Design of greenhouse monitoring for hydroponic based on microcontroller and android system

Cite as: AIP Conference Proceedings **2484**, 040008 (2023); https://doi.org/10.1063/5.0109934
Published Online: 23 March 2023

Aji Akbar Firdaus, Franky Chandra Satria Arisgraha, Irgi Oktamaulana, et al.

Design of Greenhouse Monitoring for Hydroponic Based on Microcontroller and Android System

Aji Akbar Firdaus [1, a)], Franky Chandra Satria Arisgraha [2)], Irgi Oktamaulana [1)] Thomi Tri Subekti [1)], Dimas Okky Anggriawan [3)], Machrus Ali [4)] and Dimas Fajar Uman Putra [5)]

[1]*Department of Engineering, Faculty of Vocational, Universitas Airlangga, Surabaya 60286, Indonesia.*
[2]*Department of Physics, Faculty of Science and Technology, Universitas Airlangga, Surabaya 60286, Indonesia.*
[3]*Politeknik Elektronika Negeri Surabaya, Indonesia.*
[4]*Department of Electrical Engineering, Universitas Darul Ulum, Jombang, Indonesia.*
[5]*Department of Electrical Engineering, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia.*

[a)] *Corresponding author: aa.firdaus@vokasi.unair.ac.id*

Abstract. Food crisis can hamper economic growth and progress of a nation. According to the World Food Program data in 2017 stated that 87 million Indonesians are still vulnerable to food security. In addition, agricultural land in urban and rural areas is increasingly narrow so that the food crisis cannot be prevented. Therefore, making greenhouse is used to increase food productivity in Indonesia. This greenhouse is equipped with temperature, humidity and light controls as well as a roof that can be opened and closed so that the condition of the greenhouse can be set as desired. And conditions in this greenhouse are also monitored using the Android application. From the test results, greenhouse monitoring based on microcontroller and android system can work in accordance with the desired program instructions.

INTRODUCTION

Every year the area of cultivation has decreased because the area of farming has been converted into a residential area so that the production of agricultural products has decreased. In addition, uncertain climatic conditions so that the productivity is less profitable produced per unit area of land [1]. The low productivity is also caused by the competence of farmers in the application of good and true technological innovations that have not been fully met [2]. Whereas on the other hand the market and consumers have wanted agricultural products with more quality standards than those produced by farmers [3].

In addition to reduced agricultural land, weather conditions also affect crop quality. Therefore, a greenhouse is needed to optimize land use, room conditions. Several hydroponic systems have been implemented, namely hydroponic systems with Arduino, Raspberry Pi, and ZigBee [4], controlling water temperature, acidity (pH) of the nutrient, water level, and higher densities of nutrient solutions [5, 6, 7, 8]. However, a monitoring system with Android has been made to control the condition of the greenhouse room.

In this study, the greenhouse system is proposed to regulate the condition of a greenhouse room. The conditions of this room include setting the temperature, humidity, light intensity and rainfall. Then the condition of this room can be accessed and controlled via Android.

THE PROPOSED METHOD

Android is an operating system based on Linux, an operating system designed to develop touchscreen mobile devices such as smartphones and tablet computers [9]. In this study, Android is used for monitoring and control of the tools contained in the greenhouse. Whereas Node MCU is used for the controller of all sensors and the connection for

1st International Postgraduate Conference on Ocean Engineering Technology and Informatics 2021 (IPCOETI 2021)
AIP Conf. Proc. 2484, 040008-1–040008-6; https://doi.org/10.1063/5.0109934
Published by AIP Publishing. 978-0-7354-4436-2/$30.00

Wi-Fi like Fig. 4. The sensors used include Light Dependent Resistor (LDR), Rain Drops and DHT22 sensors such as Fig. 1, 2, and 3, respectively. Finally, Blynk is used for the Mobile OS application (Android) which aims to control the Arduino module via the internet. Table 1 Table 1 is addressing pins in Node MCU.

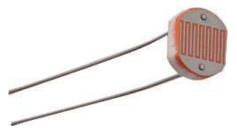

FIGURE 1. LDR Sensor [10].

FIGURE 2. Rain Drops Sensor [11].

FIGURE 3. DHT22 Sensor [12].

FIGURE 4. Node MCU [13].

TABLE 1. MCU Node Pins Addressing.

Node MCU Pins	Hardwares/tools
A0	LDR Sensor
D0	Fan 1
D1	Fan 2
D2	Servo
D4	Indicator light
D5	Water pump
D6	Rain Drops Sensor
D7	DHT 22 Sensor

In this paper, the procedure used is as follows:

1. The Start is the first step in starting a program.
2. The next step is to set and initialize the date and initialization to the Blynk server.
3. After that, wait until the Android device is connected to the same server as Blynk.
4. The next process is the reading of weather data.

