PROTOTYPE PESTICIDE SPRAYERS ON RICE PLANTS BASED INTERNET OF THINGS

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ABSTRACT

The prototype of spraying pesticides on rice plants based Internet of Things a tool used to spray pesticide liquid used to prevent and overcome pests in rice plants. This tool can be controlled remotely using an internet connection that is connected to a web-based application so that farmers no longer do the process of spraying pesticides on rice plants by manual method, which is spraying pesticides on rice plants directly from close range, which in this way farmers are more at risk Negatively affected by pesticides directly. With the prototype of pesticide sprayers, it is possible for farmers to monitor and regulate the process of spraying pesticides on rice plants without having to go directly to agricultural land. This study uses the Prototype method in the construction of this prototype and by testing black boxes for web applications and beta testing to determine the suitability of the hardware testing needs to test the quality of prototype pesticide spraying hardware on rice plants. This prototype can be developed into a larger scale spraying tool for pesticides which is a flat plot of rice farming that wants to apply the process of spraying pests in a more modern direction.
Keywords: IoT, Agriculture, Prototype, Microcontroller, Spraying

1. INTRODUCTION

1.1 Backgorund of The Problem

In the world of agriculture especially in rice plant use of pesticides as chemicals upon plant maintenance process is a common thing to do. Pesticides are chemicals or mixtures of some of the chemicals used to control or eradicate the pest organism (pest/vermin). The advantages of the use of pesticides, among other things, the protection of crops from pest attack, ensuring the availability of food, and disease control at the plant. Ideally, the pesticide had toxic effects only on the target organisms, namely the pests. However, in reality, most of the active ingredients used are not specific enough, so that toksisitasnya negatively impact health (human) (Costa, 2008). In addition, the use of pesticides also negatively impact the environment and ecosystems (WHO, 2008). [2]

The negative impact of pesticides on health depending on the type or active ingredients of pesticides. In General, pesticides are grouped based on the type of active ingredient (chemical classification) and the mechanism of its work, namely the carbamate, organoklorin, organofosfat, and piretroid (Weiss et al., 2004). Light exposure by pesticides can lead to irritation of the eyes or skin membranes whereas exposure in high doses can cause poisoning by pesticides such as fatigue, vomiting, nausea, diarrhea, headaches, blurred vision, sweating a lot, anxiety, failed the breath and heart failure (Office of Environmental Health Hazard, 2008). [3]

Currently farmers in Karawang especially in the village of Alang – alang Lanang, Cilamaya Wetan Subdistrict, still using the pesticide atomizer system on rice plant by manual i.e. farmers use pesticide atomizer directly. It is very risky because farmers will be directly affected by the negative effects of pesticides.

Based on the above issues, then the author intends to build a prototype atomizer pesticide on rice plant-based Internet of Things that allow farmers to use melakukakan the process of spraying pesticides without having to work directly as it does not require human power to menyeprotkan of pesticides. This process is done by controlling the tool through the application and use the sensor and microcontroller which in design sedemekian a way that became a prototype of the spraying of pesticides on crops of rice. The appliance can be controlled remotely by using the internet, using spraying systems spraying systems because with this system of pesticides will easily decompose.

1.2 Goal and Purpose

The purpose of this research is to build a prototype sprayer pesticides on crops of rice that can be controlled remotely. As for development purposes, the prototype is as follows:

1. Help relieve farmers ' work at the time of the process of spraying pesticides on crops of rice.
2. Create a control system by using a microcontroller to create a system of spraying pesticides.

2. THE CONTENT OF RESEARCH

2.1 The Scope of Research

The object of the research is meticulous in rice paddies covering about half a hectare property of Mr. Mashudi who is a member of the farmers branch Cilamaya Srikat Karawang located in the region of rice fields in the area of Alang – alang Lanang,

Cilamaya Wetan village, subdistrict of Karawang The Province Of West Java.

