



IoT Plant Watering and Fertilizing System

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Received 10 January 2020;
Accepted 10 February 2020;
Available online 25 March
2020

Abstract: Internet of Things or IoT is an advance technology that allows user to control hardware devices through the internet. In this work, IoT technology is used to water and fertilizing the plants when needed. This system is created to make user's daily life easier than before since the process of watering and fertilizing the plants can be done by using user's mobile phone. Moisture sensor is placed at soil to give input to Arduino UNO microcontroller. Then, a user will be notified the condition of the soil moisture through Blynk application at their mobile phone. The water pump then receive an instruction from microcontroller to water the plants with the correct amount of water until the soil dryness reading is change from 'High' to 'Low'. This situation indicate that the plants is receiving enough water from the soil. Besides, fertilizing system will be activated once the time duration is triggered. User can set the time duration at any time they want to do fertilizing. In a nutshell, this project not only can save a lot of user's energy, the time and money can be affected too since we already have an automatic system that can replace the traditional system.

Keywords: Internet of Things, Arduino UNO microcontroller, Blynk application, plant watering, fertilizing

1. Introduction

Industry 4.0 focused on creating intelligence products, processes and procedures that allow workers, machines, resources and customers to communicate easily. By leveraging on Industry 4.0 technologies, businesses are able to grow without compromising quality, cost or time. Although technology has always been present in manufacturing, Industry 4.0 is about advanced digital technology. There are nine pillars within Industry 4.0 such as Internet of Things (IoT), System Integration, Simulation, Augmented Reality, Additive Manufacturing, Big Data, Cloud Computing Autonomous System and Cyber Security [1].

In this 21st century, people are busy talking about technology that makes our daily lives routine easier. Among the nine pillars of Industry 4.0, IoT is one of the technologies to help in increasing the productivity and quality of human life. According to K.K.Patel and S.M.Patel [2], the IoT refers to a type of network to connect anything with the Internet based on stipulated protocols through information sensing equipment to conduct information exchange and

communications in order to achieve smart recognitions, positioning, tracing, monitoring, and administration.

The goal of the IoT is to enable things to be connected anytime, anywhere with anything and anyone ideally using any path/network and any service. This technology can be implemented in almost every area such as from homes to industries, from agriculture to manufacturing, from transportations to warehousing and even from our shoe to robotics.

Referring to Fig. 1, a traditional user needs to water the plant at a consistent time every day without any excuse. He also needs a tractor in order to water the plants since it involves a large area of the field. However, if that user has an emergency that he needs to take a leave, a replacement needed to cover his job. This situation is complicated if no other users willing to take over his job and the leader need to hire other peoples to take care of the plants..

On the other hand, the soil dries faster during the drought season. The user needs to make sure the plants have enough water in order to survive. If this situation happened, the user needs to water the plants frequently to avoid the plants from wilt or die. The correct amount of water needed by the plants

also is important. Thus, a good care and extra observation are essential to make sure the plants grow healthy.

The main aim of this paper is to design an automatic plant watering system used to water the plants with the right amount of water so that the plants will not wilt or die by using IoT technology. In addition, the system provides a fertilizing system so that the plants can be fertilized accordingly as scheduled. The primary focus is on minimizing the manual labor on field; so that the time, money and user's power is saved. This project not only can be used for agriculture, it can also be applied to a garden or any landscape area as shown in Fig. 1.

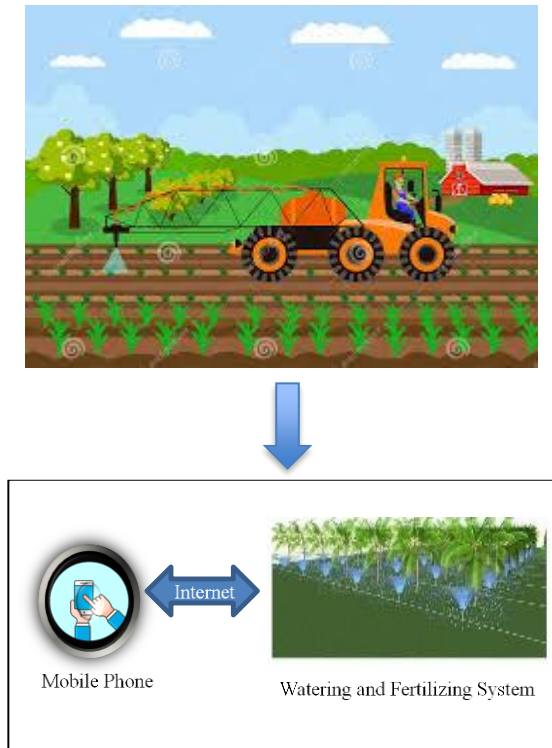


Fig. 1 - Traditional method vs IoT technology for plant watering and fertilizing system

2. Literature Review

As we can see, there are plenty of current research of watering the plant in order to reduce the cost of hiring workers. Most of the methods is automatic system which is using the IoT technology and all them can save a lot of user's manpower, money and time.

