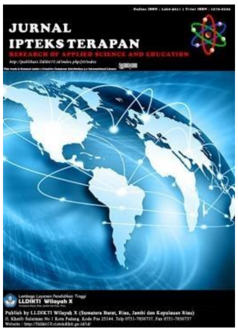

SMART IRRIGATION SYSTEM PROTOTYPE FOR RICE PLANTS USING THE AWD METHOD

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Abstract

Irrigation is a system for irrigation in the form of waterways used to distribute water. In fulfilling the need for water, especially in rice farming, it is necessary to increase agricultural yields and reduce crop failure. All of that can be done with a well-controlled irrigation system to increase agricultural profits. Irrigation systems, especially in rice farming, have irrigation systems that have been widely implemented in Indonesia and have been proven to increase agricultural yields. The farming system is called the wet-dry irrigation system. To control the irrigation system and to be able to monitor it regularly, an IoT-based irrigation system was created. The device used for the main control is Arduino Uno. The results of the smart irrigation system produce a prototype that can control irrigation based on soil moisture and close irrigation using a water level sensor. After creating the prototype of the IoT device, the process of irrigating the land can be carried out automatically according to the wet and dry irrigation system, and monitoring the condition of irrigating rice fields via the internet can be carried out to increase the effectiveness of farming.

Keywords: Arduino, AWD Irrigation, IoT

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INTRODUCTION

The increase in world population today is directly proportional to the increase in the need for food. Food needs, especially rice, will increase due to increased public consumption[1]. This can lead to food shortages if food production is not increased. Therefore, national food production must continue to be increased to meet the community's needs [2].

An increase in production results is influenced by how the irrigation system is applied. Irrigation can be interpreted as an irrigation system in the form of waterways which are usually used to distribute water from water sources to agricultural land to meet crop needs. Water is crucial in an irrigation system, so the new method must implement less water use compared to the old method [3][4]. Based on this function, the maintenance or development of irrigation systems is very important, considering that Indonesia has large agricultural land, especially rice. An optimal and well-controlled irrigation system can produce good agricultural results, in other words, increase agricultural yields and reduce crop failure [1][5][6].

The food needs of a region so that they do not have to rely on agricultural products from other regions to meet their food needs. To escape this dependency, a food management program is needed that specifies a location for use as agricultural land. A good irrigation or irrigation system is needed to develop increased food in agriculture. In this study, the problem was raised from the management of irrigation on paddy fields. Paddy land is one sector that is important to note [4][8][9][10].

Paddy or rice is the main commodity of Indonesian society. Paddy fields in Indonesia, in general, are still managed manually by farmers, especially the irrigation system. Irrigation systems carried out manually could be more efficient for plants, may not meet the needs, and result in a decrease in the quality of rice products. When water resources are reduced in the dry season, water use becomes more limited and needs to be used optimally without wasting water for unnecessary plant needs. Therefore we need a technology to increase rice production with the help of IoT, which works by monitoring the water content in rice fields and automatically adjusting irrigation systems that can improve the quality of rice products [11] [12].

RESEARCH METHODS

The author's steps in building a monitoring and control system for irrigation in paddy fields using the Research and Development (R&D) method are research methods used to produce a particular product and test the effectiveness of that product. The method used to develop smart irrigation can be seen in Figure 1 below:

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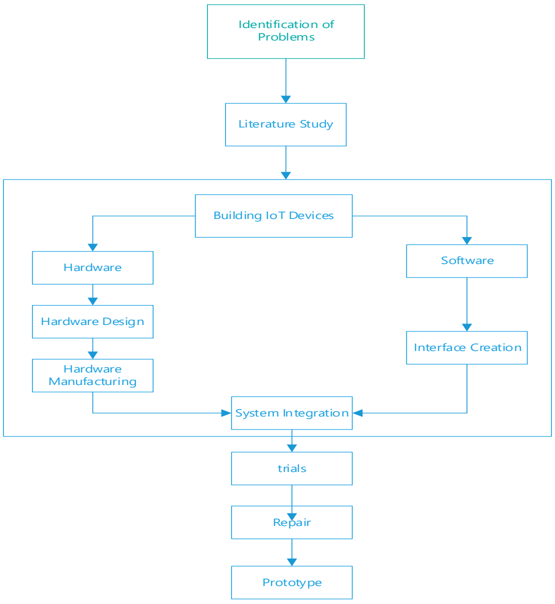