2.2 The Theory of Prototypes

The prototype is the early form (example) or a standard size of an entity. In the field of design, a prototype is developed or created before is precisely made to development before the actual scale made in or before mass-produced.

2.3 Pesticide

In the world of agriculture we are familiar with the term pesticides. The farmers are already familiar and unfamiliar with pesticides. Pesticides are used with the purpose of optimizing the cultivation of a crop. Farmers use pesticides according to the needs and goals of its use.

Understanding pesticides in general are all substances or toxic chemicals used to fight/kill living organisms which interferes with either animals or plants (weeds). [1]

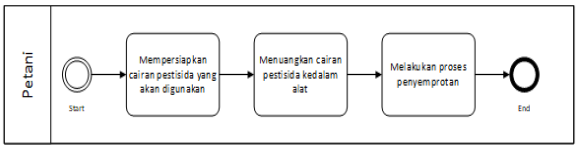
Pesticides are divided into several types, among which are the following:

a. Insecticide used for insects.
b. Fungicide used for disease caused by a fungus.
c. Akarisida used for mite/pest ranked karina.
d. Rodentisida is used for rodent (mouse).
e. Molluskisida used for snails or mollusks.
f. Nematisida used for nematode (worm).
g. Bactericide used to a disease caused by bacteria.
h. Herbicide used for weeds or weed.

2.4 Analysis Of The Running System

In system analysis at this stage gives an overview of the system that is running at the moment. This analysis aims to provide a more detailed picture of how the workings of the system that is running and at this research focuses upon the process of watering pesticides against rice plant. The following system processes that are running:

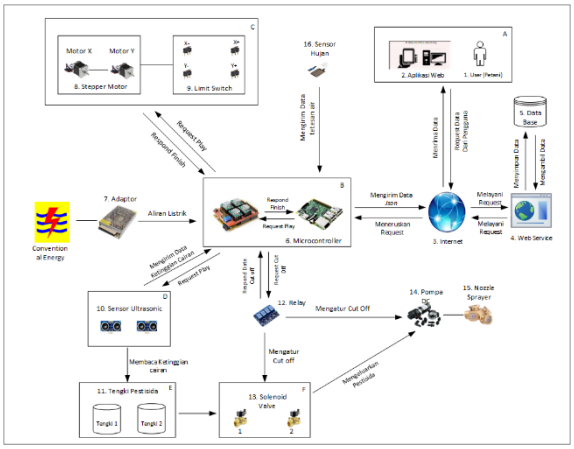
1. Farmers prepare the liquid pesticides to be used in the process of spraying.
2. The liquid pesticides will be placed into a spray tool.
3. Spray Tool brought farmers by way of his arms.
4. After all ready, farmers spraying pesticides by walking down the rice fields would be sprayed.



Picture 1. BPM in Progress

2.5 System Architecture To Be Built

Analysis of system architecture is a process of medeskripsikan of the physical system to be built and also its supporting components. The following is an overview of the system architecture to be built.



Picture 2. System Architecture To Be Built

As for the rather simplistic explanation of automatic spraying systems architecture pest i.e. spraying to do automatically, that the user set the schedule and choose the type of pesticide to be used on the process of spraying. Ultrasonic sensor aiming to find out the amount of liquid pesticides present in the pesticide tank, while the rain sensor is used to prevent the spraying tool at the time of the occurrence of rain.

