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The use of Internet of Things (Iot) Technology in the Context of "Smart Gardens" is Becoming Increasingly Popular

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Abstract: When we're away for a few days. In these circumstances, we can't water our beloved plants or we're too busy to do so, so we often forget about them. Indoor plants require regular watering, so it's hard to keep them alive. Simple solution. It's perfect for lazy individuals like me. We wish to implement IOT and cloud-based technologies, which are popular presently. This project measures the micro garden's soil moisture, temperature, and humidity. We can cut water waste by using machine learning models to determine if a farm needs watering based on soil factors. It has a microcontroller to which other things are attached. NodeMCU is the hub to which moisture, humidity, and temperature sensors are attached. A soil moisture sensor connected to a water tank shows tank level. Other sensors feed data to NodeMCU, which has built-in Wi-Fi. BLYNK is an online database that updates sensor values every second. Users can monitor parameters from anywhere. Soil type affects garden watering. For software automation, sensor values are predetermined. A switch in the app automates garden watering as needed. This improves garden maintenance.

Keywords: Internet of Things (IoT), Technology, Smart Gardens, Increasingly Popular, Moisture Sensor, Humidity Sensor, Temperature Sensor.

INTRODUCTION

At times, as when we're away for a week or more [1]. In these circumstances, we are unable to water our beloved plants, and, because we are preoccupied with other tasks, we frequently neglect them. Most houseplants need to be watered on a consistent basis, which makes maintaining them a challenge. The answer we came up with is quite elementary [2-5]. This is fantastic for folks like myself who are too busy to do anything else. The Internet of Things (IoT) and cloud computing are becoming increasingly popular, and we hope to incorporate them into this sector. The primary objective of this study is to determine the soil moisture, temperature, and humidity of the miniature garden [6-13]. We can significantly cut down on water loss by using machine learning algorithms that can tell whether or not a farm needs watering based on all these soil parameters. A microcontroller acts as the hub to which various devices are linked. For the smart garden, a NodeMCU serves as a hub to which various sensors, such as moisture sensors, humidity sensors, and temperature sensors, are attached [14-19]. A second soil moisture sensor, this one linked to a storage tank, reports on the liquid volume in the latter. NodeMCU has built-in Wi-Fi technology, so data from other sensors can be transmitted to it from wherever they happen to be [20]. BLYNK is an online database that continuously stores the sensor's current values as they are measured in real time [21-25]. This allows the user to remotely check the settings. Garden irrigation needs shift depending on soil composition. Therefore, the software has already decided on the values for the sensors for automated functions [26-33]. The user can set the programme to automatically water the garden whenever they feel the need to do so by flipping a switch. In the long run, this aids in the garden's overall upkeep [34-37].

Problem Definition

Many home and garden plants die from neglect, lack of nutrients, too little water, or too much sunlight because these factors are often overlooked by their owners [38]. In order to address this problem, we have built a system that analyses the weather and recommends crops to the client according on their specific needs [39-45].

Project Objectives

- In order to lessen plant mortality due to unsuitable weather.
- Develop a sensing network to identify the limits of a garden's climatic zones.
- If the sensors detect a certain condition in the nursery, please advise on what plants to put where.
- This system is easily scalable to include additional regions.
- Putting it together shouldn't break the bank, but it should be sturdy.

Functions

- Several sensors can be used to gather information about the environment, including temperature, humidity, soil moisture, and light intensity [46-49].
- The qualities/values retrieved by each sensor will be displayed on the UI for each section of the garden [50].
- Give advice on getting the garden started, such as how often and how long to water, how much direct sunlight each plant should get, etc.
- To avoid relying on external entities, try building your own BLYNK network [51].

Expected Outcomes

- In that way, the plant will receive water just when it needs it.
- Through the use of the app, it is possible to see the soil's water retention rate (from any place under the sun where the web is accessible) [52-66]
- It will also display the ambient temperature and humidity for the plant.
- The pot can also be used to store liquids like water. This creates a clean of sorts (we needn't install any huge water tank nearby), as the sensor can detect the water level and display it in real time [67-77].
- A literal watering can be done for plants with this software [78].

Hardware & Software Requirements

- ESP8266 NodeMCU*1
- Capacitive soil moisture sensor*2: It is used to measure the moisture content of the soil.
- DHT11 sensor module*1: It is used to measure the humidity and the temperature content of the soil.
- L293d motor driver/ relay*1
- 5v mini water pump*1
- 1 meter small 1cm hose*1

- 7.4 volt battery(9v or 6v)
- Female header pins
- 1N4007 diodes*2
- Common PCB
- Wires
- BLYNK application and the web dashboard.

