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Internet Of Things Based Plant Watering System Design

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Abstract— The productivity of plant cultivation can be increased through intensive care and maintenance. Maintenance and maintenance consist of applying fertilizers or nutrients, weeding, pruning, and watering. Watering systems in hydroponic, aquaponic, and other plant cultivation will affect crop yields. Watering is important in maintaining lost moisture during the day, and at night as a substitute for the moisture lost at night. This study aims to design a watering tool for plant cultivation using the help of digital Internet of Things (IoT) technology. To make plant cultivation there is no lack and excess of water and nutrients. This tool can do watering remotely and can monitor moisture and soil temperature conditions via a smartphone device. Apart from helping farmers, this tool can be installed in plantations, nurseries, city parks, hotels, offices, and homes.

Keywords—Watering Systems, Moisture, Temperature, Internet of Things

I. INTRODUCTION

Plants are able to present something completely different from the perspective of people's lives, because they have functional and aesthetic properties that are very useful for us [1]. Plant cultivation technologies that are developing in Indonesia include plant cultivation using aquaponics, hydroponics, and the use of mechanization tools such as automatic planting and harvesting tools. Plants don't need much care except regular watering, because too little or too much water can damage them [1]. Some farmers in Indonesia still depend on the rainy season for farming. It makes the production of agricultural products unstable [2].

Water is a valuable resource that must be used with extreme care. [3] Water use must be regulated to achieve long term sustainability. To ensure maximum crop production, greener gardens and a cleaner environment, water must be used efficiently. [4] Plants need enough water to grow properly. Watering plants is a job that farmers and plant lovers need to do in caring for plants. Watering plants with the appropriate volume of water is important because it has a direct impact on plants [5]. Besides water, humidity is also an important factor for plants, due to high relative humidity (above 80 - 85%) it should be avoided because it can increase the incidence of disease and plant transpiration. [6]

Today, technology connects everything to the world from the Internet, which is called the Internet of Things (IoT). Humans control any object using a wireless network, which increases convenience in everyday life. [7]. This study aims to design a watering plant using Internet of Things (IoT) technology, where human control has the highest priority, [3]. Application through the Internet of Things (IoT) is important for monitoring plant conditions effectively [8]. The design of this tool is in the form of facility irrigation control that uses sensor technology to sense soil moisture [9] and the temperature around plants.

II. METHOD

A. *System Block Diagram*

This study examines the use of soil moisture sensors and temperature sensors to monitor plants via smartphones. The tools used in this study were NodeMCU ESP 8266, soil moisture sensor [2], temperature sensor, and DC water pump.

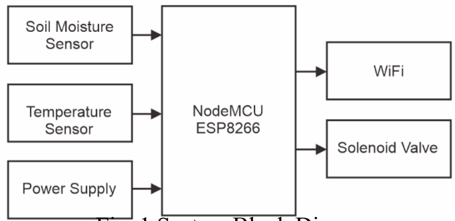

Fig. 1 System Block Diagram

From the block diagram in Fig. 1 input in this tool is from Soil Moisture Sensor, Temperature Sensor, and Power Supply, which are processed by NodeMCU ESP8266 to produce output in the form of data sent via WiFi media and activate the Solenoid Valve.

B. *System Flowchart*

The workflow of this plant watering system is through 2 stages, namely the stages on the tools and the stages in the application on the smartphone as depicted in Fig. 2.

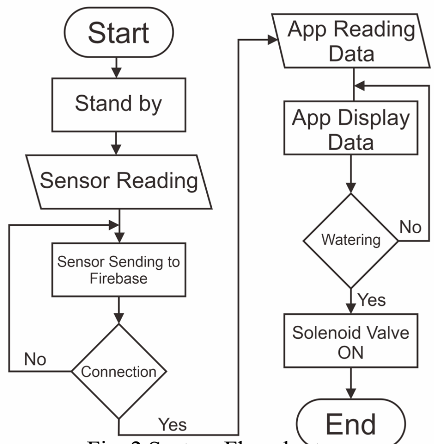

Fig. 2 System Flowchart

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- The first stage is when the tool is in standby condition to read the input data from the temperature sensor and the soil moisture sensor. The reading data is sent via WiFi to the Firebase data server.
- Second stage, data from firebase is read by the smartphone application in the form of temperature and humidity value data displayed in the text, then the application receives input in the form of watering action or not when flushed, the application sends a signal to turn on the solenoid valve on the appliance.

III. RESULT

A. *Hardware Design*

Fig. 3 shows the components used in a plant watering system using IoT technology. This component is a soil moisture sensor that is used to measure water content in the soil from time to time due to the evaporation process and water intake by plants to survive [8], a temperature sensor to determine the temperature around the plant, NodeMCU ESP8266 as data processing, relay module as a breaker and current connector on the solenoid valve.

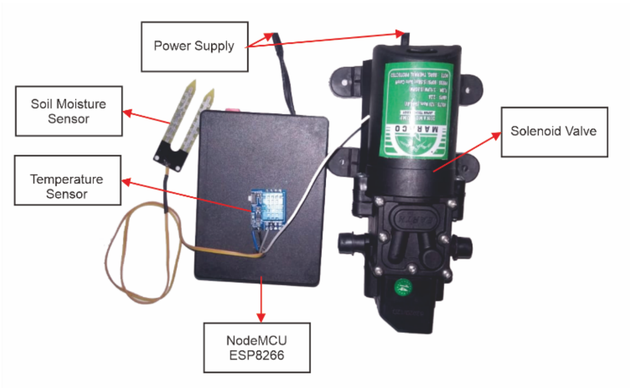

Fig. 3 Hardware Kit Watering System

B. *Sofware Design*

Fig. 4 is a display in an application on a smartphone that contains information about temperature, humidity, connection status to the appliance, and menus for watering.

Fig.4 App Monitoring Display

C. *Testing*

• *Soil Moisture Sensor Test*

The sensor consists of a copper plate as an electrode for measuring soil moisture. The measured soil moisture is the conversion of the electric voltage which is converted into digital data [2]. The results are shown in Table 1.

TABLE 1. MEASUREMENT RESULT FOR SOIL MOISTURE SENSOR TEST

No.	Water Volume (cc)	Moisture (%)
1	2	36
2	4	42
3	6	49
4	8	56
5	10	63
6	12	70
7	14	77
8	16	84
9	18	91
10	20	98

• *Temperature Sensor Test*

The temperature sensor works by changing the resistance value which is converted into digital data. The results are shown in Table 2.

TABLE 2. MEASUREMENT RESULT FOR TEMPERATURE SENSOR TEST

No.	Time (GMT +7)	Temperature (C)
1	08.00	34
2	10.00	35
3	12.00	37
4	14.00	35
5	16.00	35

- *Driver Relay and Solenoid Valve TestSome Common Mistakes*

This tool is an electric water pump that can open the valve automatically with a magnet which is controlled by NodeMCU ESP8266. The measurement results are shown in Table 3.

TABLE 3. MEASUREMENT RESULT DIVER RELAY AND VALVE

Logic	Driver relay input voltage (Volt)	Driver solenoid input voltage (Volt)
1	4.9	11.4
0	0	0

IV. CONCLUSION

This IoT-based plant watering system produces a new technology in terms of plant maintenance to keep plants in good condition. Plants can be monitored both temperature and soil humidity which can be monitored via a smartphone application that can be taken anywhere. This tool can save electricity because it uses a solenoid valve which has a relatively small voltage compared to using a water pump which requires a larger voltage.

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