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Water level control system in rice fields with the SRI (System Rice Intenfification) model based on IoT (Internet of Things)

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Abstract. The SRI (System Rice Intensification) model of rice cultivation has been able to produce higher productivity than conventional system. With the SRI model, land productivity can reach 21 tonnes per ha, 4 times the national productivity of 5.3 tonnes per ha. The water controller is one of the requirements in this model, and this one is become a major obstacle to be applied in the field at the farmer level. The water controller that is able to provide the highest land productivity is in the initial phase. in this phase the water level is 0-2 cm above the soil surface, in the vegetative and generative phases 3 cm below the soil surface, during the grain filling phase 7 cm below the soil surface, and it is dried. (irrigation is stopped) during the ripening phase or 10 days before harvest. In this research we develops a water control system using Internet of things technology so that all water level data can be recorded precisely and the process of adding water to the SRI rice field model can be done through an automation mechanism which controls the recorded process of control as well. The results of this study indicate the level of precision of the measuring tool works well and the automation system works as desired. The recorded measurement data can also be part of the analysis for the growth of the rice plant

1. Introduction

SRI is a rice cultivation technique that is able to increase rice productivity by 50%, even in some places it reaches more than 100%. According to 1] , water management mapping with SRI in West Java is at the age of vegetative rice, water is given capacity field except when weeding is done inundation (2 - 3) cm. When the age is more than 45 days, the land should be dried for 10 days to inhibit the growth of tillers, then water is given in random order again until the time of panicle growing, filling the grains of rice until well, then at the age of the plant more than 100 days the fields are dried until harvest.

The most optimum water supply is in the mild treatment regime wet with the average yield of experimental pots was 194.7 g / hill and water productivity 3.16 kg / m3 2]. In the slightly wet treatment regime, the water level in the initial phase was left randomly 0 cm to the soil surface. In the vegetative and generative phases, the water level is lowered at level -3 cm from ground level. next, in the grain filling phase the water level is high maintained at a level of -7 cm from the ground level. Then in the grain ripening phase until harvest.

From the story above it can be conclude that controlling the water level in the SRI model of the rice field irrigation system is very necessary and by using IoT technology, data recording is important to monitor plant growth.

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2. Design overview SRI model of rice field irrigation prototype

In this research, SRI model of rice field irrigation prototype create in demonstration plot with size 244 x 122 cm in which there is a given paddy soil and a place for rice to be planted. There are 2 pipes planted in the demonstration plot where 2 pipes are attached, each measuring the water level with 1 pipe filled with manual measuring instruments and the other pipe filled with measuring instruments designed using a JSNSR04 water level sensor which is connected to a microcontroller in charge of retrieving data and send to a database located on the cloud server. The overview of the tools shown in Figure 1

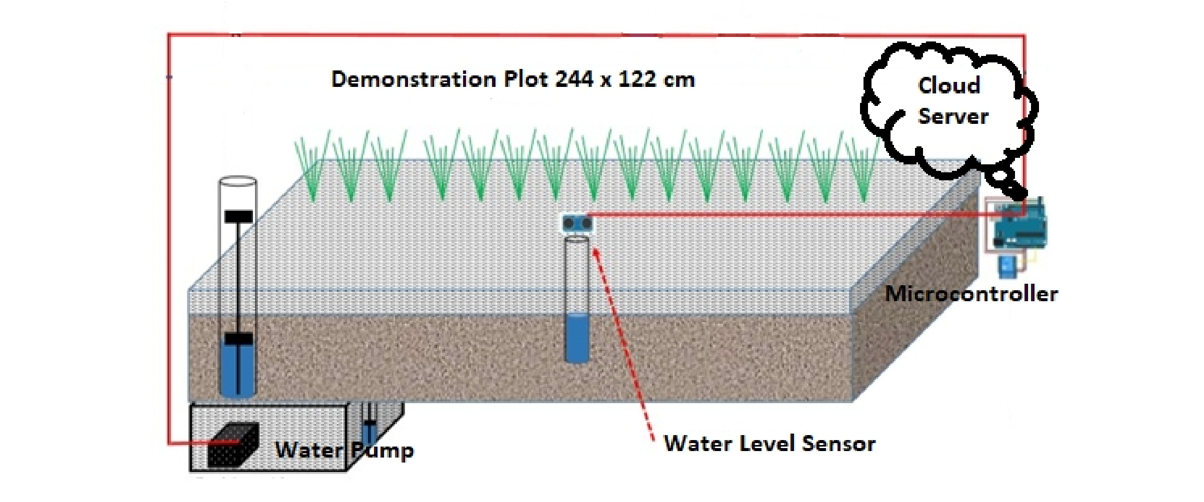

Figure 1. Demonstration Plot SRI Model of rice irrigation system.

3. Water level system kontrol based on IoT (Internet of Things)

3.1. Water level sensor otomation

The water level sensor in this research using ultrasonic sensor that is able to measure the distance between the sensor and the water surface in the pipe. The length of the pipe is the basis for calculating the water level where the length of the pipe minus the distance between the sensor and the water level will be the water level value in the irrigation demonstration plot. Part of the development of this equipment is sending water level data with IoT platform so that the data height value processed as an automation system to turn on and turn off the water pump to fill the field irrigation demonstration plot accordingly specified value.