1. Stage from the IoT Side
   a) Raspberry Pi as a microcontroller to retrieve data from the sensor and ultrasonic sensor rain, raspberry Pi serves to send the command to the CNC stepper motor to run the shield, limit switches, pumps, and set the cut off on the relay.Data obtained in the process of using a modem that is available in raspberry Pi which will be submitted to web services via internet network.
   b) Web service will perform data storage of liquid pesticides and data tetessan water from the rain sensor into the database.
2. Stage Of The User Side
   a) Users sign in to the web-based application system via a browser connected to the internet network.
   b) Users choose the menu to perform the process of spraying, spray schedules set, set the liquid pesticides used or would like to see data on the results of the spraying in the web.
   c) Request will be sent to the Pi and Raspberry web service through the internet network.
   d) Web service processes the request by accessing the data in the database.
   e) Web services send the required data from the database to the user interface in web applications.
3. Stage from the hardware side
   a) Adapter
      In this system the adapter is used to deliver electricity to the microcontroller along with other components.
   b) Stepper Motor

In this system there are 2 stepper motors, which is to move the device towards X +, X-, Y +, Y-. Used to run the tool during the spraying process.

c) Limit switches

In this system there are 4 limit switches that are installed to limit the movement of the stepper motor, if the device driven by stepper motor has touched the limit switch X + then the stepper motor will move in the opposite direction, if the device has touched the limit switch X- then the stepper motor move forward. If the device has touched the Y + limit switch then the DC pump will stop and the stepper motor will move back to the original place until the limit switch Y- and the tool stops and the spraying process is complete.

d) Relay

In this system relays are used to connect and disconnect electric current to DC pumps and selonoid valves.

e) Selonoid Valve

Selonoid Valve in this system is used to open and close the flow of pesticide liquid in a pesticide tube, if you choose the type of pesticide 1 then the flow of pesticide liquid contained in the pesticide tube 2 will be closed.

f) DC pumps

In this system the dc pump is used to pump and remove pesticide liquid during the spraying process.

g) Ultrasonic Sensor

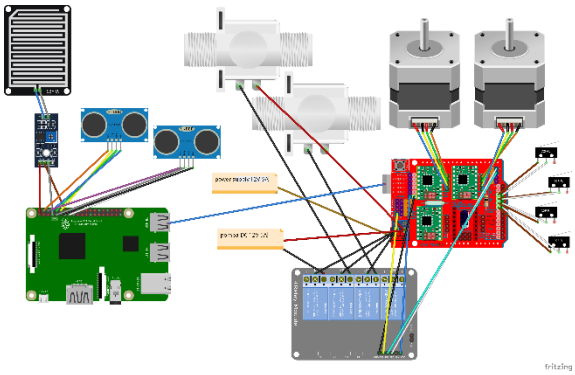
Ultrasonic sensors in this system are used to find out how much liquid is in the pesticide tube, then the data obtained will be sent to the microcontroller and displayed on the application.

h) Rain sensor

Rain sensor on this system is used to find out if there is rain or not. If there is rain during the spraying process, the tool will not work.

2.6 Device Communictaion

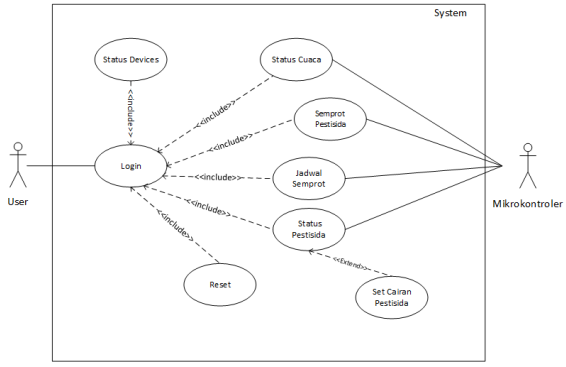
Device communication is a picture between one device and another device so that this system is integrated with each other.



Picture 3. Device Communication

2.7 *Use Case* Diagram

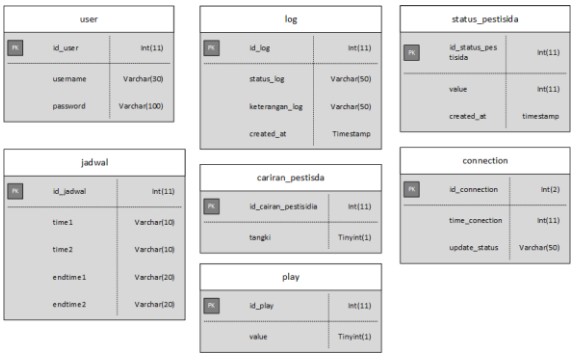
Use case diagram is a diagram that shows the functionality of a system or class and how the system interacts with the outside world and explains the system functionally as seen by the user. From the identification of the actors involved above, the Use Case Diagram can be seen in the picture below.



