Smart Watering System for Aloe Vera

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Abstract. Aloe Barbadensis Miller is a plant that requires a long watering process until the soil moisture is completely dry. This plant can store water for a long time. But if the soil moisture is too low, then these plants will wither quickly. For this reason, the process of watering plants must follow the water requirements of Aloe Barbadensis Miller. With today's technology, it can be easier to do automatic monitoring, such as with a plant sprinkler. With this technology, Aloe Barbadensis Miller plants will be watered precisely when the soil moisture is lacking. The owners of the Aloe Barbadensis Miller plant don't have to worry about the plants wilting due to drought. They can save water because the watering process already uses technology. The system used in the technology uses a soil moisture sensor to determine the water content contained in the soil. The development of the internet has changed the daily lives of most people around the world. Internet of Things (IoT) technology allows objects to connect and communicate with each other. For automatic watering of plants, sensor devices and water pumps are connected to the IoT and monitored via the Internet. This paper will discuss the design of an automatic watering system for Aloe Barbadensis Miller. The author will also show the results of measuring soil moisture in plants using this system.

Keywords: smart watering system, IoT, aloe barbadensis

1 Introduction

Farming activities are common activities that are usually carried out, starting from planting Farming activities are common activities that are usually carried out, starting from planting plants for basic needs, planting flowers, caring for ornamental plants, or using hydroponic plants. These plants require different levels of water consumption so that they can grow and develop properly. One of the plants that require special care is ornamental plants. Ornamental plants require special care because they wilt quickly if they lack water. One of these is the Aloe Barbadensis Miller plant.

Aloe Barbadensis Miller is a plant that requires a long watering process until the soil moisture is completely dry. This plant can store water for a long time. But if the soil moisture is too low, then these plants will wither quickly. For this reason, the process of watering plants must follow the water requirements of Aloe Barbadensis Miller.

However, many owners of Aloe Barbadensis Miller plants do not have enough time to care for and control the plant. This is because the owners of the Aloe Barbadensis Miller plant have their own busy lives. With current technological developments, technology can solve these problems by using a system that can monitor and water plants remotely using the Internet of Things (IoT).

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The Internet of Things (IoT) is a technology that can facilitate human activities by using sensors and system devices connected via the internet network. IoT uses a microcontroller as an electronic circuit controller and stores programs in it.

Based on some of the problems described above, the authors designed a plant sprinkler that can work automatically and systemically. According to Ressy Dwitias Sari, the system is a network of procedures that are interconnected and gathered together to carry out activities or to carry out certain goals [1][2]. The parameters used in making this tool are measurements of soil moisture using a soil moisture sensor. This automatic plant sprinkler will be designed using Internet of Things (IoT)-based technology so that the process of monitoring and watering plants can be done remotely [3].

2 Research Method

2.1 Research methods

In designing a smart watering system based on the Internet of Things to monitor and water Miller's Aloe Barbadensis plants, In this case, the author uses the waterfall development model. The waterfall model was chosen because this model is suitable for designing a system because there are several steps consisting of analysis, design, implementation, verification, and maintenance of the system, as shown in figure 1 below.

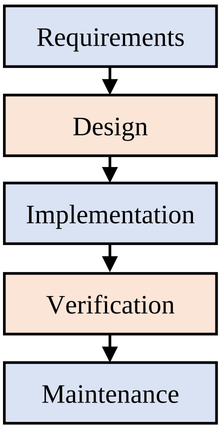

Figure 1. *Waterfall Model*

1) Requirements
   The requirements stage is the stage for analyzing the needs needed in the process of making this smart watering system.
2) Design
   The design phase is the stage that must be carried out before the process of building the system. The goal of the design stage is to provide an overview so that there are no problems when building the system.
3) Implementation
   The implementation stage is the stage in which the system is built from the initial stage to the final stage according to the design that was created previously.
4) Verification
   The verification stage is used to determine whether or not the system is functioning properly.