Figure 1. Development stages

The research was conducted using a research and development (R&D) methodology. This research model was carried out by first studying research on related topics that had been done previously. The results of studying previous research will later be used to create new improvements to products that have been made before. This is done to produce a better system design by making a prototype with development to increase further the results or benefits of the new product that has been made. The R&D methodology uses an iterative research system to create products that meet planned needs. The stages of project work are as follows [13].

Hardware design aims to design equipment/support circuits for the system, including flowcharts, schematic diagrams, and the manufacture of related tools and systems. The IoT device to be built consists of a soil moisture sensor and a water level sensor. The microcontroller used is Arduino UNO which will be connected to the internet using a WiFi module. The irrigation system will be controlled using a servo motor to open the floodgates and a water pump to distribute water when needed. At this stage, an interface is created to display the data sent by the microcontroller. Making interfaces using a third-party Cloud Platform IoT, namely Thinkspeak. Some input data from sensors will be collected. The data that has been collected will be calculated to calculate the average accuracy of the Soil Moisture sensor and Water Level sensor.

Testing is carried out by running the system to find out whether the tools that have been made are running properly. Testing includes the delay time from the sensor to the motor control. Testing is also done by seeing whether the data can appear on the website.

RESULTS AND DISCUSSION

Hardware design aims to design equipment/support circuits for the system to be made, including flowcharts, schematic diagrams, and the manufacture of related tools and systems. The IoT device that will be built consists of a soil moisture sensor and a water level sensor. The microcontroller used is Arduino UNO which will be connected to the internet using a WiFi module. Control of the irrigation system will be carried out using a servo motor to open the floodgates and a water pump to distribute water when needed [14]. The display of the IoT system to be built can be seen in Figure 1 below.

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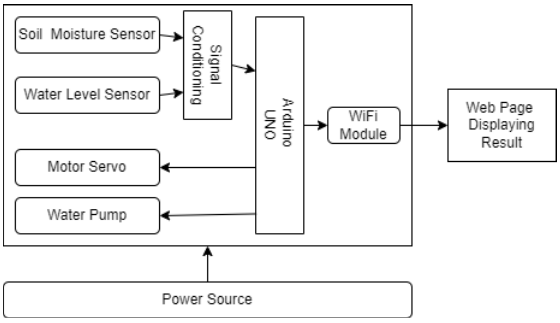

Figure 2. Block Diagram

The way the system or tool works is by taking data from the sensor, then the data will be processed by the microcontroller to then control the motor to run the irrigation system automatically. Apart from being directly processed by the microcontroller, sensor data is also sent to the IoT Cloud Platform service for system monitoring. Workflow or system flowchart can be seen in Figure 2 below

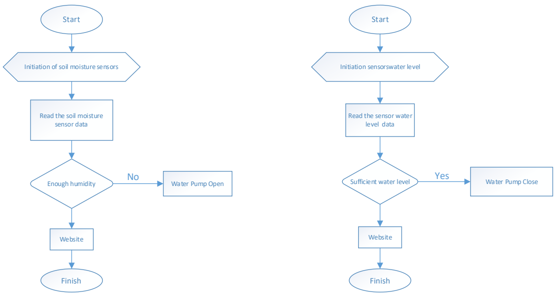

Figure 3. Flowchart Systems

Making a schematic of the tools used to provide data to monitor land can be seen in Figure 3 below.

