Internet of Things Design on Chili Plant

by R Hafid Hardyanto

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R. Hafid Hardyanto[1], Prahenusa Wahyu Ciptadi[2], Nurdin Mukhayat[3]

[1,2,3] Universitas PGRI Yogyakarta, Indonesia

[1]hafid@upy.ac.id, [2]nusa@upy.ac.id, [3]nurdinukay@gmail.com

Abstract. This study aims to develop system application in chili plants. Chili is a fruit commodity that cannot be released in daily needs. This plant is widely used to meet the need for vitamins and minerals necessary for growth and health. Many factors influence the development of plant cultivation, for example temperature, soil pH, humidity, the need for irradiation or light intensity used, and other factors. All of these are a combination that must be known in order to produce good chili plant growth. This study aims to produce a system design for monitoring the growth of chili plants based on the internet of things. The method used in this study uses a waterfall. The results of the study resulted in an IoT design on chili plants that is ready to be tested on a large scale.

1. Introduction

Indonesia is an agricultural country, the agricultural sector plays an important role in the national economy. One of the superior plant products is the chili plant. Based on data [1] the level of consumption of chili is estimated to increase from 2016-2019. To maintain the availability of national supplies, it is necessary to maintain the planting pattern so that the stability of chili production is stable. Chili plants grown in Indonesia are influenced by factors: environmental temperature, sunlight and soil fertility [2]. According to [3], the appropriate pH for chili cultivation ranges from 5.5 to 6.8 with an optimum pH of 6.0-6.5. While the optimal temperature for the growth of chili plants is 24ºC-28ºC [3]. According to [2] Light intensity greatly affects the growth of chili plants. Based on the results of research conducted by [4] with a light intensity of 100% (4287 lux), rice plants can grow optimally. Based on these factors, researchers are interested in engineering the growth of chili plants so that chili plants can grow optimally. The engineering carried out by researchers with this system uses temperature sensor parameters to regulate the temperature required for chili plants. This system also uses a light sensor, and also a PH sensor. This study aims to test the IoT-based chili plant engineering system.

2. Method

This research uses the prototyping method [5]. The stages in making a prototype of this system are as follows: Creating a hardware architecture design, designing a system process, implementing the system.

2.1. Literature review

2.2. The research by [6] describes the design of an automatic pesticide spraying system based on the type of disease that attacks using the Internet of Things. The results of the design concluded that in 10 trials the automatic spraying had determined the 100% success indicator. And Quality of Service for sending value during the trial with an index value of 3 (satisfactory). [7][8] Presented an idea of utilizing the internet of things (IoT) for hydroponic farming methods. This research produces an IoT technology design that is implemented in the hydroponic farming method. This design consists of a hardware system design and system software for the system user interface. IoT design also consists of hardware, software and data base. The user interface is also required so that users can monitor directly [9][10].

In the study conducted by [11], Establish remote monitoring system for soil parameters. This system provides information about the pH value, temperature and soil water content. This system works according to the sensor information. In this case, the antimony electrode is used for pH measurement. Soil temperature determination is done using the DS18B20 sensor. The research by [12] design a remote spraying machine status monitoring system. This system was built using microwave and vibration sensors to prevent invasions with the operation of sprinkler machines. The research by [13] propose a system that will capture all the details about soil and temperature using different sensors. The data from the sensor will be forwarded to the processor so that the system can determine the amount of water that must be given to the plants. This system can also determine the amount of fertilizer that must be given to plants. The research by [14] about the monitoring system for smart home.

3. Results and Discussions

3.1. IoT Architecture for chili plants

Internet of Things Technology Implementation for chili plants consists of hardware and software. The device comprises of sensors, controls, power supplies, wifi modules. The software includes microcontroller, programming software and user interface via android app. The sensor comprises a light sensor, Soil moisture sensor, and humidity sensor, and the control system comprises of ESP8266 module for wireless communication. Figure.1 shows the overall architecture diagram of the Internet of Things Technology Implementation for chili plants. The water pump functions as a water spray to the plants if the soil lacks moisture according to the dosage of chili plants. The fan functions to control the temperature to keep it stable. If the hot temperature exceeds the specified parameter, the fan will turn on automatically, then the fan will turn off when the temperature returns to normal.

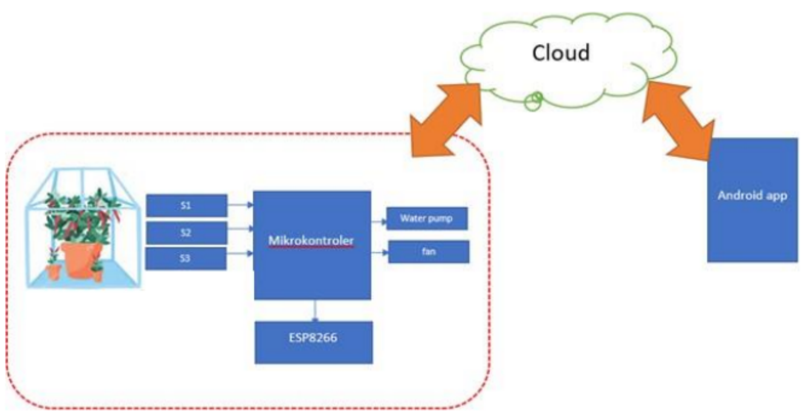

Figure 1. Architecture diagram of the Internet of Things Technology Implementation for chili plants