According to Sandhya.B.R [3], the system they build can detect appropriate time to water the plant and trees in the garden depending on the garden land moisture level and daylight intensity. In this research, the data received from the sensor transmitted to Raspberry Pi 3 via Wi-Fi module. The user will be notified if there is water shortage in the main water supply.

In paper [4], the researcher used three types of sensors; humidity sensors, temperature sensor and soil sensor to detect the soil and plant conditions. The readings from these three sensors will be sent to PIC microcontroller and the readings of humidity, temperature and soil sensor will displayed at LCD. The motor will turn ON to water the plant if the temperature

is 35°C and above, humidity value is 35 and above and soil moisture reading is 100 MA and above.

Smart Irrigation System proposed by S.Nalini et. al [5] focused on irrigation monitoring and controlling system. This system could optimize water levels based on soil moisture and weather predictions. All the data from sensing part are save in cloud server. They use ATmega328 microcontroller as the control unit in order to turn ON or OFF the valves, thus the right amount of water will be pump at the right time.

Gaikwad Tararani et. al [6] used the value from temperature sensor, humidity sensor, moisture sensor and rain drop sensor as their input to raspberry pi in order to ON the water pump to watering the plants. The data in term of throughput and current value from sensors displayed and stored in web server.

Based on these previous researches, it can be said that there are many types of microcontroller such as Raspberry Pi, PIC microcontroller and Arduino to be used as the head of project to water the plant. Most of the objective is to design an automatic watering plant system based on the soil moisture reading. Thus, in this paper we add the feature of fertilizing the plant instead of only watering the plant.

3. Methodology

The project of IoT Plant Watering and Fertilizing System mainly created to reduce the manual labor on field and to make sure the plants receive adequate amount of water without worrying on the weather. This project is divided into two parts; software and hardware part.

Fig. 2 shows a block diagram of the proposed project. The Arduino Uno microcontroller, ESP8266 Wi-Fi module, soil moisture sensor, relay module and water pump used as part of components.

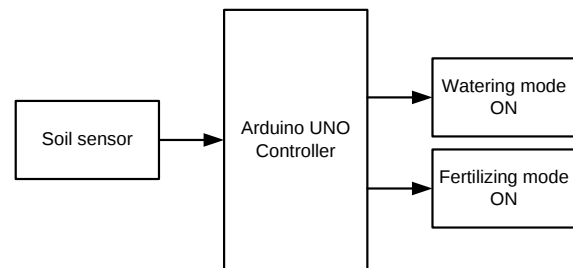


Fig. 2 – The block diagram of proposed project

This system can be controlled by using user's mobile phones. Blynk application is an interface for user to control the ON button to water and fertilize the plants, user is notified prompt to water the plants when the soil is too dry and set the timer for fertilizing system. This Blynk application connected to an Arduino UNO Microcontroller through ESP8266 Wi-Fi Module.

Arduino UNO microcontroller receive data from soil sensor regarding the dryness of the soil. If the soil dryness is high, the user can choose either he want to water the plants or not just by click the ON button on Blynk application. Otherwise, Blynk application will send a notification to farmers to water the plants. A Blynk application also read the soil moisture reading which detected through the moisture sensor, either the soil has high or low dryness

The water pump will receive an instruction from microcontroller to water or fertilizing the plants. If the plants

already receive an adequate amount of water, user can click the ON button again to stop the process.

Fig. 3 represents the schematic diagram of this proposed project while Fig. 4 indicates the PCB layout. Proteus 8.0 Professional software has been used to create the schematic diagram, PCB layout and simulation for this project.

