ICORHESTECH 2024
Vol. 1, No. 1, 2024, pp. 79~87
Journal Homepage: https://journal.ibrahimy.ac.id/index.php/icorhestech

Soil Moisture Monitoring and Water Drip Irrigation on Chili Plants Using Solar Panels

Jefri Andri Rifai[1],Stywati [2], M.Ibnu Al Furqoni [3]
[1]Universitas Teknokrat Indonesia, Bandar Lampung, 35123
Jefri_Andri_Rifai@teknokrat.ac.id

ABSTRACT

The process of growing chili peppers is carried out with specific irrigation conditions to maintain PH and soil moisture. In chili plants, soil moisture needs around 60% to 80% so that plants can grow optimally. Chili plants do not get optimal nutrition if the soil conditions get excessive or less water, usually because there are still many chili farmers who still do manual watering plants. Farmers always encounter chili plants that experience poor growth so that crop yields have decreased, especially in the last year coupled with hot and dry weather causing the soil to require adequate water intake, this was also felt by one of the farmer groups cultivating chili plants in Kertosari Village, Tanjung Sari District, South Lampung. By utilizing current technological developments, namely the Internet of Things (IoT) which is a technology that can help us monitor and control remotely with the help of the internet so that it greatly facilitates human work. This study aims to build a soil moisture monitoring system and drip irrigation on chili plants. which will be made using the Yl-69 soil moisture sensor as a soil moisture detector, then the sensor will send data through a microcontroller, namely NodeMcu through the android interface. The monitoring system is made using solar panel power.

Keywords: *Soil moisture; NodeMcu ; Internet of Things ; Sensor soil moisture ; Solar Panel*

INTRODUCTION

Chili is a type of vegetable that is consumed by many people in Indonesia and is easily found in the market. The process of growing chili peppers is carried out with specific irrigation conditions to maintain PH and soil moisture. In chili plants, soil moisture needs around 60% to 80% so that plants can grow optimally. Chili plants do not get optimal nutrition if conditions. The soil gets excessive or less water, usually because there are still many chili farmers who still do manual watering of plants(Priyono & Triadyaksa, 2020).

According to karta saputra in research (Zikrilla et al., 2021) states that irrigation or irrigation is an addition to the lack of moisture content in the soil artificially, namely by systematically providing water to the soil. Irrigation needs built for plant growth must be adjusted to the number or level of use and efficiency of existing irrigation networks so as not to interfere with plant life. In research (Fakhrah et al., 2022). Banks stated that drip irrigation is a method of giving water to plants that can reduce excess water use by letting water flow dripping slowly by dripping slowly to the roots of plants that can go through the soil surface or directly to the roots of plants.

The cultivation of chili plants belongs to the Farmer Group which is one of the chili plant cultivation in Kertosari Village, Tanjung Sari District, South Lampung. The Farmer Group cultivated its chili for approximately 3 years with a width of chili plants reaching 1500 m2 with the type of cayenne pepper, based on the results of surveys and interviews conducted by the author with the owner of the chili cultivation, farmers always encounter chili plants that experience poor growth so that crop yields have decreased, especially in the last year coupled with hot and dry weather causing the soil to need water intake. enough, but the Farmer Group does not know how much water capacity his chili plants need. The effort made by the owner of the chili plant in overcoming the problem is to provide water intake in the morning and evening, but the effort made was considered ineffective because there are still many chili plants whose growth is not good and even die, especially when the owner of the chili plant is busy with other activities, watering becomes hampered.

By utilizing current technological developments, namely the Internet of Things (IoT) which is a technology that can help us monitor and control remotely with the help of the internet so that it greatly facilitates human work (Ukar et al., 2022). The use of Internet of Things (IoT) technology is now widely applied to agriculture, as an effort to provide convenience and comfort in the business world on farms. One of the efforts to realize this convenience and comfort is the use of Internet Of Things (IoT) technology as a soil moisture monitoring system and drip irrigation on chili plants.

Research on soil moisture monitoring and irrigation systems on chili plants has been carried out by (Zotarelli et al., 2011). This research utilizes IoT technology that can help in the irrigation process by turning off or turning off the pump automatically. The method of developing internet of things systems uses prototyping, with this approach can find out well the needs of users and analysts of system development results quickly. IoT devices used to form this system include NodeMCU, soil moisture sensors and mobile-based applications.

