

An Integrated Actuator Based Technique for Creating Smart Domotics Environment using ESP8266 and MQ5

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Abstract—With further development of robotization. Entity becomes uncomplicated in every way. Domotic systems differ from supplementary systems where users can handle the system. All sensors, software and hardware used by Domotic can be individually and easily edited, but integrating them all can be very difficult. Most likely a domotic. Domotics approaches are becoming increasingly popular because they improve accuracy by compensating for human effort and errors. Home automation enables users to maintain and build homes that use less electricity. This paper shows an implementation of Domotics with an ESP8266 with wireless connectivity and applications. It monitors room temperature, detects smoke, checks water levels in tanks, soil moisture, and controls various devices such as lights, fans, doors, and televisions. For demonstration purposes, we will use various sensors such as Solenoid Door Lock, Soil moisture, MQ5 Gas sensor, LM35 and turn them into smart home appliance prototypes with the ability to monitor and control their performance to save people time and energy and it plays an essential role for people with disabilities and seniors who face daily challenges. Here we have installed the application that displays the sensor status on our smartphone.

Keywords- ESP8266, Sensors, Smart Domotics, Wireless Communication

I. INTRODUCTION

Home is a place where people spend their long, sad days and dream. People go home after work. To become a small device that helps manage home appliances. Home uses fixed devices, allowing users to manage devices whether or not they exist. Things get smarter over the next few years; even common home systems will migrate to IoT platforms. The basic model of an automation system is a basic control system that includes inputs/sensors, controllers and actuators. This model helps implement any industrial application with the right hardware and software choices.

The main idea of the device is to access the Internet to control the device and collect data from sensors on the home network. The industry 4.0 has become a zone of great potential, brunt and learning. Cost of living is rising day by day. The Internet of Things is paying off, and things will get smarter in the coming years.

Domotics which exist pre- owned to handle various devices, monitor certain devices, and transmit all data to users using the Internet and other WIFI applications. Since the Industry 4.0 are stretching of

information highway, it is tolerant of remotely actuator, or discrete steadily gadgets. Work better and get better results. Enhanced homes in broaden native land embrace a part of Robotic Technology, contingent each household monetary and willingness to procure in convenience.

Before long, many crowd comprehend the requisite of original green technology and will be interested in using them economically in their homes. The popularity of the grading is enlarged by reason of one's inadequate cost. It offers flexible features that can be easily configured to suit our needs. So, all these systems are in great demand and have great value such as helping the handicapped or sick because they cannot walk very well, so this system is very beneficial to them and the patient or individual. It is also beneficial for bedridden seniors and most seniors who live alone at home. Integrated communication systems facilitate monitoring and control of residential operations, providing residents with targeted support of existing facilities.

Today's modern homes have a variety of systems installed, inclusive of Central air frost, heating technique, fire alarms, and other devices such as home theater, television lighting, etc. These symbols and devices are usually quite far from each other.

This integrated system includes room temperature, smoke detection, tank level monitoring, soil moisture monitoring, lighting, fans, TV, doors, and this paper describes connected sensors and devices. Implemented on the board with the ESP8266 development board Arduino and a control app called MIT APP Inventor installed in our smartphone, we can control your home and other devices over WIFI.

II. LITERATURE SURVEY

An assortment of Domotic systems have been developed. Documents with different properties and functions. [10] The system uses a variety of yet technological sensors to control small household appliances. Applications are used to handle and bear up the structure. It has combination of schedules:

- Software connecting modem and internet services
- Modem Juncture schedule

This integrated system is based on the ESP2866 as the main controller with light, fan and temperature sensors and open-source Arduino IDE software.

[15] The proposed system is suitable for various domotics devices. An intelligent and energy-saving approach to residential energy management allows consumers to consider the impact of additional equipment and higher rated loads during periods of peak power consumption. Results show that this approach is effective in reducing power consumption and energy costs while improving the user experience. The temperature, humidity, light, vibration, and air quality sensors were connected to the microcontroller of the ESP8266 node for the Wi-Fi network and the controller for the measurements.

With Reference to paper [3] as this system provides more than security and operates in over 56 countries. On average, 3 out of 5 people buy a smart product to monitor their home with a smartphone. Commonly used smart home products are locks and alarms, thermostats and fans, lights detectors as shown by 2020, more than 477 million smart home products are expected to be shipped worldwide.

In [15], a plan was proposed to launch a remote home computing framework based on the ESP8266 microcontroller. A physical robot mode that allows customers to see and control home via Wi-Fi progress.

Paper Proposed By [7] a wireless connection that sends commands to relays that turn lights on or off. These commands are sent by the application.

[1] The hardware used for the project is the WIFI module (ESP8266 WIFI), to establish the connection of WIFI with application and a few relays. This application demonstrates the benefits that domotic systems combining the different technologies can offer along with enhanced convenience, remote access and control of various domotic devices.

Another implementation of domotic is proposed by [6] using ESP2866, DHT11, Relay, Servo Motor, Wi-Fi Module, Application. Fans and lights are controlled by the user.

[5] Another energy efficient domotics proposes to reduce efficiency in a restricted domain. Recommended domotics System remotely controlled by wireless technology communication devices such as smartphones, tablets and others Remote wireless device via the Internet It can be controlled and managed remotely as suggested by the home automation system.

