AUTOMATIC CHILI PLANT WATERING BASED ON INTERNET OF THINGS (IOT)

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ABSTRACT

Watering plants that are carried out by farmers on the land of thieves is still manual using human power, manual watering what is often used is to water with water through a water hose then the end of the hose is fitted with a water rotating device that is useful to rotate water so that it can reach many plants. To facilitate the watering of plants when farmers leave the city on agricultural land and know the level of soil moisture periodically, an automatic watering device based on IoT notification is made using the arduino Uno microcontroller. The whole tool is divided into several parts which consist of smartphone, esp, arduino uno revision three microcontroller, soil moisture, relay module, and pump. This tool works when the esp module connects to the internet, from esp then to siol moisture sensor if the level of moisture in the soil is detected below 70%, then provide information to the arduiono microcontroller to provide information on the humidity level to the LCD and the website www.pemuri.unaux.com as well as watering orders for plants. From the microcontroller then to the relay module to turn on the water pump. After the pump is running, the automation of the soil mositure sensor re-detects the soil moisture level, if it is above 70% then gives it again to the arduino microcontroller to give the command to turn off the pump. The results of the research show that esp can communicate well with arduino uno when it's connected to the internet.
Keywords: Internet of Things, Arduino Uno, Humidity Soil Moisture Sensor, ESP, Relay.

1. Introduction

At this time information technology is something that cannot be negotiated anymore(Ordila et al., 2020). Information technology is believed to be a means of change to gain convenience in activities of daily life and has a vital role in all fields, one of which is agriculture. So by making good use of technological information, agriculture in Indonesia will be more advanced(Qiang et al., 2011). PEMURI is an organization spearheaded by Riau youths who care about current agricultural conditions. PEMURI is a concrete step for the role of youth in supporting agricultural development.

Young Riau farmers have about 2 hectares of land on Jalan Sialang Butut, SAA Agro-tourism, Tenayan Raya District (28131) where several types of crops are planted on this land, namely: corn, red chilli, cayenne pepper, cucumber. Chili is a plant that does not grow well in the dry season where there is not much water stagnating and the air is not too humid(Mulyono et al., 2019). The moisture level in this red chili plant is around 65 -70%(Susilawati et al., 2022). Caring for chili plants besides fertilizing is proper watering(Ichwanudin, 2017). Watering is sometimes carried out regularly, but punctuality and humidity are not noticed by chili plant keepers(Maftu'Ah et al., 2019). Moreover, if the plant keeper has other activities, the watering of the plants will be increasingly irregular(Yang et al., 2018).

One of the manual watering methods that is often used is to water with water through a water hose, then attach the end of the hose to a water spinner that allows it to rotate the water so that it can reach many plants(Gómez-Chabla et al., 2019). But this method is also less effective, because we can't tell how much water has been splashed. As a result, if too much water is splashed, the moisture in the soil will be even higher(Madushanki et al., 2019). From these problems, the authors are moved to contribute to the community by making an IoT notification-based automatic chili plant watering tool using an Arduino microcontroller to help farmers or chili plant maintainers in watering agricultural land(Rayhana et al., 2020).

Research conducted by (Jacquline,2017) by title Design of Sensor and Microcontroller Based Automatic Plant Sprinkler. If the sensor detects that the water content in the soil is already in a humid condition, then the sensor sends a signal to the microcontroller to be able to deactivate the relay and solenoid valve and stop the watering function. This automatic tool can be used to assist the work of watering plants based on the sensor detection results regarding the moisture content in the soil(Waworundeng et al., 2017).

Research conducted by (Erricson Z, 2018) by Design And Construction Of Plant Waters Based On Arduino Uno Using Yl-39 And Yl-69 Humidity Sensors. This research was conducted by designing a structure that can water plants using the YL-69 soil moisture sensor which is controlled by Arduino Uno and instructed to Android to display the soil moisture value according to soil pH. The plant sprinkler system that has been made can water the plants automatically. Android will receive and display the value of the soil condition whether dry, moist or wet according to the readings from the soil moisture sensor(Zet Kafiar et al., 2018).