The results of this study can turn on the irrigation pump automatically, users can also turn on or off the pump manually through the user's android smartphone connected to the internet network with NodeMCU. The suggestion from the research is that the tool is made limited to a control system, so further development is needed, namely the device is made more smart irrigation so that users can find out what the chili plant needs.

In this study, the author will design "MONITORING SOIL MOISTURE AND DRIP IRRIGATION OF WATER ON CHILI PLANTS USING SOLAR PANELS" in chili cultivation owned by the Farmer Group. The monitoring system that will be made uses the Yl-69 soil moisture sensor as a soil moisture detector so that the value of soil moisture in chili plants is known, then the sensor will send data through a microcontroller, namely NodeMcu which will control the drip irrigation system needed by chili plants right away, the monitoring system is made using solar panel power because in addition to being environmentally friendly the reason for using solar panels is because of sufficient access to electricity Far, if only using the battery will not last long. In addition, the sensor will also send soil moisture data through an android-based interface that can be accessed using the chili plant owner's smartphone, so that the owner can monitor soil moisture remotely.

METHOD

The method applied in this study is an experimental method used to find the effect of certain treatments on a variable under controlled conditions, according to a statement from Sugiyono in 2013 in a book (Nurfurqon et al., 2022) entitled "Iot Power Logger Calibration and Validation Techniques for DC Current". This experimental method gives the researcher full control over the phenomena to be observed and the mechanism of data collection in the research he conducts. In this study, which was conducted using experimental methods to test interrelated variables, namely monitoring soil moisture and irrigation of water drops in chili plants with several interrelated variables such as Soil Moitsture with NodeMCU as a microcontroller and solar panels as a source of solar electrical energy use. research.

Stages of Research

This research uses an experimental method with stages or steps of research as shown in Figure

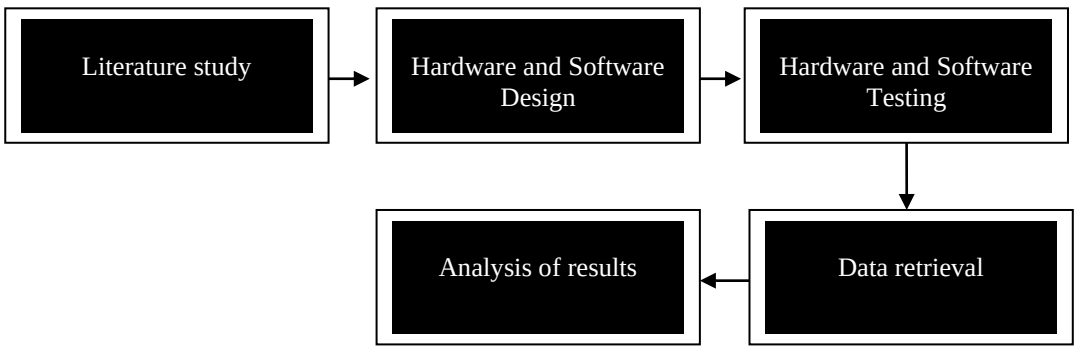

Figure 1. Stages of Research

Data Collection Methods

Data collection methods can be done by researchers to obtain the information needed in order to achieve the objectives of a study to be carried out. Data collection method is a way or technique carried out by researchers to collect data. In this study, the author conducted a study on chili farming owned by the Farmer Group addressed in Kertosari Village, Tanjungsari District, South Lampung, using the following 4 stages:

1. Observation

Observation is carried out to collect data by observing directly at the place of research or case studies and data obtained originally. In this study, the author made direct observations, namely by observing the conditions in the chili farming area to study and see firsthand the condition of what chili agricultural land might affect the growth and development of chili plants belonging to the Farmer Group.

2. Interview

The author conducted a direct interview with the owner of the chili plant, the Farmer Group, regarding the problems faced, where according to the results of interviews conducted chili plants often experience poor growth due to watering that is not as needed coupled with dry weather conditions.

