IOT BASED LOW-COST GREENHOUSE MONITORING SYSTEM

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ABSTRACT

Since our country is historically based on agriculture, most of the country's economic output comes from the agricultural sector. This system includes NodeMCU board based on a microcontroller, humidity sensor to measure the amount of vapor in the air, soil moisture sensor to measure the soil, light dependent resistor sensor to measure the amount of light and water pump to irrigate the plants automatically. 9V power supply must be provided to the NodeMCU board first. Through this, the amount of vapor, the moisture of the soil, and the amount of light are sent to the microcontroller on the NodeMCU board. And then, microcontroller send to Blynk application for monitoring the levels of it, and to message for alerting the condition of it on mobile phone. Simultaneous the water pump through a relay will irrigate for the plants and soil. This system is designed to cope with the difficulties caused by climate change, such as temperature rise, increased soil degradation, and scarcity of agricultural land. Farmers who will use this greenhouse system will save time, reduce labor, and reduce costs, as well as protect against pests and diseases from the outside.

Keywords: NodeMCU, Humidity Sensor, Soil Moisture Sensor, LDR Sensor, Water Pump, Blynk Application.

I. INTRODUCTION

Most of Myanmar's population lives in rural areas. Most of them work in agriculture. The heads of state are establishing and implementing the country's prosperity and food security as a national process. When we use a greenhouse in our country, we have the ability to grow a variety of plants. Food shortages are one of the biggest problems facing humanity in the 21st century. Global warming and other climate factors have demanded vast amounts of land available for growing crops. The main advantage of growing in a greenhouse is that it gives us a better growing season. A green house has parts that cover of sunlight, but the climate inside the greenhouse is to change slightly. Maintaining a garden can be difficult during inclement weather. Greenhouse technology can now be automated in agriculture due to the low cost of the electronic components required for its implementation. Many researchers have made efforts to automate the conventional greenhouse system. A block diagram of a low-cost greenhouse monitoring system for smallholder farmers is shown in Figure 1.

![Figure 1: Block diagram of the system](chart.png)
II. METHODOLOGY

Basically, this system is designed and constructed both hardware and software. The hardware architecture was constructed NodeMCU board, Blynk application, humidity sensor, soil moisture sensor, LDR sensor module, buzzer and 5V water pump. The software development was operated Lua Programming language, Arduino IDE.

2.1 Hardware Architecture

NodeMCU

NodeMCU ESP8266 is an open-source Lua based firmware and development board specially targeted for IoT based applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems and hardware which is based on the ESP-12 module, and like this, it can also be programmed using Arduino IDE and can act as both WiFi Hotspot or can connect to one. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects. Its applications include prototyping for IoT devices, low powered battery-operated applications, and projects I/O interface with Bluetooth and WiFi capabilities. Figure 2 shows the NodeMCU board.

IoT

The internet of things, or IoT, is a network of interrelated devices that connect and exchange data with other IoT devices and the cloud. IoT devices are typically embedded with technology such as sensors and software and can include mechanical and digital machines and consumer objects. Increasingly, organizations in a variety of industries are using IoT to operate more efficiently, deliver enhanced customer service, improve decision-making and increase the value of the business. With IoT, data is transferable over a network without requiring human-to-human or human-to-computer interactions.

Blynk Application

Blynk is a platform with the Android and IOS apps that can run many hardware modules like Raspberry Pi, Arduino, NodeMCU and over four hundred hardware modules. In addition, to connect the hardware module device to the internet, the sustained choices connectivity is Wi-Fi, Ethernet, Cellular, USB, serial, and Bluetooth. Blynk lets creating many applications and use it to control many boards connected to a device that have internet access, from anywhere, anytime in the world with a smartphone. The GUI (Graphic User Interface) at the smartphone using Blynk App is very simple and friendly user by adding the widget that want to use and controlled them via choices of connectivity for example Wi-Fi internet. Figure 4 shows the Blynk application.

Humidity Sensor

The humidity sensor is a device that senses, measures and reports the relative humidity of air or determines the amount of water vapor present in air. It works by detecting changes that alter electrical currents or temperature in the air. Humidity sensor refers to an electronic device that detects humidity in its surroundings and converts the data into electric signal. The maximum amount of humidity for air at about a similar temperature is compared to the live humidity. Humidity sensor is shown in Figure 5.

Soil Moisture Sensor

The moisture of the soil plays an essential role in gardens for plants. Soil moisture sensor measures the water content in the soil and can be used to estimate the amount of stored water in the soil horizon. The sensor produces an output voltage according to the resistance, which by measuring we can determine the soil...
moisture level. Supplying water to the plants is also essential to change the temperature of the plants. The soil moisture sensor is extremely simple to use and only requires four pin to connect. By using this sensor, one can automatically water the flower plant, or any other plants requiring automatic watering technique. Soil moisture sensor is shown in Figure 6.

LDR Sensor Module

LDR sensor module is used to detect the presence of light or measuring the intensity of light. It is a resistor whose resistance changes as the amount of light falling on it changes. The resistance of the LDR decrease with an increase in light intensity. LDR sensor module is shown in Figure 7.

Water Pump

The water pump works using water suction method which drain the water through its inlet and released it through the outlet. It can be used as exhaust system for this aquarium and controlled water flow fountain. 5V water pump is shown in Figure 8.