Picture 4. *Use Case* Diagram

2.8 Relation Scheme

The relation scheme is a series of relationships between two or more tables in the database system. The following is the design of the relation scheme for fire monitoring can be seen in the figure below.

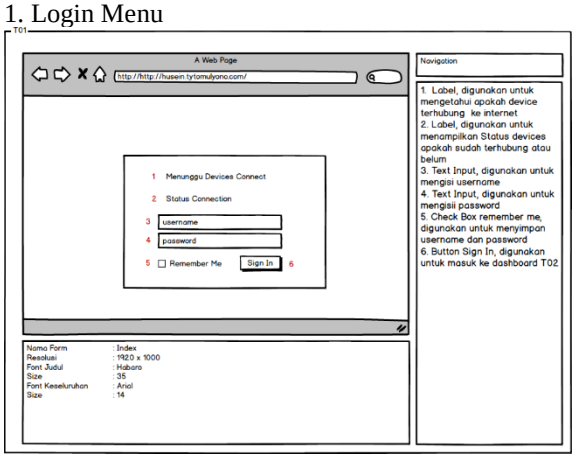


Picture 5. Relation Scheme

2.9 Interface Design

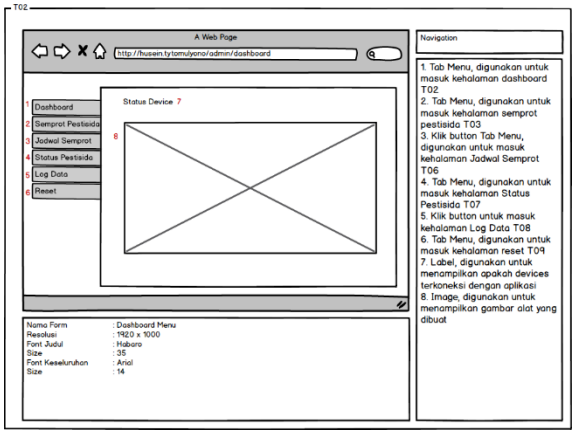
Interface design aims to describe the application that will be created. The following is the interface design for the prototype application of pesticide sprayers on rice plants.