3. Literature study

At this stage the author gets data sources from journals and books related to the research topic, for example such as research journals on monitoring soil moisture of chili plants.

4. Documentation

Documentation is done by the author by looking and reading directly at the sources of related documents. This method is done by looking at and reading books and literature related to the research topic conducted.

Overall system design

The design of a system for monitoring soil moisture and irrigation of water drops on chili plants using solar panels is an important part of the research to be carried out. Designing the system well and paying attention to every component of the tools and programs that will be made so that maximum results will be obtained. In system design, accuracy is needed because the initial system design will determine the end of a system or tool manufacturing process, if you design with inappropriate steps, the design results will be inappropriate and inappropriate. The design of a system for monitoring soil moisture and irrigation of water drops in chili plants consists of several stages, namely block diagrams, flowcharts, and schematics. In this study, the author will give a little overview of what steps are taken.

1. Block Diagram

Block diagram is a description of a system that is comprehensive, the process of defining needs to be elaborated on the system or tool that Alan discusses as a whole, meaning that there is a clear picture of the scope discussed, namely by using Block Diagram (Kim et al., 2003). With block diagrams we can analyze how the circuit works and design hardware that will be made by researchers General history The following is a block diagram of the working of a series of systems monitoring soil moisture and irrigation of water drops on chili plants using solar panels. Overall, the system of monitoring soil moisture and irrigation of water drops on chili plants using solar panels as shown in Figure 2.

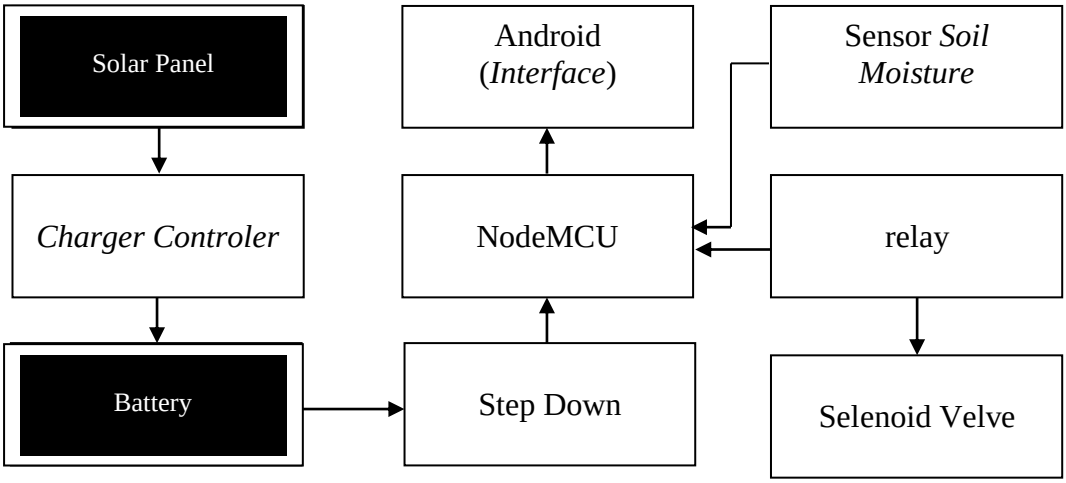

Figure 2. Block Diagram

Information:

a. NodeMCU

This research uses NodeMCU as a microcontroller, NodeMcu is an IoT platform that is open source. Consists of hardware in the form of an ESP 8266 system on chip from ESP 8266 made by espressif systems, as well as the firmware used. Use an outside scripting programming language. The term nodeMCU by default actually refers to the firmware used rather than the development kit hardware. MCU nodes are usually analogous to Arduino boards ESP8266 (S. S. Y. D. Evi and G. V Ijaykiran, 2017).

b. Solar Panel

Solar Panel Surfaces Against Power Generated From Different Types Of Solar Cells From this collection of solar cells can be converted sunlight into direct current electricity. By adding a battery connected to a solar panel, the power from the conversion of sunlight will become electricity that can be stored as a backup of electrical energy (Labrador, n.d.).