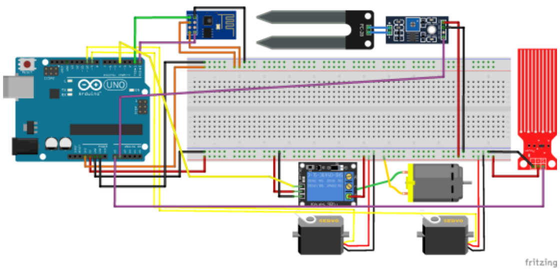

Figure 4. Schematic of the tools

After making the schematic of the IoT device, then the tool assembly is carried out, the results of which can be seen. The electronic circuit on the protoboard has a soil moisture detection sensor supported by a comparator and connected to a water level detection sensor installed as input to the Arduino UNO microcontroller so that the relay output functions to increase the voltage as well as an amplifier for physical rotation on the servo motor on the water pump which is obtained at the condition of the measurement sensor water level in copper in the soil—related to information sent over the network on the wifi module so that it can be displayed on the web server in the graphical form about soil moisture levels and water levels that have been set under certain conditions.

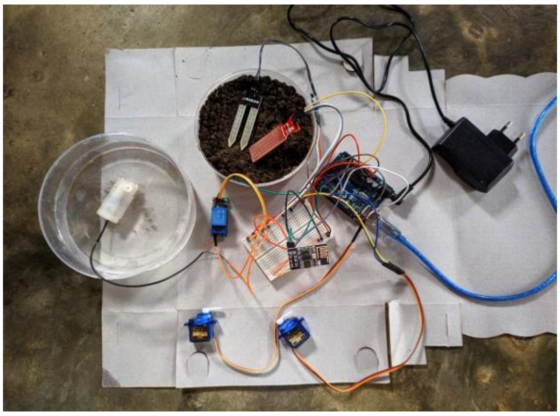
Figure 5. Schematic of the IoT device

At this stage, an interface is created to display the data sent by the microcontroller. We are creating an interface using a third-party IoT Cloud Platform, namely Thinkspeak, as shown in Figure 6 below.

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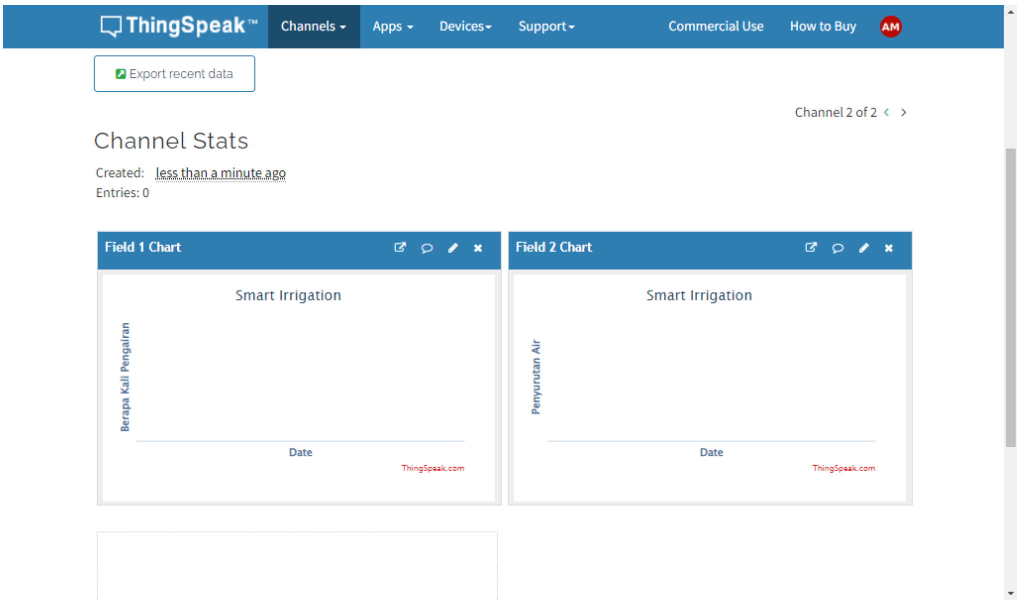