Components Description

Esp8266 NodeMCU:

NodeMCU is the central component of Smart Garden [79-85]. There is no cost to use the NodeMCU Internet of Things platform. Hardware based on the ESP-12 module is the cheapest option and is powered by Espessif Systems' ESP8266 Wi-Fi SoC. It's a microcontroller on a single circuit board with 4 megabytes of storage and 128 bytes of RAM. It was made with developers with simple programming and prototyping in mind [86-95]. It has a built-in Wi-Fi module and NodeMCU as a hub for transmitting sensor readings to the cloud [96]. A smart garden can be built with any microcontroller. However, an internet connection is required for the smart transformation to take place. Since this is the case, we have decided to use the NodeMCU. With NodeMCU, we can both send and receive data. The number of digital pins is sufficient for our needs [97-111].

The capacitive soil moisture sensor:

Soil moisture sensors are designed to measure the amount of water present in the ground. Capacitive Soil Moisture Sensors and resistive moisture sensors are the two main possibilities in this class of sensor [112-135]. Capacitance changes are the basis of a capacitive soil moisture sensor, as the name suggests. The metal electrodes in capacitive sensors are not directly exposed, unlike in resistive sensors. This can greatly prevent electrode corrosion [136-147]. Moisture can be detected using a capacitive sensor by monitoring the shift in capacitance as a result of variations in the dielectric. It is well knowledge that capacitance increases with increasing dielectric strength. A voltage proportional to capacitance is generated by a NE555-based circuit, which is used to detect the sensor's capacitance [148-167]. There are 3 pins on the sensor: VCC, GND, and OUT. Moisture sensors that use capacitance to detect moisture release an analogue reading. Capacitive moisture can also be used as a water level sensor [168-172].

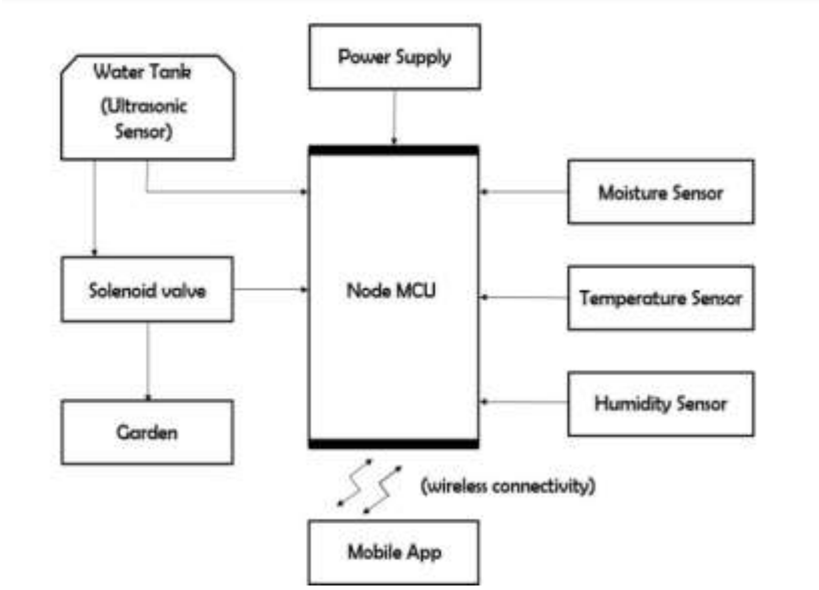
DHT11:

Among sensors that measure both temperature and humidity, the DHT11 is among the most used. The sensor has an integrated NTC for precise temperature readings. A DHT sensor's output is temperature and humidity readings transmitted in serial form [173-186]. The DHT library makes interfacing with microcontrollers simple, and the sensor is far more precise than its competitors. The sensor has a measuring range of 0 to 50 degrees Celsius, and a humidity range of 20 to 90 percent, both with an accuracy of 1 degree Celsius and 1 percent, respectively. In such case, we've found the solution for our purpose [187-202].

Motor driver/ relay module:

Since pumps require more power, connecting them directly to the microcontroller would cause the latter to overheat and fail. Because of its small footprint, the Relay module was selected for controlling the pump. Furthermore, this relay works well for operating low-powered motors [203-215]. Two motors can be controlled by one single module. One side is all that's required (figures 1 and 2).