c. Charge Controller

The Charge Controller is used to regulate the current for charging to the battery, then used to avoid over charging, and over voltage. If the battery is fully charged, the electricity supplied from the solar module will not be put back into the battery / battery and vice versa also if the condition of the battery is less than 30% then the charge controller will recharge the battery to full and the Charge controller can make the battery / battery can be used for a longer period of time (Bianchi & Dai Pre, 2003).

d. Sensor Soil Moisture

This study uses a Soil moisture sensor as a detection of water intensity in the soil (moisture). The soil moisture sensor consists of two probes to pass current through the soil, then read the resistance to get a value for the soil moisture level. The more water it will make it easier for the soil to conduct electricity (small resistance), while if the soil conditions are dry it is very difficult to conduct electricity (large resistance). The function of these two probes as a medium that will conduct analog voltage whose value is relatively small, this voltage will later be converted into digital voltage which will be processed into a microcontroller (Kirianaki et al., 2002).

e. Selenoid Valve

Selenoid Valve functions as a counter for flowing water discharge where there is a motor movement that is converted into liter unit values. This sensor consists of several parts, namely a plastic valve, a water rotor, and an effect thing sensor. The motor in the module will move at a changing speed according to the flow of water (Hudiono et al., 2021).

2. Flowchart

Flowcharts are parts that have flow and describe the steps of solving a flowchart problem, have a way of presenting an algorithm, there are three purposes of making a flowchart (Xinogalos, 2013). According to Azhar aryad in research (Note, 2007) mentioned that flowchart or flow chart is a process chart that shows a sequence of procedures, or process flow. The flowchart used by the author in this study is a flowchart monitoring soil moisture and irrigation of water drops on chili plants using solar panels.

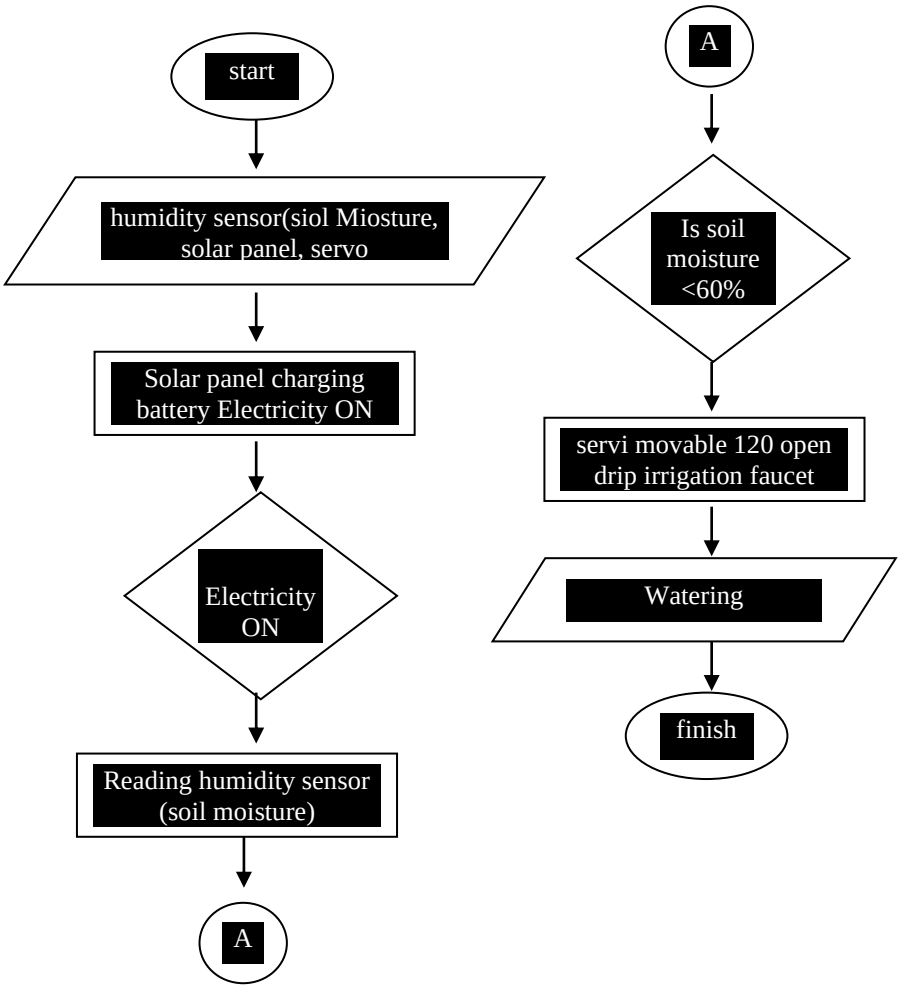

Figure 3. Flowchart

Network Design

Circuit design is a stage consisting of several components in the form of inputs and outputs. Design begins with designing a series of tools and components into a system and then assembled into a unified system.

