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Information technology based smart farming model development in agriculture land

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ABSTRACT

Smart farming in various worlds is not just about applying technology in terms of storing data on agricultural land. However, having a concept of measurable data based on available computational techniques trained and then generating knowledge. As an application, the agri drone sprayer can be used for the process of applying pesticides and liquid fertilizers on each side. In addition, drone surveillance is also useful in implementing smart farming such as mapping land so that farmers will know the condition of their agricultural land. However, the soil and weather sensor will also help the farmers to monitor the farmland as well. Devices with sensors can only obtain data in the form of air and soil humidity, temperature, soil pH, water content and forecasting the harvest period. So that the smart farming model can help farmers to get recommendations, in preventing the predicted damage to their land and crops. However, according to its geographical location, the application of smart farming can be a smart solution to agricultural problems in Indonesia and make the future of Indonesian Agriculture a technology-based smart agriculture.

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1. INTRODUCTION

The advancement of digitalization in combination with telecommunications has brought computer equipment into its “revolutionary” period [1], [2]. In the 1970s, computer-based technology known as the personal computer was introduced as an alternative to mini-computers [3]. A computer or also known as a desktop computer is capable of conveying processed data and information to someone who needs the data and information at an accelerating speed with the speed of a mini computer, even a mainframe [4], [5]. The use of computers in companies is not only for increasing efficiency, but also for supporting more effective work processes [6]. The use of computers among companies is increasing, especially supported by the competitive environment that has changed from a monopoly to a free market [7]. In various fields, it has also shown benefits with the development of computers and highly advanced information technology [8], [9]. This is evidenced by the emergence of sophisticated technology known as unmanned aerial vehicle (UAV) or more popularly known as “drones” [10]. Drone controlled by humans and remote control [11]. Drones also function in shooting at high resolution and connected to a global positioning system (GPS) system [12] and centralized to a computer system [13]. The drone itself is capable of flying as high as a maximum of 150 meters or a range of around 446.016 h [14]. Lately, there have been many innovations and developments from the drone itself [15]. The increasingly rapid economic and industrial development has also made experts innovate to create drones that are able to support the economy and industry of the community in order to be able to reduce production costs [16]. Drones for agriculture have also begun to be created to help maintain large tracts of agricultural land [17]. From 2013-2015, investment in drone development for agriculture has continued to increase [18].

It is impossible to monitor hectares of agricultural land [19]. It takes a lot of human labor to carry out maintenance and checking of the agricultural land, this will result in an increase in maintenance costs [20]. It takes special technology such as satellite imagery so that farmers can get precise images and are able to cover all agricultural land [21]. In Indonesia there are still a lot of vast agricultural land, with the extent of agricultural land owned by Indonesia, of course, the fertilization process will require a lot of energy in carrying out the fertilization process [22]. For example, in areas of rice fields and plantations that plant the fertilization process, a lot of rice and vegetables are still carried out, not to mention the manual way, namely human labor, where the area of rice fields and plantations is not possible with just one human labor and it will take time [23]. Time and extra energy to provide fertilizer for these rice and vegetable crops. From these problems, smart farming was made assisted by using a drone for spraying pesticides, liquid fertilizers and land mapping as well as soil and weather sensors to perform soil and weather sensors [24], [25]. Technology like this is very necessary for agriculture, especially in Indonesia [26]. Smart Farming is a technology-based smart farming method [27]. The technology used in smart farming includes agri drone sprayer, namely drone spraying pesticides and liquid fertilizers, drone surveillance, namely drones for land mapping and soil and weather sensors to obtain soil and weather sensors [28].

2. MATERIAL AND METHOD

2.1. Smart farming

The application of technology to the conservation system is aimed at building a production process in the agricultural sector so that the results of the agriculture are still running and sustainable [29]. The implementation of agricultural technology has been used for more than 40 years, this technology provides a great contribution value in supervising and maintaining the supply line either in the form of agricultural products or distribution of other supporting tools. includes agriculture, animal husbandry, fisheries, food crops, plantations and others [30]. If several of these businesses are carefully combined and planned, it can provide more results than similar businesses, especially for small and medium farmers [31]. By utilizing the application of smart farming technology in the form of the use of RiTX soil and weather sensor which is used to record real time land conditions and predict the weather [32], [33]. Smart farming technology is an agricultural concept using modern technology to increase quantity and quality [34]. The smart technology used is the RiTX soil and weather sensor which is used to record land conditions in real time and predict precise weather so that farmers in Kadungora village can optimize their commodity production. Through smart farming technology, the cultivation process is more effective and will result in increased production and the welfare of farmers [35]. The application of smart farming technology is expected to maintain food estate [36]. Food estate is the main thing in development in order to achieve community welfare. Efforts to achieve food estate have become a concern at the national and international levels. Vulnerability to food can result in a lower quality of life for people, both in physical-health, social and economic aspects [37].

2.2. General architecture

The general architecture in the focus of this paper is to recognize drones on agricultural land. Where the process in this paper does not come out of what is expected in the results and discussion so that what is desired can be found in the general architecture. The general architecture can be seen in Figure 1. In Figure 1, you can see the general architecture starting from the user setting up data and information and making knowledge known as the application domain. then it is necessary to have a network domain to signal to drones and agricultural land so that the divice domain of agricultural land arrives and drones are able to sense what is needed. from agricultural land to be carried out by drone.

3. RESULT AND DISCUSSION

The drone uses a rotor for propulsion and control. In addition, the rotor is also referred to as a fan, because it works almost the same as a fan. The rotor is able to rotate to push the air down. Of course, all forces are paired, meaning that when the rotor presses against the air, eating the air pushes the rotor. This was the basic idea behind the creation of the elevator, which came to control the upward and downward forces. The faster the rotor rotates, the greater the lift, and vice versa. The drone has the principle that it will hover and be able to point to the north and can turn it back to face east. However, each drone firmware will have a different motor sequence configuration. Figure 2 shows the drone rotation model.