Research conducted by (Aziz Musthafa, 2018) by title Design and Build a Watering Control System for Shallots in a Greenhouse Using a Smartphone. In this research, we will combine microcontroller technology in agriculture. The trial results prove that the control system can help the performance of farmers or greenhouse management officers in controlling the watering of the plants they plant in the greenhouse. so that remote managers can water the plants in the greenhouse(Musthafa et al., 2018).

2. Methodology
The method in implementing this research consists of the following stages:
a.   Requirement definition

Here the researchers collected complete data in the form of soil moisture levels for chili plants at 70%, then analyzed and defined the needs to be used for development, namely doing automatic plant watering with a soil moisture sensor using the Arduino R3 microcontroller (Revision 3) based on IoT notifications. This is very important because it can help farmers when they are out of town(Siva et al., 2019).
b.   System and software design

In this stage the researcher describes the design of the system to be built in accordance with the data analysis carried out, namely when the dry plants are below 70%, this plant watering tool automatically sends information to the web and LCD that the plants are dry, then the pump automatically starts, and when the plant humidity is above. 70% then the pump automatically shuts down and sends periodic soil moisture level information to the web. At the previous stage. In modeling the system, researchers use procedural concepts(Wahyuni et al., 2021).
c.   Encoding

The program design in the previous stage was translated into codes using a programming language. In this system the programming language used is C ++ using the Arduino IDE software.
d.   Testing

In this stage, the modules that have been made are combined and tested to find out whether the system that has been built is in accordance with the design and whether there are still errors or not. Testing using the Black Box is testing carried out directly by the User.

3. Results and Discussions
Hardware Design
Hardware design is a design or a series of tools used to build a prototype of an automatic chili plant watering tool based on IoT notifications using the Arduino uno microcontroller(Prasojo et al., 2020).
Whole set of hardware configurations
The picture below is a whole series of automatic chili plant watering tools based on IoT notifications using an Arduino microcontroller.
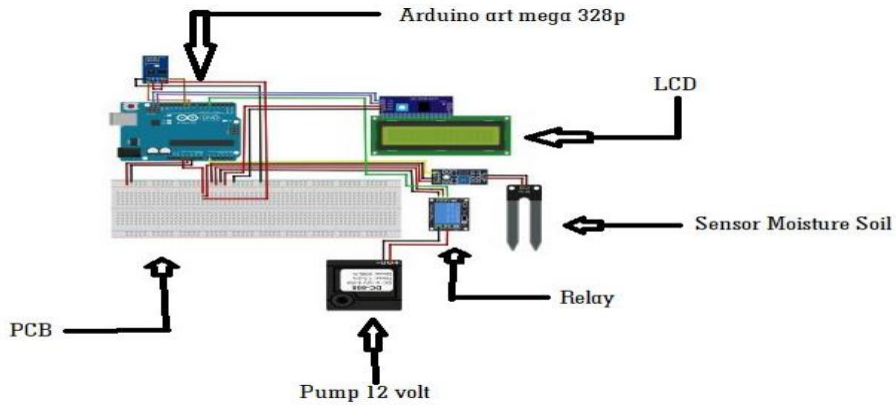
Fig.1. The Series of The Entire Hardware Configuration

Arduino microcontroller circuit with moisture soil sensor
This moisture soil sensor functions as a moisture level detector which is connected to the Arduino Microcontroller so that it can regularly detect soil moisture levels on agricultural land belonging to PEMURI members.
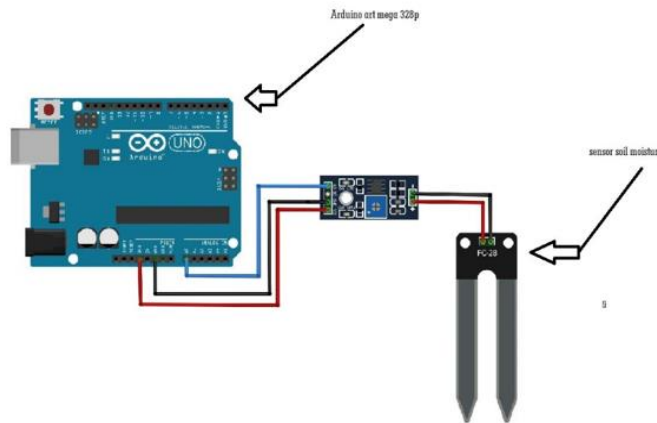