1. Tool Schematic Suite

The schematic series of tools is created using Fritzing Software in the form of an overview of the entire tool that will be implemented in real form. Here is an example of a schematic circuit of the entire tool to be used. The series can be seen in the picture.

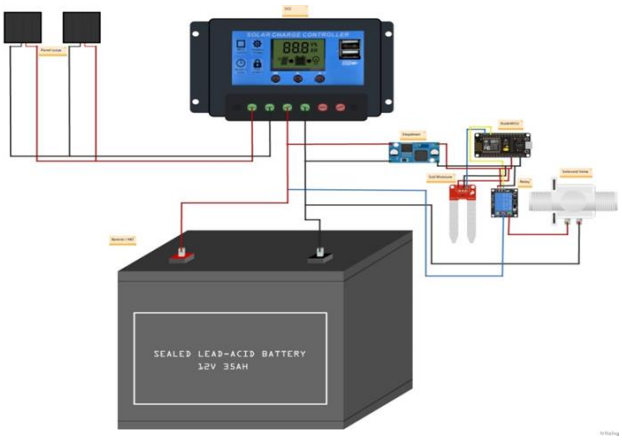

Figure 4. Schematic Suite

2. Tool Design

The design of the tool is made to get a 3D picture of the tool to be designed with the aim of being a guide in making the tool. The design of this tool is made with Blender software in the form of 3D modeling which is designed in such a way as to make it easier for the author to get a real picture of the tool to be created. Below is an example of a tool design that the author will use in research.

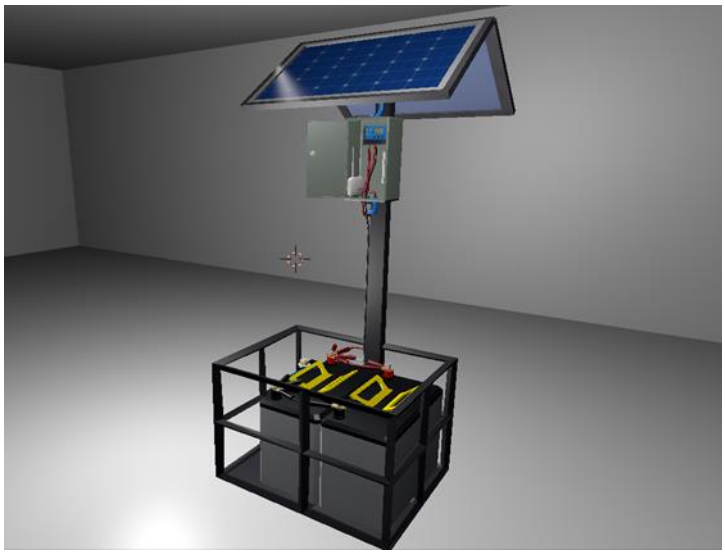

Figure 5. Tool Schematic Suite

3. RESULTS AND DISCUSSION

At this stage, testing of the performance of the soil moisture monitoring system and drip irrigation of water on chili plants using solar panels was carried out. Testing in this study includes 3 things, namely testing on sensors, system testing, and tool performance testing. The testing conducted aims to determine the performance of the tool in this study can run well according to the author's expectations.

Figure 6. Physical form of photo equipment with chili farmer group

3.1 Testing

Tool testing is a stage carried out by the author which is carried out by testing directly on case studies

1. Soil Moisture Sensor Testing

The purpose of this test is to determine the performance of the soil moisture sensor in detecting the moisture of chili plants with a minimum moisture value of 60% which functions as an indicator of ON / OFF control on the solenoid valve.

