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Design And Construction Of Soil Monitoring In Chili Farming Using Temperature, Ph And Humidity Sensors Based On Arduino Uno

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ABSTRACT

Modern agriculture is increasingly adopting technology to improve efficiency and productivity. This study proposes the development of a Multi-sensor-based Chili Plant Monitoring System integrated with Internet of Things (IoT) technology and accessed via a website. This study is designed to monitor important parameters such as temperature, soil moisture, and soil pH in real-time to improve the efficiency of agricultural management. This system uses a number of sensors placed around chili plants to measure environmental parameters accurately. The temperature sensor is used to monitor the temperature of the plant environment, while the soil moisture sensor monitors the level of soil moisture which is important for plant health. Thus, they can monitor the condition of their chili plants remotely and make more timely decisions. In addition, the system can provide automatic notifications to farmers via the website when environmental conditions reach a specified limit. For example, farmers can receive a notification if the temperature exceeds a threshold or if soil moisture drops below the desired level. This allows farmers to take preventive measures or make necessary adjustments quickly. This research makes an important contribution to the development of efficient and sustainable technology-based agriculture. The implementation of the Multi-sensor-Based Chili Plant Monitoring System accessed via this website allows farmers to better manage their agricultural land, increase yields, and optimize resource use.

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INTRODUCTION.

Modern agriculture is increasingly adopting technology to improve efficiency and productivity. One of the most popular technologies is Internet of Things (IoT)-based agricultural monitoring that utilizes connected sensors to collect real-time data on the agricultural environment. In this context, this study aims to discuss the development of a Multisensor-Based Chili Plant Monitoring System integrated with IoT technology and accessed via a website.

Agriculture is one of the sectors in meeting food needs and sources of community income. However, challenges such as climate change, lack of resources, and pest and disease attacks often prevent farmers from achieving optimal harvests. Therefore, the use of accurate and integrated monitoring technology is becoming increasingly important in efficient and sustainable agricultural management.

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This study aims to develop a Multisensor-Based Chili Plant Monitoring System that allows farmers to monitor the condition of chili plants in real time using temperature, soil moisture, and soil pH sensors. The temperature sensor is used to monitor the temperature around the plant, while the soil moisture sensor monitors the level of soil moisture which is important for plant growth. In addition, the soil pH sensor is used to measure soil acidity which affects the availability of nutrients for chili plants.

The implementation of this system involves the use of IoT technology to transmit data collected by these sensors to a control center connected to a website. The data is processed and displayed in the form of graphs and interactive displays on a website that can be accessed by farmers through any internet-connected device. This makes it easier for farmers to monitor the condition of their chili plants remotely and take timely action based on the data obtained.

The use of this Multisensor-Based Chili Plant Monitoring System provides significant potential benefits for chili farmers. They can optimize the use of resources such as water and fertilizer by monitoring soil moisture levels and soil pH in real time. In addition, the system can also provide automatic notifications to farmers if environmental conditions reach a specified limit, such as extreme temperatures or drought. Thus, farmers can take preventive measures or necessary adjustments quickly.

Through this research, it is hoped that it can contribute to the development of efficient and sustainable agricultural technology. With the implementation of the Multisensor-Based Chili Plant Monitoring System accessed through the website, farmers can better manage their agricultural land, increase yields, and optimize resource use. This research also has the potential to be the basis for the development of a broader IoT-based agricultural monitoring system in the future.

METHOD

The research procedure can be seen in Figure 1. This procedure explains the steps of how all components work which are then used to produce a complete system that can be implemented according to the initial objectives of the designed system.

