Application of Drone Technology for Mapping and Monitoring of Corn Agricultural Land

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Abstract. *Utilization of technology in agricultural systems has been widely used and applied in industrial areas 4.0, with technology in the agricultural sector it will be greatly helped from the beginning of planting until the harvest comes, one of the uses of technology that has been done is the use of creation technology using images taken from above To find out how the conditions of the planted agricultural plants are, whether they are suitable for harvesting or are still waiting for the process to ripen, with the Drone technology, the imaging system will be easier to monitor because with Drone technology, taking pictures that are initially difficult will become easier. The research method used in this research is to use literature review and conduct experiments on drones that will be used in this experiment, with data testing it will produce research that has a high level of validity, the experiment proves that the use of drone technology is very useful for agriculture, especially corn agriculture. The use of Image processing media has indeed been widely used in research in the field of agriculture, but the use of Drone technology is still rarely used because technology is still the latest technology, and is still not widely applied in many agricultural fields. In this research, we will produce a system proposal that will provide the effectiveness of using drones, in image processing that can be used as monitoring and mapping on maize farms in Indonesia, with the experimental use of drones, it will be known how the effectiveness is in determining the level of harvest in a certain area. agricultural land.*

Keywords: *Drone, Mapping, Monitoring, Land, Corn Farming.*

I. INTRODUCTION

To find out the level of maturity of an agricultural product is very important, because knowing the right time to harvest an agricultural product will be very useful for the sale period of the product, so far it is still done manually by looking directly at the field or at the land used as a medium. planting, with the existence of a manual system like this, farmers have to frequently see the land and the mapping of the maturity of agricultural products is still not well mapped, therefore with the technological system applied to agriculture, it will greatly assist the agricultural sector in developing products and marketing developments [1].

Many studies have used image processing in agriculture, but the use of drone media is still not fully developed, image processing in agriculture is still done by taking photos from above using a helicopter or taking pictures from a higher place, with the existence of this short coming is that the research provides the best proposal by using drone media, so that it can be mapped and can be known the level of maturity of an agricultural product in a land [2], with the processing of images obtained by the drone media, it will be possible to know directly the level of maturity of the agricultural products raised [3].

The problem raised in this research is how to determine the level of maturity of an agricultural product using the latest technology, namely drones, by using drone technology, the problem that is initially difficult to know the maturity level can be done quickly with drone technology [4].

The method used in this research is to use literature review and the testing process on a tool in the form of a drone, with the literature review method it will be a good research base and can find problems from current problems so this research can become research . the latest and can be the basis for future research, with the existence of testing it will be known the effectiveness of the technology proposed in this research [5].

The aim of this research is to produce a proposed system that can prove how the latest technology trials in agriculture, with the latest technology systems will be able to assist farmers in mapping and monitoring in maize farming, by being able to find out how the level maturity of an agricultural product that has been planted in an agricultural land [6].

II. LITERATURE REVIEW

The technology that was discovered in the early 2000s is based on the idea of the development of helicopters, and how helicopters can be small and can be used by many people, with the above premise a drone is created that is made like a small helicopter that is inserted into a camera, with a camera it can Taking pictures from a distance and the results of the images can be analyzed for many purposes, for example mapping on agriculture, with drones will be able to help this research by mapping and classifying photos of corn plantations. Advantages of Drones: Low Cost, Easy Application of Technology, No Need for Special Operators, Good Image Results, Easy-to-use System [7]. Disadvantages of Drones: Taking pictures must be precise, limited drone coverage, the weather must be sunny [8]. Mapping and monitoring are part of machine learning, with a lot of data that will be able to make the data base answers and create something new because of the new data, by mapping the fields of corn farming can help farmers in monitoring the land from planting seeds to harvesting corn. arrived, in the field of monitoring in the corn field can monitor the level of maturity of the corn, so that farmers can determine the right time to harvest corn [9].

Figure 1. Distribution Map of Superior Corn Varieties

Source: Ministry of Agriculture

Based on the picture above, it can be seen that the distribution of agricultural products in the form of maize is found throughout Indonesia, from Sabang to Merauke, with this fairly even distribution [10], corn is an agricultural product that can be applied in all kinds of places, because not all places in Indonesia have the same temperature or soil conditions, therefore the spread of superior maize varieties throughout Indonesia is very good and can be a superior product of the Indonesian state that can be exported abroad, therefore the application of technology must be applied to assist farmers in

increasing maize production for the sake of national and international market interests [11].

