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Monitoring and Watering System for Indoor Gardening using Internet of Things (IoT)

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Abstract: The monitoring and watering system for indoor gardening using the internet of things (IoT) is introduced in this project as an alternative method to monitor control indoor gardening remotely. It can help people in their daily routine to ensure that their plants get enough water to grow. This system consists of soil moisture sensor, humidity sensor, ultrasonic sensor, microcontroller, water pump and mobile application. This system's primary purpose is to design a system that monitors soil moisture, humidity, water level and develop an automatic watering system based on the sensor reading. When a soil moisture sensor detects a soil moisture reading that is less than 50% of the threshold level, the water is automatically released. The data is then stored in the Arduino and simultaneously sent to the ThingSpeak through the internet routers ethernet connection. The user can monitor their plants through either web browser or their mobile phone using the Blynk application. Therefore, this project is useful not only to houseplant fans but also can be commercialized to the houseplant industry.

Keywords: Monitoring System, Watering System**,** IoT

1. Introduction

Indoor plants are good for our health. Not only for their visual beauty, but they also release oxygen and absorb carbon dioxide. This not only freshens up the air, but also eliminates harmful toxins[1]. Extensive research by NASA has revealed that houseplants can remove up to 87% ofair toxin in 24 hours [2]. At work, placing plants, especially those with broad leaves on the officedesk will help regulate humidity and increase levels of positivity.

Supplying sufficient water is very important for the plant to grow healthy. Other than sunlight, water is also needed for the plants to get nutrients. Nutrients are drawn from the soil andused by the plant [2]. Without sufficient water in the cells, the plants may wilt. With too much water, the roots could rot, and the soil could not provide enough oxygen to the plants. Unfortunately, over-watering is one of the factors that can cause the indoor plants to die.

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People who have busy lifestyles sometimes struggling to monitor their plants growth. They do not have enough time to do watering. Therefore, an efficient water monitoring system for indoor plant is proposed in this research to improve the system implemented by Matti Satish [3]. The monitoring and watering system can monitor the soil moisture, humidity, surrounding temperature, water level, and controlling the water pump. All of these factors are necessary for a healthy and rapid growth of plants [4].

Nowadays, Internet of Things (IoT) application is widely used in verity fields of study such as car parking [5], agricultural system [6] as well as environment monitoring system [7][8]. In this research, indoor plants monitoring system on data on the Thingspeak and Blynk applications is applied to help more people to ensure that their plants growing well especially during the Covid-19 pandemic.

2. Research Methodology

2.1 System Overview

Figure 1 shows a complete overview of the monitoring and watering system for indoor plants gardening. This research consists of two main parts: i) monitoring system and ii) watering system. P1, P2, and P3 represent the data from sensors that are connected to Port 1, Port 2, and Port 3 of the microcontroller as the inputs. Soil moisture sensor and humidity sensor are used for monitoring system. Soil moisture reads the soil moisture level, while humidity sensor reads the surrounding temperature and humidity level. The programming code is uploaded into Node MCU as the microcontroller unit to control the operation of water pump using relay. Then, the microcontroller sends the data to the cloud known as Thingspeak. The data that is stored in the ThingSpeak can be accessed anytime as needed. The ultrasonic sensor which is placed on top of water tank is used to measure the water level in the tank. Once the microcontroller receives the data from the ultrasonic sensor, it is sent to the mobile applications, called Blynk. This application notifies the user through the mobile phone that the water level in the tank is low and should be top up.

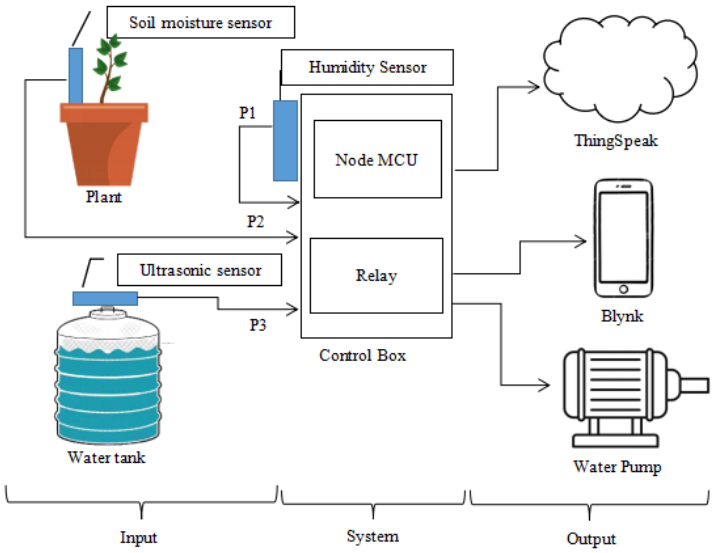

Figure 1: Overview monitoring and watering system

2.2 Schematic Diagram

Figure 2 shows the schematic diagram sketched by using EadyEda tool. The main part used in the system are the NodeMCU as a microcontroller. The capacitive soil moisture sensor monitors the soil moisture level. The ultrasonic sensor monitors the water level in the tank, while the humidity sensor monitors the humidity and air temperature. Relay is used to control the watering operation based on soil moisture reading.

