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Automated Smart Garden using IoT System

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Abstract

This study is an innovative and original work that combines IoT technology with automation to revolutionize traditional gardening practices. This work aims to improve plant health and promote effective growth while also enabling users to remotely monitor the health of their indoor plants and the environment. The work reduces the need for human involvement and develops a fully automated solution using sensors, micro-controllers, and IoT technology by implementing a system that makes use of temperature sensors to effectively control the plant environment. Complete circuit design simulations and code development are part of the methodology, which has resulted in significant advancements. The IoT platform has been successfully developed, making it possible for data to be smoothly retrieved from the Wi-Fi module and displayed on the IoT portal server. Both the serial monitors and the IoT server portal accurately record and display crucial measurements like humidity, temperature, and soil moisture content. With improved plant care and higher user convenience, the Automated Smart Garden using IoT System introduces an innovative approach to transform gardening methods.

1. Introduction

A major part of the current system is the Internet of Things (IoT), which links devices and makes it possible to control and monitor them using a cloud-based platform. IoT technology is used by the Smart Garden Automation system to automate plant maintenance. It has a fan, a water pump, a soil moisture sensor, a temperature sensor, and a humidity sensor. The water pump is turned on when the soil moisture sensor notices low water levels. A rise in temperature is similarly detected by the temperature and humidity sensors, which triggers the fan to turn on (Kurniawan et al, 2021). The system also comes with a monitoring surveillance camera that is remotely accessible thanks to IoT privileges (Alauddin et al, 2018). With the help of this IoT system, people can easily and conveniently monitor their plants, which decreases their workload. The work addresses problems faced by time-constrained people who are unable to consistently care for their plants, preventing plant death or subpar growth. The Node MCU serves as the Wi-Fi module for IoT server connectivity, and Arduino UNO serves as the micro-controller (Nugraha et al. 2022). The temperature and soil moisture sensors' real-time readings are displayed on the LCD Display.

2. Methodology

The outcome of this proposed system is that getting the reading of moisture sensor and humidity & temperature sensor on the serial monitor in the end of this system, the performance result is the humidity and temperature of the surrounding and the soil moisture will be monitored on the garden and the real-time data display in the BLYNK Platform. When the micro-controller is powered up, both sensors, DHT11 and YL-69 will start to measure the surrounding temperature & humidity and the soil moisture from the sensor will be displayed and show the reading accurately. The displayed output will be shown in the IoT platform which can be accessed by the any smart devices. Fig. 1 illustrates the block diagram of the system.