Fig. 2. Arduino Microcontroller Circuit with Soil Moisture Sensor

Arduino microcontroller circuit with a 12 volt pump
This pump functions as a tool to draw water which is connected to the Arduino Microcontroller so that it can water the chili plants.
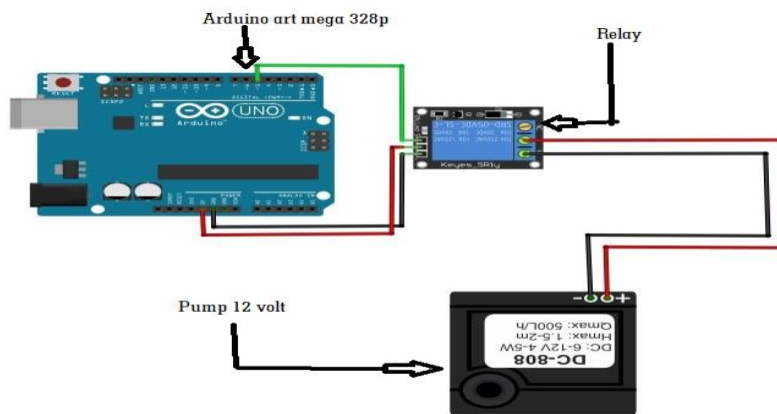

Fig. 3. Arduino microcontroller circuit with a 12 volt pump

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Arduino Microcontroller Circuit with LCD Module
This LCD module functions as a medium for providing information which is connected to the Arduino Microcontroller so that it can provide information about the soil moisture level periodically that is attached to the sensor.
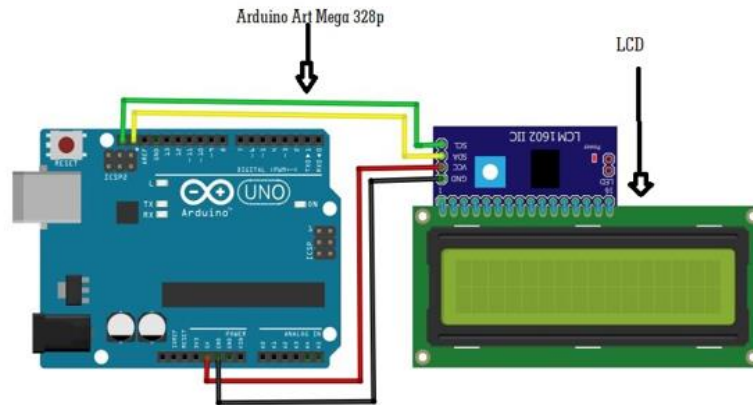

Fig. 4. Arduino Microcontroller Circuit with LCD Module

Arduino Uno Microcontroller Circuit with ESP8266-01S Module
This ESP8266-01S module functions as an internet network connector which is connected to the Arduino Microcontroller in order to send periodic soil moisture level data to the pemuri.unaux.com website.
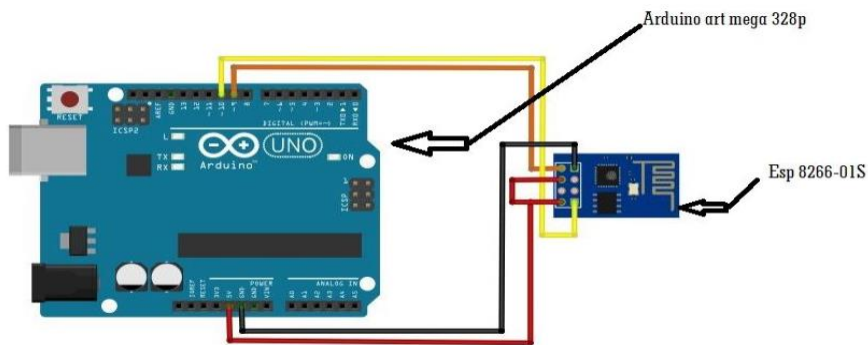

