Automatic Watering of Red Ginger Plants Based on Telegram Using ESP8266 Nodemcu

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ABSTRACT–The design of an automatic watering tool for telegram-based red ginger plants has been realized using nodemcu esp8266. This study aims to create an automatic plant watering system using the YL-69 sensor and monitor the water supply in the reservoir using an ultrasonic sensor that can be monitored using Telegram application. This tool is assembled with various components such as nodemcu ESP8266 as a microcontroller, YL-69 sensor to detect soil moisture, ultrasonic sensor functions as a water level detector, water pump, and 16×2 LCD. The system works when the sensor reads soil moisture in red ginger plants> 60% then the pump turns off and if <60% then the pump turns on. Based on the results of the study, the tool can run well as indicated by the average accuracy of the YL-69 sensor of 98.61±1.32% and the water pump can turn on and off according to soil moisture conditions. In addition, the Telegram application can control and monitor watering either manually with the command /Humidity to check soil moisture, /Distance to monitor the water level in the reservoir, /PumpON to turn on the pump, /PumpOFF to turn off the pump or automatically.

KEYWORDS : monitoring system; telegram; ultrasonic sensor; YL-69 sensor.

INTRODUCTION

Ginger plants with the Latin name Zingiber Officinale are included in the class of one piece of plants and also includes the family Zingiberacea (Soenanto 2010). Ginger is one type of spice plants that grow in Indonesia with many benefits and mixtures and are widely used as the main raw material for herbal medicine and traditional (Setyaningsih and Saparino 2013).

Demand/consumption of medicinal plants such as red ginger is expected to increase, red ginger itself is not only needed as a hometown ingredient, but also needed in industries such as the cooking industry, pharmacy, traditional herbal medicine, and the cosmetic industry (Mentari *et al.* 2017). Therefore ginger deserves to be a superior commodity. To get maximum production results, a commodity production is increased, one of which is by a good watering, knowing the characteristics of plants and soil (Ningrum 2019).

Research on automatic watering using the humidity sensor was previously carried out by (Sari *et al.* 2020), (Setyowati *et al.* 2020), and (Dani and Aldila 2017). In this study using the YL-69 soil humidity sensor. Research conducted by Jupita dkk., (2021) uses voltage input with a microcontroller in the form of Arduino Uno. The output is produced in the form of the humidity value displayed on the 16 × 2 LCD screen and there is a relay that serves to control the on/off pump.

Automatic watering system can also be based on internet of things (IoT). Internet of Things is a system that can monitor hardware and move the device remotely using internet communication technology (Doshi *et al.* 2019). Automatic watering system can using the help of applications such as blnyk (Sasmoko and Horman, 2020) whatsapp (Hidayat et al., 2019), sms gateway (Tullah et al., 2019) and website (Fariz et al., 2021). However, this research using telegram because the display is user

friendly and easy to operate for all ages.

Based on the description above, this research will make automatic watering using Nodemcu ESP 8266 as a control and control center, YL-69 sensor to detect soil humidity, and ultrasonic sensor as a water level detection. Users can control plant watering directly through a good telegram bot manually or automatically.

Red Ginger

Red ginger has the Latin name Zingiber Officinale varrubrum. This ginger is usually called Sunti Ginger. Red ginger has a very spicy taste with a very sharp aroma, so it can be used for making ginger oil and other medicinal ingredients. This red ginger has a reddish rhizome and is smaller than other types of ginger. Having rough fiber and an essential oil content of around 2.58 % - 3.90 % of the dry weight (Setyaningsih and Saparino 2013).

Soil Humidty

Soil is a layer of the surface of the earth that physically acts as a place to grow and develop roots that support plant growth and meet the needs of water (Oktavianus *et al.* 2017). Another definition of soil humidity is the amount of water stored between the pores of the soil. Soil humidity is very dynamic, arising from evaporation through the surface of the soil, transpiration, and filtration. Factors that determine soil humidity are rainfall, soil type, and evapotranspiration rate, where soil humidity will determine the availability of water in the soil for plant growth (Djumali and Mulyaningsih 2014)

YL-69 sensor

The YL-69 sensor is a sensor that can detect humidity in the soil (Darmawan *et al.* 2020). The relationship between the probe length and the ADC voltage value with the resistivity value is the deeper the YL-69 probe sensor is plugged into the ground, the resistance value will decrease (Setyowati *et al.* 2020).