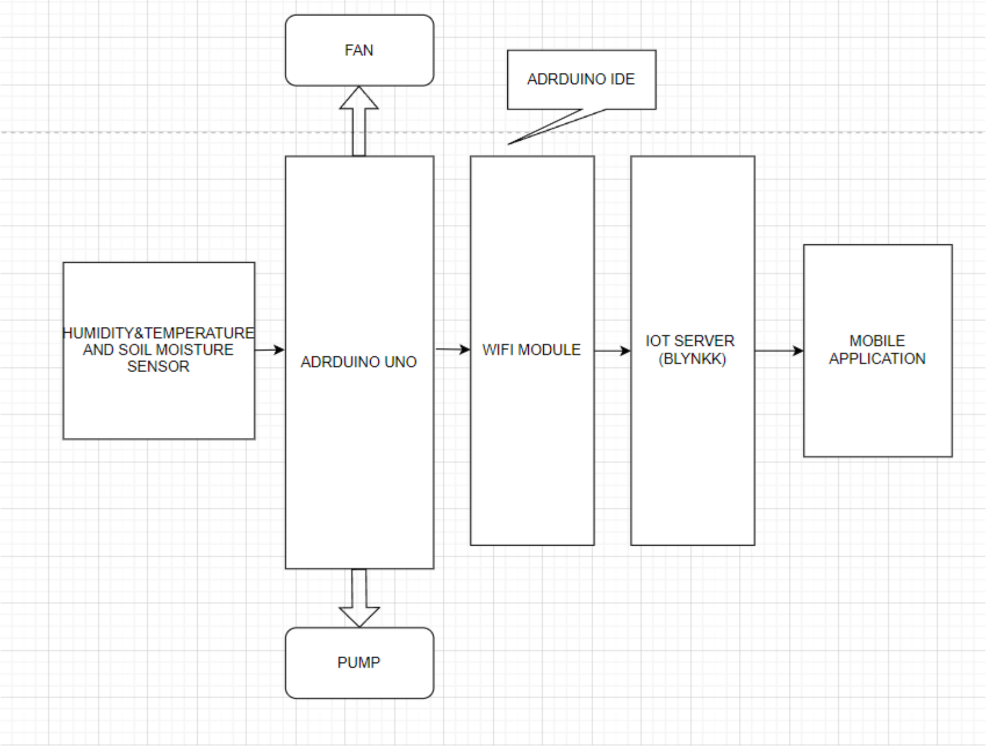


Fig. 1 *Block diagram of the system*

The system implementation involves configuring and connecting the sensors and microprocessor to the relevant input and output devices, as shown in Fig. 2. This workflow details the process of accurately reading sensor data and handling any errors during initialization. The next step focuses on measuring three parameters: humidity, temperature, and soil moisture. This is achieved using the DHT11 and YL-69 sensors in the smart garden system. The moisture and humidity/temperature sensor detect changes in the smart garden, and the serial monitor displays precise readings.

Once the serial monitor displayed the accurate reading of the sensors the output of the data will be send to the Wi-Fi module (Esp8266) which need to be coded with specific coding to displayed out the results that received from the micro-controller (Arduino Uno). The output will be transmitted to the specific IOT server (Blynk) to showcase the output which will be used to monitor the reading and condition of the plants. In this implementation, there will be two main components which is micro-controller and NodeMCU which takes control over the whole system (Ipin et al, 2020).

3. Results and Discussion

The source code shown in Fig. 3 states the operational function of the three sensors based in their parameter that have been set up. These two main components which is fan and pump will be working based on the reading that the both sensor which is Dht11 and Yl-69 based on the parameters will be send the impulse to the relay from the micro-controller based on the main coding that have been uploaded. In Fig. 4, coding to connect the micro-controller input with the Blynk platform, with the help of NodeMCU (Esp8266) to transmit the output to the respected server.

As shown in Fig. 6, once connected to the coms, and run the coding the serial monitor will showcase the reading of each sensor based on their reading accuracy. The serial portrays the moisture sensors and humidity/temperature sensors reading after successfully uploaded the coding into the micro-controller (Arduino Uno). Fig. 6 shows the accurate reading of each sensor based on the characteristics of the source code as shown in the serial monitor.