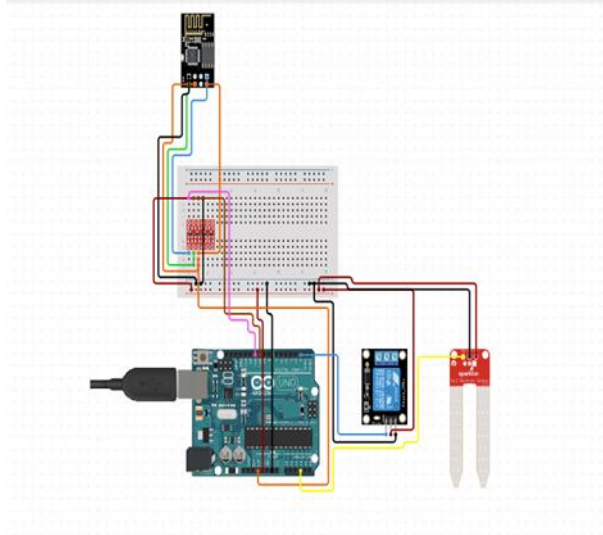


Fig. 3 – Schematic diagram for the system

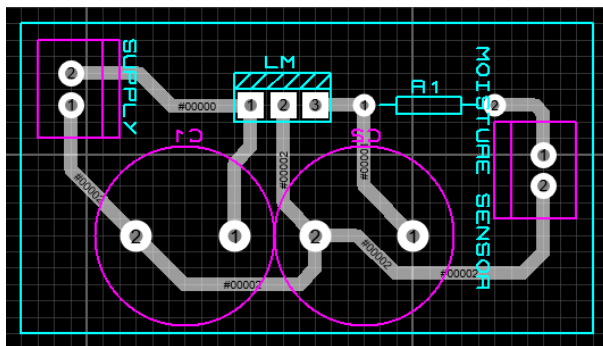


Fig. 4 – PCB layout

The flowchart of the proposed IoT Plant Watering and Fertilizing System are shown in Figure 5. Firstly, the soil moisture sensor check whether the soil is dry or wet. The data in terms of voltage is sent to the Arduino UNO Microcontroller. The reading for wet soil is between 3V to 5V while the reading for dry soil is between 0V to 2.9V.

The Arduino then tell the Blynk server the condition of the soil and the Blynk application will display the dryness of the soil. If the soil moisture is dry, 'High' dryness reading displayed on Blynk application. However, if soil moisture is wet, 'Low' dryness reading displayed on Blynk application

Instead of watering the plants, the user can choose to fertilize the plants only. For the fertilizing system, a timer is set to notify the user twice a month. When the timer has started, the relay will be triggered to switch on the motor pump and fertilize the plant.

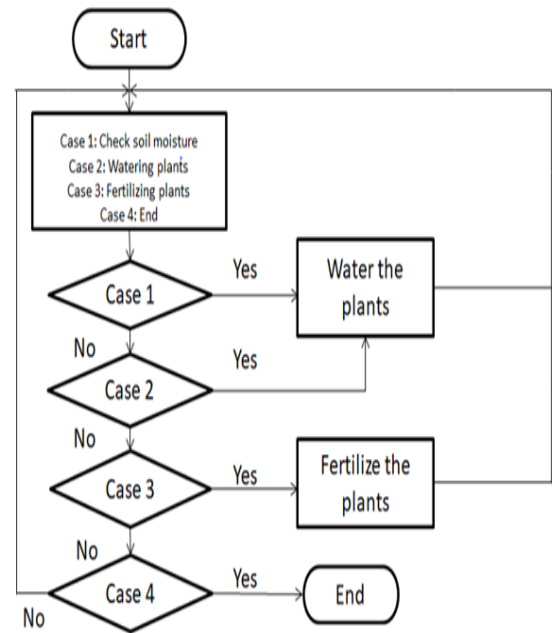


Fig. 5 – The flow chart of the proposed system

4. Result and Discussion

In order to test the functionality of this proposed project, we need to make sure the Blynk application and all components function well so that the water pump will receive an order from microcontroller to water and fertilize plants.

The notification of 'High' dryness reading of the soil in the Blynk application shown in Figure 6. Blynk had notified the user to water the plant because the soil now is in low moisture condition. In order to avoid the plants from wilt or die, user only need to click the 'OK' button to water the plants.

The first ON button on the left of Blynk application created to water the plants while the next ON button is for fertilizing the plants. To stop the process, user need to click the ON button again according to what proses that he want to stop. At one time, only one process can be done.