Ultrasonic Sensor

Ultrasonic sensor type HCSR04 is a device used to measure the distance from an object.

The measurable distance range is about 2450 cm. This sensor has four pins, namely GND (power ground), TRIG (trigger input pin), ECHO (receiver output pin), and VCC (5 V power supply). This device uses two digital pins to communicate the distance read. The working principle of this ultrasonic sensor is that by providing a positive voltage to the trigger pin, and the sensor will send ultrasonic pulses with a frequency of 40 KHz, then a signal will be received on the echo pin (Puspasari *et al.* 2019). To measure the distance of the object reflecting the signal, the difference in time when sending and receiving the signal is used to determine the distance of the object with Equation 1.

$$s = v \times \frac{t}{2} \qquad (1)$$

where s is the distance of the object, v is the speed of the sound wave which is 344m/s, and t is the travel time from when the ultrasonic signal is emitted to return to the receiver (Julian and Triyana 2017).

RESEARCH METHOD

Making this device, there are several stages carried out, namely the design of the device, testing the work of the tool, and taking measurement data. The steps taken in this study are:

Design of the Device

This study was made to monitor and control watering in red ginger plants by utilizing the Nodemcu ESP 8266 microcontroller. In addition, this tool is also equipped with information on the detection of water supply that is accommodated in a water box. The monitoring system consists of Nodemcu ESP 8266, YL-69 sensor, ultrasonic sensor, I2C LCD, relay, and water pump. Nodemcu ESP 8266 functions as a microcontroller that is used as monitoring as well as control. The YL-69 sensor is used for soil humidity for the detection in ginger plants, and ultrasonic sensors are used as detection of water supply in water boxes. Then, the I2C LCD, which serves to display the value of humidity and water distance, the relay that

functions as an automatic switch in the water pump. This system also has a water pump that has a function as a tool that can distribute water, when the soil conditions are dry, the pump will turn on, and the water will be watered into the red ginger plant. The monitoring system diagram block is shown in Figure 1
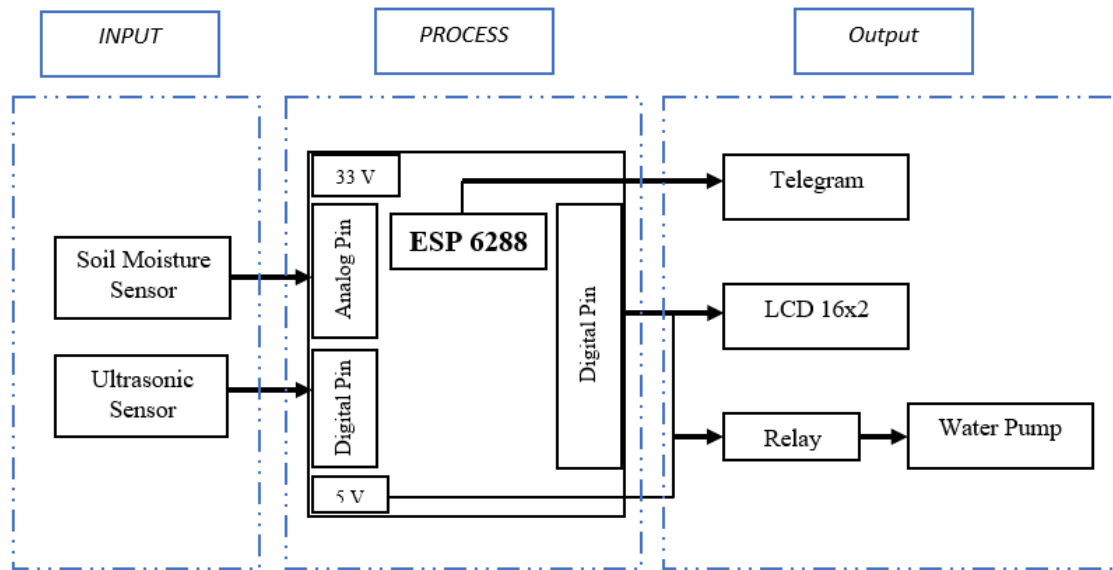