Design

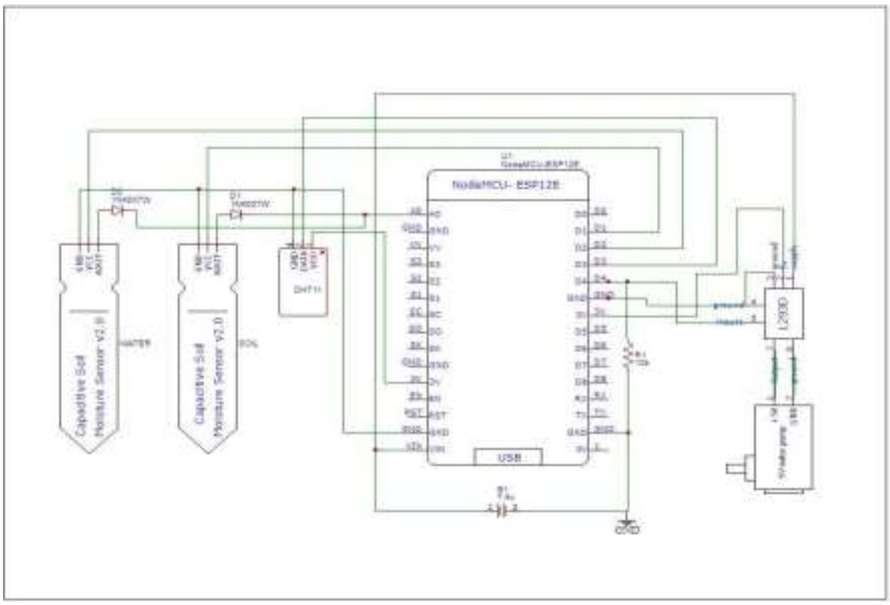


Block Diagram

Figure 1: Block Diagram

Circuit Diagram

Figure 2: Circuit Diagram



Implementation

Web Configuration

- We began by joining the BLYNK system online. There will be a user interface available to us after that [216].
- There, you'll need to fill in the project's essentials like title and contact information [217].
- The saturated readings from the sensors will then need to be entered into the data streams.

- There, you can choose not only the output's hue but also its pin, data type, and measurement system (figure 3) [218].

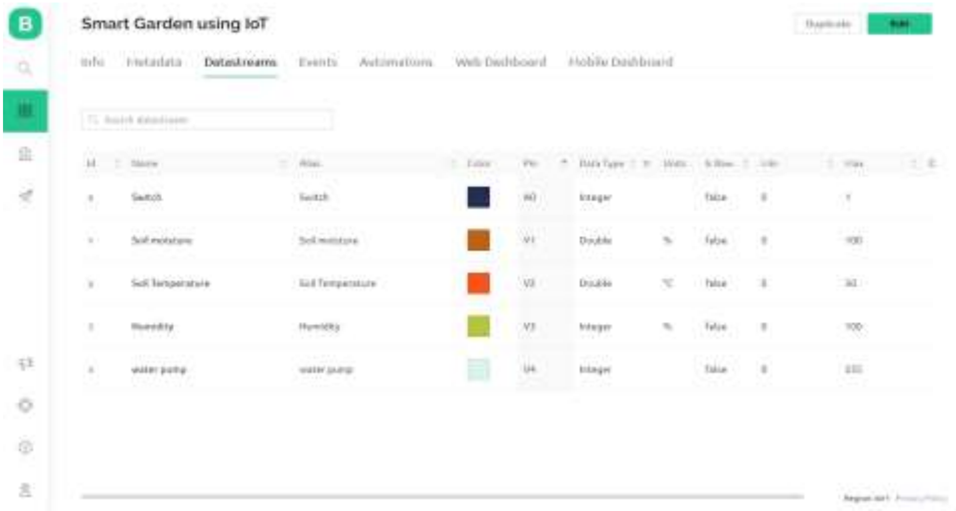


Figure 3: Web Configuration

Depending on the requirements, a data stream can be generated after the user's basic information has been entered (figure 4) [218-233].