5) Maintenance
The maintenance phase is the stage in which the system that has been successfully designed is maintained. At this point, routine maintenance will be performed to ensure that the system continues to function properly.

2.2 Design

In making this *smart watering system*, a design is needed. The design in making this system is as follows:

1) Tools and materials.
The tools and materials needed in the manufacture of this *smart watering system* are as follows: (a) PC/Laptop in designing this system is needed because a PC/Laptop is used to install the Arduino IDE software which will be used to type the codes that will be uploaded to the microcontroller; (b) NodeMCU esp8266, is a microcontroller that already includes a wifi module. In designing this system, NodeMCU (ESP8266) is used to connect the system to the internet [5,10]. The shape of the esp8266 nodeMCU can be seen in figure 2 below.

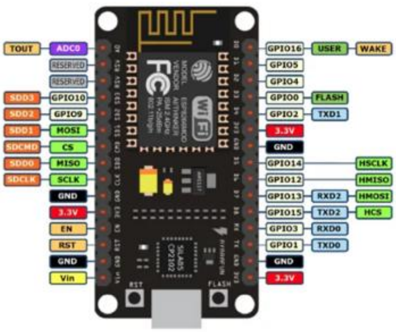

Figure 2. NodeMCU esp8266

2) Soil Moisture sensor
Soil Moisture sensor is a sensor that can detect soil moisture. The shape of the soil moisture sensor can be seen in figure 3 below:

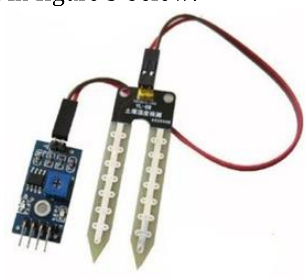

Figure 3. Soil Moisture Sensors

3) LCD (*Liquid Crystal Display)*
LCD (*Liquid Crystal Display)* is a module that is used to display data. The shape of the LCD can be seen in figure 4 below.

Fig. 4. LCD

4) Relay Modules
Relay Modules is a module that can be used as a switch to disconnect and connect currents [8,9]. The condition of the relay can be seen in figure 5 below.

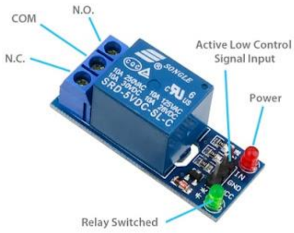

Figure 5. Relay Modules

5) Mini pump 5v
Mini pump 5v is a tool used to pump water to be flowed into the hose [9][10]. The condition of the 5v mini pump can be seen in the figure below.

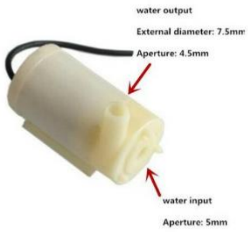

Figure 6. Mini Pump

6) Mini Hose, can be used to deliver water to plants.
   a) The 9v battery serves to provide power to the system. The condition of the 9v battery used is shown in figure 7 below.

Figure 7. 9v battery

b) Smartphones, in this system design is used to accommodate the Blynk application.
c) Jumper cables, are tools used to connect one component to another. In designing this system, *male-to-male* cables, *male-to-female* cables, and *female-to-female cables are used.*

2.3 Network Schematic

A circuit scheme is needed in the process of designing an IoT-based system to make it easier to assemble tools [4][5]. The circuit scheme used in designing this smart watering system can be seen in Figure 8 below:

Figure 8. Network Schematics

The figure above explains the *pinout circuit* between one component and another which can be seen in table 1 below:

Table 1. Network Schematic

Device	Device Ports	Esp8266 port
Soil Moisture sensors	Vcc	3v3
	G	G
	A0	A0
Relays	Vcc	3v3
	G	G
	in	D4
LCD Module 12C	Vcc	VIN
	G	G
	SDA	D2
	SCL	D1

2.4 System *Flowcharts*

The flowchart describes all the flows that occur in the system, from the initial process to the final process. The flowchart also displays the steps and decisions that will be taken from the process of a program [6][7]. The flowchart used in the process of designing this smart watering system can be seen in Figure 9[8].

