IDEATION

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Design and Implementation of IoT based Automated Tomato crop production

Abstract

Tomatoes need a proper watering system in order to grow and provide optimal yields. The factors that must be considered in watering the tomatoes are soil moisture and air temperature. The soil moisture needed for planting tomatoes is between 60% to 80% with a temperature rate between 24 to 28 degrees Celsius. We propose to implement an IoT based agricultural technology innovation to address the problem of precise watering system based on soil moisture and air temperature rate, which can be controlled remotely via internet connection. This system was designed and assembled using ESP8266 with soil moisture sensor and DHT11. This system was also programmed to be controlled using the Telegram Messenger application. The data read by the sensor could be seen through the Telegram Bot and do watering the plants automatically or manually.

1.Introduction

Tomato (Lycopersicum Esculentum) is one of the horticultural products that must be ensured in Indonesian household needs. The demand for tomato commodities in the household market reached 631.290 tones' in 2019.

However, this high level of demand was not followed by a high level of production.
There are various factors that influence the low production of tomatoes, one of them is the agricultural sector in Indonesia still applies conventional systems and rarely implements technology, such as utilizing Internet of Thing technology for precise agriculture Currently, there are several factors that become obstacles in using IoT for smart agriculture especially in Indonesia. Firstly, software development for IoT-based applications, such as irrigation for agriculture, is not yet
fully automatized. Furthermore, advance IoT software platforms are still missing, for automating part of the process and integrating different technologies such as IoT, big data analytics, cloud computing and fog computing to deploy applications for smart watering management. The next issue is the integration of heterogeneous and advanced sensors require adequate standards and information models. Tomato plantation watering process is a very important activity in order to avoid crop failure. One component that must be considered is soil moisture, because it plays role in the process of transferring nutrients and

other compounds from the soil medium to plants, maintaining plant temperature and optimizing the maturity of leaves and fruits. Tomato plants must have optimal soil moisture between 60% -80% so that the soil is not too dry or wet. Air temperature also plays an important role in the tomato growth process. The ideal temperature for tomatoes to grow properly is 24-28 degrees Celsius. If it is too high, the growth and development of flowers and fruit is not optimal, tomatoes will tend to be yellow. If it is too fluctuated, growth will be low and stunted, and tomatoes will not ripen evenly. Soil moisture and air temperature are two aspects that can be used as the basis for creating a precise watering system. Sensors that are placed in the ground will be connected to a relay using an effective communication protocol and provide a very low duty cycle.

2. Methods

In this research, we designed an automatic watering system based on the block diagram as shown in Figure 1. Based on Figure 1, there are several components that are used in automatic watering systems. The explanation of each component is as follows.

2.1. ESP8266

This watering system uses ESP8266, which is a Wi-Fi module so that the system can be connected directly to Wi-Fi and can be connected to TCP/IP. ESP8266 can be used stand alone or by using an additional microcontroller such as Arduino as the controller. This module requires low power consumption, only requires around
3.3v of power so it is widely used in the latest IoT devices.

2.3. Soil Moisture Sensor

Soil Moisture Sensors are used to measure the water content in the soil. On this sensor there are two conducting plates, if the two plates are exposed to the conducting medium, in this case water, the electrons will move from the anode to the cathode, producing an electric current which will cause a voltage. The movement of these electrons is used to detect whether there is water in the ground or not.

2.2. Router/Wi-Fi

The system requires a Router in order to connect with the Telegram Messenger Bot API via the internet. API (Application Programming Interface) is a technology

that allows programmers to exchange data through several different devices via internet. By using an API, a device that does not have a dedicated IP Public can communicate with other devices by using API secret code. The watering system will be connected to Telegram Messenger application which can be accessed by using Android devices, so that users can monitor the plant anywhere via Telegram.
We can also program an alarm or notification as needed, for example if the soil is too dry, the telegram bot can display a notification via telegram chat that the plant is experiencing drought so that the water pump will be activated.

3. Result and Discussion

The components used in this study were ESP8266, Soil Moisture sensor, LCD, buzzer active and jumper wires. While the other tools needed are Telegram Messenger and Arduino IDE. The device used as the control center for this automatic plant watering system is the ESP8266. ESP8266 is a System on Chip (SoC), this device can store and transfer data. The ESP8266 will be programmed using the Arduino Integrated Development Environment (IDE) together with other supporting components. Later, the tools will run based on command messages that we send via telegram by using the Bot father feature on Telegram. we used two sensors, namely the DHT11 sensor to detect room temperature, and a soil moisture sensor to detect soil moisture rate in tomato plants. These sensors are very helpful for alerting the humidity level of plants or monitoring soil moisture.
This system is connected directly to telegram chat via the Telegram Bot feature.

4. Conclusion

This system was built by involving several input, process, and output components. The input components consist of a soil moisture sensor and a temperature sensor. The process components consist of the ESP8266. While the output components consist of a water pump, LCD, FAN, and relay that control each component. This system can water plants and keep the soil moisture stable. The temperature sensor was embedded so that the system would be able to control room temperature by using a fan in circulating air. By utilizing this system, it will be easier for farmers to control and monitor tomato plants from anywhere and at any
time through the Telegram Messenger application on an Android smartphone. However, this tool must always be connected to the internet in order to send data via Telegram application