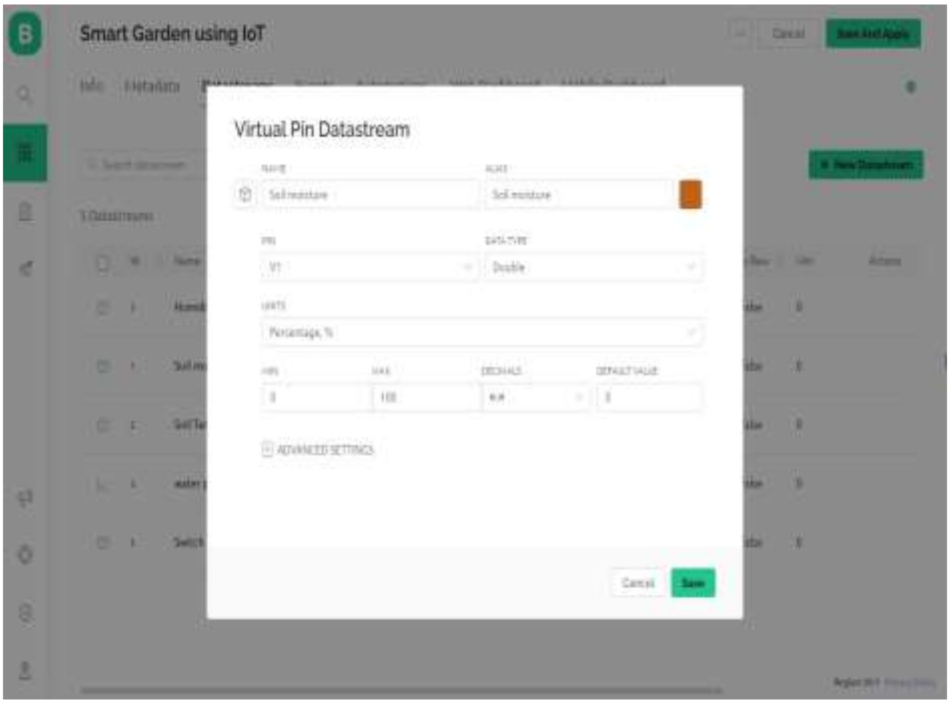


Figure 4: Virtual Pin DataStream

Adapt the flow of data to your needs (figure 5).

Figure 5: Data stream

You must add the Events in order to receive the alerts. Add widgets and toggles to the Web dashboard and save your changes (figure 6) [234-241].

Figure 6: Web Dashboard

And the Web Dashboard is ready.

App Installing & Configuration

Step one is to get the BLYNK app from the Google Play or Apple App Store. Enter your login information and sign up. Choose Add New Device now (figure 7) [242-247].

Figure 7: App Installing & Configuration

Then you can connect with Wi-Fi or by scanning the QR code, or you can create the new template after picking the Quickstart device.

- Once the device is synced with the BLYNK's web cloud, it will display an identical dashboard to the one accessible online.
- If this is the next big thing in tech, then this is the blueprint we'll need to follow. Above, you can see a panel with four different devices and a toggle switch. The values must be entered based on the requirements.

Arduino

For NodeMCU, any language will do for the code. When it comes to writing code for the NodeMCU, the Arduino IDE is superior [248-252]. It's a Java programme that works on multiple platforms. A code editor, as well as the ability to copy and paste text, search for and replace text, indent and brace automatically, and highlight syntax are just some of the functions offered by this software [253]. The programme should be updated to support NodeMCU boards and contain the necessary libraries. The board is first put through its paces using a blinking LED programme, and only after that is the smart garden's code developed [254-258]. It comes with the necessary library files to connect to Firebase. .info is the file extension for the sketch application.

- To begin the coding process, launch the Arduino IDE and upload the ESP82166, BLYNK, and DHT libraries.
- As the BLYNK Server is being utilised, the token id is required for any and all server-to-server interactions. The token id is emailed to the designated address. Then we reveal our hotspot's SSID and password.
- Then, we utilised integers to store both the read value and the translated soil moisture, and we defined all the necessary integers right here. We then made the sensor and motor pins official. We also specified the DHT pin and sensor type. At last, we provided the calibrated values as both decimal and fractional representations.

Arduino Studio

By JetBrains, it is an open-source IDE for creating Android apps. This programme works on Windows, macOS, and Linux computers. To help users design more intuitive Android apps, it includes a number of capabilities. It is compatible with languages like Java, Kotlin, and Python. It has the Android Virtual Device that may be used with Android Studio for testing and debugging. The Garden app's implementation code is written in Java, while the design code is in XML. As part of the implementation, the connection to Firebase is also made. The first screen you see after logging into the app is the home screen. The Smart Garden is automated through a series of events. Use this mobile app to keep an eye on your Smart Garden System from anywhere in the world. The user receives push notifications whenever the sensor values exceed the maximum or threshold value. Users are able to access and manipulate the system from afar. Since this approach is free and publicly available, it can save you a lot of money (figure 8).

Figure 8: Arduino Studio

Arduino Code

The code uses the ESP8266, Blynk, and DHT libraries. You can download the libraries from the given links. So first, We included these libraries and defined the blynk serial print function.