The temperature of the room, automatic fan ON/OFF, automatic ON/OFF of the lighting, automatic detection of gas leaks with sensors, automatic control and management of the air conditioner, etc. [6] Many systems have been developed for domotic and are used in the literature of varying sizes, from complex to simple systems.

With reference to [21], Domotics uses multiple control frames to control household machines and appliance. Domotics gives users more control over their home appliances using the ESP8266 NodeMCU, Arduino, and other microcontrollers. Several sensors such as a Door Lock, gas sensor, water level monitoring, Temperature monitoring and soil moisture etc. are integrated through a microcontroller to perform a specific function.

In the field of smart home security, [18] systems have come to play an important role in family daily life and modern business. Home security relates to all of us in some way and includes our equipment and personal security practices. Equipment's includes inputs, alarms, interlocks and IR Sensors to detect positive conditions.

Systems that control simple devices such as fans and lights are called simple home automation systems, and systems that control heavy devices such as automatic smart doors are called complex systems. Most systems don't offer the convenience of controlling the atmosphere in your home [9]. An Android phone with a user interface and an ON/OFF button was used as a remote control. Based on a literature review, WIFI was selected as the communication method and a low-cost sensor was selected based on user needs.

[3] Here we deliver the proposed domotic system Which is having the ability to control and monitor the following components of a user's home:

- Digital safety door lock system
- Light on/off control system
- Fan on/off control system
- Water level monitoring
- Compact flexible temperature sensor
- Gas Sensor
- Soil moisture sensor
- IR Sensor

This System is inexpensive, uncomplicated definitive while programming all these devices and sensors. This system is useful to handle and bear up the equipment's.

III. SYSTEM DESIGN

This proposed system uses IOT-based devices for low-cost and efficient monitoring. The integrated system offers features such as temperature and humidity monitoring, fire, gas and water levels inside the tank. According to the environmental parameters and enhance your lifestyle by controlling lights on/off and entire home appliances from fans to power supplies to automatic water tanks. Users can also control and manage their homes from the outside.

Fig.1 shows a working scenario of ESP8266. The sensor collects data from the appliance and sends it to the ESP8266, which passes the data to the MIT APP Inventor.

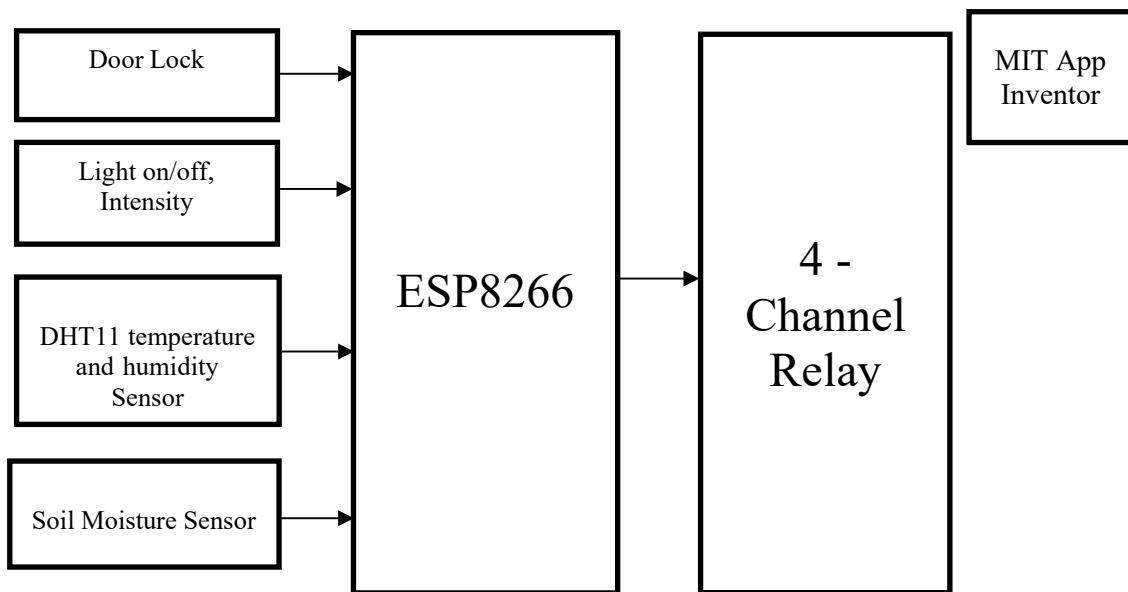


Fig. 1. Block Diagram of ESP8266

Fig.2 shows a working scenario of Domotic System using Arduino. The Sensor collects data from the appliance and sends it to the Arduino, which passes the data to the Application.