1. Login Menu



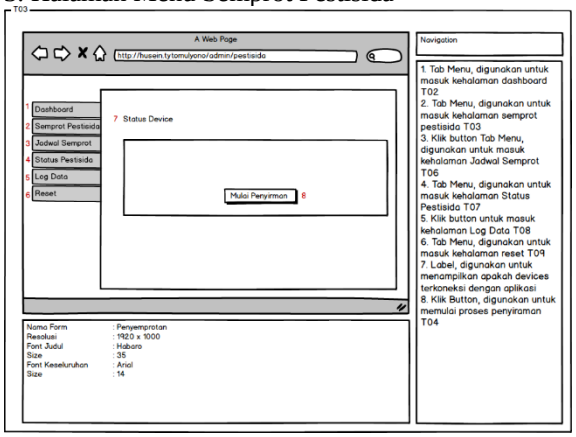
Picture 6. Interface Design Login

2. Main Menu



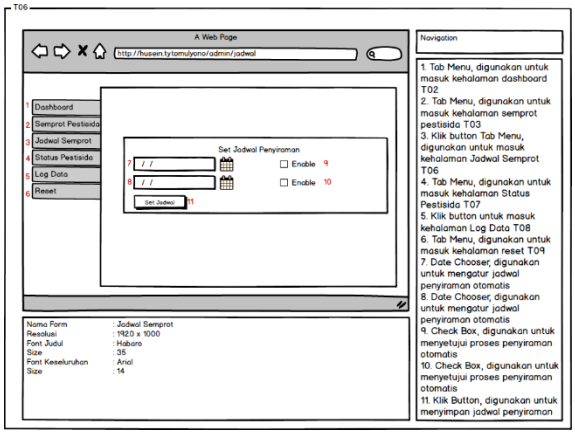
Picture 7. Interface Design Main Menu

3. Halaman Menu Semprot Pestisida



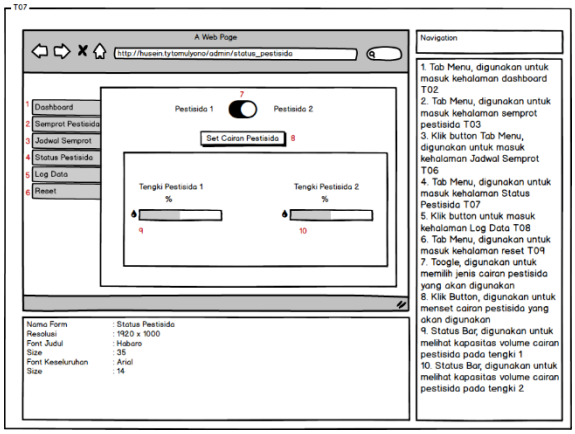
Picture 8. Interface Design Semprot Pesticide Menu

4. Halaman Menu Set Jadwal Semprot



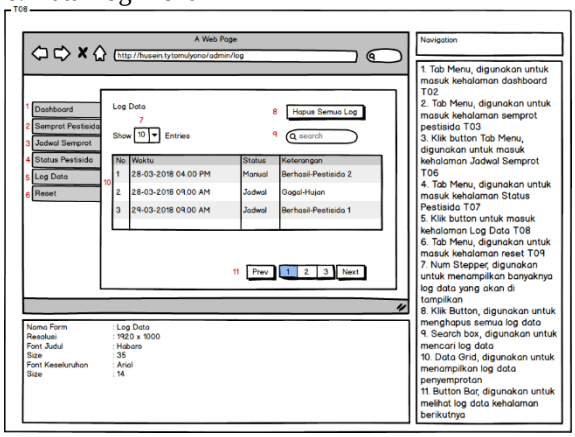
Picture 9. Interface Design Set Jadwal Semprot Menu

5. Stat Of Pesticide Menu



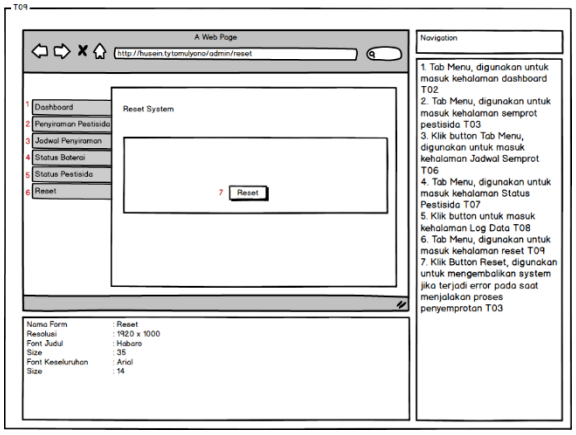
Picture 10. Interface Design Status of Pesticide Menu