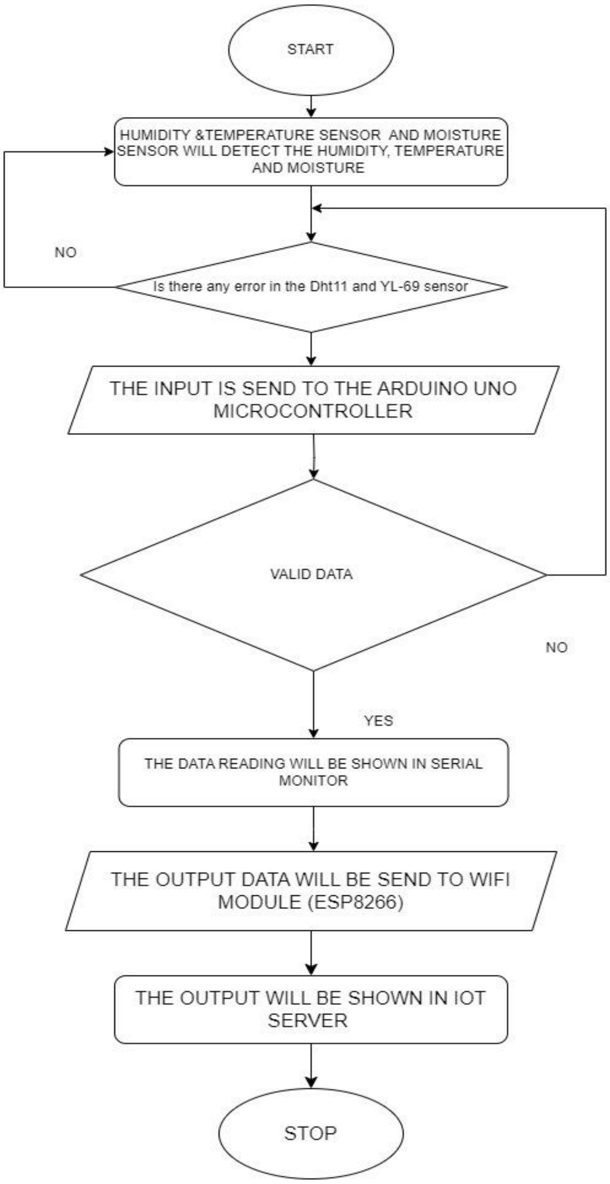


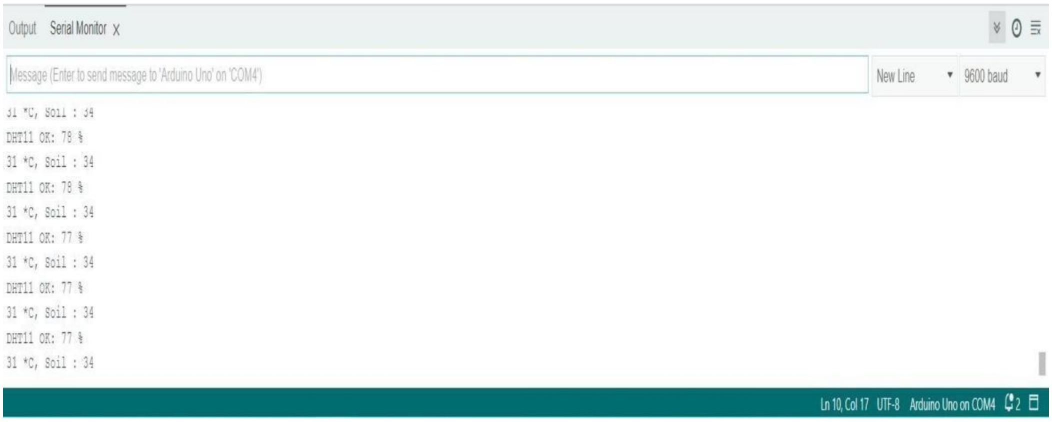
Fig. 2 *Details implementation of the proposed system*

```
myStr = String(humidity) + "%" +
String(temperature)+ "%" +
String(Val1);
mySerial.print(myStr);
Serial.print(myStr); if
(temperature>=30)
{
digitalWrite(Fan,HIGH);
lcd.setCursor(0, 3);
lcd.print("Fan ON ");
}
if(temperature<30)
{
digitalWrite(Fan,LOW);
lcd.setCursor(0, 3);
lcd.print("Fan OFF");
}
```

Fig. 3 *Source code of Arduino*

```
//
// String total =
String("Humidity=")+(humidity)+String(
"Temperature=")+(te
mperature)+String("soilmoisture=")+(so
ilmoisture);
// Serial.println(total);
Blynk.virtualWrite(V1, humid);
Blynk.virtualWrite(V0, temp);
Blynk.virtualWrite(V2, soil);
```

Fig. 4 *Source code of Blynk server*



```
31 *C, Soil : 34
DHT11 OK: 78 %
31 *C, Soil : 34
DHT11 OK: 78 %
31 *C, Soil : 34
DHT11 OK: 77 %
31 *C, Soil : 34
DHT11 OK: 77 %
31 *C, Soil : 34
DHT11 OK: 77 %
31 *C, Soil : 34
```