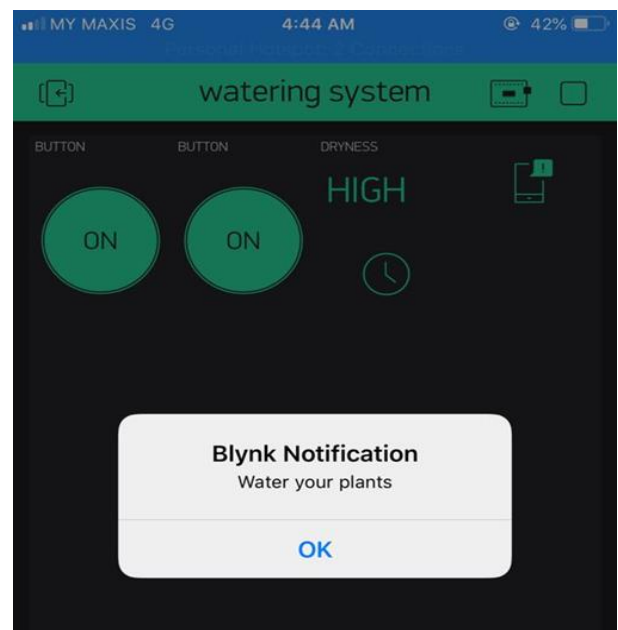


Fig. 6 – High dryness reading on Blynk application

Fig. 7 illustrates the 'Low' dryness reading of the soil. In this situation, users does not need to water the plants since the plants get enough water from the soil. The relationship between the soil moisture and a moisture reading display on the Blynk application tabulated in Table 1. If the soil moisture is dry, the "High" reading will be displayed at Blynk application. On the other hand, if wet soil moisture detected, the 'Low' reading displayed.

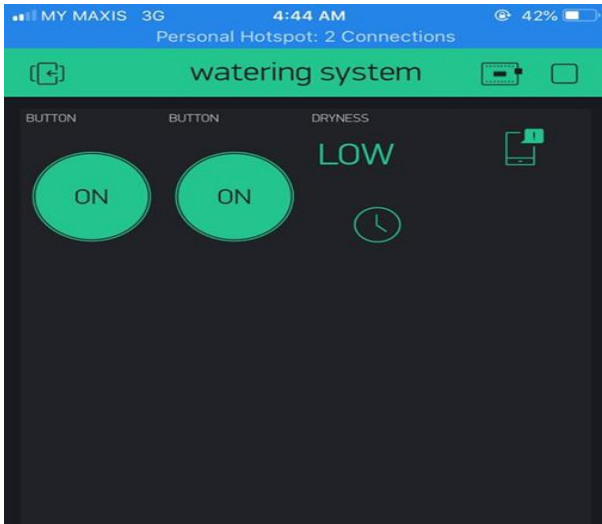


Fig. 7 – Low moisture reading on Blynk application

Table 1 – Dryness condition of the soil

Soil Moisture	Moisture reading on the BLYNK apps
Dry	High
Wet	Low

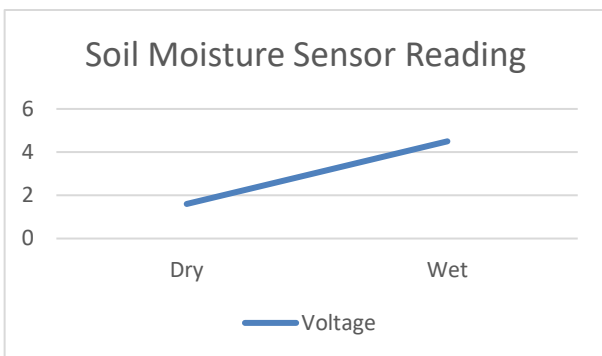


Fig. 8 – Soil moisture sensor reading

The moisture sensor reading depicted in Fig. 8. Earlier, a user receives a notification to water the plant. The reading read by Arduino Uno microcontroller in term of voltage is 1.6V. The user then presses the button to water the plants. The soil moisture increasing to 4.5V which in wet soil category. The user can press the button again to stop watering the plant.

A prototype of the timer alarm itself made by modifying the conventional alarm clock. The timer alarm installed with

Arduino UNO, relay module, ESP8266 Wi-Fi module and moisture sensor. The IoT Plant Watering and Fertilizing System design outcome is such showed in Fig. 9.



Fig. 9 – The prototype of IoT Plant Watering and Fertilizing System

5. Conclusion

As a conclusion, the IoT Plant Watering and Fertilizing System successfully created. The objective of this project achieved where the user's manpower, money and time can be saved since this system is automatic and can be controlled by user's mobile phone wirelessly. The traditional ways that have been implemented long time ago improvised aligned with the technology development that occurs fast in today's world

Acknowledgement

We would like to thank all research members who gave countless cooperation in completing this research. All help and assistance had given an impactful effect to the research.

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