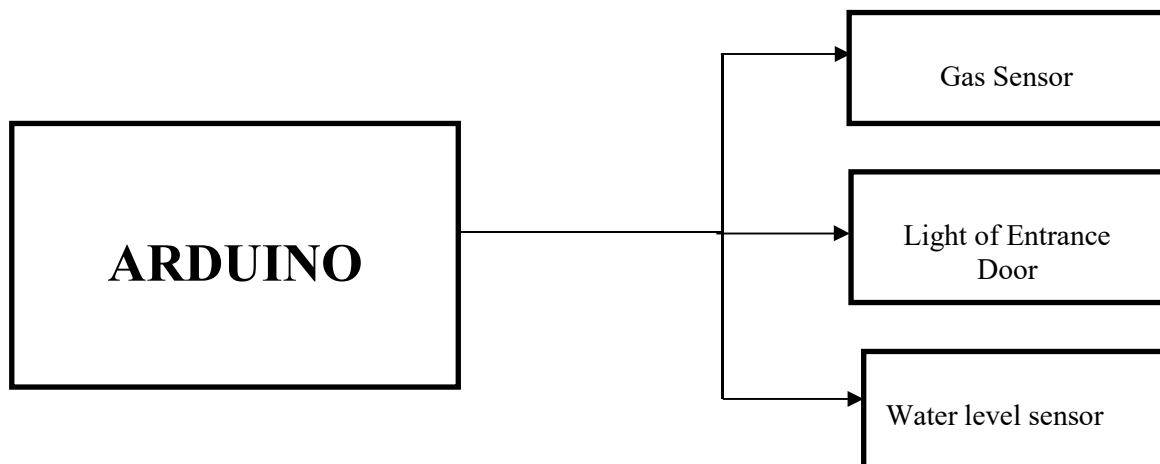


Fig.2 Block Diagram of the Domotic System using Arduino

A. Hardware Requirements

- 1) ESP8266
- 2) Relay Board
- 3) Arduino
- 4) DHT11 Temperature and Humidity Sensor
- 5) Soil Moisture Sensor
- 6) Smoke Detection Sensor
- 7) Servo Motor
- 8) Water Level Sensor
- 9) IR Sensor

1. ESP8266:

Fig.3 shows the ESP8266 used as a standalone device to WIFI adapter to allow other micro- controllers to connect to a WIFI network. The ESP8285 is a similar chip with 1MB of flash built in, allowing development of single-chip devices that can connect via Wi-Fi. These micro-controller chips have been replaced by the ESP32 family of devices.



Fig. 3. ESP8266

2. Relay Board:

In this project the relay is an important element component used to control high voltage domestic appliances. Fig.4 is a 4-channel 5V relay junction, each channel. It can be used to control various devices and high current devices. It has an input terminal and an output terminal, and is used to control the voltage of the power supply.



Fig. 4. 4-Channel 5V Relay

3. Arduino:

Arduino is a global open-source hardware and software ecosystem. Software tools, hardware platforms and data that enable everyone to be creative with technology. Arduino as shown in fig 5 is one of the most popular IoT devices and one of the most successful STEAM learning tools. Arduino is used for development. Arduino is the first widely used open-source hardware.



Fig. 5. Arduino

According to Ohms Law, $v = i * r$ (4.1)

Where,

v = potential difference which we apply between end points of a metallic conductor.

i = electric current produced due to the movement of charge in the conductor.

r = Be the resistance of conductor

From equation (4.1)-

$$r = v/i \quad (4.2)$$

If there is a uniform cross-section of conductor then,

$$\text{Resistance, } r_0 = \rho_0(l/a) \quad (4.3)$$

Where, l = length of conductor

a = cross-section area

ρ_0 = resistivity If the temperature provided is not too high then,

$$\rho = \rho_0[1 + \alpha(T - T_0)] \quad (4.4)$$

where, ρ = resistivity at T_0C

ρ_0 = resistivity at $T_0 0C$

Now,

from equation (4.3) and (4.4)

$$\rho * l = (r_0 * a) [1 + \alpha (T - T_0)] \text{ and } r = (\rho * l) / a \text{ so,}$$

$$r = r_0 [1 + \alpha (T - T_0)] \quad (4.10)$$

where, r_0 = resistor off sample at any reference temperature T_0

α = temperature coefficient

If, $T_0 = 0$

$$\text{then equation (4.5) will become } r = r_0 [1 + \alpha T] \quad (4.5)$$

$$\text{or } r = r_0 + r_0 \alpha * T \quad (4.6).$$

On comparing equation (4.6) with linear equation $y = mx + c$ (4.7)

the equation becomes $\alpha = \text{slope} / r_0$ (4.8)

For the closed circuit if the resistors are connected in series, then,

$$v = i(r_a + r_b) \quad (4.15) \text{ or } i = v / (r_a + r_b) \quad (4.6)$$

So, according to ohms law the equation (4.6) can be written as $v_a = i / r_a$ (4.7)

$$v_b = i / r_b \quad (4.8)$$

Now, from equation (4.6) and (4.7)-

$$I = v_a / r_a \text{ Substituting the value of (4.7) in equation} \quad (4.6)$$

$$v_a / r_a = v / (r_a + r_b)$$

$$v_a (r_a + r_b) = v * r_a$$

$$v_a * r_a + v_b * r_b = v * r_a$$

$$r_a (v - v_a) = v_a * r_b \text{ } r_b = r_a (v - v_a) / v_a \quad (4.9)$$

In Arduino for obtaining the potential value of v_a we note the reading from pin a_0 .