Table 1. National Corn Production and Needs

Source: Ministry of Agriculture

	2014	2015	2016	2017	2018
Production (Thousand Tons)	19,008	19,612	23,578	28,924	30,056
Land Area (Thousands of Hectares)	3.837	3,787	4,444	5,533	5,734
Consumption (Thousand Tons)	15,500	15,500	15,500	15,500	15,500

Based on table 1 above, the following explanation will be given from 2014 to 2018 there has been an increase in national maize production every year, and continues to increase in land area for maize nationally , but national maize consumption remains every year, meaning there is excess production, which could result in Indonesia, exporting maize abroad .

Table 2. Corn Quality Standards

Source: Ministry of Agriculture

Characteristics	Terms and Conditions		
	Quality 1	Quality 2	Quality 3
Maximum Moisture Content	14,0	15,5	15,5
Maximum Broken Seeds	3,0	5,0	9,0
Maximum Dirt Content	3,0	4,0	5,0
Damaged Maximum Lice	5,0	8,0	11,0

Based on table 2 above, it will be explained as follows, there are four characteristics of corn quality standards, the first is moisture content compared to weight, crushed seeds compared to weight, dirt content is proportional to weight, damaged lice are proportional to weight [12], with these four characteristics, There are three qualities, the first quality, the second and the third quality means what, the first quality is the lowest quality and the third quality is the best quality, what does that mean, if it meets the third quality requirement then the corn quality standard can be exported abroad [13].

The results of the ANOVA study based on the results of flying from drones produce significant data with the number of identifiable objects [14]. The use of drones in the industrial field is very much needed because the effectiveness of sending goods by drones is very fast and efficient, and can be controlled remotely [15].

The use of drones in agriculture is very effective and efficient in assisting mapping and surveillance in agriculture, by using IoT and sensors, the mapping will be maximized and the data obtained can help farmers [16]. Automatic flight tools are very helpful for monitoring in the field of mapping in agriculture, with low costs, automatic flying tools are very reliable for many things in agriculture using autopilot [17].

With the use of drones, it will help the flight system and can be used to enforce the law and focus on maintaining existing regulations. The conclusion of this study is to develop and improve existing flights, the presence of drones will help mapping by developing low-cost wings [18]. The conclusion of this paper is the Long Range Wide Area Network (LoRaWAN) can link drones and agricultural surveillance, with the Long Range Wide Area Network (LoRaWAN) will be able to carry out surveillance from quite a distance [19].

III. MODEL PROPOSED

Based on the model image proposed below, it will be explained as follows, will go to the land where the data classification will be identified and then retrieve data from the image and then send it to the system after being processed in the system, the system will identify the results of the data or images sent from The drone after the data is clarified it will produce 3 pieces of data, namely ready to be harvested, not ready to be harvested and not yet planted. Therefore, the data will be stored in a database system.

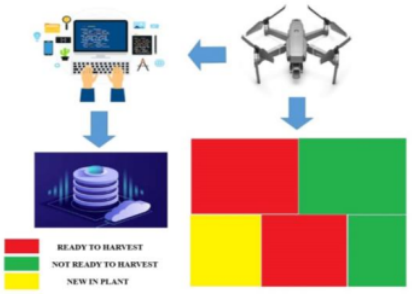

Figure 2. The proposed system applied to maize land mapping and monitoring

Based on the flowchart image below, it will be explained as follows. First, the data is taken through and then the data will be created so that the data can classify the corn agricultural land to be taken so that it can make a decision whether the data will be processed or not. generate new data so that data classification will produce very accurate data so that the data can be used as the basis for harvesting corn.

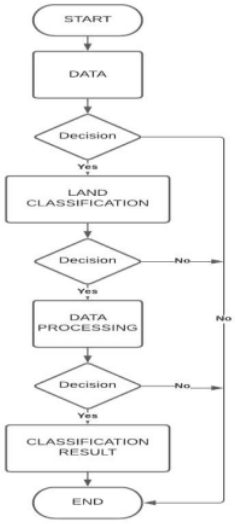

Figure 3. Flowchart Sistem

Based on the picture below, it will be explained how the diagram of the system that will be proposed, the system that will be proposed has two factors, namely the farmer and the system. Therefore, here will be described there are 2 vectors that say farmer and system and here has the activity of farmers will run drones then use the leaves as identification from the corn farm, then the farmer takes a picture of the corn farm and produces the results of the identification while the system actor has the task or activity of turning on the drone using a drone on a corn farm and taking pictures and then analyzing the results from the photo and then having the results from the analysis of photo taken.

