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Component Modification and Data Communication Lines of Automatic Crop Sprinklers on Soil Moisture-Based Agricultural Land

Aditya Ilham Sujana[1]✉, Liman Hartawan[2]
Program Studi Teknik Mesin, Institut Teknologi Nasional Bandung [(1,2)]
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✉ Corresponding author:
[adityailhams@yahoo.com]

Article Info	Abstract

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Plants are living things that need water for their growth. This research was carried out designing, making, and developing tools that previously existed. This development focuses on how to communicate between microcontrollers and aims at the needs of large and open land. Where in previous studies the coverage area was only the area around the radius of the wifi router and the coverage will be increased again using NRF24L01. In previous studies using relays on the solenoid valve will be replaced using Mosfet LR7843 which has lower electrical power requirements. This system uses the Wemos D1 Mini and Arduino Uno as its microcontroller, where data from sensors in the system in the Arduino Uno will be sent using NRF24L01 and received by NRF24L01 on the Wemos D1 Mini. Then the data that has been received will be processed and sent to the internet and can be monitored through the Blynk application which can see temperature conditions, air humidity and soil moisture. From the test results, the average difference obtained at a temperature reading of 0.44 ° C and air humidity of 3.2%, and when the humidity reaches >50% the solenoid valve can open automatically. The distance that can be reached when testing as far as ±20 meters can be due to the test site being blocked by walls.

1. INTRODUCTION

Plants are living things that need water for their natural growth, so plant growth affects the amount of water and nutrients that are absorbed properly in the growth process. In addition to the depth and height of the soil which affects the amount of groundwater, it is also influenced by the level of soil surface moisture. In order for the quality of soil moisture to remain stable, special handling is needed, namely regular watering to maintain water content ranging from 50%-70% (muchyar Hasiri &; Suryawan, 2017).

Based on this, the author will develop a previously existing tool in the form of automatic plant sprinklers based on the Internet of Things. In previous studies, the monitoring system for soil moisture detection devices

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could only be used in areas covered by internet or wifi networks (Hartawan, 2022). Where the tool is intended for large and open land. So that the distance that can be reached on a wifi router has a maximum limit that cannot be reached on the previous tool (Fitrianto, 2022). In this development, the author added NRF24L01 to transmit data over long distances, and previously used a relay on the solenoid valve replaced with Mosfet LR7843 and used DHT11 to determine the temperature and humidity conditions of the surrounding air. The soil moisture reading results from the soil moisture sensor when the soil moisture data is <50%, the solenoid valve will open the valve and drain water to the soil and. If the soil moisture has reached >50%, the solenoid valve will close the valve and no water will come out. Due to the absence of internet network in the garden, NRF24L01 was added to send signals. The system on the Arduino Uno microcontroller is a signal sender or transmitter and Wemos D1 Mini as a receiver and Wemos D1 Mini is in an area within internet coverage. The data sent to the Arduino Uno will be processed by Wemos D1 Mini which can later be monitored on a smartphone connected to the internet network and can facilitate the process of plant supervision.

2. METHODS

In designing there are implementation methods such as inputs in the form of Wemos D1 Mini, Arduino Uno, knowing the temperature, air humidity and soil moisture and watering automatically. The selection of system components used adjusts to the needs needed and procures goods carried out by completing or buying the goods needed. After that, wiring diagrams are made and make system design schemes while assembling tools and components. Next, a program was made and tested the DHT11 sensor, soil moisture sensor and mosfet and solenoid valve whether it was running in accordance with the program that had been made. Then proceed with testing NRF24L01 whether it can send data from the transmitter system to the receiver. If NRF24L01 can send the program, then create an overall system program where the data received earlier will be sent to Blynk IoT in order to monitor the input data via smartphone. After that, the system tests whether the tool can work, namely: when soil moisture >50% will open the valve and temperature data, air humidity and soil moisture can be seen through the Blynk application on a smartphone. The next step is the process of taking data and conducting analysis to obtain results in the form of data and information needed to achieve research objectives. And the last stage concludes the results of the design in order to show the results of the study.

3. RESULT AND DISCUSSION

Wiring Schematic *Diagram* of the Tool

In Table 1. is the Wemos D1 Mini with NRF24L01 *socket adapter* where the function of the *receiver system* scheme is to receive data from the *transmitter*. Furthermore, when the data from *the transmitter* has been obtained, the Wemos D1 Mini will send the data to the Blynk application so that it can be monitored for temperature, air humidity and soil moisture at a distance that is not reached by the *wifi network*.

