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Smart Agriculture and Irrigation System Using IoT

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Abstract: As Myanmar is an agriculture-based country, an irrigation system has been implemented to develop farm land. In this system include NodeMCU board based on ESP8266 WiFi module, humidity sensor for detecting the temperature and moisture around the environment, soil moisture sensor for sensing the moisture of the soil in the farm land, rain sensor for measuring the condition of the rainfall, Blynk application for getting the weather information, LCD for displaying the values of the sensors, water pump for irrigating in the farm land. The information received from the sensors is sent to the microcontroller on the NodeMCU and the microcontroller send it to the Blynk application and the LCD. Then Blynk application runs the irrigation system in the farm land. It is designed to meet challenges such as soil degradation and low crop yields caused by climate change. Farmers who use this system will be able to increase crop yields, increase incomes, and reduce labour force.

Keywords: NodeMCU, IoT, humidity sensor, soil moisture sensor, rain sensor, Blynk application, water pump.

I. INTRODUCTION

By utilizing Internet innovation and sensor community innovation we are able to take care of water wastage and to enhance the logical advances in water machine techniques [1]. Consequently, it is able to incredibly enhance using water and might construct water efficiency. The Internet of Things (IoT) is a modernization somewhere in a cell phone can be used to display the capability of a gadget. The Internet of Things (IoT)is anxious about be integrated handing over objects that are bring together at a number of areas that are theoretically indifferent from one extra. The smart irrigation system has wide scope to automate the complete irrigation system [2]. Here we are building a IoT based irrigation system using ESP8266 NodeMCU module and DHT11 sensor. It will not only automatically irrigate the water based on the moisture level in the soil but also send the data to Blynk server to keep track of the land conditions. The system will consist a water pump which will be used to sprinkle water on the land depending upon the land environmental condition such as moisture, temperature and humidity. Block diagram of smart agriculture and irrigation system is as shown in Figure 1.

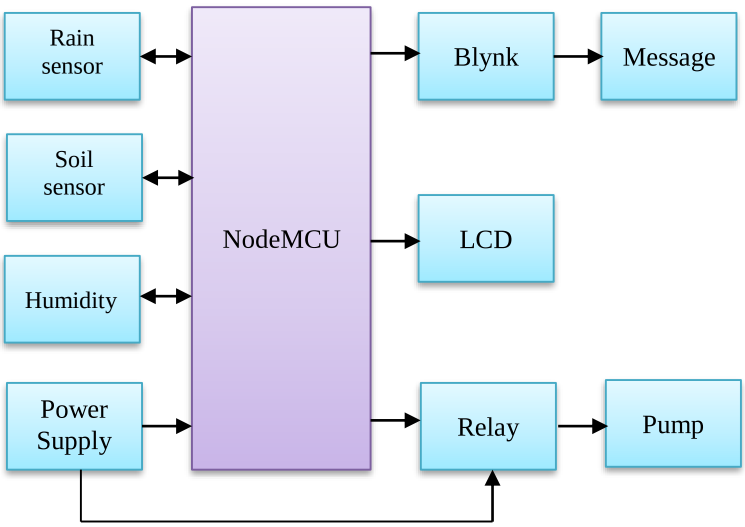

Fig. 1. Block diagram of smart agriculture and irrigation system

II. METHODOLOGY

Basically, the designed and development of this system are divided into two main parts which are hardware architecture and software details. The design of the circuit was constructed and the prototype of the system was built. While in the software development, the whole completed prototype was operated via programming codes.

2.1 Hardware Architecture

NodeMCU is an open source IoT platform. It includes firmware which runs on the low-cost WiFi enabled ESP8266 WiFi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. It has GPIO, SPI,12C, ADC, PWM AND UART pins for communication and controlling other peripherals attached to it. On board NodeMCU has CP2102 IC which provides USB to TTL functionality. In this IoT smart agriculture and irrigation system, GPIO pin and analog pin are used to get the digital and analog data from the sensors. NodeMCU is as shown in Figure 2.

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction as shown in Figure 3. A thing in the internet of things can be a person with a heart monitor implant, an atomically smart agriculture and irrigation system, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network [3]. Increasingly, organizations in a variety of industries are using IoT to operate more efficiently, better understand customers to deliver enhanced customer service, improve decision-making and increase the value of the business [4]. Internet of things is as shown in Figure 3.