6. Data Log Menu



Picture 11. Interface Design Data Log Menu

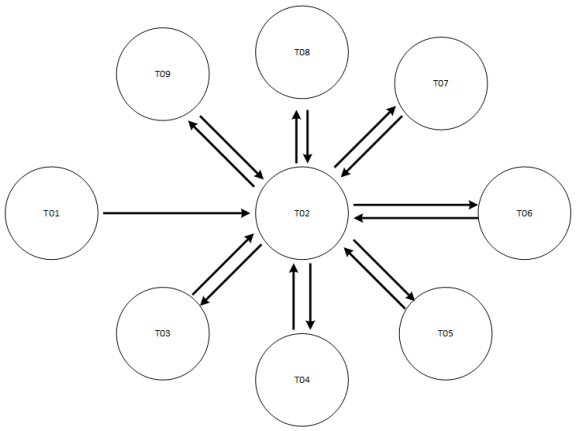
7. Reset Menu



Picture 12. Interface Desgin Reset Menu

2.10 Semantic Network

Here is a Picture diagram of the semantics that describe the relationship between the relation of each form that is described on the design of the interface, but for more details can be seen in the image below.



Picture 13. Semantic Network

2.11 The Hardware Implementation

Devices used in building Prototypes Atomizer Pesticide On rice plant are as follows :

Table 1. Implementasi Perangkat Keras

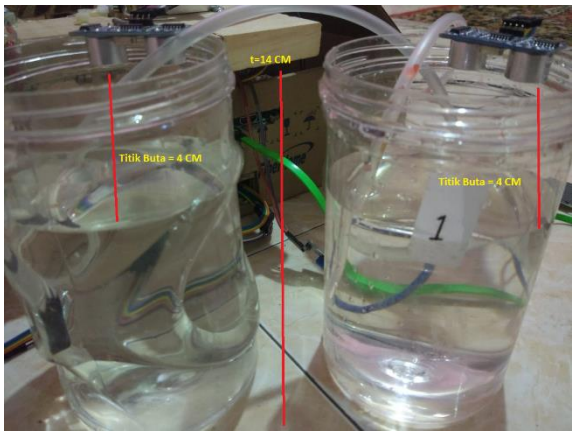
No	Hardware	Type
1	Mikrokontroler	Raspberry Pi 3
2	Stepper Motor	Nema 17 HS-4401
3	Driver Stepper Motor	A4988
4	Pulley dan Belt	Diameter 5 mm
5	Sensor Ultrasonic	HC-SR04
6	Pompa DC	DP-537
7	Sprayer	Nozzle Sprayer
8	Selonoid Valve	Ver 2.10
9	Relay	Relay 2 Channel
10	Micro SD	Sandisk Class 10
11	Kabel Jumper	Dupont male dan female
12	CNC Shield	Ver 3.00
13	Sensor Hujan	FC-37

2.12 Hardware Test

Installation of the tools have been made on the implementation of the perangkata hard. To find out if the equipment goes in accordance with the draft early, needed a testing. Testing is done after the initial setup is already running. Testing done on the Ultrasonic sensor, sensor SR04 HC-FC-37, stepper motor and DC pump.

a. Ultrasonic Sensor HC-SR04 Test

Ultrasonic sensor testing done to find out the amount of liquid contained in the tank. Ultrasonic sensors are used has a blind spot that is 4 cm can be seen in the image below.



Picture 14. The Placement Of The Ultrasonic Sensors On The Tank Of Pesticide

After the tank is reduced by the blind spot so the liquid pesticides were detected by the ultrasonic sensor with a capacity of 100% as much as 0.64 liters. When the liquid is reduced sebnyak 1CM3 then the data shown on the application indicates the volume of liquid pesticides left over 90%.

b. Sensor FC-37 Test

Sensor the sensor is 37 FC-are used to determine whether or not it rains so that in the event of rain so the tool won't do the spraying process. The sensor works based on the number of droplets of water on the sensor. Here a researcher uses a split 4:6 which if the number of water droplets less than equals 4 then the sensor does not detect the onset of rain, and when the number of droplets of water hitting the sensor is more than equal to 5 then the sensor will detect the onset of rains.

This test aims to find out whether the sensor is FC-37 can function properly. To make it more easy to see if the sensor is FC-37 has really worked well, it can be seen in the Table below.

