Optimization of Flight Track Autonomous on Precision Farming Using Unmanned Aerial Vehicles For Foliar Farming

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Abstract. Spraying on agriculture by humans has a shortage of high costs, the efficiency of time and costs becomes a problem with the extent of agricultural land, the wider the area the higher the time and costs incurred. Accuracy in the spraying process in agricultural land is important because of the accuracy in spraying directly proportional to the accuracy of the agricultural land and objects sprayed, not exactly spraying will make it inefficient, in this study research will be carried out on altitude with the best spray area, for the process of spraying on agricultural land and useful for reducing costs, time effectiveness and accuracy of sprays in the field of agricultural land that has been determined. So that engineering must be pursued that is able to carry out fertilization and spraying activities quickly, efficiently and accurately. The method that will be used for this problem is to make a prototype of a fertilizer spraying system using liquid media on a platform of Unmanned Aerial Vehicle (UAV) on a quadcopter basis. The stages in this study include: desk assessment, making design requirements objective, making conceptual and basic designs and making real UAV prototypes. Meanwhile, to find out the performance results of spraying carried out flight stability test and the performance of fertilizer spraying. The test results show that the best UAV altitude platform prototype for farming foliar is 1.5 from the height of the meter plant area with an area of 1.15 square meters for 1 second. So that it only takes 100 seconds to grow 115 square meters of foliar farming. The results of this test will be further developed to create a platform with a larger dimension and the ability to carry it.

1. Introduction

Precision farming is an agricultural business with an approach and technology that allows careful treatment (precise treatment) of a big data-based agribusiness chain [1]. One example of precise treatment is the optimization of IoT-based water use through web services for farmers [2], a smart mobile agricultural service system developed based on WSN (Wireless Sensor Network) offering irrigation decision support according to real-time field information and irrigation model agricultural land [3], the monitoring system of agricultural environmental data such as temperature, humidity and light [4]. During this time the fertilization process is carried out manually and cooperatively, the process of spraying liquid fertilizer with a relatively large agricultural area, the activity is less effective and inappropriate target. Fertilization is carried out by manual human labor where it is impossible to use only one human power for the agricultural area, manual pump spraying also has the potential to damage
crops because in the process of spraying many plants are trampled on. In this paper developed an auxiliary equipment innovation that is able to replace agricultural tasks in terms of fertilizing agricultural crops through technology applications.

![Unmanned Aerial Vehicle of Quad Copter](image)

**Figure 1.** Unmanned Aerial Vehicle of Quad Copter

The technology that is chosen is to use unmanned aircraft or Unmanned Aerial Vehicle (UAV) combined with the best height liquid fertilizer spraying system and the best area for farming foliars. Experiments in the Jember State Polytechnic farming area. The process of applying this research consists of the relevant research sections, the methods applied, the results of the trials, and conclusions.

2. **Related Work**

Unmanned aerial vehicles can be used for a variety of benefits, carried out for pedestrian traffic monitoring and also for market road management so as to facilitate evaluation of regulating road characteristics on the market, this is very helpful in taking policy [5]. To evaluate vehicle tracking accuracy, so the vehicle is known to the position in real time[6]. To test potential use in intertidal surveys in the northern Alaska Gulf. Images taken by unmanned aerial vehicles in high, medium and low intertidal strata on rocky coasts and in seagrasses were compared with data from observers' visual surveys and images taken by observers in the field [7]. Integrated sensing system to verify the safety factor of structural design [8], to detect trees that appear in the tropical rainforests of Sumatra, Indonesia, using cloud point photogrammetry derived from RGB images collected using unmanned aerial vehicle [9]. In this study, an approach to precision farming with a measured amount of fertilizer, measured area and shorter time using the unmanned aerial vehicle for Foliar farming is carried out.

3. **Method**

The research method used is an experimental method, first the preparation stage is to prepare the tools and materials to be used, namely the UAV components, sprayer components, control components. Continued by conducting literature studies and observations, namely conducting a theoretical study of the design of a quadcopter-based Unmanned Aerial Vehicle (UAV) combined with a spraying system for agricultural activities, namely liquid fertilizer. Furthermore, to carry out technical design, assembly design, while the last is to test the performance of flying, what needs to be done is measurement and recording of performance and flight stability. In the hardware configuration the water pump has an additional circuit as a transmitter amplifier RC voltage amplifier to activate and turn off the water pump when the water pump will spray fertilizer liquid, for the fertilizer spraying method found in Figure 1.
The initial process is to create a coordinate point. Using this waypoint mode, besides being able to create a coordinate point, it can also adjust the speed and height of the quadcopter. After the coordinate point has been created, the pilot will send data to the flight controller and then activate the action camera. For the filling of liquid pesticides, it is by pouring pesticide liquid on the installed container between the landing gear quadcopter. When you take-off with the waypoint mode, the pilot only activates the throttle button and directs the throttle button up. The quadcopter will automatically take-off and point to the coordinates that have been made. When the quadcopter is in the second coordinate point, the pilot activates the spray button on the remote control. Then the water-pump will activate and spray the rice until the indicator on the LED is in an off condition which indicates that the pesticide is exhausted. After the pilot knows the pesticide has run out based on the state of the LED indicator in the off condition, then the pilot turns off the spray button. Automatically the quadcopter will land at the specified coordinate points.

Figure 2. Flowchart Foliar Farming Using UAV

Figure 3. Detail Unmanned Aerial Vehicle for Foliar Farming
In this research the effectiveness of unmanned aerial vehicle on foliar farming by measuring the spray area in the field of plants with different heights with the path using unmanned aerial vehicle as in Figure 2. The path has been determined according to the waypoint, so that the direction of the plane is directed according to the plan as in Figure 3.

![Figure 4. Track Waypoint](image)

With the same waypoint trajectory, testing with different altitudes is 50 cm, 100 cm, 150 cm and 200 cm with a width of 1 meter sprayer. This is done to find out the best height to get spray coverage that is in accordance with the area, size of liquid fertilizer and time on farming foliar.

**4. Experimental Result**
The test was carried out on the plantation area in Politeknik Negeri Jember by analyzing the area of the sprayer in the field of plants along with the correct altitude. Because it is still the prototype stage the tank capacity contains 1 liter of water with a time of 90 seconds, tested at a speed of 20 km / h. The magnitude of the spray coverage value is shown in Table 1. This test was carried out when an unmanned aerial vehicle was aired.

<table>
<thead>
<tr>
<th>Altitude (meters)</th>
<th>Sprayer (meters²)</th>
<th>Time (seconds)</th>
<th>Speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.95</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>1</td>
<td>1.05</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>1.5</td>
<td>1.15</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>0.8</td>
<td>1</td>
<td>20</td>
</tr>
</tbody>
</table>

**5. Conclusion**
From the results of this experiment, it is known that the lower the altitude is not directly proportional to the smaller the spray field, the plant area is not wide in scope but it consumes a lot of liquid fertilizer, but it also has the potential to damage the plant because the closer the altitude distance to the crop field causes the plants to collapse due to tightness the wind from the propeller. Likewise, the higher the
altitude does not guarantee a wider range of crop fields, because there is potential with high speed and altitude, fertilizer fluids blown away so that they are not on target, which results in uneven fertilizer to the crop fields. The results of this study can be concluded that the best altitude for farming foliar is 1.5 meters with an area of 1.15 square meters for 1 second. So that it only takes 100 seconds to cultivate a foliar farming area of 115 square meters.

Acknowledgments
The author would like to thank PNBP fund research program, number: 636 / PL17.4 / PL / 2018 has supported this research.

References