Blynk was designed for the Internet of Things as shown in Figure 4. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things. There are three major components in the platform. Blynk Application: allows to create amazing interfaces for researches using various widgets. Blynk server:responsible for all the communications between the smartphone and hardware. Our Blynk Cloud can be used or your private Blynk server is locally run. It's open-source, could easily handle thousands of devices and can even be launched on NodeMCU. Blynk Libraries: for all the popular hardware platforms:enable communication with the server and process all the incoming and outcoming commands. Every time it is pressed a Button in the Blynk application, the message travels to space the Blynk Cloud, where it magically finds its way to hardware. It works the same in the opposite direction and everything happens in a Blynk of an eye. The Blynk application is as shown in figure 4.

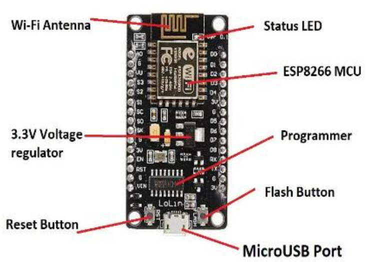

Fig. 2. NodeMCU

Fig. 3. Internet of Things

Fig. 4. Blynk application

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.

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 three 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.

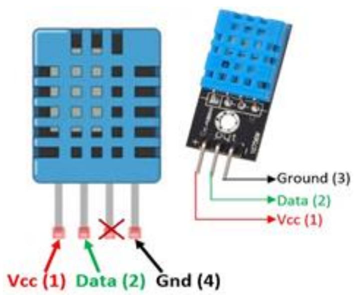

Fig. 5. Humidity sensor

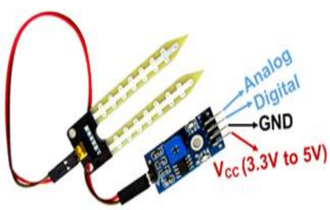

Fig. 6. Soil Moisture sensor

A rain sensor module is an easy tool for rain detection. It can be used as a switch when a raindrop falls through the raining board and for measuring rainfall intensity. Figure 7 shows a depiction of a typical rain sensor module. Due to its compact design and light weight, it can be easily attached into any system. The module features, a rain board, and the control board that is separate for more convenience, a power indicator LED, and sensitivity adjustable through a potentiometer. A raindrop sensor is a board coated with nickel in the form of lines. It works on the principle of ohms law. When there is no raindrop on according to V=IR. When drop present it reduces the resistance because water is a conductor of electricity and the presence of water connects nickel lines in parallel so reduced resistance and the reduced voltage drop across it. Rain sensor is as shown in Figure 7.

The dc water pump motor as shown in Figure 8 is a low cost, small size submersible pump motor which can be operated from a 2.5 ~ 6V power supply. It can take up to 120 liters per hour with very low current, consumption of 220mA. Just connect tube pipe to the motor outlet, submerge it in water and power it. Water pump is as shown in Figure 8.

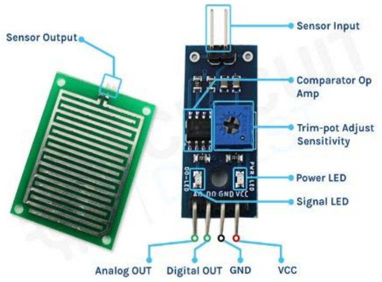

Fig. 7. Rain sensor

Fig. 8. Water pump

2.2 Software Architecture

In this work, the program is written Lua programming language. It must use Arduino software (IDE)version (2.1.1). This software is an open source. The code will be written on this software and it will be upload to NodeMCU board. The program of microcontroller reads the program and sends the data to the indicator LCD display and Blynk application. Blynk is a platform with ios and android applications to control sensors. After connecting microcontroller USB via into computer, it will choose and port. Then, it will complete and upload the program toward the NodeMCU board. The flowchart of the system is shown in Figure 9.