Suppose $v = 5v$ and let input voltage between $210 = 1024$ And $0-5$ volt will correspond to the integer value between 0 and 1023 . Now, the analog value read from pin a_0 can be transformed into volt with the help of equation $v_a = (\text{reading value} * 5v) / 1023$ (4.10)

4. DHT11 Temperature and Humidity Sensor:

Fig.6 shows DHT11 Temperature and Humidity Sensor. These sensors are used for a variety of purposes. For hygrometer and temperature monitoring, freshening and climatization. It is a simple humidity sensor for efficient measurement. Effective monitoring at low cost. Moist sensors are preowned in damp domotics systems. This is a very affordable, thermostat and hygroscope. Therefore, use a sensor reading interval of at least 2 seconds in your code. Relative Humidity (RH) = $(w/s)100$

Fig.7 shows the temperature measurement of the sensor DHT11 and Thermometer.

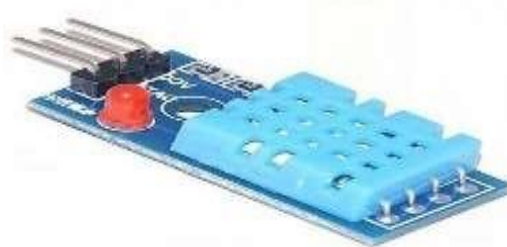


Fig. 6. DHT11 Temperature and Humidity Sensor

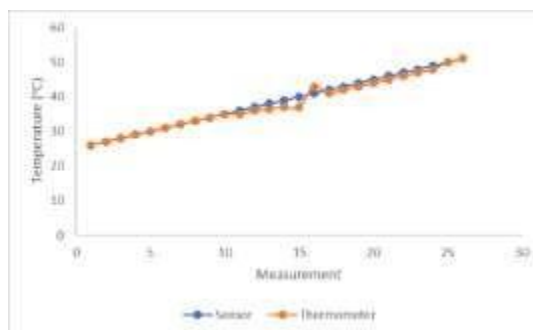


Fig. 7. DHT11 Temperature and Humidity Sensor

5. Soil Moisture Sensor:

These sensors are preowned to compute the moisture of ground. Preowned in agriculture, ecology, horticulture, botany, soil science and water biology. This resistance is inversely proportional to soilmoisture. Since direct gravimetric moisture measurement without soil requires sampling, drying, and weighing. As an indicator of water content, electrical resistance, permittivity or interaction withneutrons. Soil Moisture Sensor shown in Fig.8

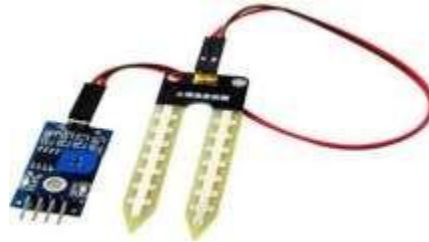


Fig. 8. Soil Moisture

Volumetric water content (VWC) can be used to calculate water removal rate from soil using the formula:

$$\% \text{ Soil Water Depletion} = \left[1 - \left(\frac{\text{Sensor VWC}(\%) - \text{PWP}(\%)}{\text{FC}(\%) - \text{PWP}(\%)} \right) \right] * 100$$

Field capacity can be measured very easily in the field using a soil moisture sensor. The VWC measurement given by a soil moisture sensor after heavy watering or rain for 12 to 24 hours is the capacitance of the soil electric field.

6. Smoke Detection Sensor:

It is an electronic firefighting gadget that naturally locates the presence of fog as a sign of gunfire. Trade and manufacturing fog gadget send a signal to a detector that is fragment of a construction halfway danger signal. All workplaces are required by law to install a fire alarm system. They are used to detect smoke in homes. Smoke Detector Sensor Shown in Fig.9.



Fig. 9. Smoke Detector Sensor

7. Servo Motor:

Servo motors are DC motors that provide precise angular position control. A DC motor that is gradually decelerated by gears. Servo motors typically have a rotation range of 90° to 180°. Some servo motors have rotation stops greater than 360°. However, servo motors do not rotate all the time. Rotary or linear actuators that provide handling at an angle, acceleration is a combination of CC Motor control, gearbox, encoderand switching control elements which is as show in fig.10.



Fig. 10. Servo Motor

The Sensor Output of Servo Motor:

$$M = L \cdot N$$

By KVL,

$$N(\dot{\theta}) = S(\dot{\theta}) + K_v \cdot \omega + K_p \cdot \theta$$

$$n = S \cdot \dot{\theta} + rK \cdot \theta + lw$$

Step 1: The angle of rotation can be determined on the axis constrained by Pulse Width Modulation (PWM).

Based on an internal gear train, the shaft provides significant torque to speed.

$$F + Qf = Qy$$

$$\text{Where, } \alpha = d\omega / dt \quad \omega = \int \alpha dt \quad \omega = 1 / s\alpha$$

$$\omega = d\theta / dt ; \quad \theta = \int \omega dt \quad \theta = 1 / s\omega$$

When combined, the equation will be $1/N = \ln \theta / 2$

Step 2: Powerful top speed with moderately tuned shifters. DC servo motors consist of three colored power wires: black, red, and white for power, ground, and shaft position control.