Table 1. Connection between Components on the *receiver system*

NO	NRF24L01 *Socket Adaptor*	Wemos D1 Mini
1	VCC	5v
2	GND	GND
3	CE	D4
4	CSN	D8
5	SCK	D5
6	M0	D7
7	MI	D6

In Table 1. is the overall system connection of the device that functions to obtain temperature, air humidity and soil moisture data, and can open the *solenoid valve* automatically when the system reads that the humidity reaches >50%. The data obtained from this sensor will be processed in Arduino Uno and will be sent to *the receiver* which in this *transmitter* system is located on a land where there is no *wifi network*.

Table 2. Connection between Components in the *Transmitter System*

NO	Arduino Uno	Sensor DHT11	Modul *Soil Moisture*	*Probe Soil Moisture*	Mosfet LR7843	*Solenoid Valve*	NRF24L01 Socket Adaptor	Battery
1	3,3 v	+	VCC					
2	5v						VCC	
3	GND	-	GND		GND		GND	
4	A2	OUT						
5	A3		A0					
6	D3				PWM			
7	D8						CSN	
8	D9						CE	
9	D11						MO	
10	D12						MI	
11	D13						CSK	
12			+	+				
13			-	-				
14					+	+		+
15					LOAD	-		
16					-			-

Furthermore, programming and testing the function of each component is carried out whether it works properly or not. After checking the function of each component and the component runs properly, the next step is to create a program where this program can send data from the Arduino Uno system to the Wemos D1 Mini system via NRF24L01. Where the Wemos D1 Mini can be connected to the internet and the data on the sensor can be displayed through the Blynk application on *a smartphone* connected to the internet network (Wei et al., 2013).

Function Testing and Comparison with Tools

In this function testing aims to find out whether the system in the series has functioned properly or not, and the comparison with this tool aims to compare the system used in the tool with measuring instruments that have similar functions to the system used (Maulana, 2022).

1. DHT 11 Function Testing and Comparison with Tools

In Figure 1. is a comparative test of air temperature and humidity on DHT11 with *a digital thermometer hygrometer*. Where the sensor will be compared with *a digital hygrometer thermometer to find out the difference between the DHT11 sensor and the* digital hygrometer *thermometer* (Millán et al., 2019). Temperature comparison testing compared to digital *thermometers produces a value of 27.3 °C and the DHT11* sensor produces a temperature of 26.7 °C, there is a difference between the digital thermometer and DHT11 *where the temperature in the* digital thermometer is greater 0.6 °C. In Table 4. obtained after conducting 5 tests on the DHT11 sensor With a *digital thermometer* it was found that the average difference achieved at temperature readings was 0.44 °C.

Table 3. Temperature Comparison Testing

NO	*Themometer Digital* (˚C)	Sensor DHT 11 (˚C)	Selisih (˚C)
1	27,3	26,7	0,6
2	26,7	26,3	0,4
3	26,9	26,4	0,5
4	27,2	26,8	0,4
5	26,8	26,5	0,3
Average Difference			0,44

Testing the comparison of air humidity compared to *digital hygrometers produces a humidity value of 76% and the DHT11 sensor produces a humidity value of 81%, there is a difference between* the digital hygrometer and DHT11 where the temperature in the *digital hygrometer* is greater by 5%. In Table 5. obtained after 5 tests on the DHT11 sensor With a *digital hygrometer*, it was found that the average difference achieved in air humidity readings was 3.2% (Dukes & Scholberg, 2005).

Table 4. Air Humidity Comparison Testing

NO	*Hygrometer Digital* (%)	Sensor DHT 11 (%)	Difference (%)
1	81	76	5
2	80	78	2
3	77	74	3
4	79	75	4
5	75	73	2
	Average Difference		3,2

Figure 1 Comparison Test of DHT11 with Tools

2. NRF4l01 and Wemos D1 Mini Function Testing

The NRF24l01 and Wemos D1 Mini sensor function tests were carried out to find out whether the NRF24l01 and Wemos D1 Mini can function to send signals or data from DHT11 and the *Soil Moisture Sensor* on the Arduino Uno to the Wemos D1 Mini which is connected to an internet connection and uses the Blynk application to monitor the situation. In Figure 3. shows the conditions that can be seen in the Blynk application including temperature conditions, air humidity and soil humidity (Pramujianto, 2010).