Fig. 5. Arduino Microcontroller Circuit with ESP8266-01S Module

Implementation of the IoT Notification-based plant sprinkler device.
Implementation is one of the stages in system development, this stage is the stage of placing an automatic plant watering tool on the chilli farm belonging to PEMURI members. Iot notification display on this tool can be seen in Figure 6 below:
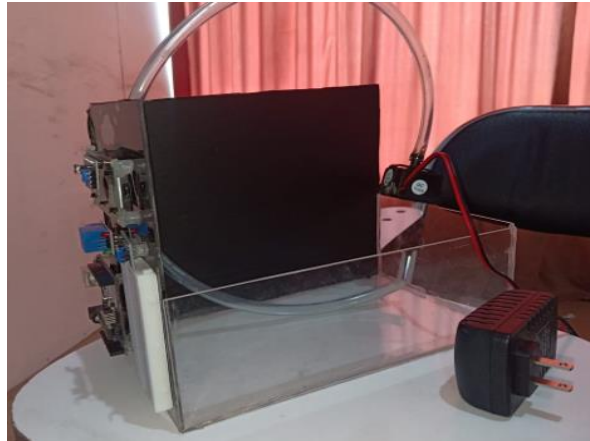
Fig. 6. Implementation of automatic plant watering hardware.

System Testing
Testing the system of an automatic chili plant watering device based on IoT notifications using an Arduino microcontroller can be done in steps as follows :
1. Connect the source of PLN electricity to the electrical power control hardware circuit.
2. After that the plant watering tool will turn on like its supporting devices, namely Arduino Uno, DC motor, Power Supply, and its relay circuit.

Fig. 7. System devices

Automatic plant watering test
This test is done by reading the soil moisture sensor. So that when the plant is below 70%, the pump will automatically start and if it is above 70%, the pump will automatically shut down.

Table 1 - Automatic Plant Watering Test

No	Testing Scenarios	Expected results	Test result
1	Installing sensor of *soil moisture*	Data sensor soil moisture Show at LCD	Successful
2	Installing a soil moisture sensor	The water pump will flush automatically and display soil moisture conditions on the LCD and Website	Successful
3	Soil moisture sensor is placed in moist soil	Displays soil moisture conditions in the form (%) on the LCD and Website	Successful
4	Soil moisture sensor is placed in the soil of the chili plant in wet conditions	The water pump is not active and displays soil moisture conditions in the form (%) on the LCD and website	Successful

5. Conclusion
    Based on the results of the analysis, design and implementation that has been done. So several conclusions can be drawn including the following: This automatic chili plant watering tool uses a soil moisture sensor that watering chili plants automatically based on IoT notifications.

This automatic chili plant watering tool can make it easier for farmers to do automatic plant watering. The head and members of PEMURI Farmers can easily monitor the soil moisture level regularly through the website www.pemuri.unaux.com.

References

Gómez-Chabla, R., Real-Avilés, K., Morán, C., Grijalva, P., & Recalde, T. (2019). IoT Applications in Agriculture: A Systematic Literature Review. *Advances in Intelligent Systems and Computing*, *901*, 68–76. https://doi.org/10.1007/978-3-030-10728-4_8

Ichwanudin, I. (2017). Kajian Dampak Sanitasi Total Berbasis Masyarakat Terhadap Akses Sanitasi di Kabupaten Wonogiri. *Jurnal Kesehatan Lingkungan Indonesia*, *15*(2), 46. https://doi.org/10.14710/jkli.15.2.46-49

Madushanki, A. A. R., Halgamuge, M. N., Wirasagoda, W. A. H. S., & Syed, A. (2019). Adoption of the Internet of Things (IoT) in agriculture and smart farming towards urban greening: A review. *International Journal of Advanced Computer Science and Applications*, *10*(4), 11–28. https://doi.org/10.14569/ijacsa.2019.0100402