#define BLYNK_PRINT Serial #include
#include #include

Since we are using the Blynk Server, the token is necessary to communicate with the server. You can copy the token from the registered email id. Then I give the SSID and password of my hotspot. If you are going to replicate this project, then just replace the characters with your token, SSID, and password.

char auth[] = "EqF6GGkVt_kFgBJHIX0v32TrFcc_Wxy5"; char ssid[] = "KrishT";
char pass[] = "krish123";

Next, we included all the needed integers; in this case, we kept track of the read value and converted soil moisture using integers. We then made the sensor and motor pins official. Aside from that, it specified the sensor kind and DHT pin. At last, we provided the calibrated values as both decimal and fractional representations.

int readD1; int readD2;
int moisture_sensor1; int moisture_sensor2; int Pin_D1 = 5;

```
int Pin_D2 = 4;
int Pin_D4 = 2; #define DHTPIN 0
#define DHTTYPE DHT11
const int dry = 600; // value for dry sensor const int wet = 200; // value for wet sensor DHT DHT(DHTPIN, DHTTYPE);
BlynkTimer timer;
```

For easier debugging later on, we started the serial communication right away in the setup phase. The pin's modes were then defined; there are three outputs and one input. Furthermore, it kicked off both the DHT and Blynk networks' communication.

```
void setup()
{
Serial.begin(9600);pinMode(Pin_D1,OUTPUT);pinMode(Pin_D2,OUTPUT);     pinMode(Pin_D4,OUTPUT);
pinMode(A0,INPUT); dht.begin();
timer.setInterval(1000L, sendSensor); Blynk.begin(auth, ssid, pass);
}
```

The DHT sensor's humidity and temperature were read and saved as a float in h and t, respectively. These values were then communicated to the blynk server via the Blynk.virtualWrite method. In this case, pins V7 and V8 are purely fictitious.

```
void sendSensor()
{
float h = dht.readHumidity(); float t = dht.readTemperature(); Blynk.virtualWrite(V7, t); Blynk.virtualWrite(V8 , h);
}
```

Here we run through a loop and read the numbers from the moisture sensors. We need to get creative because our nodemcu only has a single analogue input. For this, (first refer to the circuit diagram) we power up the D1 (first sensor) and simultaneously read its analogue value, storing it in readD1. Then it disconnected the first sensor, activated digital pin 2, and read the analogue value from the second sensor, saving it in readD2.

```
void loop()
{
Blynk.run(); digitalWrite(Pin_D1, HIGH); delay(100);
readD1 = analogRead(0); digitalWrite(Pin_D1, LOW); delay(100); digitalWrite(Pin_D2, HIGH); delay(100);
readD2 = analogRead(0);
digitalWrite(Pin_D2,LOW); delay(100);
```

So after getting the analog values of sensors, we have to convert that into a percentage because the analog values vary from 0 to 1023.

The map function allowed us to accomplish this. Each component of a map function is composed of three pieces. The first is the input, which is the analogue value in this example. Maximum and minimum measurements are next; in this case, we have already obtained those numbers. Finally, the values here range from 0 to 100 when converted.

```
moisture_sensor1=map(readD1, wet, dry, 100, 0);
moisture_sensor2=map(readD2, wet, dry, 100, 0); Serial.print("sensor 1 = ");
Serial.print(readD1); Serial.print(" / sensor 2 = "); Serial.println(readD2);
```

Here, we use if statements to specify when the motor should be on and off based on the moisture level of the soil. When the soil moisture is below 50%, the first motor will activate, and when it's above 50%, it will shut off.

```
if (moisture_sensor2<=50)
{
digitalWrite(Pin_D4,HIGH); delay(10);
}
if (moisture_sensor2>50)
{
digitalWrite(Pin_D4,LOW); delay(10);
}
```

Finally, we send the moisture and water levels to the blynk server. Blynk.virtualWrite(V5, moisture_sensor1); // to Blynk server Blynk.virtualWrite(V6, moisture_sensor2); // to Blynk server timer.run();

```
}
```

The code is uploaded to the nodemcu after it is connected to the computer. Open the blynk app and activate your Wi-Fi hotspot. Our plant health may now be tracked and managed remotely.

Conclusion

Once development is complete, connect NodeMCU to the computer and copy the code across. Now is the time to activate your Wi-Fi hotspot and launch BLYNK. The health of our plants may now be monitored and managed from any location with internet access. In order to ensure that the Smart Garden framework leveraging the Internet of Things works adequately, it was tested by connecting different soil limits to the cloud and being partially managed by a mobile application. The proposed framework does more than merely filter sensor data like humidity, temperature, and air pressure; it also activates varying boundaries based on the situation. This framework requires a small amount of space to begin with and to set up, thus it may be used in almost any setting. As sensor technology advances, so too may the capacity of the system to help clients make money off their passions. Incorporating sensors to monitor soil nutrients would allow the system to be fine-tuned to reliably replenish fertiliser.

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