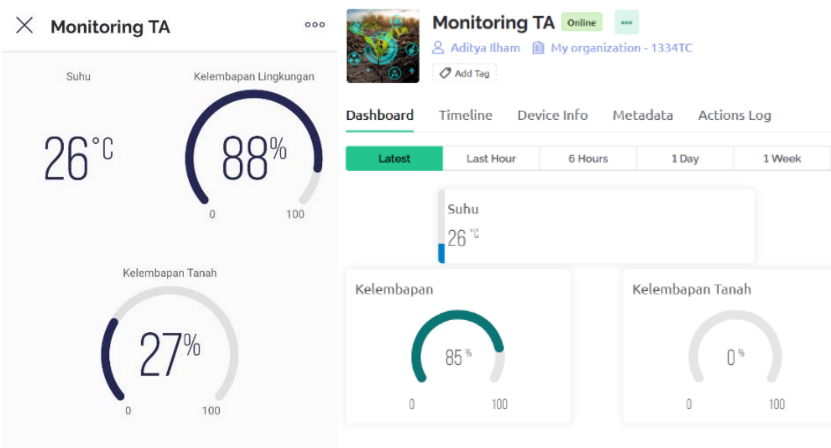

Figure 2. Function testing of NRF24l01 and Wemos D1 Mini sensors

3. Pengujian Fungsi Mosfet, *Solenoid Valve* dan *Soil Moisture*

In testing the function of *the solenoid valve* and soil moisture sensor *was carried out to find out whether when* the soil moisture sensor when reading soil moisture >50% whether the mosfet is able to water automatically or not to see the condition of soil moisture through the Blynk application on *a smartphone*. In Figure 3. is a condition when soil moisture is >50% which can be seen on Mosfet LR7843 the indicator light is off which indicates that there is no current flowing to the *solenoid valve and the solenoid* valve does not open the valve and cannot do watering (Najmurrokhman et al., 2018).

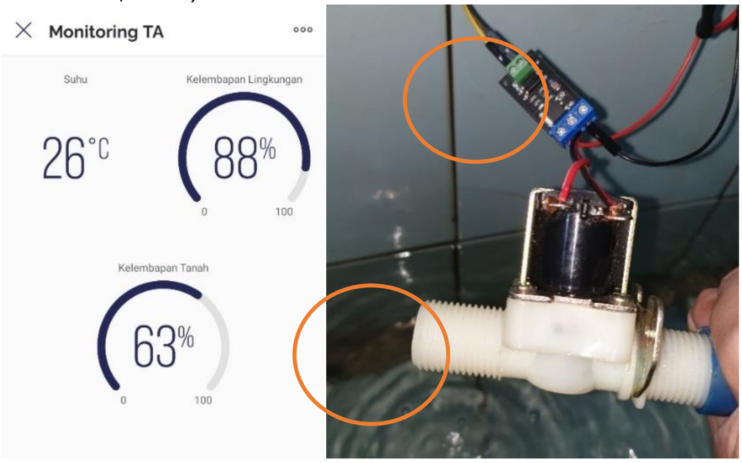

Figure 3. The condition of *the solenoid valve* when closed

In Figure 4. is a condition when soil moisture is <50% which can be seen on Mosfet LR7843 the indicator light is on red which indicates a current that flows into the solenoid valve and the *solenoid* valve can open the valve and can do watering .

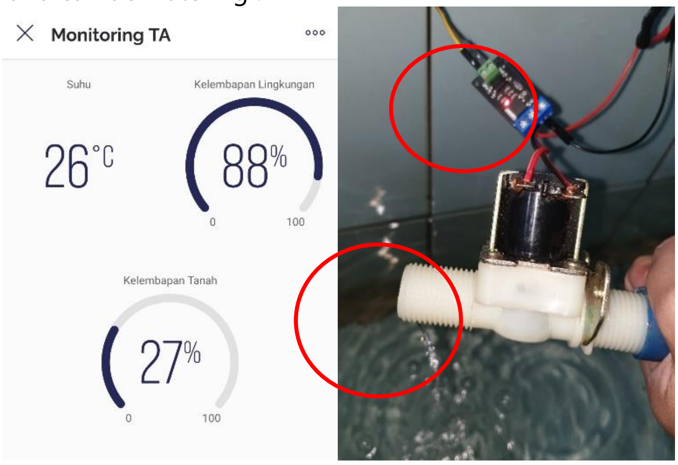

Figure 4. The condition of *the solenoid valve* when it opens

4. CONCLUSION

Based on the description above, it can be concluded that, in this case, the design of the automatic crop sprinkler system on agricultural land based on soil moisture used has been produced and a wiring diagram has also been produced for all components used in the automatic crop sprinkler system on soil moisture-based agricultural land is seen in Table 2. and Table 3. An overall program has been created of components and systems of automatic crop sprinklers on agricultural land based on soil moisture connected to the Blynk application so that it can monitor or monitor through electronic devices seen in Figure 5. In this test there are two tests, namely function testing and comparison with tools, in testing the function of the components of the system from automatic crop sprinklers on agricultural land based on soil moisture. Where the average difference achieved at a temperature reading of 0.44 °C is shown in Table 4. and an air humidity reading of 3.2% is shown in Table 5. and when the humidity reaches >50%, the solenoid valve can open automatically, shown in Figure 5. and the distance that can be reached when conducting tests as far as ±20 meters.

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