System modelling,

$$U = 1/lq(r^2 f K + rF + |glq| U(r))$$

$$= 1/M = lq(r^2 F + rF + LgLqM =$$

$$L \cdot N$$

$$U(r) = 1 / Lg(rQu + 1)(rQg + 1)$$

$$1/N = Ln / LgR(RQu + 1)(rQg + 1)$$

Step 3: When the engine is started, the gear train of the internal assembly turns on. Rotation of the rotor is controlled by the resistance of the potentiometer. create an encoder transfer function

$$1 = 2^v / 2 = 10,435$$

Consider, $G = S - B$

Step 4: You can modify the control loop to get the position of the axis using the modified angular condition of the PWM method. This amount of torque will vary for the same servo motor due to the placement of the internal coil assembly. Here, the PID controller is applied in various forms such as P, I, and D.

$$= \cdot G$$

$$= \cdot G$$

$$= /R \cdot$$

The summation of all various controller,

$$= + +$$

$$(r) = + r + /R$$

Step5: Proposing transfer function of DC Motor,

$$n(r) / (r) = L / (r^2 F + r)(S + Kor) + l2r = (1 / r) (L / (Fr +)(So + Ko) + l2)$$

This is designed with motor torque value, and motor specifications.

8. Water Level Sensor:

Fig.11 shows water level Sensor. It is convenient and only requires 3 clasp to join. A contact (VCC) supplies power to the sensor. The water level sensor is built into the top of the water tank and measures the waterlevel. Activates the water engine on and off signals at the circuit level.

Depending on the liquid level measurement method, there are two types: contact and non-contact. The input water level sensor is a contact measurement that converts the height of the water level into an electrical signal and outputs.



Fig. 11. Water Level Sensor

9. IR Sensor:

An infrared sensor is an electronic device that emits light to detect certain objects around it. Infrared sensors measure the temperature of objects and detect motion. In general, all objects emit some amount of thermal radiation in the infrared spectrum. This type of radiation is invisible to our eyes but can be detected by infrared sensors.



Fig.12 IR Sensor

B. Software Requirements

The following software was used to create the proposed system.:

- 1) **Arduino IDE**
- 2) **MIT APP Inventor**

1) **Arduino IDE:**

It contains a data processor for encoding, acceptance, animate, a taskbar to perform ordinary tasks, several spread, as shown in Figure 13. The Arduino IDE is what you create and upload code to your living environment. Editor has functions for text cut/paste and search/replace. The system is fully compatible with all Arduino programming boards. Connects to Arduino hardware for program download and data exchange.



Fig.13. Arduino IDE

2) **MIT APP Inventor:**

MIT APP Inventor is an application platform for commanding Arduino, ESP8266 and networked as shown in fig.14. MIT App Inventor is a free, open-source web application that anyone can use to create mobile applications. Used by over 8million people worldwide who have created over 30million applications. Available in 12 languages and intended for children 13 and older. In our Project, Application has been developed by MIT APP Inventor.