Fig. 5 *Result of the main coding at Arduino IDE*

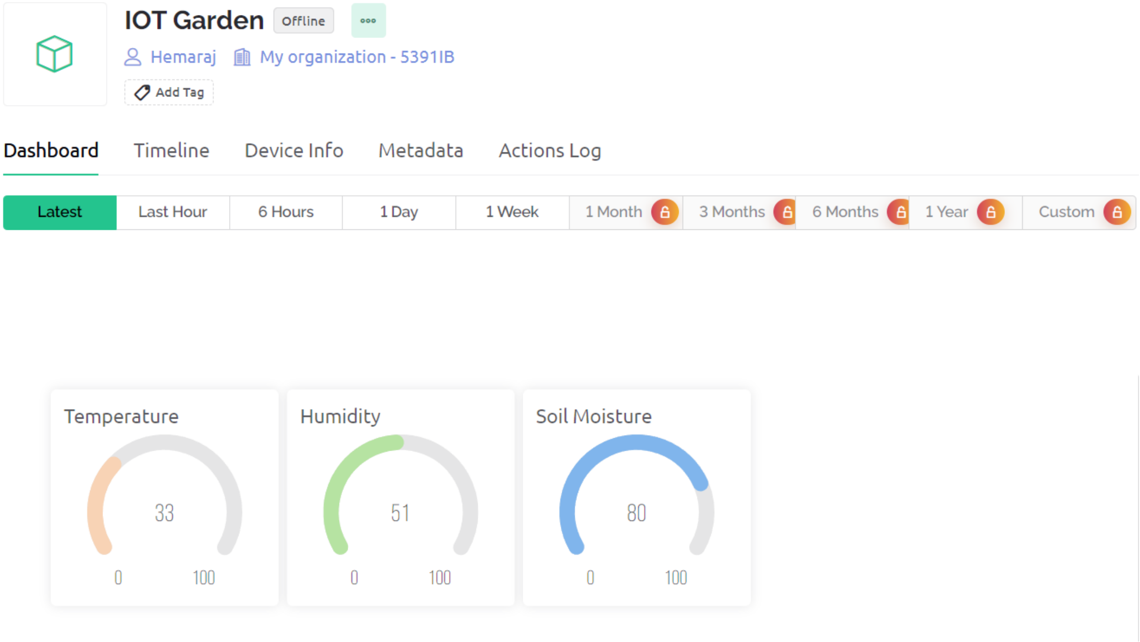
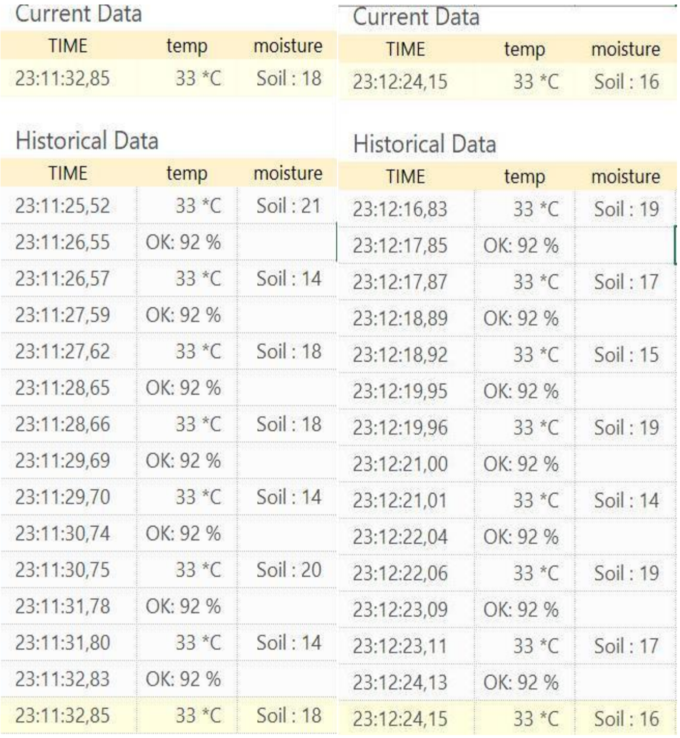


Fig. 6 *The successful data derived from the Wi-Fi module*

Based on source code in Fig. 4, the coding has shown a live data from the sensors that being transmitted by the Wi-Fi module to the Blynk server. As shown in Fig. 5 to 7, the dashboard serves an indication for three indicators for temperature, moisture, and humidity readings. Based on the coding that implemented into connecting the Blynk server gives out the real live data monitoring for the user to get to inspect on their plant.

