IoT Based: Hydroponic Using Drip Non-Circulation System for Paprika

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***Abstract*— One of the vegetables that have high commodities namely paprika, paprika provides a great opportunity for local and export markets. Paprika contains high enough nutrients consisting of protein, fat, carbohydrates, vitamins A, B, C and minerals such as Ca, Fe, P also K. Paprika plants need intensive treatment, in addition to temperature and nutrient changes that are not suitable to be one source of risk for paprika production decreases. Even though in the greenhouse, evaporation by plants decreases so the paprika becomes rotten especially during the rainy season. Using the drip non-circulation system with IoT technology is a smart way to reduce risk. The system research method proposed explains the application of non-circulating hydroponic systems with IoT technology to paprika plants with Rockwool planting media. The monitoring results can be accessed automatically and real-time through the cloud on mobile phones with it can control paprika hydroponic non-circulation and are expected to be according to the level of damage and increase the efficiency of use of nutritious water.**

Keywords: Iot, hydroponic system, drip non-circulation, paprika

I. INTRODUCTION

Agricultural systems in developed countries are currently developing a lot of modern agriculture or smart agriculture. The use of IoT technology plays an important role in supporting modern agriculture, such as the process of planting, maintaining, monitoring, harvesting and distributing crops[1][2]. There are many types of modern agriculture, one of which is agriculture that applies hydroponic systems. In Indonesia, the use of agriculture with a hydroponic system is widely applied to paprika plants [3]. Hydroponic agriculture in greenhouses is still constrained by the problem of evaporation by plants that are reduced especially during the rainy season so the paprika becomes rotten [4]. The use of drip systems in paprika plants is a solution but requires extra control and supervision [5]. The use of a non-circulating drip system reduces the high pH level because water that is not absorbed by plants does not return to the reservoir. In this research the management of paprika farming [6] hydroponic drip non-circulation system is to control and monitor nutrient water efficiency using IoT technology that can be accessed in real time using a mobile smartphone, thus minimizing decay in paprika plants and saving nutrient solutions[7][8].

The workings of IoT technology on non-circulating hydroponic drip methods prioritize the performance of sensor sensors that are used based on the ability to detect the state of the environment around the plant. Some of the sensors used in this study include: temperature and humidity sensors DHT11 moisture sensors, Ultrasonic HC-SR04 sensors, pH sensors, and nutritional sensors[9]. The function of the temperature and humidity sensor of DHT11 is to detect moisture around the plants in the greenhouse[10]. The moisture sensor works by detecting moisture in the growing media [11]. For the ultrasonic sensor, the placement is at the top of the edge of the nutrition reservoir [12]. The workings of the ultrasonic sensor are to detect the elevation of the water surface in the reservoir that is obtained from ultrasonic waves emitted and then received back by an ultrasonic receiver. The distance between transmit time and receiving time is a representation of the distance of the object[13]. While the nutritional sensor and pH sensor are placed in the reservoir, the function of the nutrition sensor and pH is to measure the level of nutrients and the pH in the water that will be distributed to plants through the media[14]. To be able to process input data from the sensors, Arduino uno microcontroller and ESP 8266 WiFi module are used as modules that deliver data to the cloud for mobile access [5][15].