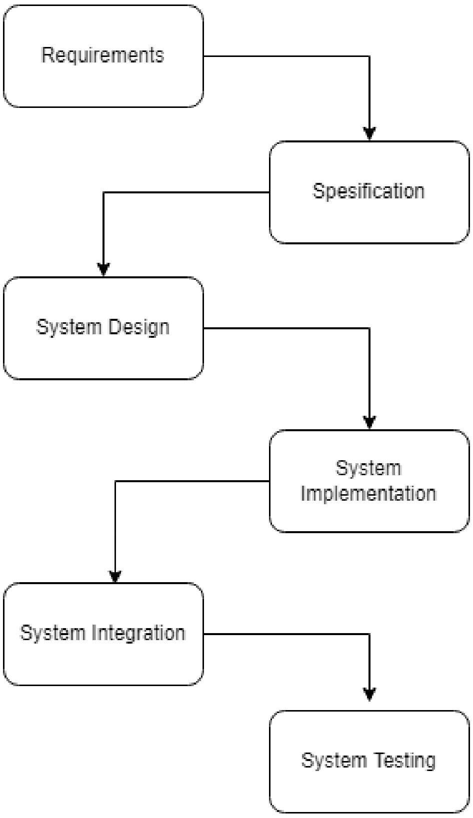

Figure 1. Research Procedure

Conduct a comprehensive literature study on IoT-based agricultural monitoring, temperature, soil moisture, and soil pH sensor technologies, and their applications in agriculture. Examine previous related studies to understand the existing framework and methodology. A sensor is a device or tool used to convert physical signals, such as temperature, humidity, light, into electrical signals that can be measured and processed. Sensors are tasked with detecting or measuring certain environmental parameters or conditions.

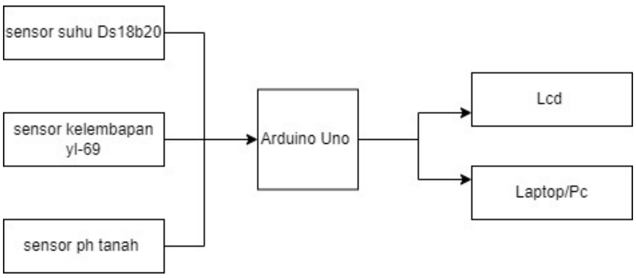

Figure 2. Sensor Flow Chart

In this system there is a soil condition section consisting of several parameters as data input to the sensor, namely soil pH, soil moisture and soil temperature. Second, there is a sensor node consisting of a Ph sensor, DS1820 sensor and humidity sensor, the sensor will send data to the microcontroller for further processing. Third, there is a microcontroller section in the form of Arduino Uno as a tool to process all data received

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from each sensor. Fourth, there is a display section in the form of a 16x2 LCD that will display all readings from each sensor used.