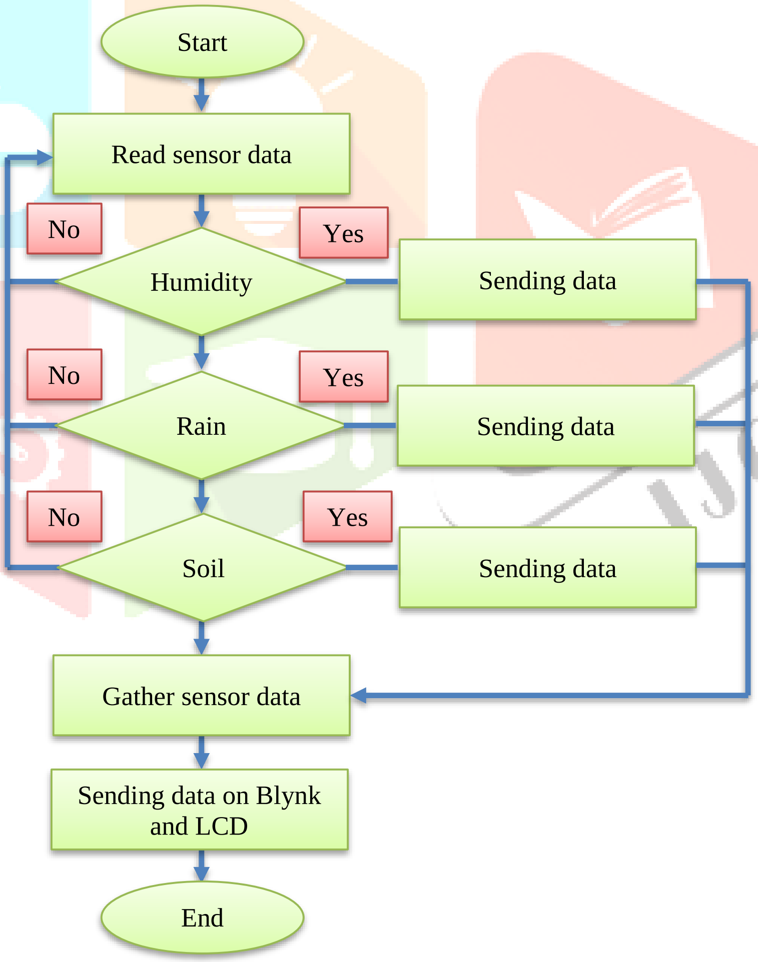

Fig. 9. Flowchart of the system

III. Working System

This system includes NodeMCU Esp8266 Wi-Fi module, rain sensor, humidity sensor, soil moisture sensor, LCD display, 5V water pump and Blynk application. NodeMCU is board based on the microcontroller with the WiFi module. The microcontroller will be commanded using Lua programming language. The Lua programming language must be written in Arduino IDE and then command the microcontroller on the NodeMCU. In this system, rain sensor is used to detect rainfall when it is raining. The temperature and humidity of the surrounding area are analyzed using the DHT11 sensor and the water pump is used to irrigate the farm land. In this work, Blynk application is used to send the notifications on the phone when the raining and no raining conditions occurs. At the same time, the weather conditions will be notified as well as on the LCD display. As soon as the rain sensor detects the raining or no raining the data are sent to the microcontroller on the NodeMCU. If a certain level of humidity reached, the pump was kept ‘OFF’. While the decreasing humidity reached, the pump was turned ‘ON’. The soil moisture sensor is used to test the soil values for all climatic conditions and results are interpreted successfully. The notification message is sent on the phone by Blynk application after the microcontroller has registered the raining conditions. Finally, the completed circuit of the system is designed and constructed as shown in Figure 10.

Fig. 10. Completed circuit of the system

IV. RESULTS AND DISCUSSION

In this system, the actual collected data is saved and listed by the sensors. The obtained results for each place are tabled and graphed. The soil value of the soil moisture sensor is read on the LCD display. The humidity and temperature will display on gauge in Blynk application. The user received the SMS message on notification in Blynk application from the rain sensor when it is raining. The different places saved the real data at Hainggyi, Thabaung, and Einme in Ayeyarwady Region as the following tables and graphs.

4.1 Hainggyi Ayeyarwady Region

Table 4.1 summarizes the results from the sensors at this place. The data are collected eight days in a month. They are showed in Figure 11 and 12.