Figure 1 The monitoring system diagram block

Design of the Control System

Control consists of software devices in the form of telegram and laptop. This second system functions as control or control by utilizing bots on telegram features. Information in the form of soil humidity and water supply can be sent or informed of the telegram bot. This research was conducted on an area of ±1 m². Telegram bots can also control watering manually and automatically. Soil humidity needed for red ginger plants is around 60% -80% humidity (Sari *et al.* 2006). For automatic watering, the sensor works when the humidity value is <60% then the pump will automatically turn on and the pump turns off when the humidity value is >60%. The flowchart of soil moisture monitoring is shown in Figure 2.

The ultrasonic sensor functions to detect the water level in the reservoir. If the water level is 5 cm from the lip of the tub, the system will send a full water notification, similarly if the water level is 15 cm from the lip of the tub, there will be a notification that the water is half low, and the surface level 20 cm of water from the lip of the tub, water is running low notification will appear on the telegram bot. The flowchart of water level monitoring is shown in Figure 3.

Calibration Process

This research is a test of the tool testing, and testing is carried out by measuring soil humidity using the American Standard Method (ASM) method as a reference standard (Yudhana and Putra 2016). The equations used in this method, namely Equation 2 and 3.

$$MA = MTB - MTK \qquad (2)$$

$$KD = \frac{MA}{MTK} \times 100\% \qquad (3)$$

where MTB refers to wet soil mass (g), MTK as dry soil mass (g), KD is water content (%), and MA is water mass (g).

The equations used to calculate the error, accuracy, and standard deviation value are given by Eq. 4, 5, and 6:

$$\%Error = \left|\frac{Y - X_n}{Y}\right| \times 100\% \qquad (4)$$

$$\%Accuracy = \left(1 - \left|\frac{Y - X_n}{Y}\right|\right) \times 100\% \quad (5)$$

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{X})}{n}} \qquad (6)$$
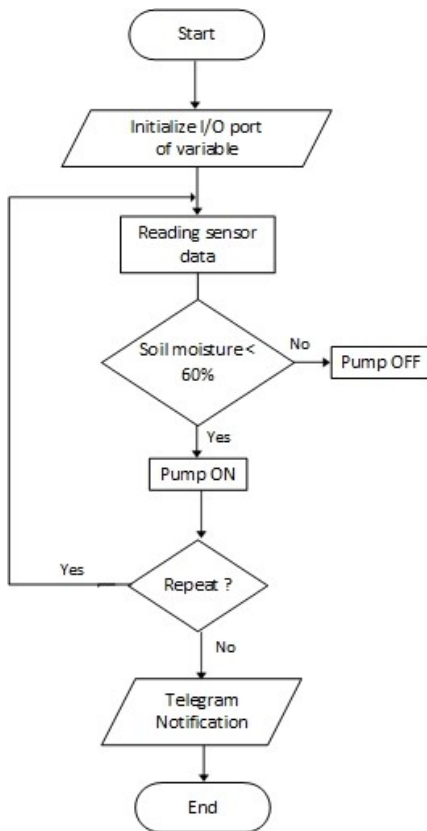
Figure 2 Flowchart of soil moisture monitoring
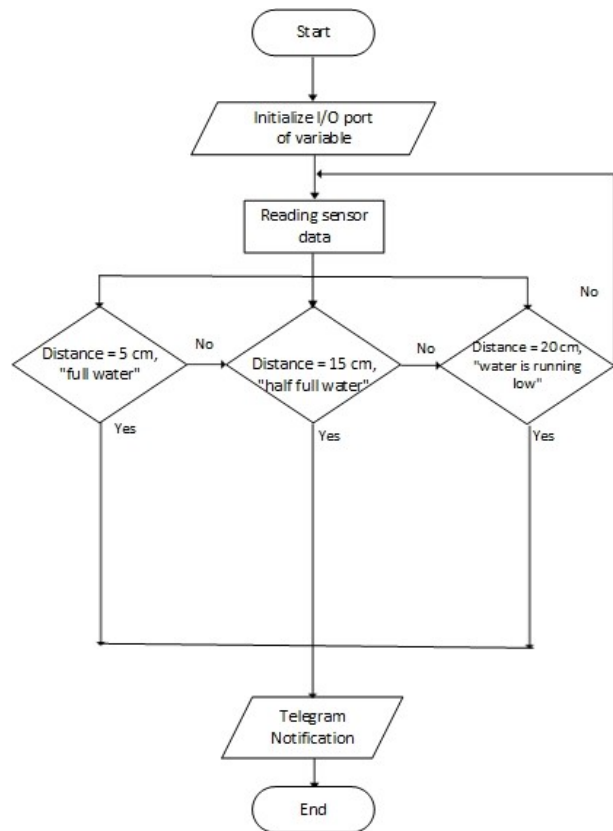