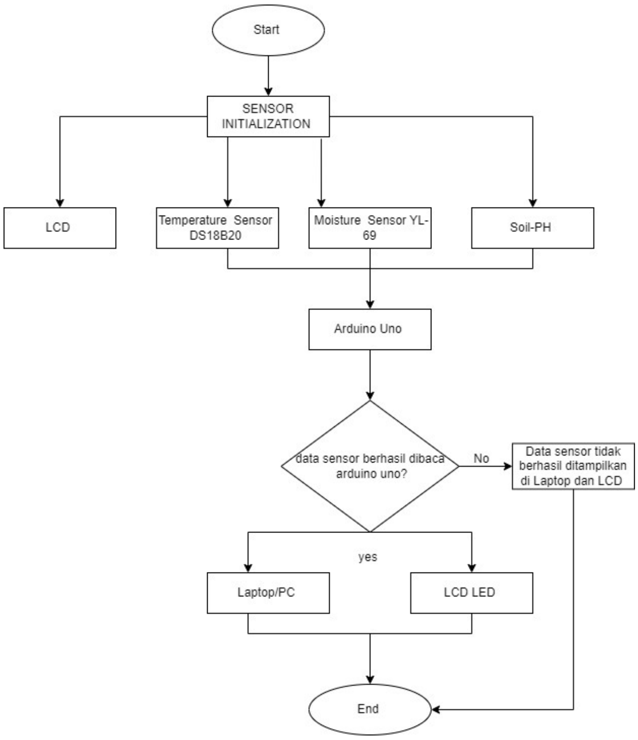

Figure 3. Flowchart Monitoring all sensors

The researcher designed a flow diagram of the monitoring system to be created. The diagram shows how the sensor node device works, starting with the initialization of each sensor used to determine whether each sensor can be used or is active, then the Arduino Uno will wait and receive reading data from each sensor. which will then be displayed on a laptop/PC and 16x2 LCD. If the sensor reading results are displayed on a laptop/PC and 16x2 LCD, it can be said that the sensor node device's working system is running well, but if the sensor reading data is not displayed, the system will re-initialize all the sensors used until the sensor reading results can be displayed on the 16x2 LCD. The design of the monitoring subsystem consists of several sensor components, microcontrollers connected by cables. The following is the sensor design wiring:

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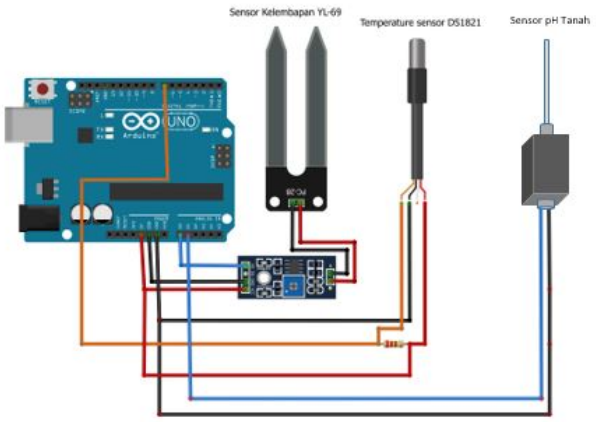

Figure 4 Sensor system wiring

Image Description 5:
(1) Arduino Uno
(2) Soil moisture sensor
(3) ds18b20 temperature sensor
(4) Soil pH sensor
(5) LCD

RESULT

Design and Implementation of the Data Transmission Communication and Monitoring Website Dashboard Implementation.

Serial communication is data communication by sending data one by one, so that serial data communication can function by using only 2 data cables for transmission. The 2 data cables are Transmitter Tx as transmitter and Receiver Rx as receiver. This serial communication can provide advantages compared to parallel communication, because in serial communication the distance between sending and receiving can be done with a fairly large distance compared to parallel communication, but the speed obtained is still slower than parallel communication.

Synchronous serial data communication is a form of serial data communication that requires a clock signal for synchronization, the clock signal will light up on each bit of the first bit sent with a change in data bits that can be known by the recipient by synchronizing via the clock signal.

While asynchronous communication is serial data communication that does not require a clock signal for synchronization. However, this data transmission must begin with the start bit and end with the stop bit. The clock signal is the baud rate of data communication produced by each recipient and sender of data with the same frequency, if the baud rate value is different then communication will never occur. In principle, the recipient only needs to detect the start bit as the start of data transmission, then data communication occurs between the two shift registers on the sender and receiver.