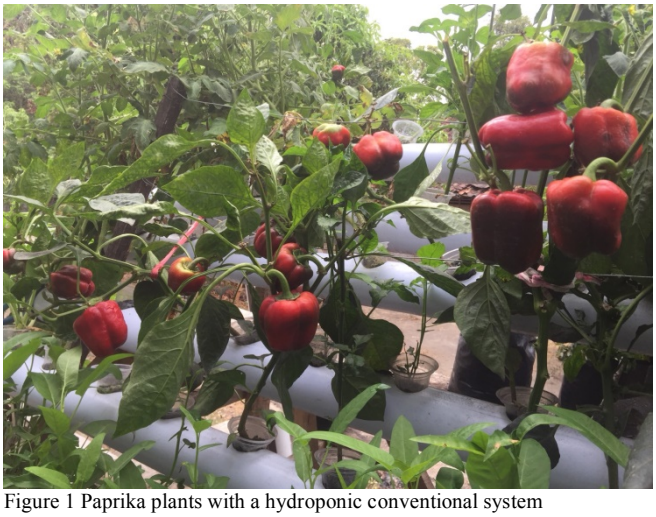

Figure 1 Paprika plants with a hydroponic conventional system

Figure 1 shows paprika plants that growing in hydroponic conventional system which in that system is the risk with damage because without correct management of water distribution and over humidity. Nutrition in paprika plants has a diversity of needs based on the age of the plant. This study focuses on the method of non-circulating hydroponic drip by utilizing IoT technology as management in controlling and monitoring paprika plants that prioritize the balance and uniformity of nutritious water distribution in plants and require continuous care. So that with this method, it is expected to be able to help control and monitor mobile smartphone, with that the nutrients given to paprika plants

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can be provided optimally, maximizing the efficiency of the use of nutritious water and minimizing the occurrence of decay due to moisture.

II. LITERATURE REVIEW

The main challenge in this research is combining IoT technology and knowledge in agriculture, especially modern agriculture to help farmers get good results[4][16]. Several studies on hydroponic plants, paprika, and IoT technology in the agricultural sphere have been carried out. The hydroponic method has been developed for a long time, one of the hydroponic techniques is the Nutrient Film Technique (NFT) which prioritizes the distribution of nutrient fluids at the root [17]. While many drip irrigation systems are developed in open agriculture on land with soil media, the benefit of this drip system is to optimize the use of water and fertilizer [18]. There are two conventional hydroponic drip systems, the drip circulation system which makes the pH of nutrient water high and the non-circulating drip system which makes use of nutrient water wasteful [18]. Paprika is a plant that requires more care, conventional paprika cultivation is a way that can be done to overcome the constraints of paprika in a conventional manner [19]. IoT Technology is not widely used in agriculture such as utilization of pest control, crop selection, climate monitoring, irrigation management [20][21].

Agriculture with a hydroponic system in a greenhouse provides great benefits, besides being safe against hydroponic farming pests in greenhouses, it is also more manageable [22]. The several studies on utilization of IoT technology in the field of hydroponic agriculture which is widely used in managing irrigation [23]. In many studies explained the use of sensors to support IoT technology, such as pest control sensors, temperature, and humidity detection sensors, and sensors that estimate soil structure and others. Whereas in many studies IoT use is inseparable from the role of micro-sensor controls such as Arduino, and WiFi modules for sending data to cloud services [24]. Agriculture with a hydroponic system in a greenhouse provides great benefits, besides being safer against hydroponic agricultural pests in a greenhouse, it is also easier to maintain. The several studies on utilization of IoT technology in the field of hydroponic agriculture which is widely used in managing irrigation [23]. In many studies explained the use of sensors to support IoT technology, such as pest control sensors, temperature and humidity detection sensors, and sensors that estimate soil structure and others[3]. Whereas in many studies IoT use is inseparable from the role of micro-sensor controls such as Arduino as sensor spraying control on farms[24] and WiFi modules for sending data to cloud services [25].

Hydroponic plant cultivation techniques on paprika plants with non-circulation systems prioritize irrigation management, drop distribution control on Rockwool planting media that will improperly remove nutrients or provide a risk of damage to paprika plants if excessive moisture. Research on non-circulating hydroponic systems in paprika farmers with IOT technology is proposed to have clear differences compared to other studies related to the cultivation of hydroponic paprika plants with both the circulation and non-circulation systems.

III. PROPOSED METHOD

A. Material

The hardware needed in this hydroponic control and monitoring system in generally are as follows Table 1:

TABLE I. COMPONENT HYDROPONIC CONTROL AND MONITORING SYSTEM

Component	Total	Unit	Specification
Microcontroller	1	Piece	Arduino uno
Pcb	2	Pieces	Single layer
Modul wifi	1	piece	ESP 8266
Temperature &Humidity Sensor	1	Piece	DHT11
Ph sensor	1	Piece	
Ultrasonic sensor	1	Piece	HC-SR04
Moisture sensor	2	Pieces	FC28
LCD	1	Piece	-

Table 1 is a sensor used in hydroponic plants with the proposed non-circulation drip system, there are four main sensors, an Arduino Uno microcontroller, and a WiFi module.