Based on the parameter that have been set up in the coding makes the pump and the fan operate automatically based on the output given by the micro-controller (Vighnesh et al, 2019).



Current Data

TIME	temp	moisture
23:11:32,85	33 *C	Soil : 18

Historical Data

TIME	temp	moisture
23:11:25,52	33 *C	Soil : 21
23:11:26,55	OK: 92 %	
23:11:26,57	33 *C	Soil : 14
23:11:27,59	OK: 92 %	
23:11:27,62	33 *C	Soil : 18
23:11:28,65	OK: 92 %	
23:11:28,66	33 *C	Soil : 18
23:11:29,69	OK: 92 %	
23:11:29,70	33 *C	Soil : 14
23:11:30,74	OK: 92 %	
23:11:30,75	33 *C	Soil : 20
23:11:31,78	OK: 92 %	
23:11:31,80	33 *C	Soil : 14
23:11:32,83	OK: 92 %	
23:11:32,85	33 *C	Soil : 18

Current Data

TIME	temp	moisture
23:12:24,15	33 *C	Soil : 16

Historical Data

TIME	temp	moisture
23:12:16,83	33 *C	Soil : 19
23:12:17,85	OK: 92 %	
23:12:17,87	33 *C	Soil : 17
23:12:18,89	OK: 92 %	
23:12:18,92	33 *C	Soil : 15
23:12:19,95	OK: 92 %	
23:12:19,96	33 *C	Soil : 19
23:12:21,00	OK: 92 %	
23:12:21,01	33 *C	Soil : 14
23:12:22,04	OK: 92 %	
23:12:22,06	33 *C	Soil : 19
23:12:23,09	OK: 92 %	
23:12:23,11	33 *C	Soil : 17
23:12:24,13	OK: 92 %	
23:12:24,15	33 *C	Soil : 16

Fig. 7 *Data obtained during the night*

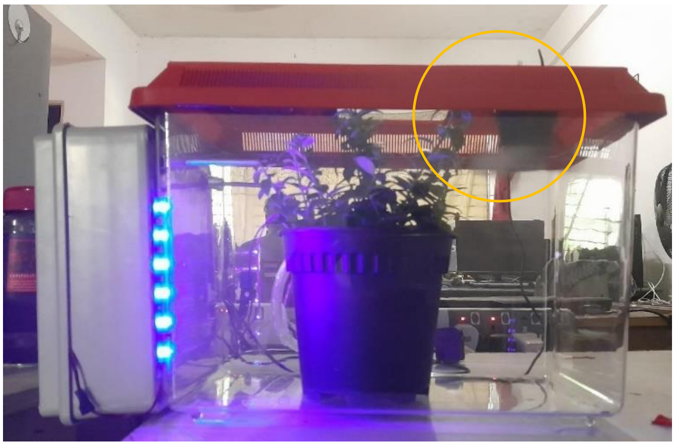


Fig. 8 *The operation of the cooling fan*

Fig. 9 *Fan used as cooling component*

Based on the data that took place at night, Fig. 8 shows the reading of the temperature was lower compared to the day and humidity stands out high at the night condition. As for the soil moisture, the rate was low due to the soil not being deprived of water. It concludes that the rate is lower during the nighttime since it is not exposed in the sunlight to get any reaction due to the heat rate (Zhang et al, 2020). The show shows the increase rate at the surrounding the micro-controller will send an impulse to the fan to be switched on and keep on run till the temperature being balanced <30 degree Celsius as shown in Fig. 9 and 10. The pump kept switched off due to the soil moisture content was below the percentage of water deprivation.