2.1 Software Architecture

Lua is a free integrated development program for windows that helps reduce the manual work required when programming. Lua Programming is an educational application that provides all of the concepts and techniques in the language Lua. NodeMCU processor basically uses the architecture where the program code and program data have separate memory. It consists of program memory and the data memory. Lua programs are written in the Arduino Integrated Development Environment (IDE). Flow chat of the system is shown in Figure 9. Figure 10 shows the coding of the system.

```c
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <DHT.h>
DHT dht(D1,DHT11);
char auth[] = "";// Enter your Auth token
char ssid[] = "";//Enter your WIFI SSIS
char pass[] = "";//Enter your WIFI password
```
BlynkTimer timer;
int LDR=D0;
int Humidity=D1;
int Soil=A0;
int Pump=D2;
void setup()
{
  Serial.begin(115200);
pinMode(LDR, INPUT);
pinMode(Humidity, INPUT);
pinMode(Soil, INPUT);
pinMode(Pump, OUTPUT);
dht.begin();
Blynk.begin(auth, ssid, pass, "blynk.iot-cm.com",8080);
timer setInterval(1000L, sensors);
}
void sensors()
{
  int valueldr=digitalRead(LDR);
  int tmp=dht.readTemperature();
  int hum=dht.readHumidity();
  int valuesoil=analogRead(A0);
  Serial.print("Temperature=");
  Serial.println(tmp);
  Serial.print("Humidity=");
  Serial.println(hum);
  Serial.print("Soil=");
  Serial.println(valuesoil);
  Blynk.virtualWrite(V0,tmp);
  Blynk.virtualWrite(V1,hum);
  Blynk.virtualWrite(V2,valuesoil);
  Blynk.virtualWrite(V3,valueldr);
  if(tmp>40 && valuesoil<500)
  {
    digitalWrite(Pump,LOW);
    Blynk.notify("Warning! Need to irrigate water");
  }
  else if(tmp>40 )
  {
    digitalWrite(Pump,LOW);
    Blynk.notify("Warning! Need to irrigate water");
  }
  else if(valuesoil<500 )
}
### III. OPERATION SYSTEM

A low-cost greenhouse monitoring system for smallholder farmers is built with NodeMCU, LDR sensor, humidity sensor, soil moisture sensor, water pump and Blynk application based on IoT. In this system, Lua language is used for programming. Blynk application displays reading values obtained from sensor readings. The DHT11 sensor can measure temperature and humidity. Weather stations used these sensors to predict weather conditions. Its temperature measurement range is -40 to +125 degrees Celsius. Soil moisture sensors are used to track soil moisture to improve crop yield. The LDR sensor module detects the intensity of light. It is designed to communicate with a microcontroller such as a NodeMCU. A water pump works using a water suction method that draws water through its inlet. If the temperature exceeds 38˚C, the water pump will pour and Blynk application shows high temperature and watering. The temperature between 15˚C and 38˚C is a normal condition, so it will be seen on Blynk application. Blynk application will show high light intensity. This system tells us the ambient temperature, easy to know soil moisture and light intensity. In addition, cost reduction, there will also be benefits such as reducing the workforce and coping with natural disasters. Therefore, this system was built to benefit farmers. The complete system of IoT based low-cost greenhouse monitoring system for smallholder farmers is shown in Figure 11.

```c
void loop()
{
    digitalWrite(Pump, LOW);
    Blynk.notify("Warning! Need to irrigate water");

    digitalWrite(Pump, HIGH);

    void loop()
    {
        Blynk.run();
        timer.run();
    }
```

### IV. OPERATION SYSTEM

The information obtained from the system is described by drawing construction tables, drawing graphs and taking photos. The solution values for this whole system can be looked in Table 1. Figure 12 shows the graph line of the soil moisture sensor. Photograph of the testing of soil moisture sensor can be seen in Figure 13. Figure 14...
show the graph lines of the humidity sensor. Photograph of the testing humidity sensor will be seen in Figure 15. Figure 16 is the graph line of the LDR sensor. Photograph of the testing LDR sensor will be seen Figure 17.

<table>
<thead>
<tr>
<th>Date</th>
<th>values of soil</th>
<th>Values of Humidity</th>
<th>Values of LDR</th>
<th>Working system</th>
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<td>35</td>
<td>57</td>
<td>390 watering</td>
</tr>
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<td>6.2.24</td>
<td>948</td>
<td>36</td>
<td>43</td>
<td>395 watering</td>
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<td>846</td>
<td>35</td>
<td>57</td>
<td>450 watering</td>
</tr>
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<td>36</td>
<td>43</td>
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<td>37</td>
<td>41</td>
<td>435 watering</td>
</tr>
</tbody>
</table>

Figure 12: Graph line of the soil moisture sensor

Figure 13: Graph lines of the humidity sensor

Figure 14: Graph line of the LDR sensor

Figure 15: Photograph of the testing soil moisture sensor

Figure 16: Photograph of the testing humidity sensor

Figure 17: Photograph of the testing LDR sensor
V. CONCLUSION

In this system, the various conditions of temperature, humidity and light intensity are monitored on Blynk application. If the humidity exceeds that set temperature, plants will be watered. Water supply is very important for plants growth. Therefore, soil moisture sensor is used to sense the level of soil moisture. When the soil is dry, water was given until it reaches the required level. Light intensity is important for plants growth, so LDR sensor is used. This system provides a safe haven for the plants and protects them from the danger of pests. In addition, it reduces exposure to adverse weather conditions such rainfall, heavy snowfall and drought. By using this system, agricultural farmers will get benefits such as less time and effort, lower costs with less labor force. This system is created to increase crop yield by using IoT technology based on weather conditions.

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VI. REFERENCES

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