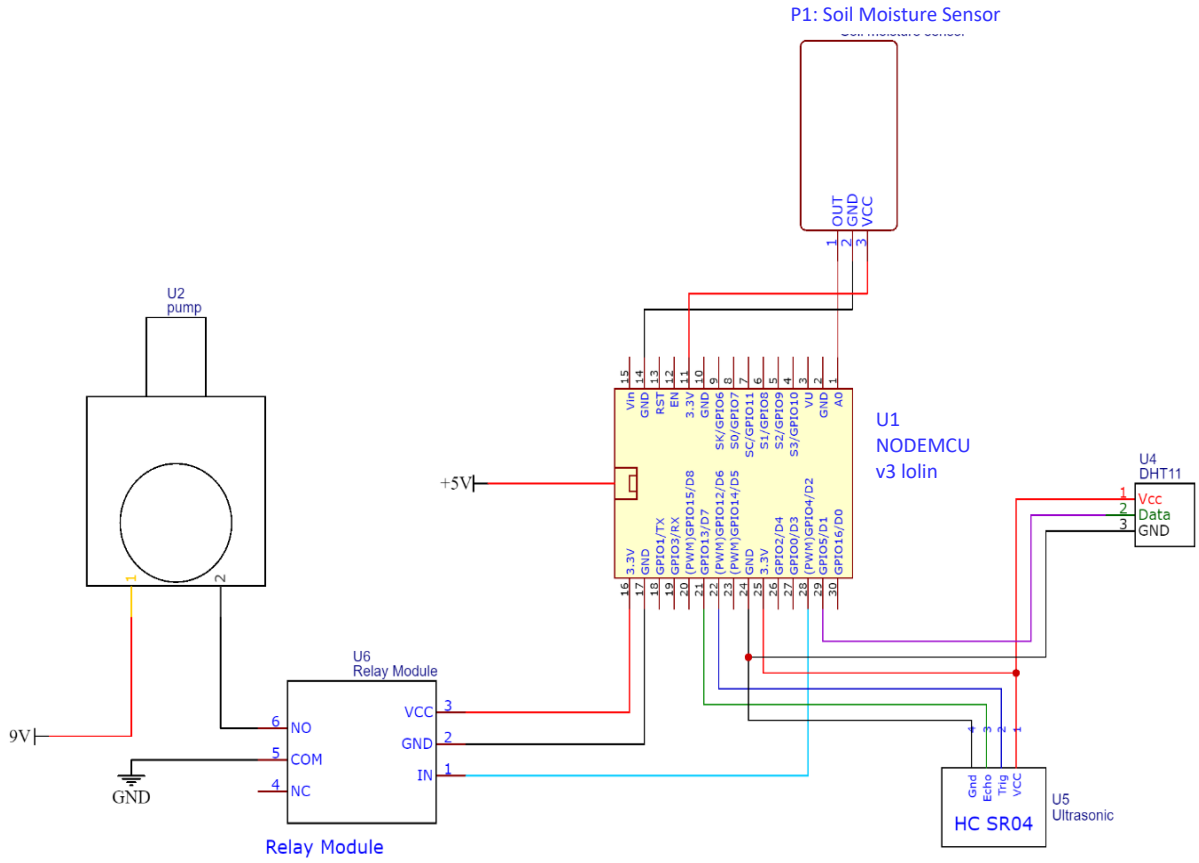

Figure 2: Schematic diagram for the system hardware

2.3 Water pump algorithm

This section explains the operation flow of the water pump that is used in this system as illustrated in Figure 3. The water pump works once the connections between the soil moisture sensor and the DHT11 temperature as well as humidity sensor are verified. If the serial monitor detects the sensor reading, the sensor's readings are stored in the Thingspeak. Otherwise, the system restarts automatically. Then, the soil moisture reading is monitored. If the soil moisture reading is less than 50% of the threshold value, the water pump automatically turned on.