TIME	temp	moisture
0:03:22,24	33 °C	Soil : 19

Historical Data

TIME	CH1	CH2
0:03:14,92	33 °C	Soil : 20
0:03:15,94	OK: 94 %	
0:03:15,96	33 °C	Soil : 23
0:03:16,99	OK: 94 %	
0:03:17,01	33 °C	Soil : 19
0:03:18,04	OK: 94 %	
0:03:18,06	33 °C	Soil : 22
0:03:19,08	OK: 94 %	
0:03:19,11	33 °C	Soil : 20
0:03:20,13	OK: 94 %	
0:03:20,15	33 °C	Soil : 21
0:03:21,18	OK: 94 %	
0:03:21,19	33 °C	Soil : 22
0:03:22,23	OK: 94 %	
0:03:22,24	33 °C	Soil : 19

TIME	temp	moisture
0:04:05,17	33 °C	Soil : 21

Historical Data

TIME	CH1	CH2
0:03:57,85	33 °C	Soil : 21
0:03:58,88	OK: 94 %	
0:03:58,90	33 °C	Soil : 21
0:03:59,92	OK: 94 %	
0:03:59,94	33 °C	Soil : 20
0:04:00,97	OK: 94 %	
0:04:00,99	33 °C	Soil : 23
0:04:02,01	OK: 94 %	
0:04:02,04	33 °C	Soil : 19
0:04:03,06	OK: 94 %	
0:04:03,08	33 °C	Soil : 22
0:04:04,11	OK: 94 %	
0:04:04,13	33 °C	Soil : 21
0:04:05,16	OK: 94 %	
0:04:05,17	33 °C	Soil : 21

Fig. 10 *Data obtained during the day*

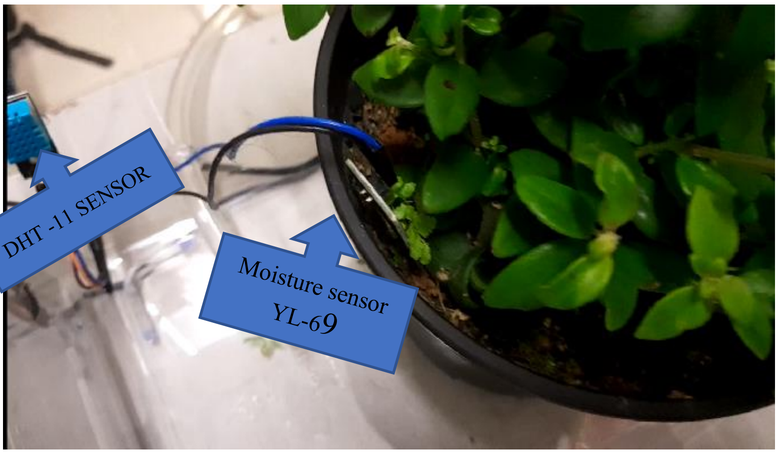


Fig. 11 *Soil moisture and DHT 11 sensor*

Fig. 10 shows the data that has been collected during the daytime since the temperature will be higher compared to night conditions. Since the temperature rate is higher the humidity and the soil moisture are affected as well. The soil moisture indicates deprivation of soil moisture compared to the nighttime. Once the indicated temperature and soil moisture exceed the parameter that have been set up via coding both fan and pump will be automatically switched on (Mackensen et al, 2019). Once the soil moisture sensor detects the deprivation of water in the soil the pump will automatically switched on by the command of the micro controller. The pump will supply the water to the plant through the hose that is connected to the pump and water supply as shown in Fig. 11 and 12. Fig. 13 show the picture of the physical circuit of the whole system as per labeled which Arduino UNO act as the brain of the system and will control the actions. Wi-Fi module will transmit the input to the server while the relay will act as automatic On/Off action when given instruction from the micro-controller.