Table 1. Soil moisture sensor testing

Soil condition	Moisture Value	Selenoid Valve
Dry	56%	ON
Normal	60%	OFF
Moist	81%	OFF

Note : dry = <60%, Normal = 60%-80%

Table 1 performed that sensor Soil moisture showed the soil moisture was less than 60%, indicating active solenoid. Otherwise, the soil moisture more than 60% indicating non active solenoid valve.

2. Web Testing

Tests are carried out to ensure that there are no errors in the control program via the Web that is used to obtain soil moisture information made, the results of the Web interface test are shown in the figure.

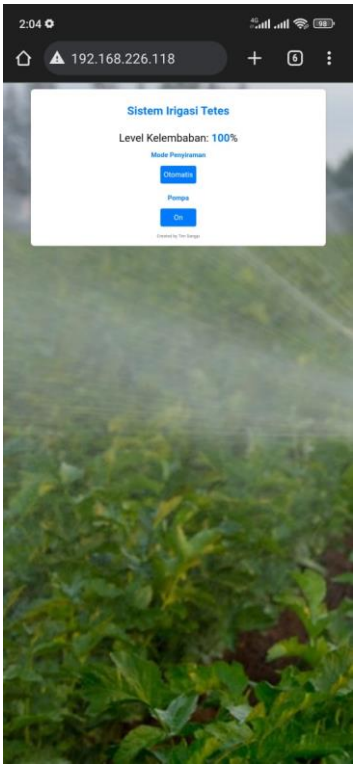

Figure.7 WEB Testing

3. Overall testing of the tool

Testing of the tool as a whole was carried out by testing directly on the case study, which was carried out in the Kertosari Village Farmer Group, Tanjung Sari District, South Lampung.

Table 2. Overall testing of the tool

No	Watering time	Soil moisture	Selenoid Valve	Water Status
1	29-09-2023 07.45	52%	ON	Live
2	30-09-2023 07.45	53%	ON	Live
3	01-10-2023 07.45	58%	ON	Live
4	02-10-2023 07.45	53%	ON	Live

5	03-10-2023 07.45	56%	ON	Live
6	04-10-2023 07.45	55%	ON	Live
7	05-10-2023 07.45	55%	ON	Live
8	06-10-2023 07.45	55%	ON	Live
9	07-10-2023 07.45	58%	ON	Live
10	08-10-2023 07.45	58%	ON	Live
11	09-10-2023 07.45	57%	ON	Live
Average		55%		

Table 2, test results are obtained from the entire tool where the table displays soil moisture data on chili plants with a predetermined watering schedule. In the trial conducted by the author, starting from September 29 - October 9, 2023 with an average soil moisture yield of 55%, this was adjusted to the conditions and soil moisture in the case study. Then the status of the solenoid valve will follow the condition of soil moisture.

3.2 Discussion

Testing of the tool was carried out in a direct case study, namely in the farmer group of Kertosari Village, Tanjungsari District, South Lampung. In this study, the initial stage of testing the soil moisture sensor where the sensor can detect soil moisture with three conditions, namely dry, normal, and moist. These three conditions have a limit on soil moisture values, namely dry less than 60%, normal 60% to 80%, and if moist then the moisture value is above 81%. if the soil condition is dry then the selenoid valve will turn on or ON then if the soil conditions are normal and moist then the solenoid valve is OFF. In this condition, the MCU node microcontroller will send data via web which can be accessed using Android or laptop.

CONCLUSION

This research entitled Soil Moisture Monitoring System and Water Drip Irrigation on Chili Plants Using Solar Panels". Soil moisture monitoring system and drip irrigation This time it can be monitored and controlled via the web so that it can facilitate agriculture, especially chili crop farming owned by the Kertosari Village farmer group, Tanjungsari District, South Lampung. In this study, watering chili plants was carried out when soil moisture reached <60% on the watering schedule at 07.45 WIB. With an average soil moisture in trials conducted for 5 days, which is 55%. In this study, the system gets the voltage supplied from the PLTS made by the author, the PLTS was built using solar panels of 20 WP then the power is accommodated by batteries and connected to microcontrollers and selenoid valves.