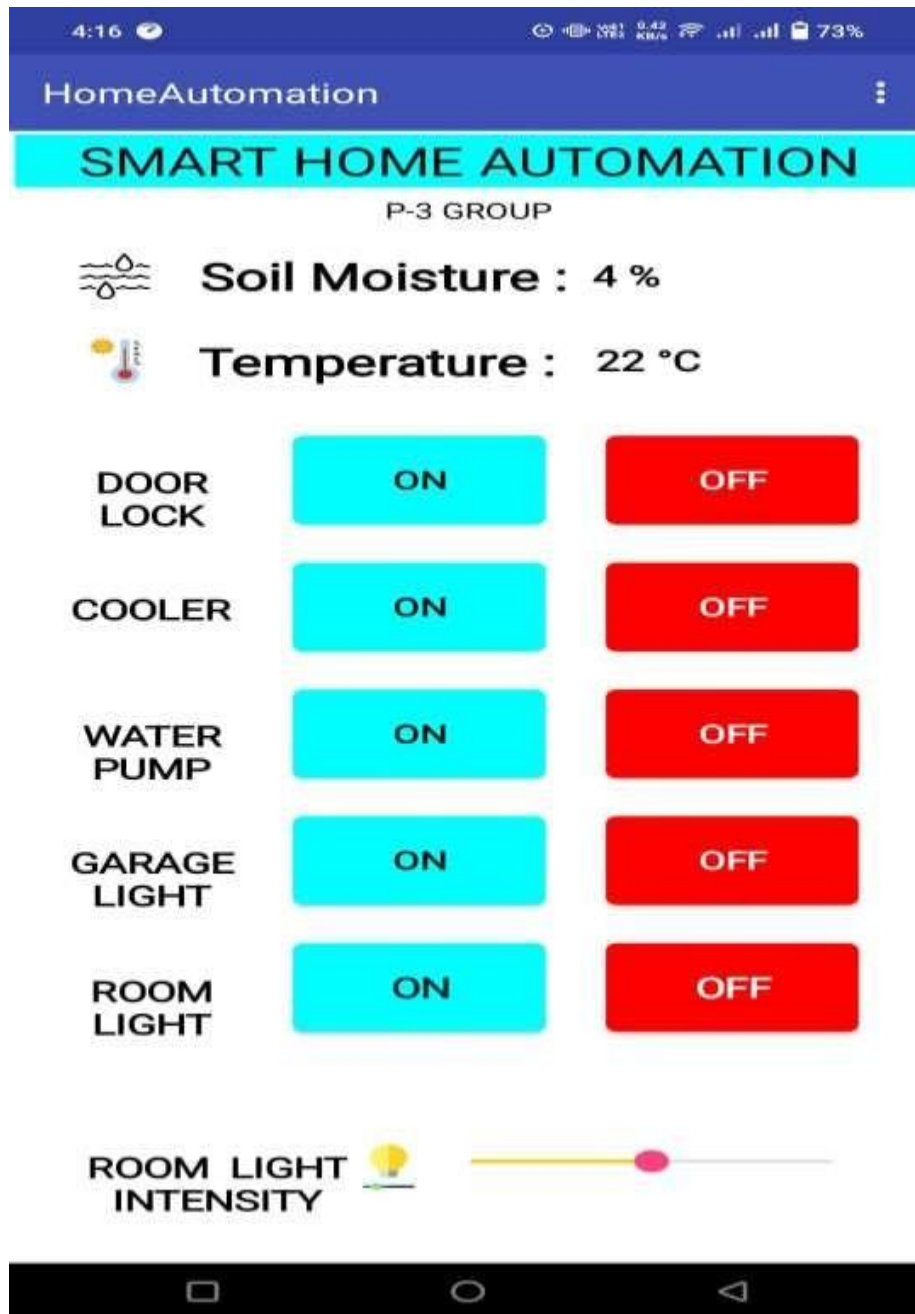


Fig. 14. Application

Light On/off: It is based on the ESP8266 beam as an IoT system. ESP8266 connects to internet through WIFI connection from smartphone's hotspot. The ESP8266 needs to connect to the smartphone's hotspot and the server needs to determine the hotspot name, password and token code to connect. We need a computer to transfer code from the Arduino IDE to the ESP8266 kit. Server checks connectivity, ESP8266 and Android connectivity. ESP8266 cipher contains badge, access point id and pass- word. ESP8266 to connects the WIFI and act exchange commands between the smartphone and ESP8266, the information contained in the code match information about access point.

The remaining process is to send commands from the app to ESP8266 to handle the load which connects to the relay as show in Fig.15, the sensor output values are sent from ESP8266 kit back to the app.

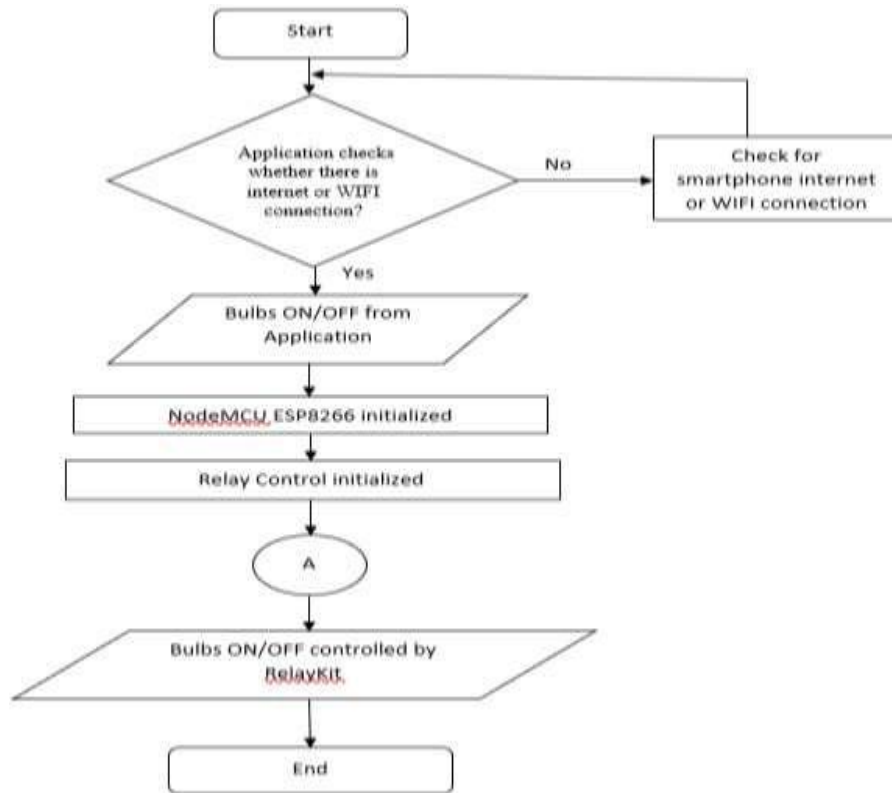


Fig. 15. Flowchart of Light On/Off

Temperature: Displays the temperature data in degrees Celsius on the display, the ESP866 sends the gadget voltage value back to the app. last on/off, the server checks connectivity, name and password, and output values to display correct temperature. Temperature is displayed by the measurement tool in the app after setting the in pin and temperature scale as shown in Fig.16.