Figure 3 Flowchart of water level monitoring

RESULT AND DISCUSSION
Design System

An automatic watering prototype using the YL-69 sensor as an internet-based humidity sensor using the Nodemcu ESP 8266 microcontroller has been made, with the results shown in Figure 4.

YL-69 sensor testing with the American Standard Method (ASM) method uses dry soil that has been dried for one week with a land mass of 700 g. This method aims to reduce water content in the soil. YL-69 sensor testing is shown in Figure 5.

This test was carried out ten times with treatment in the form of different volumes of water. The results of the measurement of the ratio of the American Standard Method (ASM) method with the soil moisture YL-69 sensor are shown in Table 1, and comparison values of YL-69n between ASM Methods is shown in Figure 6.
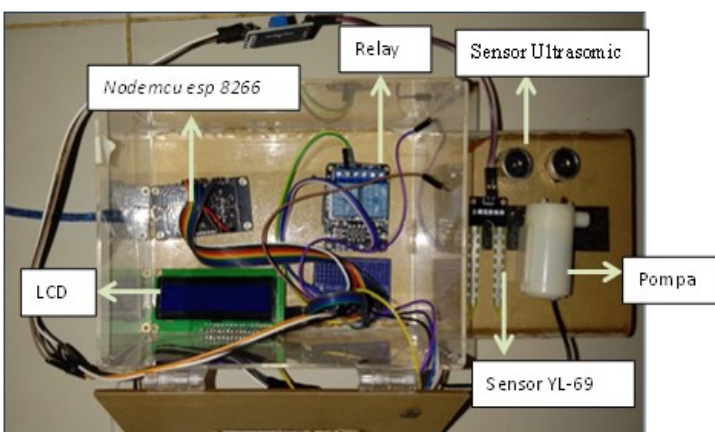