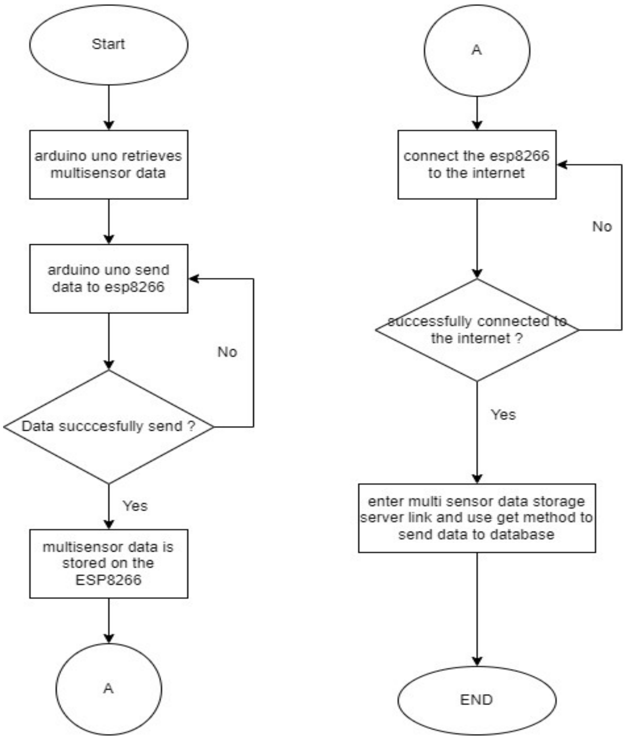

Figure 5. Process Flow Diagram of the mechanism for sending sensor reading data to the database that has been created to be displayed on the website dashboard.

Arduino uno acts as a reader of sensor results that will be displayed on the website dashboard. After the sensor data is successfully read by Arduino uno, the sensor reading data is sent to the ESP 8266 with serial communication. Sensor reading data is stored on the ESP 8266 before being sent to the database to be displayed on the website dashboard. After the sensor reading data is stored on the ESP8266, the ESP 8266 is connected to the internet so that sending data to the database to be displayed is successful. After the ESP8266 is successfully connected to the internet, the next step is to run the Arduino idea program that has been created to carry out the process of sending data to the database created using the HTTP GET method.

Implementation Prototype.

The following is the prototype implementation of the frame sensor:

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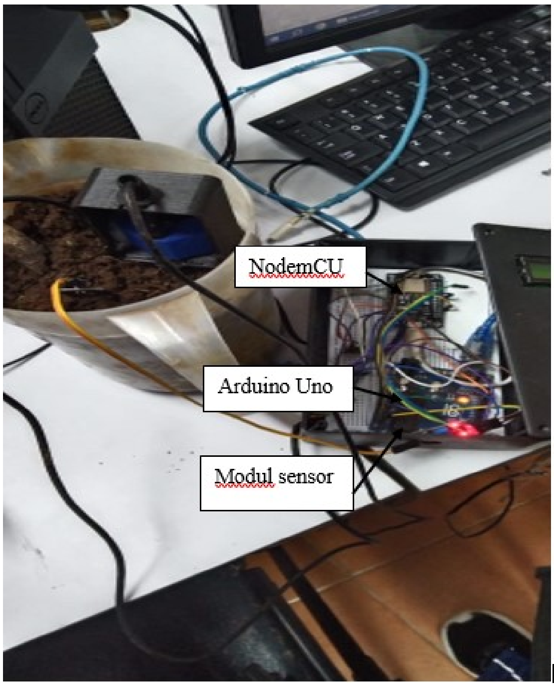

Figure 6. Implementation of the Overall Sensor Framework

Figure 6 shows that all components of the sensor frame body prototype have been completed and calibrated, after which all components are made in one box to avoid damage to each sensor module.

Figure 7. Display of chili field monitoring system

The implementation is carried out in open land planted with red chili. This monitoring is carried out in real time to obtain information on temperature, humidity and soil pH. This land is a very large land in the lowlands. The area of this chili land is estimated to be around 500 m x 30 m. When monitoring this chili land, the weather in that place changes so that the information data obtained is not significant Figure 7. Display of chili field monitoring system

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around 500 m x 30 m. When monitoring this chili land, the weather in that place changes so that the information data obtained is not significant.

Monitoring System Testing and Analysis

Sensor calibration testing is the process of verifying and confirming the accuracy and consistency of sensor readings. This is done by comparing the sensor response to a known or known value with high precision.% Error = |(xy)/y|×100 %Where x is the sensor reading value, while y is the measuring instrument reading value. To obtain the accuracy of each sensor whose data will be taken and tested, the following formula can be used:

Accuracy = 100% - (average error)

Monitoring system testing is carried out for 7 trial days, to obtain valid information or data every day.