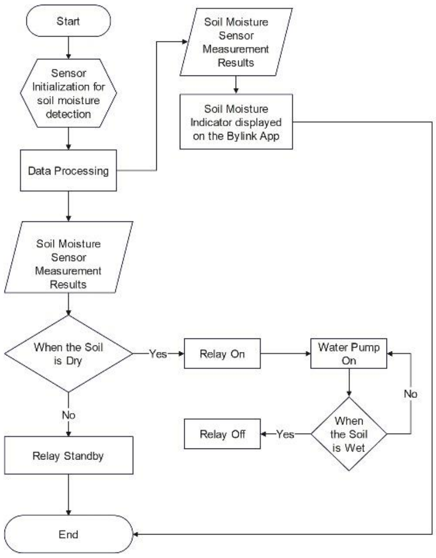

Figure 9. System Flowchart

3 Results and Discussion

The design of a smart watering system for monitoring the Aloe Barbadensis Miller plant made using NodeMcu esp8266 as a microcontroller and a soil moisture sensor as a tool for detecting soil moisture is needed so that the prototype system can be connected to the Blynk application.

3.1 Prototype View

a. Prototype Image from Front

Figure 10 is a prototype of the smart watering system that has been designed. This image is a prototype image from the front.

Figure 10. Prototype from the Front

b. Prototype Image from Above

Figure 11 is a prototype of a smart watering system when viewed from above.

Figure 11. Prototype from above

c. Side prototype

Figure 12 is a prototype of a smart watering system when viewed from side.

Figure 12. Side Prototype

d. Prototype Detailed Drawing

Figure 13 is a detailed prototype image along with a description of the components of the tool used in making the smart watering system.

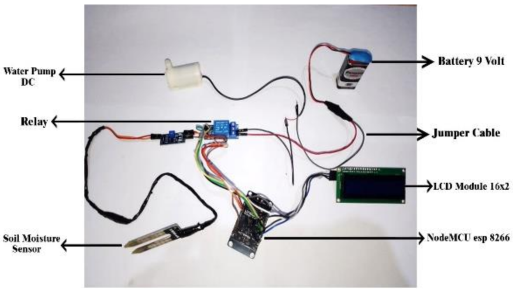

Figure 13. Component of Prototype

3.2 System Testing

System testing has several stages that will be carried out, such as tool component testing, watering system testing, and Blynk-based testing.

3.2.1 Tool Component Testing

Tool component testing is done by testing whether the tool can function properly. Table 2 below shows that all the tools used in the design of this smart watering system function and can run well.

Table 2. Tool Testing

No	Component	Description
1	E s p 8 2 6 6	well functioned
2	Soil Moisture sensors	well functioned
3	Relay Modules	well functioned
4	Mini Pumps	well functioned
5	LCD Modules	well functioned
6	Battery	well functioned

3.2.2 Watering System Testing

The sensor used in the watering system is the soil moisture sensor. The soil moisture sensor functions to detect or measure moisture in the soil. So, this sensor can be used as a medium for automatic watering by adjusting the composition and limits of the soil moisture itself.

To be able to water automatically, the system requires a watering program written in the Arduino IDE application. The designed program is uploaded to NodeMCU, causing all connected devices and sensors to operate in accordance with the predetermined program.