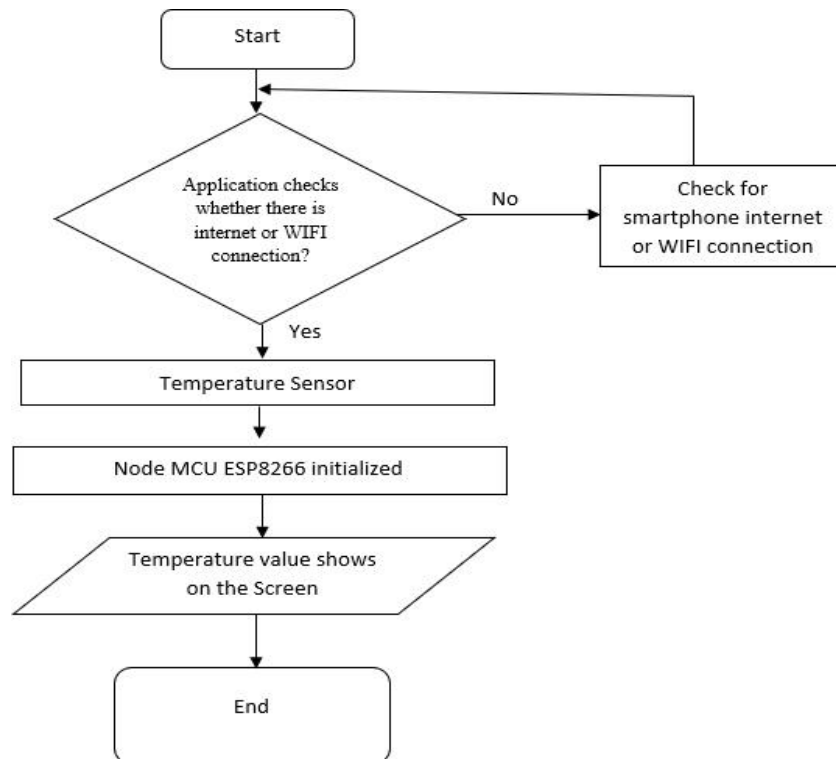


Fig. 16. Flowchart of Temperature

The data flow diagram in Fig.17 shows how the proposed system works and how users input and operate it. So, when the user enters data, the system can find or understand the specified command. If the system doesn't understand this, it checks the WIFI connection and if there is a WIFI connection it will enter data into the device and if there is no connection it will try activate the same. When the NODEMCU receives input, commands are sent to the relay module. The relay module input block supplies power to the device for which the command is intended. Finally, check if your device is working. If it is running, you need to kill the process, otherwise restart the process.