Figure 4 Prototype of an automatic watering system

Figure 5 Calibration process of YL 69 sensor

Table 1 Measurement results of YL 69 sensor with ASM method

No	Dry soil mass (g)	Additional water (ml)	Wet soil mass (g)	Voltage (V)	Value ADC	YL-69 sensor (%)	ASM method (%)	Error (%)	Accuracy (%)
1	700	50	750	2,97	944	7	7,14	1,96	96,08
2	700	100	800	2,75	879	14	14,28	1,96	96,08
3	700	200	900	2,30	736	28	28,57	2,00	99,51
4	700	300	1000	1,86	593	42	42,85	1,98	98,37
5	700	400	1100	1,41	450	56	57,14	2,00	99,51
6	700	450	1150	1,18	378	63	64,28	1,99	99,13
7	700	500	1200	0,96	306	70	71,42	1,99	98,82
8	700	550	1250	0,74	235	77	78,57	2,00	99,82
9	700	600	1300	0,51	163	84	85,71	2,00	99,51
10	700	650	1350	0,29	92	91	92,85	1,99	99,25
	Rata-rata							1,99	98,61
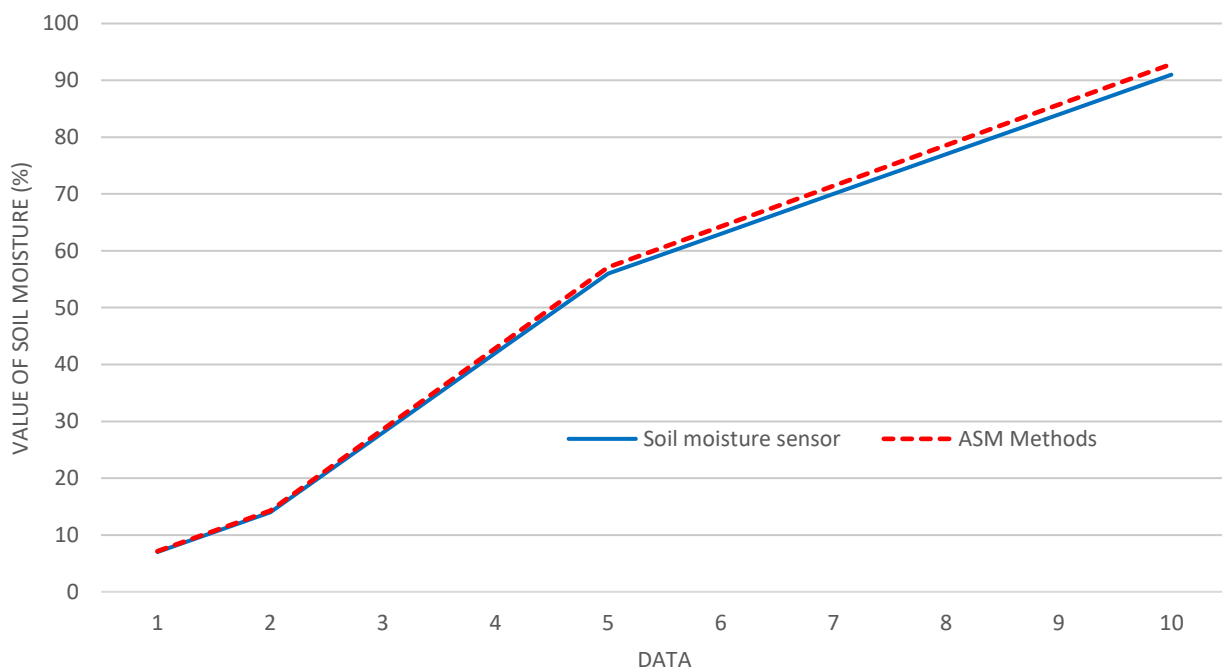
Figure 6 Comparison of soil moisture values between YL-69 sensor and ASM method

The results of the soil moisture measurement using the YL-69 sensor with the ASM method are shown in Figure 6. Based on Figure 6, it can be seen that the greater the ADC value generated from the YL-69 sensor, the smaller the soil moisture value.

The average accuracy value can be seen in Table 1. The average accuracy value of the YL-69 sensor is about 98.61±1.32%, and the error value is around 1.99%. Thus, the YL-69 sensor has a small error value and a good accuracy value so that it can be used to determine the value of soil moisture on red ginger. In addition, the length of the process of sending data via telegram has been tested by (Ayu *et al.* 2022), with the results obtained on average around 0.5 seconds.

Notification Display on Telegram Bot

System monitoring in the telegram application provides several menu options to start system performance as shown in Figures 7 and 8.