The general model of automation in water level control systems is carried out by adjusting the set point value that water needed based on the water fulfillment pattern according to plant maintenance procedures. The overview of the system shown in Figure 2

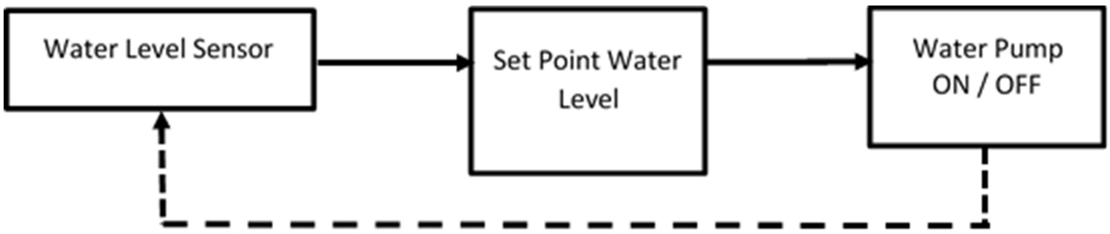

Figure 2. Basic system water level otomation.

3.2. IoT Platform to drive water level control system

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There are three layers developed in this research. The lowest layer is the layer of devices that are outside the cloud. in this layer sensors and actuators are developed as devices that will supply data or receive data. The sensor is assembled together with a WiFi module and a microcontroller which contains a program to translate the sensor into data that can be sent via the WiFi module. In this SRI irrigation system demonstration plot, the sensor made is the water level and the actuator to turn on or turn off the pump. programs embedded in this device layer use the Arduino language. the hardware package in the wifi module and micro system has been bundled in the wemos d1 mini.

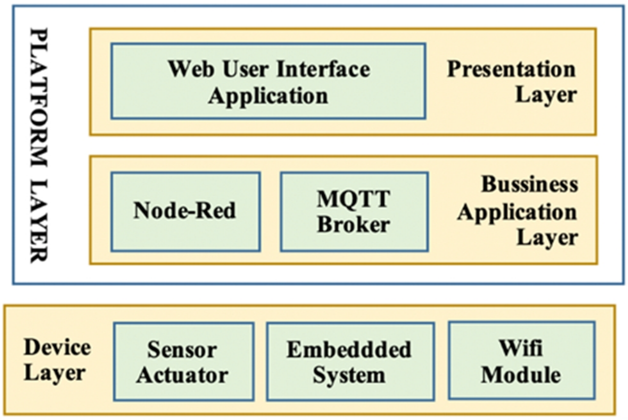

Figure 3. Iot Architecture development for water level otomation system

The platform layer consists of two parts which are developed separately, namely the business application layer and the presentation layer. The business layer application layer has functions to process data such as business process automation systems that have been designed. The presentation layer is the application development interface for the user. Technically, the business layer is developed through the Node-Red application to create a business application system and for MQTT brokers, the open source application Mosquitto is used. Illustration of the logic design of the water level automation system in the SRI model and web based interface in presentation layer can view in figure 4

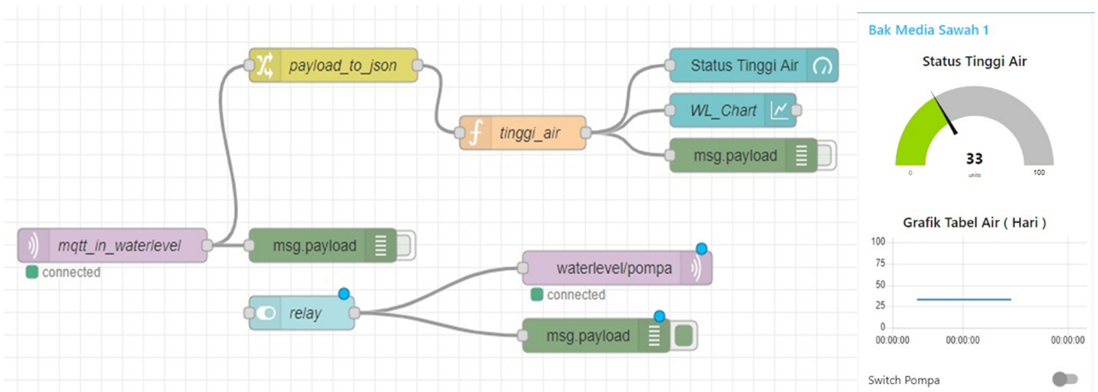

Figure 4. Logic system and presentation layer water level control system

4. Result and Conclusion

In the vegetative phase, day 1 to day 50, the water level measurements in the demonstration plot average is 4 cm and 3 cm per day. and the difference in measurement between the sensor and the manual indicates

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that the sensor is more unstable with a record shift of not more than 1 cm. in the generative phase when the water is drained the measurement on the sensor shows a value of 1 cm and in the manual measuring instrument it has a value of 0. This is a weakness of the error value of the sensor device. The process of filling the water in the demonstration plot is done by turning on the pump, and to increase the water level in the demonstration plot for 1 cm it takes 10 seconds to turn on the pump.

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