Figure 6. Interface

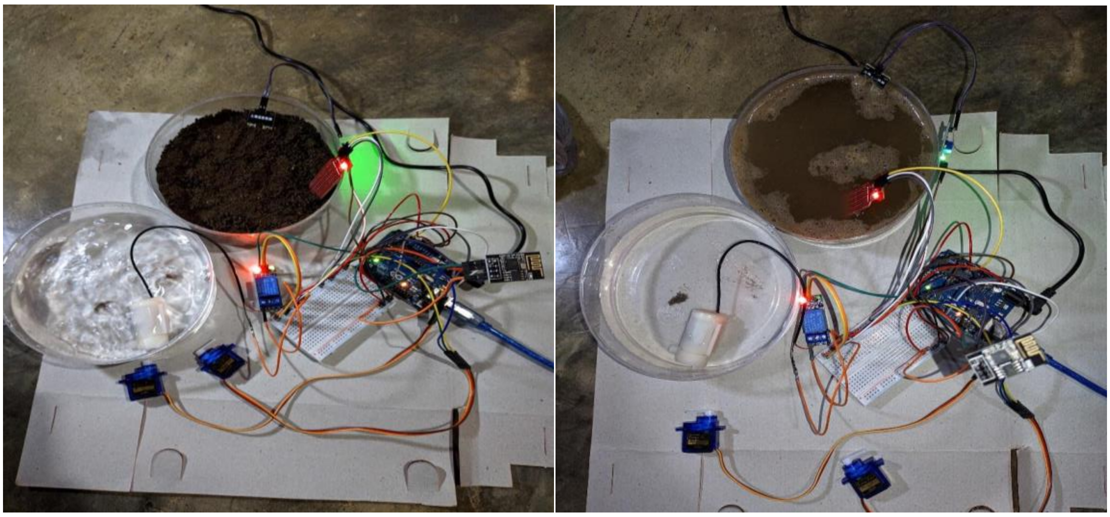

Figure 7. Equipment Testing (Dry Soil) and Testing (Wet Soil)

The first stage of testing is when the position of the soil moisture sensor detects dry soil and the water level sensor does not detect water. The second test is with a wet ground situation, and the water level touches the Water Level sensor. In this test, the sensor worked properly, the servo to open the entrance will close, and the servo for the exit will open. For the water pump to be successfully turned off automatically. The rice field irrigation monitoring system displays information about whether the soil is moist or dry and information about the water level. The data is obtained from sensor data sent by the Arduino microcontroller via the network.

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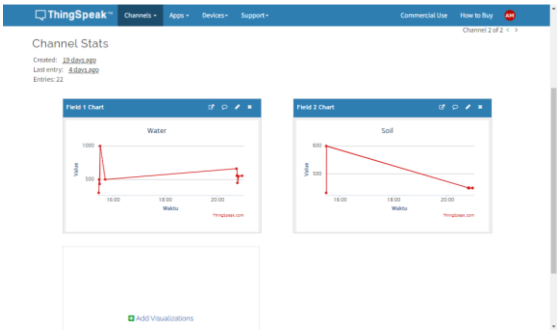

Figure 8. Monitoring Sensor

The results of the Smart Irrigation System prototype testing have been successfully summarized and can be seen in table 1 below :

No	Water Level Sensor	Soil Moisture Sensor	Servo 1	Servo 2	Water Pump
1	Value < 600	Value > 300	Open	Close	On
2	Value > 600	Value < 300	Close	Open	Off

Table 1. Results of the Smart Irrigation System

CONCLUSION

The irrigation system that has been made can already be used to regulate irrigation or irrigation on paddy fields. The system works by detecting whether the soil is moist enough. If not, then it will open the inlet water gate. In contrast, when the soil moisture sensor detects that the soil is sufficiently moist or wet and the water level measuring sensor has detected sufficient water level, the water inlet will be closed.

The irrigation system was created to help farmers make it easier to irrigate paddy fields that will be or are being worked on. The system is based on IoT, which can work automatically. The device can function properly in the opening section to open waterways to irrigate the land and automation in the water disposal section when needed when the water has seeped to the desired depth of 15 cm according to the Alternate Wetting and Drying (AWD) irrigation system.

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