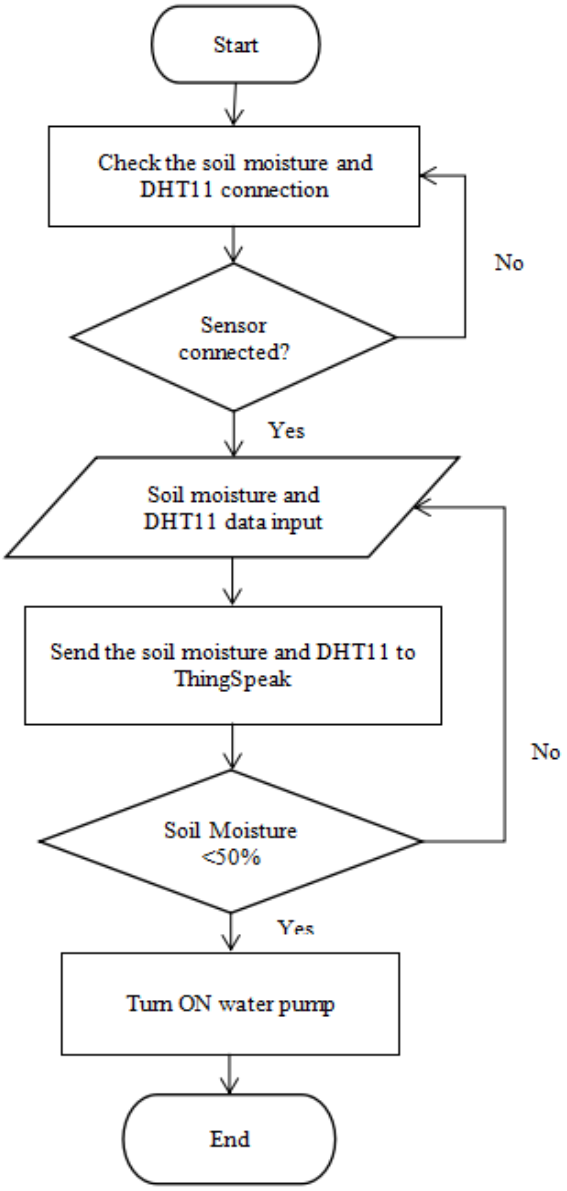

Figure 3: The flowchart of water pump operation

2.4 Water level algorithm

Figure 4 shows the flowchart of the water level monitoring system using ultrasonic sensor. The system starts by verifying the connection between the microcontroller and the ultrasonic sensor. Once the sensor is detected, the data from the sensor is extracted as the input of the system. The sensor tells the user the water level in the tank. If the level of the water is less than 50% of the tank, then the system notifies the user "Water level is low" through Blynk application. Otherwise, the sensor keeps on sensing the water level in the tank.

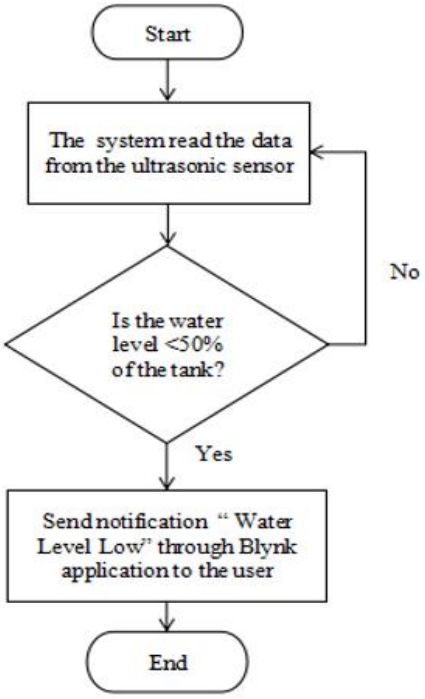

Figure 4: The water level operation flowchart

2.5 Hardware Assembly

Figure 5 shows the top view of a complete hardware assembly for this research. Eventually, the system is able to monitor the condition of soil moisture of the indoor plants, the surrounding humidity and surrounding temperature. The system is also able to do watering onto to the plants based on the data from soil moisture sensor.