Based on Figures 7 and 8, to monitor the soil moisture use the command /humidity and the height of the water level in the tub with the command /distance. Furthermore, to control the water pump in telegram with the command /PumpON and /PumpOFF.
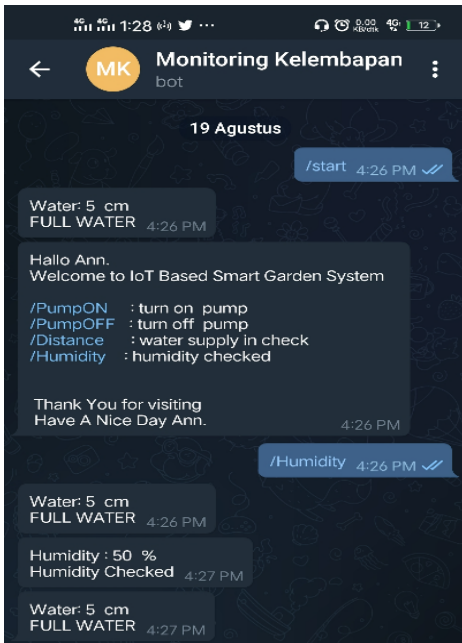
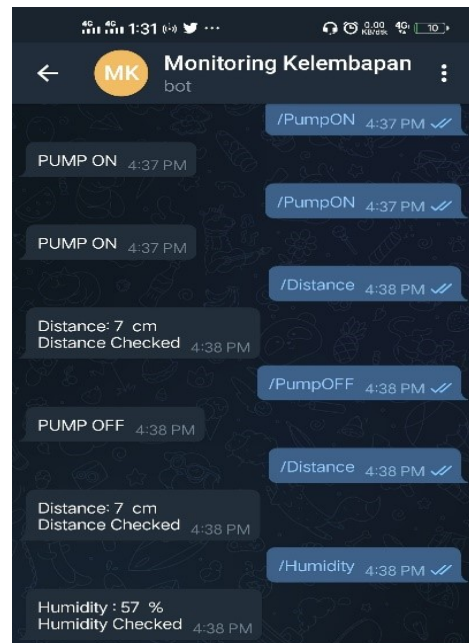**Figure 7 The initial appearance of the Telegram chatbot and its notifications**
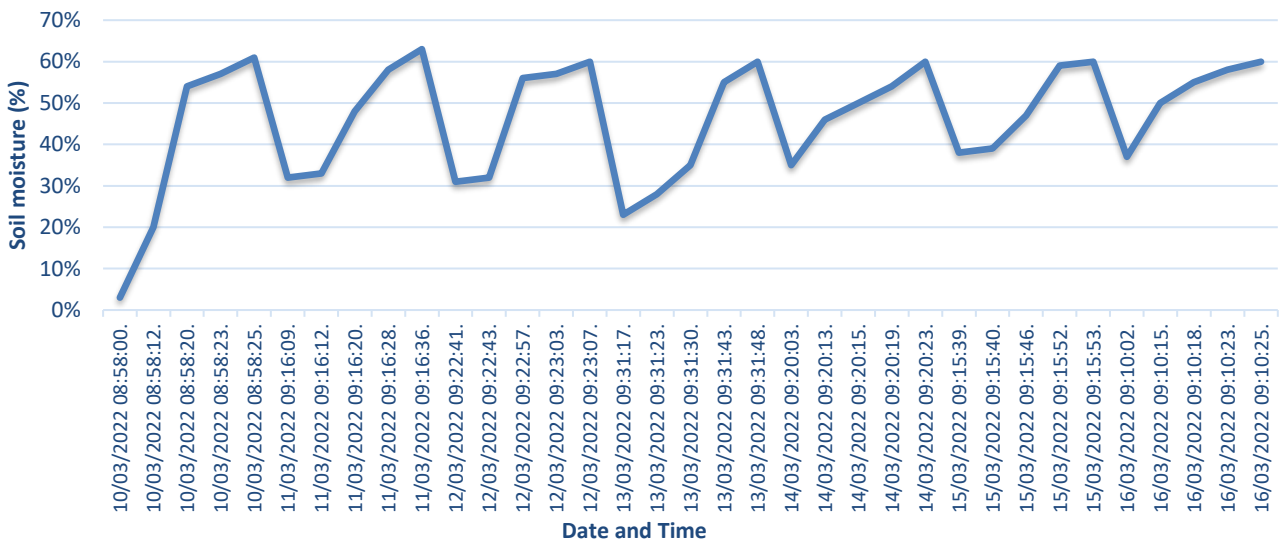