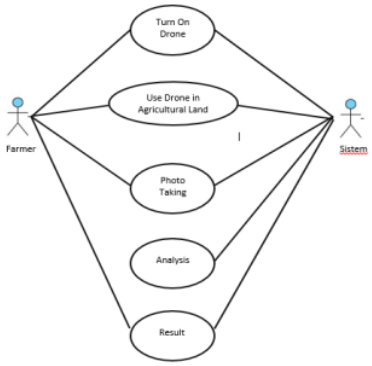

Figure 4. Usecase Diagram

Based on the picture below, the activity diagram for the proposed system will be explained, first the farmer will turn on the descent and then the system will authorize the system. will take photos of the corn fields so that the photos can be analyzed by the system after system analysis it will produce results from the system which will make analyzing the system the results of corn plantations.

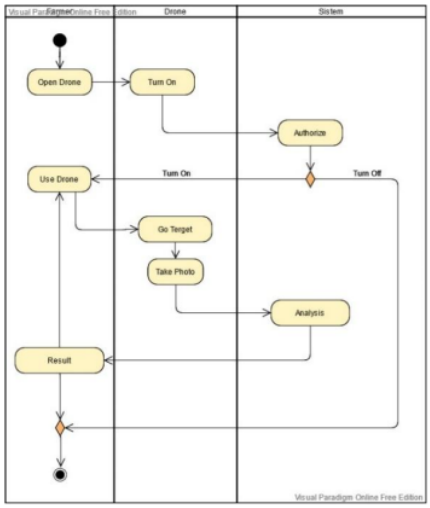

Figure 5. Aktivity Diagram

Based on table 4 below, an explanation of the five types of Brown used in this study will be given. Angkara cover of a resolution area of the material and the price of the drum with the 5 drones, it can be seen which drone will be the best in testing corn farming system adopted in this research.

Table 3. Comparison of Appropriate Drones for Application of Classification Technology in Corn Farming

Type of Drone	Coverage	Resolution	Price
Dji Mavic Air 2	10 km	48 MP	Rp 15.000.000 ,-
Dji Mavic Mini	4 km	12 MP	Rp 5.400.000, -
MJX Bugs 7	500 meters	2 MP	Rp 2.200.000, -
MJX Bugs 20 EIS	500 Meters	2 MP	Rp 3.500.000, -
MJX X103W	200 Meters	2 MP	Rp 1.300.000, -.

Based on pictures 6 7 8 9 10 below, it is the result of taking pictures on the drones that we raised in this study, with these 5 images, the results from corn farming that we will take data on will be even better, therefore the selection the right material will be able to determine which images

can be used as data to classify corn plants that are ready to harvest.

Figure 6. Drone Photos Dji Mavic Air 2

Figure 7. Drone Photos Dji Mavic Mini

Figure 8. Drone Photos MJX Bugs 7

Figure 9. Drone Photos MJX Bugs 20 EIS

Figure 10. Drone Photos MJX X103W

Based on figure 11 above is an image taken via Google Map on a corn field that will be used as data and image processing so that it can be used as a basis for classifying data whether the data can be used as a basis for harvesting on a corn plantation.

Figure 11. Image data of corn farming land before processing the system

Based on Figure 12 below, this is the result of data processing that has been taken in Figure 11 and produces several data classifications such as red data, yellow data and green data that will be able to classify the results of the corn harvest that will be carried out in the future on this plantation.

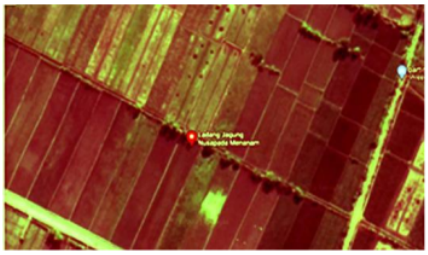

Figure 12. Image data of corn farming land after processing the system

Based on the experimental results from several drones above, it can be concluded that, which drone is the best for measuring harvest levels in a corn field using drone imagery technology, and the best advice is to choose a drone for mapping technology in corn fields.

Table 4. The results of testing data that have been processed through the stages of the data clarification process

Type of Drone	Harvest Data	Crop Data	Maintenance Data
Dji Mavic Air 2	95%	92%	93%
Dji Mavic Mini	89%	90%	90%
MJX Bugs 7	88%	86%	85%
MJX Bugs 20 EIS	75%	80%	79%
MJX X103W	80%	82%	83%
Google Map	90%	87%	89%

IV. CONCLUTION

Based on trials of the five drones that have been carried out and making comparisons with test images taken from Google Map, the result that has the most maximum data is the DJI Mavic

Air 2 Drone because it has 95% accurate data while Google Map has an accuracy rate of 90. %, therefore the DJI Mavic Air 2 Drone is the right drone to use in corn farming to detect corn harvests. Future research can classify the crops from the corn plantation, whether they have the first quality, the second quality or the third quality, by being able to classify the harvests, the data that will be obtained from the drone is complete.

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