Table 2. Sensor FC-37 Test Result

Water Droplets	Spraying Process	Status
1	Success	Not Rain
2	Success	Not Rain
3	Success	Not Rain
4	Success	Not Rain
5	Fail	Rain
6	Fail	Rain
7	Fail	Rain
8	Fail	Rain
9	Fail	Rain

From this it can be concluded that the testing of the sensors FC-37 can work well, evidenced by accuracy in detecting the number of droplets of water hitting the sensor.

c. Stepper Motor Testing

Stepper motor used to drive the process at the time of spraying pesticides. This test is done to find out if the stepper motor is working well and to know the time taken by the tool from start to finish the process of spraying. For more details can seen in the Table below.

Table 3. Stepper Motor Test Result

Experiment	Initial Time	Finish Time	Time Required (seconds)
1	08:00:00	08:01:33	93
2	08:02:00	08:03:35	95
3	08:04:00	08:05:50	110
4	08:10:00	08:11:30	90

Conclusions from the test results, the stepper motor has been functioning well but from the results of the experiment until the 3rd time required for the process of spraying the longer it caused a mengendor belt pulley. 4th experiment pulley belt was fastened back then the time it takes to become 90 seconds as in experiment 1.

d. DC Pump Testing

DC pump testing is testing that is conducted to find out how many liquid pesticides issued to perform the process of spraying. The results of this test can be seen in the Table below.

Table 4. DC Pump Testing

Experiment	initial amount of liquid (%)	Amount of final liquid (%)	Amount of Liquid Issued (%)
1	100	92	8
2	92	80	12
3	80	69	11
4	69	60	9
5	60	50	10
6	50	42	8
7	42	32	10

$$\times = \frac{total\ jumlah\ cairan\ yang\ dikeluarkan}{totaljumlah\ percobaan}$$

From the test results it can be concluded that the DC pump, average (x) liquid pesticides used for one-time spraying process as much of 9.71%.

2.13 Overall System Testing

The overall testing system is intended to test the work of sensors and actuators that have been integrated with the web as controls. The web as a control here means that the web is used to input the required parameters and an interface that provides surveillance facilities. The purpose of this test is to find out whether the system works properly.

a. Testing of Internet Connection to Devices

This internet connection test is performed to see if a significant delay occurs if the tool is operated with the internet network is not good or not stable.

Table 5. The internet connection test

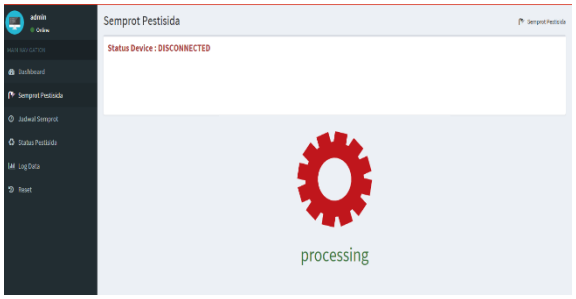
Experiment	Internet Connection (signal)	Intial Time	Moving Tool Time	Delay (seconds)
1	Very Good	10:00:00	10:00:00	0.2
2	Very Good	10:05:05	10:00:05	0.2
3	Good	10:07:05	10:07:05	0.4
4	Good	10:10:00	10:10:00	0.5
5	Good	10:13:00	10:13:00	0.4
6	Enough	10:20:00	10:20:00	0.8
7	Enough	10:23:00	10:23:00	0.8
8	Bad	10:30:00	10:30:01	1.5
9	Bad	10:35:00	10:35:02	2.2

Internet Network Information:

- Very Good = 4G (Full Bar Signal)
- Good = 4G (2-3 Bar Signal)
- Enough = 3G (3-Full Bar Signal)
- Bad = 3G (1-2 Bar Signal)

The results of this testing is that the conclusions of the internet network conditions greatly affect the working of this tool. Delay is increasingly felt at a time when the network is less good. And there is an error on the application if run with internet network

condition is not good, where the tool has finished doing the spraying but the status on the application still performs the process of spraying. Can be seen in the Picture below.



