimately providing homeowners with a heightened level of convenience, security, and energy efficiency.