Maftu'Ah, E., Susilawati, A., & Hayati, A. (2019). Effectiveness of ameliorant and fertilizer on improving soil fertility, growth and yields of red chili in degraded peatland. *IOP Conference Series: Earth and Environmental Science*, *393*(1). https://doi.org/10.1088/1755-1315/393/1/012011

Mulyono, D., Hilman, Y., Sastro, Y., & Setiani, R. (2019). Various cropping patterns of chili and shallot crops as land intensification program in some production centers. *IOP Conference Series: Earth and Environmental Science*, *399*(1). https://doi.org/10.1088/1755-1315/399/1/012082

Musthafa, A., Utama, S. N., & Harmini, T. (2018). Rancang Bangun Sistem Kontrol Penyiraman Tanaman Bawang Merah pada Greenhouse Menggunakan Smartphone. *Seminar Nasional Teknik Elektro*, 195–198.

Ordila, R., Wahyuni, R., Irawan, Y., & Sari, M. Y. (2020). Penerapan Data Mining Untuk Pengelompokan Data Rekam Medis Pasien Berdasarkan Jenis Penyakit Dengan Algoritma Clustering …. *Jurnal Ilmu Komputer*, *9*(2), 148–153. https://jik.htp.ac.id/index.php/jik/article/view/181

Prasojo, I., Maseleno, A., Tanane, O., & Shahu, N. (2020). Design of automatic watering system based on arduino. *Journal of Robotics and Control (JRC)*, *1*(2), 55–58. https://doi.org/10.18196/jrc.1213

Qiang, C. Z., Kuek, S. C., Dymond, A., & Esselaar, S. (2011). *Mobile Applications for Agriculture and Rural Development*. *December*.

Rayhana, R., Xiao, G., & Liu, Z. (2020). Internet of Things Empowered Smart Greenhouse Farming. *IEEE Journal of Radio Frequency Identification*, *4*(3), 195–211. https://doi.org/10.1109/JRFID.2020.2984391

Siva, K. N., Raj Kumar, G., Bagubali, A., & Krishnan, K. V. (2019). Smart watering of plants. *Proceedings - International Conference on Vision Towards Emerging Trends in Communication and Networking, ViTECoN 2019*, *March 2019*. https://doi.org/10.1109/ViTECoN.2019.8899371

Susilawati, Irmawati, Ammar, M., Harun, M. U., Syukur, M., Bastoni, & Novitasari. (2022). Growth and Yield of Several Red Chilli (Capsicum Annuum L.) Peat-Strains on Peat Soil. *IOP Conference Series: Earth and Environmental Science*, *995*(1), 012049. https://doi.org/10.1088/1755-1315/995/1/012049

Wahyuni, R., Rickyta, A., Rahmalisa, U., & Irawan, Y. (2021). Home security alarm using wemos D1 and HC-SR501 sensor based telegram notification. *Journal of Robotics and Control (JRC)*, *2*(3), 200–204. https://doi.org/10.18196/jrc.2378

Waworundeng, J. M. S., Chandra Suseno, N., & Manaha, R. R. Y. (2017). Perancangan Alat Penyiram Tanaman Otomatis berbasis Sensor dan Mikrokontroler. *Seminar Nasional Multi Disiplin Ilmu*, *1*(November), 241–247.

Yang, H., Liu, H., Zheng, J., & Huang, Q. (2018). Effects of regulated deficit irrigation on yield and water productivity of chili pepper (Capsicum annuum L.) in the arid environment of Northwest China. *Irrigation Science*, *36*(1), 61–74. https://doi.org/10.1007/s00271-017-

0566-4

Zet Kafiar, E., Kendek Allo, E., & J. Mamahit, D. (2018). Rancang Bangun Penyiram Tanaman Berbasis Arduino Uno Menggunakan Sensor. *Jurnal Teknik Elektro Dan Komputer*, *7*(3).