Before carrying out the test, several things must be considered, namely:

1) The sensor used for this automatic watering system is the soil moisture sensor. Watering is done with a water pump connected to the relay module so that the water pump has the power to distribute water to the plants. The two devices are connected using NodeMCU Esp8266.
2) The measurement of soil moisture detected by the soil moisture sensor is expressed in the form of an ADC, or analog to digital converter, which will be displayed on an LCD, or liquid crystal display. ADC 600 states that the soil has reached the specified maximum humidity, so the water pump will stop delivering water to the plant. The LCD screen will show that the soil is wet. When the ADC is more than 900, the water pump will distribute water to the plant, and the LCD will display that the soil is dry when it reaches an ADC of more than 900.
3) Information about the condition of the plants before and after watering will be displayed on the Android device using the Blynk application. This will help in monitoring these plants online and in real-time.
4) The plant used in this automatic watering system is an aloe vera plant. This aloe vera plant will be planted in a pot with a diameter of 15 cm.
5) *Internet of Things*- based automatic plant watering systems are shown in table 3 below :

Table 3. System Testing

No.	Soil Moisture Level (ADC)	Pump Response	Watering Duration
1.	>2000	On	5 sec
2.	900-2000	On	5 sec
3.	<899	off	-
4.	0-800	off	-

Based on the test results, if the soil moisture sensor detects soil moisture ranging from 900 to 2000 or even more than 2000, the water pump will automatically water for 5 seconds until the soil reaches a maximum humidity point of 800. When the sensor detects that soil moisture has reached 800 or below, then the water pump will stop.

The condition of the land is also displayed on mobile devices using the Blynk application. When the soil reaches a humidity level above 900, a statement will appear indicating that the soil is dry. Conversely, if the soil reaches a humidity level of 800 or below, an indication will appear that the soil is wet or moist.

3.2.3 Blynk Application-Based Monitoring Test

The monitoring process for this Internet of Things-based automatic plant watering system uses Blynk. Blynk can be used on mobile devices that are used every day. Blynk can connect mobile devices with the Internet of Things devices used in the manufacture of this automatic watering system.

By using the Blynk application, we can immediately know the soil conditions of the plants we care for with this Internet of Things-based system. Blynk will immediately display soil conditions in real-time, dry or wet, so that users can know for sure whether the plants are well cared for or not.

Based on the results of tests that have been carried out to measure the efficiency of this Internet of Things-based automatic plant watering system, when soil conditions reach 900–2000 or 2000, an indicator stating that the soil is dry will appear on mobile devices through this Blynk application. This condition can be seen in Figure 14 below. In addition, the indicators on the LCD found on the plants also show the soil conditions. This LCD is directly connected to the NodeMCU Esp8266.

Figure 14. LCD Display and Cellular Devices When Pump On

The soil moisture condition is between 0 and 899, and the indicator states that the soil is in a humid condition, so display on mobile devices and indicators on plants express wet soil conditions through Blynk's application. This condition can be seen in Figure 15 below.

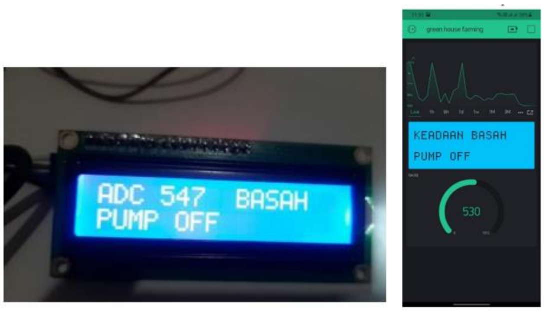

Figure 15. LCD Display and Cellular Devices When Pump Off

4 Conclusions

Based on the results of the research that has been done, several conclusions can be drawn, namely, that the Internet of Things-based automatic plant watering system can detect the condition of the soil presented in the form of an ADC, or analog to digital converter. The system is also capable of automatic watering when soil conditions reach > 900, according to the program settings on the NodeMCU Esp9266 module. In addition, the system also provides information about soil conditions via LCD or liquid crystal digital media. This can indicate soil conditions to users of this system. In addition, the system can also provide information about the condition of this land to mobile devices with the help of the Blynk Application.

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