5. After weather reading, the time conditioning process is divided into 3, namely from 07:00 to 17.59, 18:00 to 19:59 and other than 20:00 to 06:59.
6. During the conditions from 07:00 to 17:59, the weather conditioning process is divided into 4 namely sunny, cloudy, hot rain and rain.
7. From 18:00 to 19:59, the roof will be closed and the lights will be turned ON. Besides, from 07:00 to 19:59, the roof will be closed and the lights will turn off.
8. After that, the next process is reading the temperature which will affect the fan so that the fan controls the temperature in the room. The optimal temperature is 17 to 30°C.
9. Then, the humidity reading process controls the fan so that the fans blow out and the water pump turns on. The optimal humidity is 70% to 95%.
10. The last process is the process of transmitting data to Blynk.

RESULT AND DISCUSSION

Fig. 5 shows the tool design system. The green and blue lines indicate the sensors and actuators used in this system, respectively. This system consists of 2 tests namely testing logic control and testing the transmission of data sent and then displayed on the Android application.

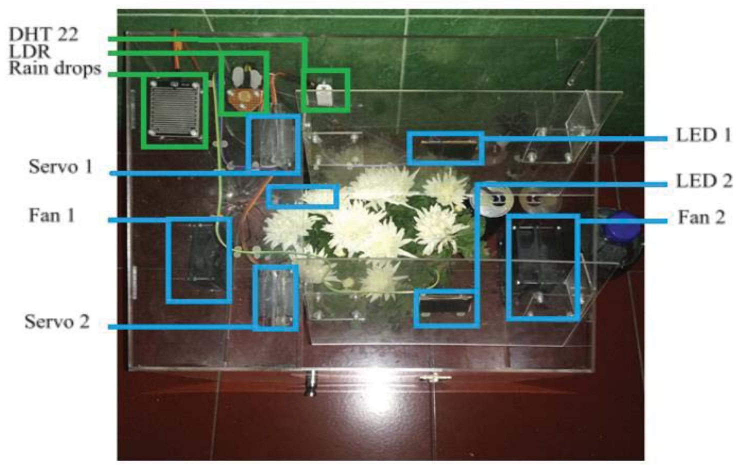

FIGURE 5. Design System.

TABLE 2. Temperature and Actuators Testing.

No	Input	Output				Information
	DHT22	Fan (In)		Fan (Out)		
		Target	Data	Target	Data	
1	25.5°C	Off	Off	Off	Off	Suitable
2	26.2°C	Off	Off	Off	Off	Suitable
3	26.1°C	Off	Off	Off	Off	Suitable
4	27.4°C	Off	Off	Off	Off	Suitable
5	28.2°C	Off	Off	Off	Off	Suitable
6	28.6°C	Off	Off	Off	Off	Suitable
7	29.8°C	Off	Off	Off	Off	Suitable
8	30.3°C	On	On	Off	Off	Suitable
9	30.5°C	On	On	Off	Off	Suitable
10	31.1°C	On	On	Off	Off	Suitable

TABLE 3. Humidity and Actuators Testing.

No	Input	Ouput				Information
	DHT22	Water pump		Fan (Out)		
		Target	Data	Target	Data	
1	74.2%	Off	Off	Off	Off	Suitable
2	73.6%	Off	Off	Off	Off	Suitable
3	73.4%	Off	Off	Off	Off	Suitable
4	72.9%	Off	Off	Off	Off	Suitable
5	72.3%	Off	Off	Off	Off	Suitable
6	71.5%	Off	Off	Off	Off	Suitable
7	71.5%	Off	Off	Off	Off	Suitable
8	70.6%	Off	Off	Off	Off	Suitable
9	70.1%	Off	Off	Off	Off	Suitable
10	69.5%	On	On	Off	Off	Suitable

TABLE 4. LDR and Actuators Testing.

No	Input		Output		Information
	LDR		Lamp		
	Data	Vout (V)	Target	Data	
1	924	4.516	Off	Off	Suitable
2	930	4.545	Off	Off	Suitable
3	929	4.540	Off	Off	Suitable
4	724	3.538	Off	Off	Suitable
5	330	1.612	On	On	Suitable
6	320	1.564	On	On	Suitable
7	310	1.515	On	On	Suitable
8	890	4.349	Off	Off	Suitable
9	940	4.594	Off	Off	Suitable
10	950	4.643	Off	Off	Suitable

TABLE 5. Rain Sensor and Actuators Testing

No	Input	Output		Information
	Rain drops	Roof		
		Target	Data	
1	1	Open	Open	Suitable
2	0	Close	Close	Suitable
3	1	Open	Open	Suitable
4	1	Open	Open	Suitable
5	0	Close	Close	Suitable
6	0	Close	Close	Suitable
7	0	Close	Close	Suitable
8	0	Close	Close	Suitable
9	1	Open	Open	Suitable
10	1	Open	Open	Suitable