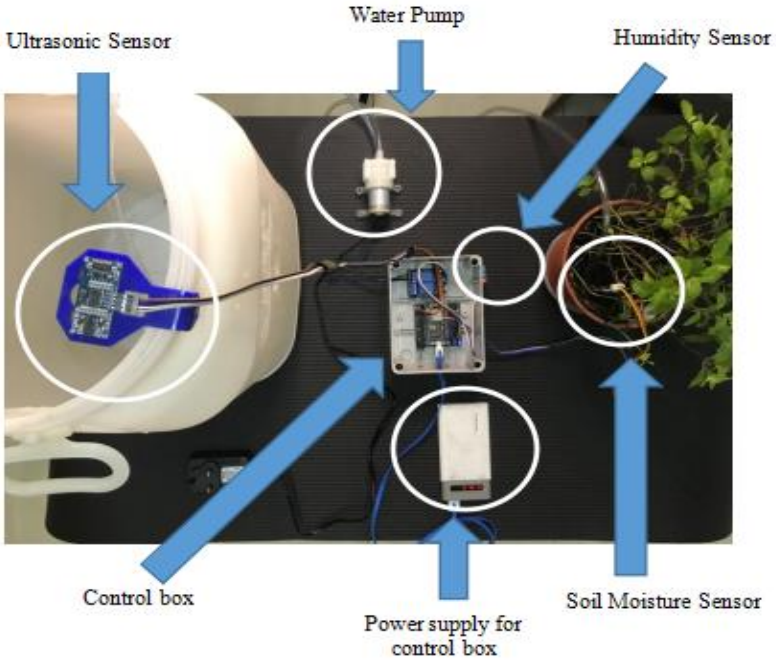

Figure 5: A top view of complete hardware assembly of monitoring and watering system for indoor gardening using IoT

3. Results and Discussion

This section discusses the results of the project based on the experiments and analysis that have been carried out to test the functionality of the whole system. The first experiment involves with a hardware part in which all sensors including soil moisture sensor, humidity sensor, ultrasonic sensor, and water pump are connected and controlled by a microcontroller, NodeMCU. The other experiment is the integration between the hardware part with the IoT technology which is Blynk application. All the data is then stored in the cloud called Thinkspeak.

3.1 Result of monitoring and watering system

Table 1 shows the data obtained from the experiment where soil moisture sensor, humidity sensor, ultrasonic sensor, and water pump are connected together.

Based on the result in Table 1, the condition of the water pump depends on the soil moisture sensor reading. If the reading is less than 50% of the threshold level, the water pump will automatically 'turn on' and the water released. To monitor the condition of the plants, humidity and temperature readings were taken by using the DHT11 humidity sensor while water level in the tank was monitored by using an ultrasonic sensor.

Table 1: Data collection of watering and monitoring system

Soil Moisture (%)	Humidity (%)	Temperature ($°C$)	Water level (cm)	Condition Water Pump (ON/OFF)
-12	85	29.5	2	ON
55	84	29.5	3	OFF
27	84	28.9	10	ON
28	87	28.1	35	ON
70	86	28.4	42	OFF

3.2 The ThingSpeak

This section analyses and discusses the results from of the Internet of Thing (IoT) technology using ThingSpeak platform. All the data from the microcontroller is sent to the ThingSpeak. Figure 6 shows the graph of data obtained from ThingSpeak. Four graphs represent the readings for temperature, humidity, soil moisture, and water level respectively. These data is stored in this platform as a database which can be accessed by the user at anytime if needed.

Figure 6: Graph data collected in ThingSpeak

3.3 Blynk Application

This section discusses the results from Blynk application that are appeared on a mobile phone. The experiment is carried out to evaluate the performance of the system especially when the system sends the notification to the user mobile phone wirelessly based on the reading obtained from the sensors. Figure 7 shows the graphical user interface (GUI) of the Blynk application. On the Blynk application dashboard, the data such as soil moisture, temperature, humidity, and water levels readings appeared on the screen so that the user can monitor their indoor plants condition remotely via mobile phone.

Figure 8 shows the notification that appeared on user mobile screen as "LOW WATER LEVEL!". It is happened when the water level is 50% less than the full tank. The information is generated using Blynk application and sent to the user wirelessly.

Figure 7: The graphical user interface (GUI) of the Blynk application

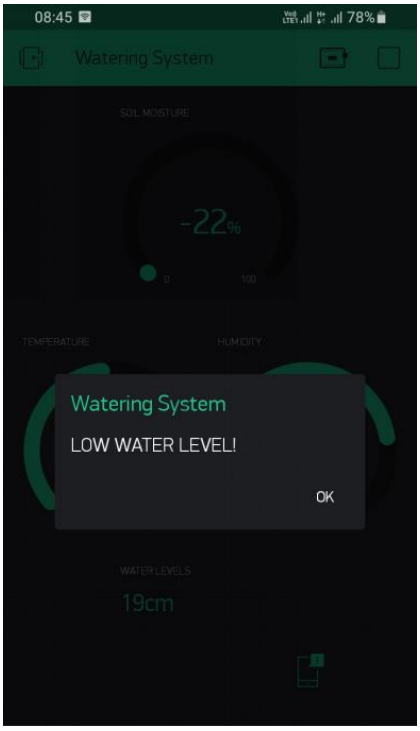

Figure 8: Notification of level of water low

4. Conclusion

In conclusion, this project represents the watering and monitoring system for indoor gardening using the Internet of Thing (IoT). The system is helpful for people who unable to monitor and water their plants on time. With the existence of this system, people can observe the soil moisture, humidity, temperature, and water level on their phones through the Blynk application.

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