Figure 8 Control the water pump and its display

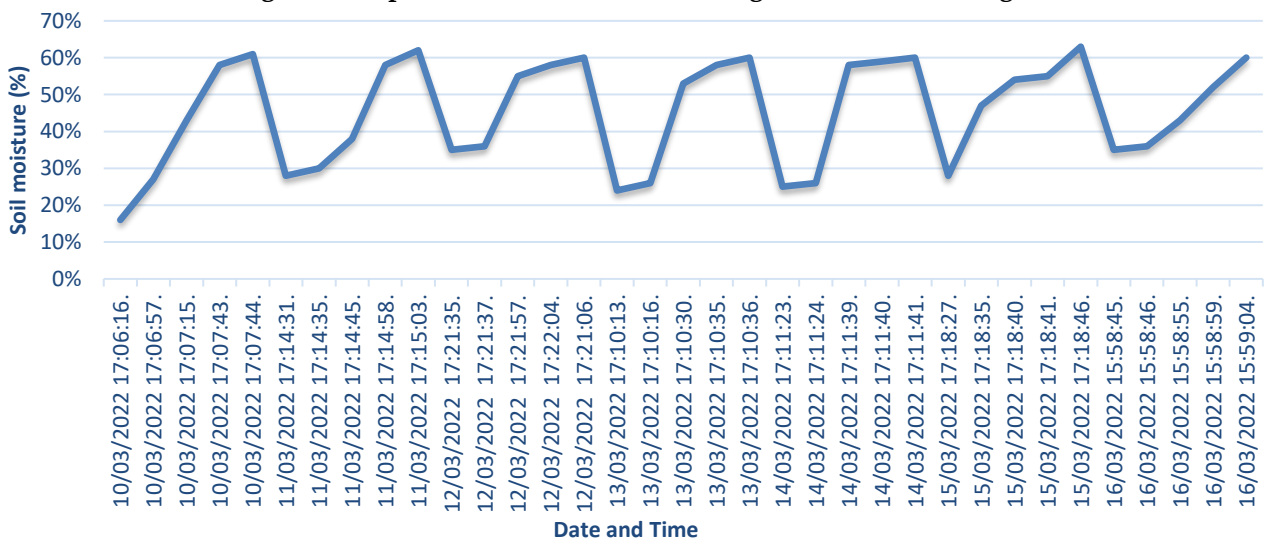**Figure 9 Graph of soil moisture to watering time in the morning**

Figure 10 Graph of soil moisture to watering time in the evening

Measurement Data

To see changes in the value of soil moisture in red ginger plants, the data collection process was carried out for 7 days. Based on the data obtained, the measurement results are in the form of a graph with soil moisture values to time in the morning shown in Figure 9 and in the evening shown in Figure 10.

Based on Figure 9, the soil moisture condition of red ginger plants measured in the morning for one week averaged 46.11%, with the lowest soil moisture value of 3% on March 10th, 2020 at 08.58.00 and the highest soil moisture condition measured on March 11st, 2022 at 09.16.36 with a percentage of around 63%.

Meanwhile, from Figure 10, we can see that the soil moisture conditions in the afternoon for one week averaged around 45.34%, with the lowest humidity value on March 10th, 2022 at 17.06.16 of 16% and the highest soil moisture value of 63% on March 15th, 2022 at 17:18:46. The water pump will turn on when the soil moisture is less than 60% and stop when the soil moisture is more than equal to 60%.

CONCLUSION

The Internet of Things-based automatic plant sprinkler has been successfully made and can work well, marked by the pump working when the soil moisture value is < 60% and the pump off when the soil moisture value is > 60%. Testing the YL-69 soil moisture sensor using the American Standard Method (ASM) method obtained an average error of 1.99% and an average accuracy value of 98.61±1.32% and was able to monitor and control the watering of red ginger plants in real-time using the telegram application.

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