Picture 15. Error Condtition

b. Testing of spraying schedule set

Testing set schedule spraying is testing that is conducted to find out the timing has been set for the time of the spraying begins against the actual time. Input time is done through the antamuka that is in the web system. The test results can be seen in the following Table.

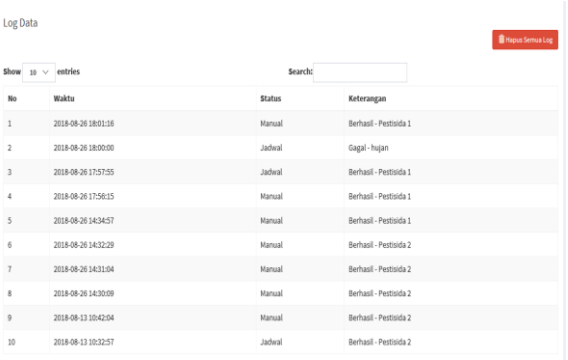
Table 6. Pengujian Set Jadwal Penyemprotan

Experiment -	Target Condition	Input Time	Real Time	Condition
1	Mulai	08:30:00	08:30:00	Device Move
2	Mulai	08:40:00	08:40:01	Device Move
3	Mulai	08:50:00	08:50:01	Device Move

From the test results it can be concluded that the system can set up a schedule of spraying despite delay 1 second before moving the tool performs the process of spraying.

c. Testing of spraying process of log data

This test is done to find out whether the system managed to save and display the data on the web application log the results of the process of spraying has done. Following the results of the spraying process logs that have been done.



Picture 16. Log Data Result Spraying Process

In order to clarify the data obtained, the following Table results of log data from the process of spraying.

Table 7. Log Data Hasil Proses Penyemprotan

No	Time	Status	Infromation
1	2018-08-25 18:01:16	Manual	Success-Pestisida 1
2	2018-08-25 18:00:00	Schedule	Fail-Rain
3	2018-08-25 17:57:55	Schedule	Success-Pestisida 1
4	2018-08-25 17:56:00	Manual	Success-Pestisida 1
5	2018-08-25 14:34:57	Manual	Success-Pestisida 1
6	2018-08-25 14:32:29	Manual	Success-Pestisida 2
7	2018-08-25 14:31:34	Manual	Success-Pestisida 2
8	2018-08-25 14:30:00	Manual	Success-Pestisida 2
9	2018-08-13 10:42:04	Manual	Success-Pestisida 2
10	2018-08-13 10:32:57	Schedule	Success-Pestisida 2

3. CLOSING

3.1 Conclusion

The conclusion of the results of the research, the analysis, the design of the system, and the implementation and testing of the interview, the following conclusions:

1. Tools and applications can be made of the media to model the idea in a development tool spraying pesticides on crops of rice that can be controlled remotely.
2. This appliance has been able to function properly, however the amount of liquid pesticides that are issued are not as expected due to the voltage of the electric current in the stream to the DC pumps are very small.

3. There is the delay time and the error on the application in the internet network connection is used.

3.2 Advice

Model Prototype Tool Spraying Pesticide On Paddy Berbasi Internet of Things is still a lot of shortcomings. Therefore it needs to be done to further development and refinement. As for a few suggestions which may be applied on the Model of the prototype Tool Spraying Pesticide On Paddy-based Internet of Things that could be better yet, is as follows:

1. Can minimize the occurrence of the delay and error on when the tool is operated by using the internet.
2. This application is expected to be made into the shape of the apk for android so that these applications more interactive with the user.
3. Expected to add alternative resources so that this tool can be used even though the blackout.
4. Expected to add camera on the tools used to monitor the course of the process of spraying in real time.

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