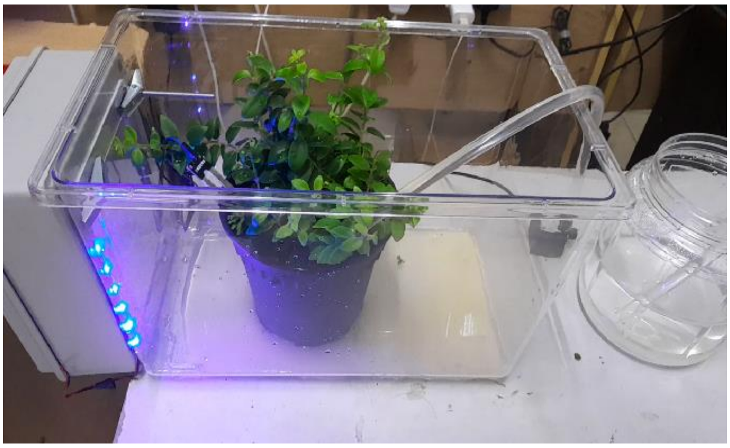


Fig. 12 *The water supply through the pump*

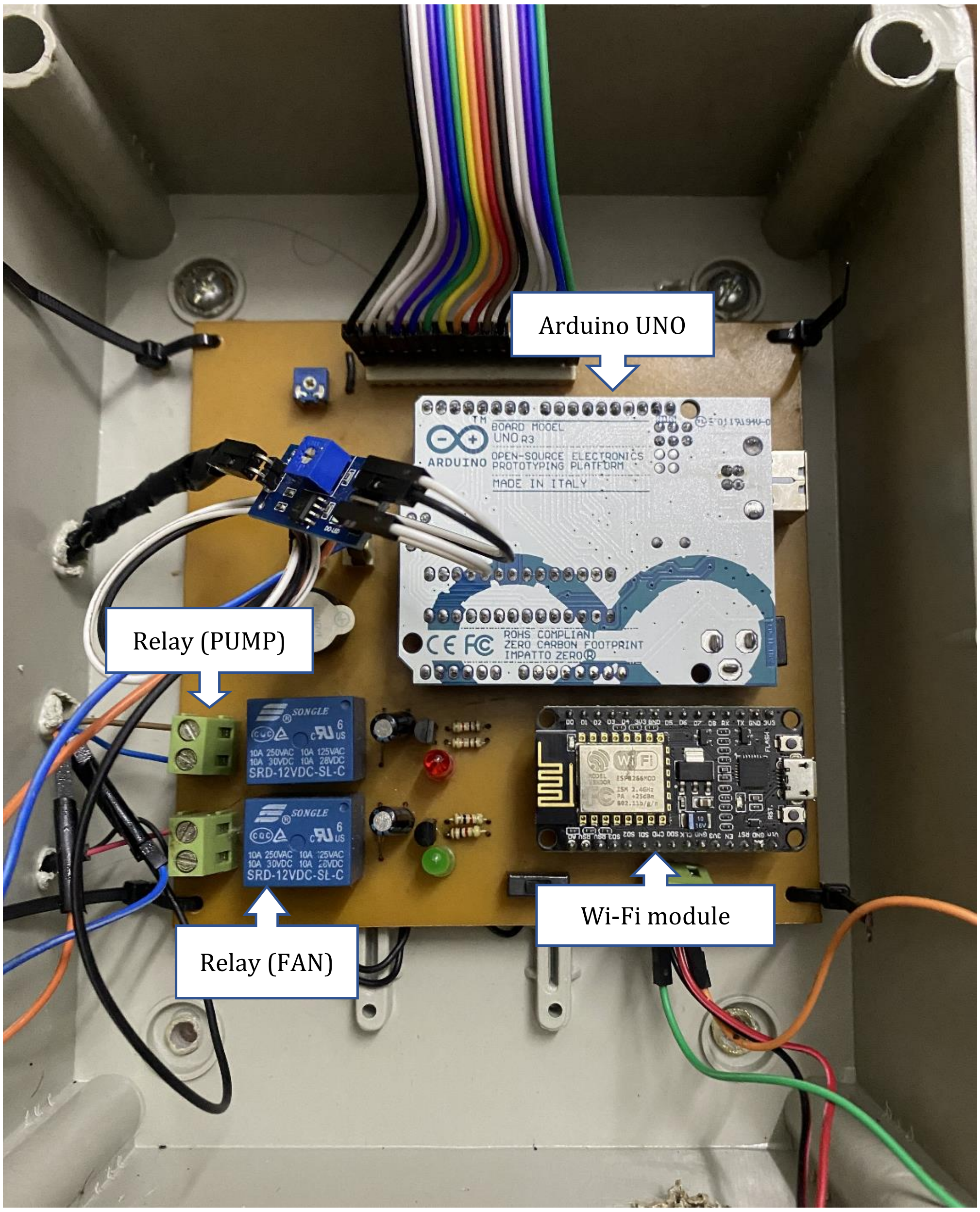


Fig. 13 *Physical circuit of the system*

4. Conclusion

In conclusion, this work is an innovative work that fuses automation and IoT technology to transform conventional gardening practices. This work aims to improve plant health and growth while enabling users to remotely monitor their indoor plants and the environment by integrating sensors, micro-controllers, and IoT technology. The system provides a fully automated solution that efficiently regulates the plant environment using temperature sensors with a focus on reducing human involvement. Significant progress has been made through extensive circuit design simulations and code development. The seamless data retrieval from the Wi-Fi module is made possible by the successful development of the IoT platform, and the data is then displayed on the IoT portal server. Both the serial monitors and the IoT server portal can access precise measurements of important variables such as humidity, temperature, and soil moisture content. The Automated Smart Garden using IoT System introduces an innovative approach to change conventional gardening practices by encouraging better plant care and offering greater user convenience.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Hemaraj Ramu, Mohd Jais Che Soh;* ***data collection:*** *Hemaraj Ramu;* ***analysis and interpretation of results:*** *Hemaraj Ramu;* ***draft manuscript preparation:*** *Hemaraj Ramu, Mohd Jais Che Soh. All authors reviewed the results and approved the final version of the manuscript.*