ACKNOWLEDGEMENTS

With great respect and appreciation, we would like to express our deepest gratitude to all authors who have contributed to the preparation of this journal. Your work and dedication not only enrich our knowledge but also provide invaluable insights for the development of science in this field. In addition, we also express our sincere gratitude to the funders who have provided financial support, without your help, the research and publication of this journal would not have been possible. Your commitment and support are greatly appreciated and encourage us to continue to work and provide the best.

REFERENCES

Bianchi, N., & Dai Pre, M. (2003). Active power filter control using neural network technologies. IEE Proceedings-Electric Power Applications, 150(2), 139–145. https://doi.org/10.1049/ip-epa

Fakhrah, F., Unaida, R., Faradhillah, F., Usrati, K., & Wati, M. (2022). Analisis Efektivitas Penyaluran Air Melalui Penerapan Irigasi Tetes (Drip Irigation) Pada Tanaman Cabai Di Lahan Kering. Jurnal Agrium, 19(3), 240. https://doi.org/10.29103/agrium.v19i3.8749

Hudiono, Taufik, M., Perdana, R. H. Y., & Rakhmania, A. E. (2021). Digital centralized water meter using 433 mhz lora. Bulletin of Electrical Engineering and Informatics, 10(4), 2062–2071. https://doi.org/10.11591/EEI.V10I4.2950

Kim, C. H., Weston, R. H., Hodgson, A., & Lee, K. H. (2003). The complementary use of IDEF and UML modelling approaches. Computers in Industry, 50(1), 35–56. https://doi.org/10.1016/S0166-3615(02)00145-8

Kirianaki, N. V, Yurish, S. Y., Shpak, N. O., & Deynega, V. P. (2002). Data Acquisition and Signal Processing for Smart Sensors. In Measurement Science and Technology (Vol. 13, Issue 9). https://doi.org/10.1088/0957-0233/13/9/706

Labrador, G. A. (n.d.). Heat energy recapture and recycle and its new applications. https://doi.org/10.1126/science.aad1920.22

Note, P. (2007). H-ll-PRODUCTION NOTE.

Nurfurqon, F. F., Wardani, D. S., & Wulandari, M. A. (2022). The Effect of The Value Clarification Technology Model on Elementary School Students' Learning Motivation in Social Studies Learning. Jurnal Basicedu, 6(2), 2556–2564. https://doi.org/10.31004/basicedu.v6i2.2385

Priyono, A., & Triadyaksa, P. (2020). Sistem penyiram tanaman cabai otomatis untuk menjaga kelembaban tanah berbasis esp8266. Berkala Fisika, 23(3), 91–100.

S. S. Y. D. Evi and G. V Ijaykiran. (2017). Things of Internet Based Smart Environmental Monitoring Using Node MCU. Ijsetr, 06(04), 789–794.

Ukar, I. A., Karna, N., & Suparta, I. P. Y. N. (2022). Purwarupa Sistem Otomasi Perawatan Tanaman Cabai pada Smart Greenbox Berbasis Iot. Jurnal Ilmiah Pendidikan Teknik Elektro, 2, 161–172.

Xinogalos, S. (2013). Using flowchart-based programming environments for simplifying programming and software engineering processes. IEEE Global Engineering Education Conference, EDUCON, March, 1313–1322. https://doi.org/10.1109/EduCon.2013.6530276

Zikrilla, Irawan, E. R., Rahmasari, E., Kurniadi, R., Aprilinando, D., Ratnasari, A. D., Novitasari, T. A., Syah, A. L., Pangestu, Y., Nurrahman, Y. F., & Hakim, L. (2021). Otomatisasi Sistem Irigasi Pada Tanaman Cabai Berbasis Arduino Dengan Parameter Kelembaban Tanah. Seminar Nasional Terapan Riset Inovatif (SENTRINOV) Ke-7, 7(3), 301–308.

Zotarelli, L., Dukes, M. D., Scholberg, J. M. S., Femminella, K., & Muñoz-Carpena, R. (2011). Irrigation Scheduling for Green Bell Peppers Using Capacitance Soil Moisture Sensors. Journal of Irrigation and Drainage Engineering, 137(2), 73–81. https://doi.org/10.1061/(asce)ir.1943-4774.0000281