Table 4.1: Experimental results (Hainggyi)

Date	Soil value	Temp value	Humidity value	Rain condition
1.5.23	20	30	50	No rain
3.5.23	21	32	40	No rain
5.5.23	453	25.9	84	Raining
7.5.23	423	24.5	80	Raining
9.5.23	433	23.2	82	Raining
11.5.23	22	30	60	No rain
13.5.23	453	26.9	84	Raining
15.5.23	20	31	50	No rain

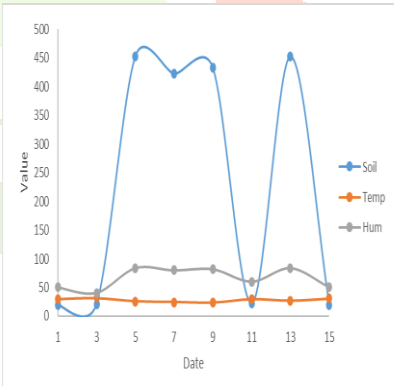

Fig. 11. Graph of the values at Hainggyi

Fig. 12. The photograph at Hainggyi

4.2 Thabaung Ayeyarwady Region

Table 4.2 summarizes the results from the sensors at this place. The data are collected eight days in a month. They are showed in Figure 13 and 14.

Table 4.2: Experimental results (Thabaung)

Date	Soil value	Temp value	Humidity value	Rain condition
1.6.23	472	27.3	86	Raining
3.6.23	453	27.9	84	Raining
5.6.23	21	29	70	No rain
7.6.23	20	30	60	No rain
9.6.23	433	28.2	82	Raining
11.6.23	443	28	83	Raining
13.6.23	21	30	60	No rain
15.6.23	463	27.7	85	Raining

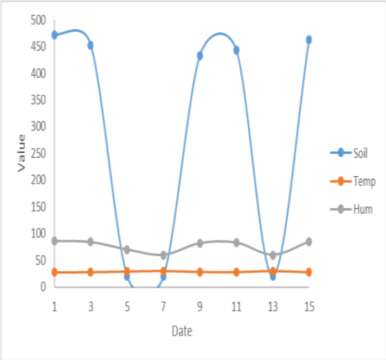

Fig. 13. Graph of the values at Thabaung

Fig. 14. The photograph at Thabaung

4.3 Einme Ayeyarwady Region

Table 4.3 summarizes the results from the sensors at this place. The data are collected eight days in a month. They are showed in Figure 15 and 16.

Table 4.3: Experimental results (Einme)

Date	Soil value	Temp value	Humidity value	Rain condition
1.7.23	443	28	83	Raining
3.7.23	21	30	60	No rain
5.7.23	22	29	70	No rain
7.7.23	423	28.5	80	Raining
9.7.23	433	28.2	82	Raining
11.7.23	443	28	83	Raining
13.7.23	21	29	70	No rain
15.7.23	463	27.7	85	Raining

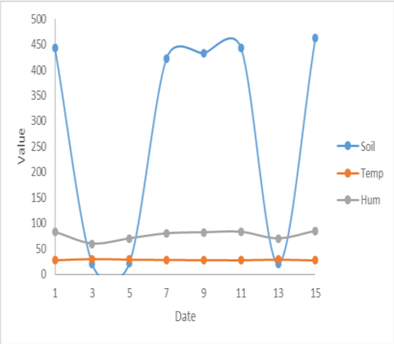

Fig. 15. Graph of the values at Einme

Fig. 16. The photograph at Einme

V. Conclusion

The research on this system has been made in order to help farmers to overcome the problem which is agriculture and irrigation in the farm land. The smart agriculture and irrigation system helps obtaining quality crops and it also reduces the human involvement in agricultural activities. This system was researched to overcome the problem of agriculture and irrigation in the fields. A smart agriculture and irrigation system helps in obtaining good quality crops and also reduces human involvement in agricultural activities. Currently, farmers use self-irrigation systems and irrigate their land regularly using wireless system. They also irrigate areas that do not require irrigation. They only need to irrigate dry, dry areas. Using the sensors in automatic system and watering is done as needed using controlled irrigation cloud. As a result, the ESP8266 WiFi based communication system was chosen due to its ease of use, maintenance, low cost and reduce the labour force.

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