TABLE 6. Sending Data to Blynk

No	Data	Information
1	Data 1	time of sending > 15 s
2	Data 2	time of sending > 15 s
3	Data 3	time of sending > 15 s
4	Data 4	time of sending > 15 s
5	Data 5	time of sending > 15 s
6	Data 6	time of sending > 15 s
7	Data 7	time of sending > 15 s
8	Data 8	time of sending > 15 s
9	Data 9	time of sending > 15 s
10	Data 10	time of sending > 15 s

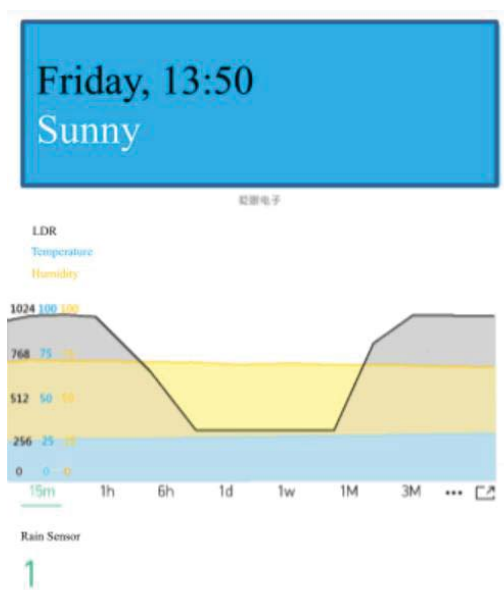

FIGURE 6. Android Display.

Table 2 shows when the temperature is above 30 °C the fan (input) state will turn on and the fan (output) will turn off. if the humidity is below 70% then the water pump will turn on and the fan (output) turns off like the Table 3. if the voltage is less than 2 volts, the weather is cloudy and the lamp is on, if the voltage is more than 2 volts, the lamp will turn off like Table 4. From Table 5, if the rain sensor detects water on the sensor plate, the sensor will be 0 and the roof will be closed. If otherwise, the sensor will be 1 then the roof will open. From Table 6, data 1 to10 can be sent properly to the Blynk server and entered into the Blynk application on the smartphone. However, the data sending time is not in accordance with the specified target of 15 s, while the sending time is more than 15 s because the running program affects the data transmission time. Display data on android such as Fig. 6, LDR (black), Temperature (blue) and humidity (yellow) are displayed in graphical form, and for the rain sensor display is displayed in the form of digital data 0 or 1.

CONCLUSION

A part Greenhouse design for monitoring room conditions has been implemented. Monitoring greenhouse conditions including temperature, humidity, light intensity, rainfall and displayed on android. The tool works according to program instructions. The instructions are that the fan (in) will turn on if the temperature is more than 30°C, the water pump will turn on if the humidity is less than 70%, the light will turn on if the LDR voltage is less than 2 volts and the roof will open if the rain sensor value is 1 (High).

ACKNOWLEDGMENTS

Thank you to the Ministry of Education and Culture of the Republic of Indonesia who has supported our research.

REFERENCES

[1] R. B. Ali, S. Bouadila and A. Mami, Applied Thermal Engineering, vol. **141**, pp. 798-810 (2018).

[2] R. Santhana Krishnan et al., Journal of Cleaner Production, vol. **252**, pp. 119902 (2020).

[3] Abdallah Chamra and Haidar Harmanani, "A Smart Green House Control and Management System Using IoT", *17th International Conference on Information Technology–New Generations (ITNG 2020)* (2020).

[4] Z.Y. Zou and M. Zhou, "Design of ZigBee & ARM Technology Based Granary Monitoring System", *IEEE 3rd information Technology and Mechatronics Engineering Conference*, pp. 1201-1205 (2017).

[5] Alejandro Castañeda-Miranda and Victor M. Castaño-Meneses, Computers and Electronics in Agriculture, vol. **176**, pp. 105614 (2020).

[6] Alejandro Castañeda-Miranda and Victor M. Castaño-Meneses, Computers and Electronics in Agriculture, vol. **176**, pp. 105614 (2020).

[7] Zhenyu Zhang, Lin Yu, Wenqing Huang, Yudong Ji and Kezhong Sun, Internet of Things Technology, vol. **9**, no. 05, pp. 6-8 (2019).

[8] Rui Ni and Wanda Zhang, Automation and Instrumentation, vol. **34**, no. 05, pp. 53-55 (2019).

[9] "What is Android?", *Google Inc.*.

[10] http://elektronikadasar.web.id/

[11] https://www.openhacks.com

[12] https://www.sparkfun.com

[13] https://www.handsontec.com.