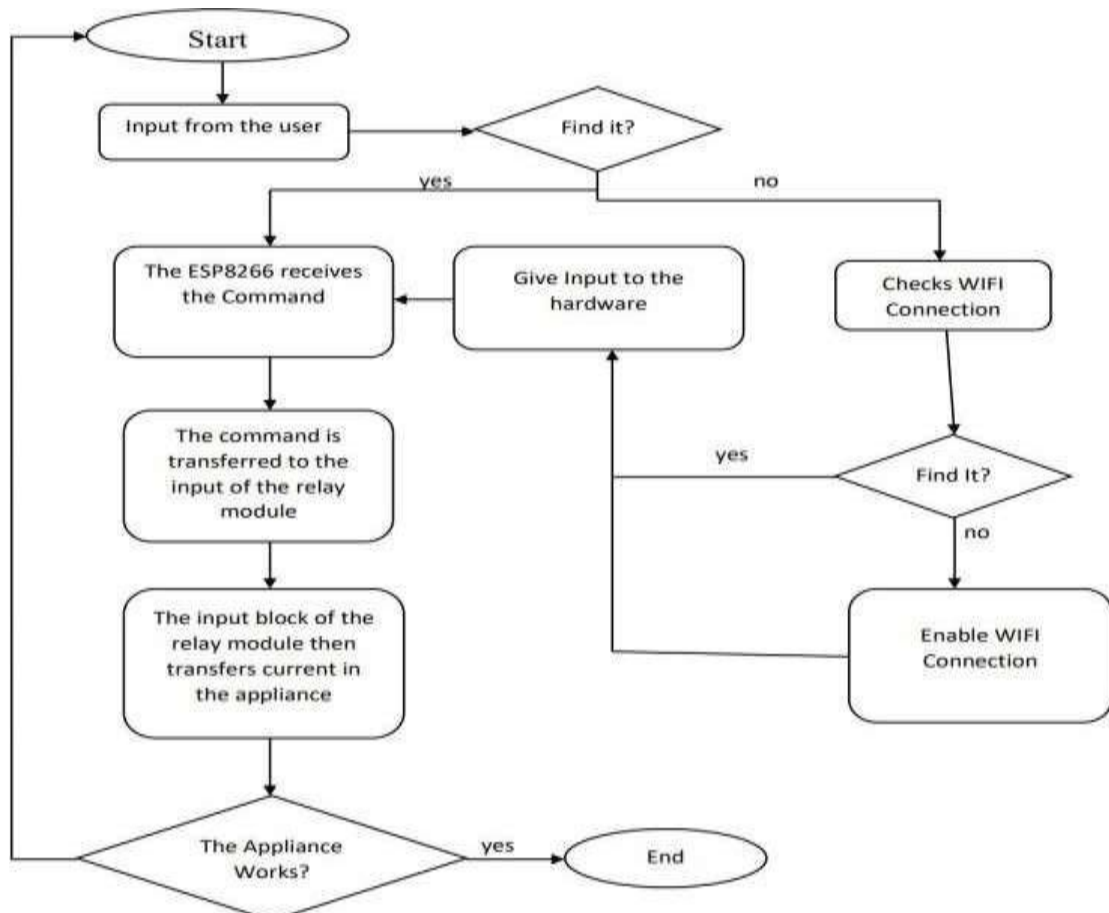


Fig. 17. Data flow diagram of the system work

IV. RESULT AND DESCRIPTION

It experimentally creates a smart home environment using IoT concepts. In Fig.18, the entire assembly is housed in a model so that the system is connected and able to withstand all conditions. Sensors record values for many types of home monitoring and device control, such as temperature and water level. Electrical devices such as lights, fans, TV and doors can be designed and tested remotely through the app. This will give us control over our device. All sensors are interconnected and tested. The system receives a positive output for known results. A variety of devices are connected to a single system. All sensors and devices are connected to the main ESP8266, Arduino and data collected in real time is transmitted through application. The job will start automatically once all connections are established. The mobile app's first task authenticates the user with a WIFI ID and password. Users can manually control all devices through the mobile app. Users can also control their devices at home while on the go. Users can control the door, lightning and fans with the mobile app. The water level Monitor shows the water level in tank. A fire alarm activates when it detects a strong flame in range. The temperature sensor detects the ambient temperature in the room. Implementation shown in the fig.18 below shows how the lights on/off, light intensity, and door locks work. IR Sensor detects the motion of person at the entrance of door. Fig 18, Shows the front view of the model and back view of the model is shown in fig 19.



Fig. 18. Front View of IoT-based home monitoring and device control connectivity

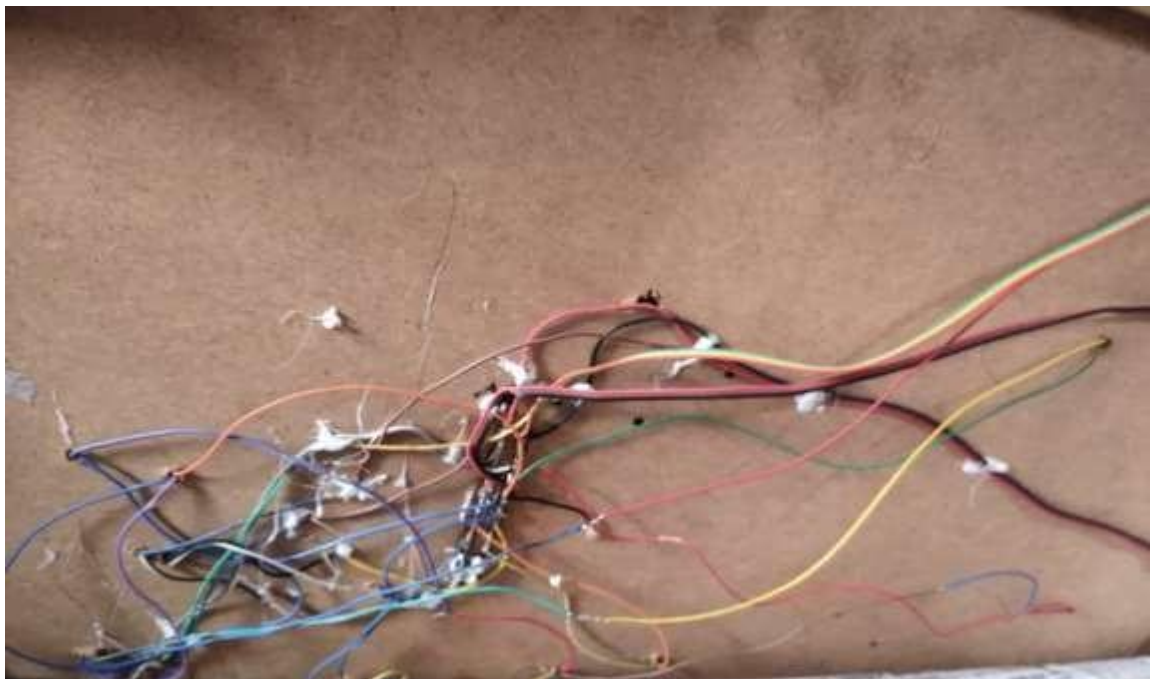


Fig. 19. Back View of IoT-based home monitoring and device control connectivity

V. CONCLUSION

We presented a system that can use the Internet of Things to monitor and control multiple devices in the home. An Internet of Things (IoT) smart home with NodeMCU ESP8266 module can be designed with hardware and software support for various components, allowing it to be deployed into a smart home system using the app for Android. Troubles happen at home. All devices such as lights, fans, doors and soil moisture sensors can be controlled remotely via an internet connected device. The door of the house is controlled automatically through the portable internet.

A temperature sensor measures the room temperature and Soil moisture sensors detect the presence of moisture in the soil. We were also able to demonstrate how to build a system that covers many areas of a smart home with continuous monitoring, security and control. We hope that new technologies will become available to more and more people, improving their standard of living.

VI. FUTURE SCOPE

In the future, we plan to improve this system by reducing time, adding voice recognition, a function to receive fire alarm notifications on a smartphone and adding security features through the Blink app. A camera module can also be added to the system for additional security. The camera activates when someone tries to enter our home. The man finds the door and opens it. We can also embed additional sensors into our home to monitor and control it using our smartphone. We also recommend of implementing an IoT-based alarm clock for our project. The alarm clock not only wakes up, but also turns on the lights according to the light intensity in the bathroom, toilet, hallway, etc. We can use Arduino UNO. It is used for this purpose.

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