Table 1 Temperature sensor testing

No	Times	Temperature DS18B20	Thermometer	Error (%)
1	12:00:46	27.7	28	0,16
2	12:15:50	28.3	29.6	0,49
3	12:30:54	27.7	29	0,05
4	12:45:58	28.1	29.4	0,23
5	13:00:02	28.3	29.6	0,31
6	13:15:06	28.1	29.2	0,54
7	13:30:10	28.3	29.3	0,02
8	13:45:14	28.2	29.2	0,28
9	14:00:18	28.1	29.2	0,23
10	14:15:23	27.6	29	0,48
11	14:30:27	27.3	28.8	0,51
12	14:45:31	27.3	28.7	0,51
13	15:00:35	27.3	28.7	0,23
14	15:15:39	27.4	28.7	0,23
15	15:30:43	27.8	28.8	0,24
16	15:45:47	28.3	29.3	0,46
17	16:00:51	27.8	28.5	0,04
18	16:15:55	27.4	27.9	0,23
19	16:30:59	26.8	27.3	0,02
20	16:45:03	26.2	26.8	0,45
Rata-rata			0,041	1,025

Monitoring the temperature of the soil

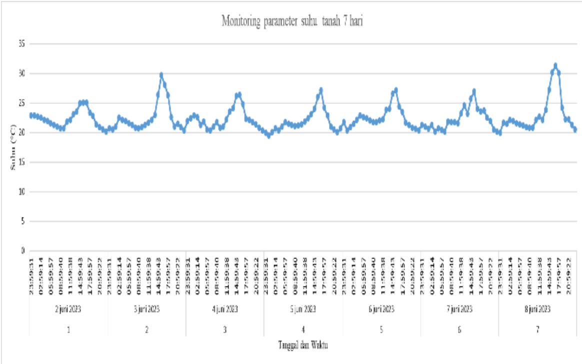

Figure 8 temperature monitoring graph

Figure 8 shows a graph of the measurement of the soil temperature of the chili land for 7 days on October 2 - October 10, 2024. It is known that the soil temperature in the morning at 09.00 - 11.00 has a range of values from 22°C. - 23°C, in the afternoon at 11.00-15.00 the temperature increases and has a range of values of 24C - 28°C, and in the afternoon at 15.00 - 17.00 the temperature drops again and is in the range of 20°C - 23°C. The characteristics of temperature measurements on 7 days have the same pattern as the previous day.

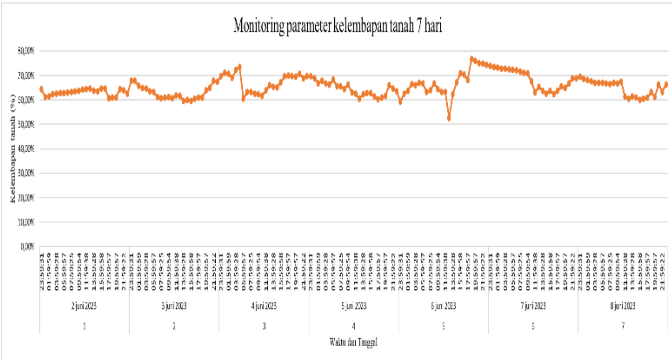

Figure 9. Humidity monitoring graph

Figure 9 shows a graph of soil moisture measurements of chili fields for 7 days on October 2 - October 10, 2023. It is known that a soil humidity in the morning at 09.00 - 11.00 has a value range of 66% -72%, in the afternoon at 11.00-15.00 the air humidity decreases and has a value range of 56% - 65%, and in the afternoon at 15.00 - 17.00 the humidity increases again and is in the range of 66% - 72%. The characteristics of temperature measurements in 7 days have the same pattern as the previous day.