3.2. Work principle

The working principle of the IoT for the chili plants prototype shown in Figure 3. In Figure 3 it is explained that the IoT for the prototype chili plants is placed of 2 parts, hardware, and software. The device consists of the power supply, a sensor as an input to the microcontroller which is placed in the chili plants. Users can obtain information on temperature, lighting, and humidity on chili plants online. The way this system works is that the light sensor detects the amount of light received by chili plants. If the chili plants get less light, the system will notify the user via the Android application. The Temperature Sensor will provide information about the ambient temperature. If the ambient temperature is hotter than the predetermined maximum temperature, the fan will turn on until the temperature returns to normal. The humudity sensor will provide information about soil conditions.

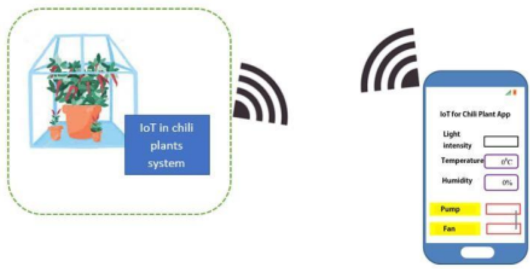

Figure 2. working principle of the IoT for the Hydroponic Planting Culture prototype

3.3. Experimental result

3.3.1 Hardware Experimental

IoT for the chili plants prototype consists of hardware and software. The experimental results show that the prototype has worked well. The temperature sensor is able to detect temperature according to environmental conditions. In temperature sensor testing is done by manipulating the ambient temperature to test whether the program is appropriate or not. Temperature sensor testing is carried out with the following procedure: If the temperature is more than 28^{o}C, the fan will turn on, if the temperature is below 28^{o}C the fan will turn off automatically. The experimental results are shown in the following table. The purpose in this experiment is to kept the temperature constant for maximum chili growth. The result is shown in table 1.

Table 1. Temperature sensor testing with fan

Temp (^{o}C)	Fan
24	Off
25	Off
28	Off
30	On
32	On
36	On

Light sensor testing also shows the system is running well. Light sensors are able to provide information to users about the amount of light received by plants. Testing the humidity sensor also shows that the system is running well. The sensor is able to detect soil moisture, if the soil is detected dry, the water pump will drain water into the ground until the soil conditions become normal (Ph 6.5).

3.3.2. Interface results

This system interface is designed using an android application. The web interface is designed to monitor the performance of sensors that provide information to users. Figure 6 shows the interface on the main activity android applications that have been created.

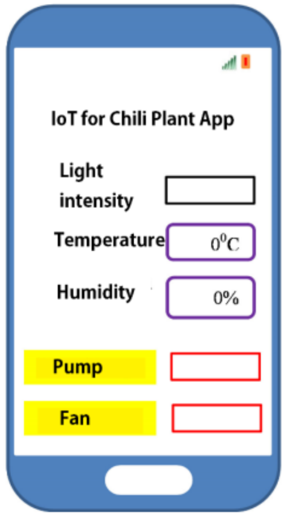

Figure 3. Android app for chili plants based on IoT

The functions of each of the interface features include: providing information on the light received by plants, informing the detected temperature in the surrounding environment, and informing soil moisture. The application also has 2 buttons, namely a button to turn on the water pump and a button to turn on the fan manually. If the button is pressed, the fan or pump will turn on according to the buttonpressed.

3.4. Discuss

In chili plants, optimal growth is influenced by factors of temperature, soil pH, humidity, the need for irradiation or the light intensity obtained by chili plants. After the system was completed, the system was tested on chili plants. The experiment was carried out by comparing chili plants that were installed with the IoT system and chili plants that were not installed by the IoT system. Based on the results of the system experiment, the results are obtained in table 2 below.

Table 2. Comparison of plants with IoT and plants without IoT

Week	Chili plant conditions	
	With IoT systems	without IoT systems
1	fresh	fresh
2	fresh	fresh
3	fresh	wither
4	fresh	wither

From these results, it can be seen that chili plants that use the IoT system can grow optimally compared to plants that do not use this IoT system. In this trial, only small-scale chili plants are used, so that if applied on a large scale it requires further testing. In this data collection, chili plants are in the room with maximum light intensity. This is done to control for other factors that are not needed in this study.

For hardware design, data transfer speed is affected by fast or slow internet connection. From these results it can be concluded that the system being developed is capable of monitoring and controlling the environmental temperature on a small scale.

4. Conclusion

Design of IoT for chili plants prototype has been successfully done. The IoT for chili plants prototype works well to monitor temperature, light, humidity via a android app. Based on this experiment chili plants that use the IoT system can grow optimally compared to plants that do not use this IoT system.

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