B. Method

The method of the non-circulating hydroponic drip system with IoT technology in paprika plants uses several Arduino Uno sensors and microcontrollers and ESP 8266 wifi modules. Sensors will detect system requirements including temperature and humidity levels and detect nutrients and pH levels in the hydroponic plant. In this non-circulating hydroponic drip system, the sensors used will provide input to the system and the pump automatically flows nutritious water by dropping into the planting media, so that the use of water is nutritious as needed.

C. Flowchart

The hydroponic non-circulation drip system is a suitable method for paprika plants, a good regulation of nutrition in this system is needed to reduce failure in its maintenance [26]. Following figure1 is the flowchart in generally the hydroponic method with the drip non-circulation system using IoT technology.

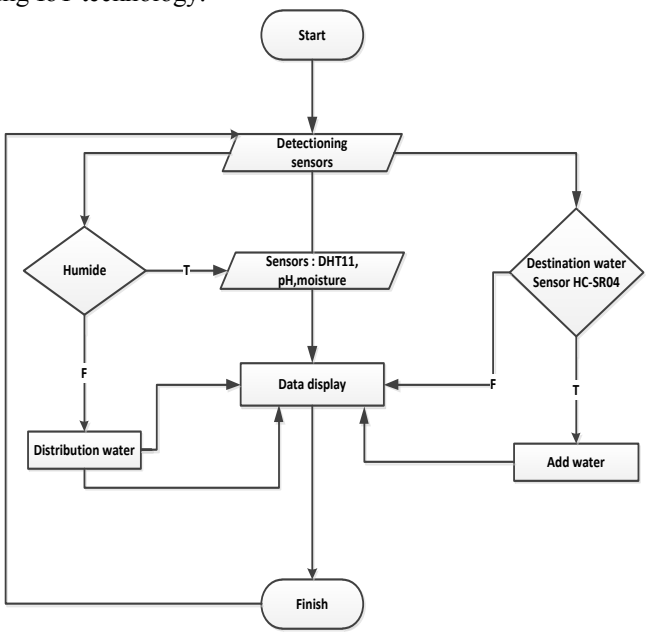

Figure 2 Flowchart system

Figure 2 shows a flowchart system, starting with sensors detection, the DHT11 sensor detects the area around the plant while the moisture sensor and pH sensor detect the planting media, the sensor detection data can be seen on the display module. If the sensor detects excessive levels of moisture, automatic water distribution can be carried out. Then in the system of adding water to the reservoir starts from the detection of the HC-SR04 ultrasonic sensor to the surface of the water in the reservoir, if the sensor detects the distance of water to the remote sensor, the engine automatically turns on and fills the water reservoir. Data will be sent to the cloud via a WiFi module, this process continues continuously.

IV. RESULT AND DISCUSSION

The proposed scheme system works based on data sent from sensors installed in greenhouse land. The nutrient pump is on because there is data from the humidity sensor. The lower limit of the humidity value is 45% and for the duration of the watering pump, the works are determined by the calculation between the value of humidity and the value of room temperature on the greenhouse land. Long time this automation system is designed to work for 24 hours.

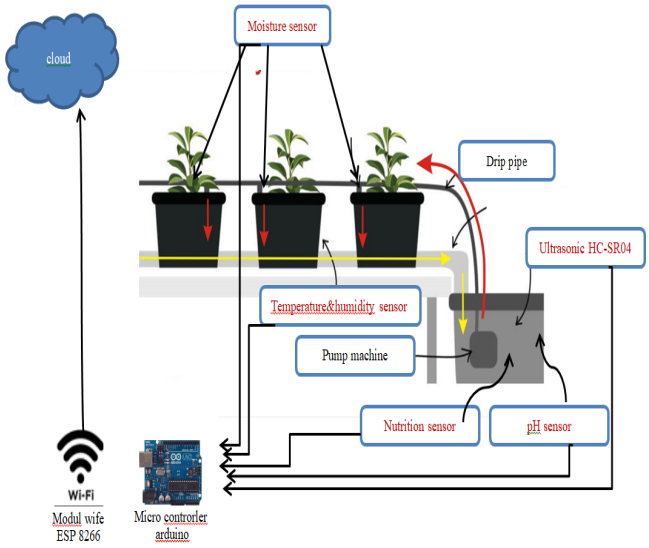

Figure 3. Architecture hydroponic drip system with IoT technology

The way the system works according to the General Architecture is in figure 3.