CONCLUSION

Based on the results of the design and implementation of a soil monitoring system for chili farming using temperature, pH, and humidity sensors based on Arduino Uno, the following conclusions can be drawn: The system successfully monitors soil conditions in real-time, including temperature, pH, and humidity parameters. Data obtained from the sensors is presented accurately through an easily accessible interface. With this system, farmers can save time and effort compared to manual monitoring. The information obtained helps in making more appropriate decisions regarding soil management and irrigation. The temperature, pH, and humidity sensors used showed good compatibility with the Arduino Uno platform, with stable sensor responses and consistent data during testing. This system supports precision agriculture practices by providing relevant data for optimizing the chili growing environment, thus potentially increasing yields and reducing the risk of losses due to non-ideal soil conditions. The Arduino Uno-based design allows this system to be easily implemented and further developed, such as integration with IoT technology for remote monitoring or the addition of other measurement parameters.

REFERENCES

Aryza. S. dkk (2021) Menganalisis Pemodelan Berbasis Data Desain Baru pada Sistem Pembangkit Listrik Piezoelektrik. Jurnal Institut Penelitian dan Kritik Internasional Budapest (BIRCI-Journal), 4(3), 5537-5547.

Aryza, S. et al (2022) Sistem Peningkatan Toilet Pintar Berbasis Kontrol Daur Ulang Hijau. Infokum, 10(02), 1156-1163.

AR Fenny Vinola (2020)Sistem Pemantauan dan Pengendalian Suhu Ruangan Berbasis Internet of Things," Teknik Elektro dan Komputer, Vol. 9, Hal. 117- 126.

Ajie, "Memulai Menggunakan Nodemcu Esp8266 Pada Arduino Ide," Indomaker, 22Desember 2018. [Online]. Tersedia:*Http://Indomaker.Com/Index.Php/2018/12/22/Memulai-Menggunakan-Nodemcu-Esp8266-Pada-Arduino-Idea/*[Diakses 31 Agustus 2021].

Anisah, S., Fitri, R., Taro, Z., & Wijaya, RF (2022). Perbandingan Efisiensi Pencahayaan (Led-CFL) Berbasis Teknologi Ramah Lingkungan.*Jurnal Teknik Terapan dan Ilmu Teknologi (JAETS)*Bahasa Indonesia:*4*(1), 568-577.

A. S. D. H. Puspowardoyo, Pembenihan dan Pembesaran Lele Dumbo Hemat Air, Bangka Belitung: Kanisius, 1996

D. Harianja, Kajian Tingkat Pencemaran Air di Kawasan Perairan Danau Toba Desa Silima Lombu Kecamatan Onanrunggu Kabupaten Samosir, Medan: Universitas Negeri Medan, 2018.

Hamdani, H., Tharo, Z., Anisah, S., & Lubis, SA (2020, September). Rancang Bangun Inverter Gelombang Sinus Termodifikasi Pada Pembangkit Listrik Tenaga Surya Untuk Rumah Tinggal. Di dalam*Prosiding Seminar Nasional Teknik UISU (SEMNASTEK)*(Vol. 3, No. 1, hal. 156-162).

L. S. a. L. Suryaningrum, Pemanfaatan Limbah Budidaya Ikan Lele (Clarias batrachus) untuk Ikan Nila (Oreochromis niloticus) dengan sistem resirkulasi, Berita Biologi, vol.14, no 3. pp 287-293, 2015.

Mandarani, Putri. (2012). Perancangan Dan Implementasi User InterfaceBerbasisWeb untuk Monitoring Suhu, Kelembaban dan Asap pada Ruangan Berbeda DenganMemanfaatkan Jaringan Local Area Network.Fakultas Teknologi Industri, Institut Teknologi Padang.

M. A. E. e. a. Bably, Influence of Water Quality on Fish Productivity, Beni-Suef Vetenary Medical journal.sj,vol,no.1,pp..313-318.

Oktofani, Y. (2013). Sistem Pengendalian Suhu Dan Kelembaban Berbasis Wireles Embedded System.Universitas Brawijaya, Malang.

Tarigan A. D (2018)Metode Baru Subjektif Kebijakan Pensiun Kabel Listrik. Dalam Konferensi Internasional Perspektif dan Kebijakan ASEAN (ICAP) (Vol. 1, No. 1, hlm. 183-186).