References

A. Alauddin, A. Haider & A. Hussain. (2018). Cloud based IoT for Smart Garden Watering System using Arduino Uno. 10.1049/cp.2018.1401.

D. Kurniawan, R. J. Putra, A. Bella, M. Ashar and K. Dedes, "Smart Garden with IoT Based Real Time Communication using MQTT Protocol," 2021 7th International Conference on Electrical, Electronics and Information Engineering (ICEEIE), Malang, Indonesia, 2021, pp. 1-5, doi: 10.1109/ICEEIE52663.2021.9616869.

E. Mackensen, J. Klose, A. Rombach and A. Spitznagel, "Energy autonomous automation of Smart Home applications using the example of a wireless Indoor Smart Gardening system," 2019 IEEE 15th International Conference on Automation Science and Engineering (CASE), Vancouver, BC, Canada, 2019, pp. 1087-1092, doi: 10.1109/COASE.2019.8843000.

P. Ipin & M. Andino & T. Omar & S. Nishith. (2020). Design of Automatic Watering System Based on Arduino. Journal of Robotics and Control (JRC). 1. 10.18196/jrc.1213.

P. Vighnesh & S. Ahmed & P. Vighnesh. (2019). Automated Watering and Irrigation System using Arduino UNO. International Journal of Innovative Science & Technology. 4. 928-932.

Y. Nugraha, and D. Santi (2022). loT-based temperature and humidity monitoring system for smart garden. IOP Conference Series: Materials Science and Engineering. 1212. 012047. 10.1088/1757-899X/1212/1/012047.

Y. Zhang, Y. Liu, Q. Zhang, & Z. Wang, (2020). Difference Between Day and Night Temperatures Affects Stem Elongation in Tomato (Solanum lycopersicum) Seedlings via Regulation of Gibberellin and Auxin Synthesis. Frontiers in Plant Science, 11, 577235. https://doi.org/10.3389/fpls.2020.577235.