1. Distance sensor and pH sensor detect the value of solution height in hydroponic plants.
2. Data the height of the water and the level of pH will enter Arduino Uno. If the solution is less than the water pump 220 Volt will live and fill the less water nutrition in a water bath.
3. moisture sensor, temperature, and humidity in the planting media and greenhouse room detects moisture levels for 24 hours if the system's high humidity level will produce nutrients in the form of drops to the media from the reservoir
4. If it has been streamed, the sensor will detect again whether the humidity level in the media is correct.
5. Sensor detection number 5 will be sent to Arduino Uno
6. Data will be displayed in the LCD and also accessed to mobile in real time.

While the IoT architecture in the proposed system can be seen in Figure 3.

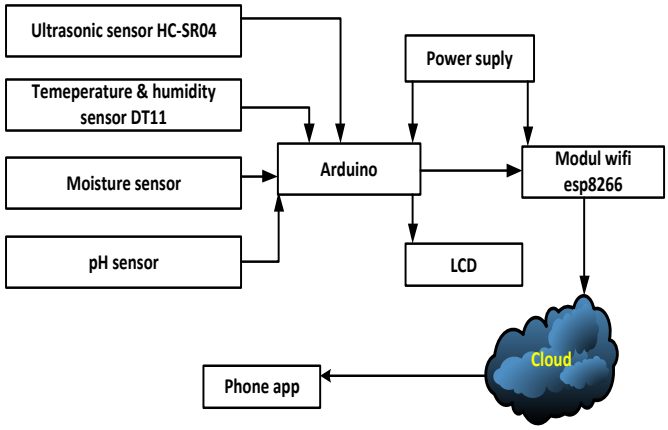

Figure 4. Conceptual design IoT on the hydroponic drip system

In figure 4, sensors embedded in growing media and hydroponic areas specifically to detect the situation around the factory, both humidity levels, temperature, the acidity of the planting media, and water level in bathing nutrients. The following will explain the explanation of the Block System Diagram:

1. After the device is turned on for the first time the proximity sensor will detect
2. That an empty bed and bed will be filled with a 6 cm high water bed.
3. The user turns on the WiFi signal that will be connected to Arduino.
4. The ultrasonic proximity sensor will detect the height of the solution.
5. nutrition, the pH sensor will detect the acidity of the solution.
6. Data on altitude, acidity, media humidity and temperature will be sent to Arduino and Arduino will display data to LCD.
7. Data from Arduino will also be sent via esp8266 WiFi to a Cloud server.
8. By using a support application that is connected to the internet, users can view hydroponic data in real time.

The problem that often occurs in hydroponic paprika plants is the use of wasteful nutrient water, water distribution does not work well causing the planting media to be moist and result in decay, especially in conventional non-circulating hydroponic systems. The based on the scheme of the system proposed above it is expected to reduce the level of damage to paprika plants due to irrigation management that is still manual. the use of IoT technology with sensor sensors implanted in non-circulating hydroponic media provides fast information through the cloud and can be accessed on smartphones so that it is expected to provide rapid handling if there are signs of damage to the paprika plant.

V. CONCLUSION

This research focuses on making a system that can help hydroponic farming in paprika plants with drip non-circulation system. Monitoring and controlling so that the nutrients given to paprika plants can be given optimally and minimize the occurrence of decay. This system is made for agriculture with hydroponic drip management using Arduino Uno Microcontroller combined with various sensors used such as DHT11 temperature and humidity sensors moisture sensors, Ultrasonic HC-SR04 sensors, pH sensors, and nutritional sensors. To be able to process input data from the sensors, the Arduino microcontroller and ESP 8266 wifi module are used as modules that deliver data to the cloud. Management with automatic irrigation can be controlled in real-time through mobile devices which are expected to be able to provide efficient use of nutritious water.

VI. FUTURE WORK

The future work of this research is the implementation of the system using IoT technology and artificial intelligence that is planted as management control and monitoring of paprika plants, and not only for paprika plants.

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