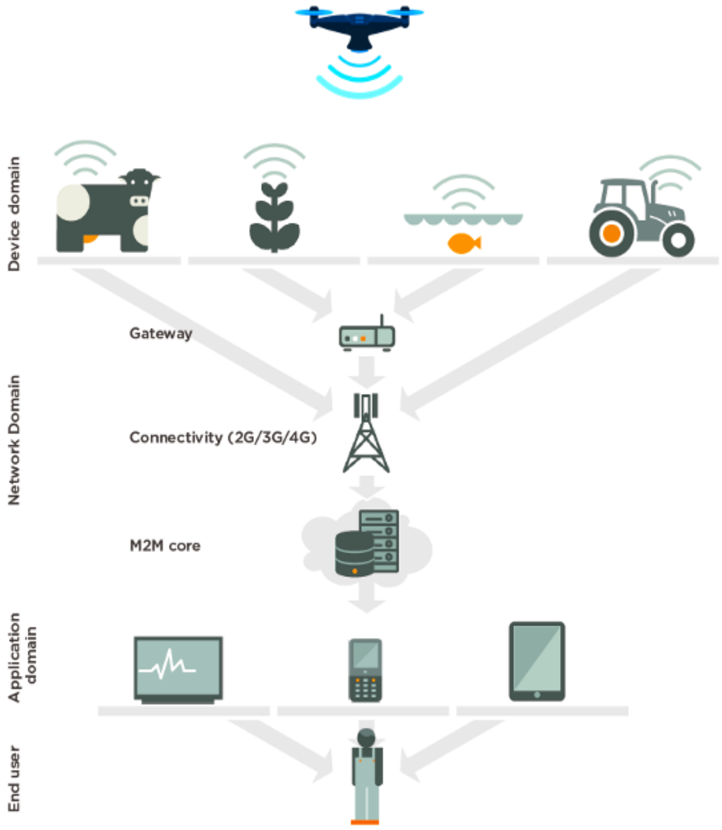

Figure 1. General architecture

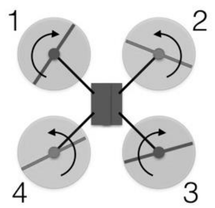

Figure 2. Drone rotation

In Figure 2 it can be seen that the red rotor rotates counterclockwise, the green rotor rotates clockwise, two sets of rotors rotate counterclockwise, and the total angular momentum is zero. Multiplying angular velocity and moment of inertia, angular momentum equals linear momentum. However, calculating the angular momentum based on the rotating rotor speed is more complicated. For the drone rotation process by reducing the rotation of the rotor 1 and 3 and increasing the rotation of the rotor 2 and 4. The momentum of the rotor angle has not increased to zero, so the drone body must rotate. But the net force is still the same as gravity, and the drone continues to hover. Since the thrust rotors are facing each other diagonally, the drone is still in equilibrium. In the process of moving, the drone can move not only forward or backward but also symetrical and side to side. Basically, a quadcopter drone has the concept of each side is the front. This means that the way to move forward also defines the way to move backward. Drone can also fly forward, requiring a boost from the rotor. Figure 3 will show a side view of a drone moving at a fast speed.

However, in the process of this paper, we will do how to make the drone move into a position to recognize the needs of the agriculture needed. Therefore, according to the previously defined process, it can increase the speed of the rear rotors 3 and 4 and reduce the rotor levels 1 and 2. The total thrust will remain the same as its weight, so that the drone will remain at the same vertical height. In addition, because one rear rotor rotates counter clockwise and the other rear rotor rotates clockwise, this increased rotation of the rotor will still result in zero angular momentum. The same goes for the front rotors, so the drone won’t spin.

However, the force on the back of the drone is greater, which means the drone will tilt forward. Now, the thrust of all rotors is slightly increased, which will cause the net boost to have a positive component and a weight balance component.

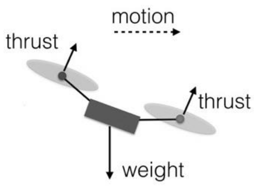

Figure 3. Drone flight process

3.1. PID control systemon drones and influence on stable on not

Proportional, integral, and derivative (PID) is a loop to calculate the error value by comparing the desired input value with the measured process value. After the error value is calculated, the PID value is used to calculate and apply corrections to unwanted errors. By changing the value associated with the PID gain, drone performance can be improved by reducing the frequency of errors during flight. To understand how the PID loop implements this change, consider the following analogy. Suppose you have to kick the ball exactly to a certain point. If you can only kick the ball once at the starting point, you will need to apply the proper force to the ball to stop it in the desired position. It is difficult and requires a lot of trial and error to complete the task properly. Imagine if you could control the acceleration and deceleration of the ball as it rolled after the initial kick, then this would allow you to reduce or increase the speed of the ball as it approached the finish line. This technique is more efficient when the PID loop tries to react accurately to the input signal. first person view (FPV) drones will perform well in the air. Even environmental factors like the atmosphere can affect how the rectangle is set up. PID adjustments are very subjective. The FPV drone setup must be suitable for different flight styles and environments, which is very important.

3.2. Drone settings for agricultural land identification

There are various ways to set up drones, each drone brand will have different treatment methods. This paper will explain how to set up a dji brand drone and drones with Betaflight firmware in them. For setting up any drone with Betaflight firmware it's easier to do first connect the drone to a laptop or personal computer without a battery and remove the propeller then click connect and enter the setup tab and click “reset settings” but if you are in doubt, we recommend it to Click on backup first to save your previous settings. In this case it can be seen in Figure 4.

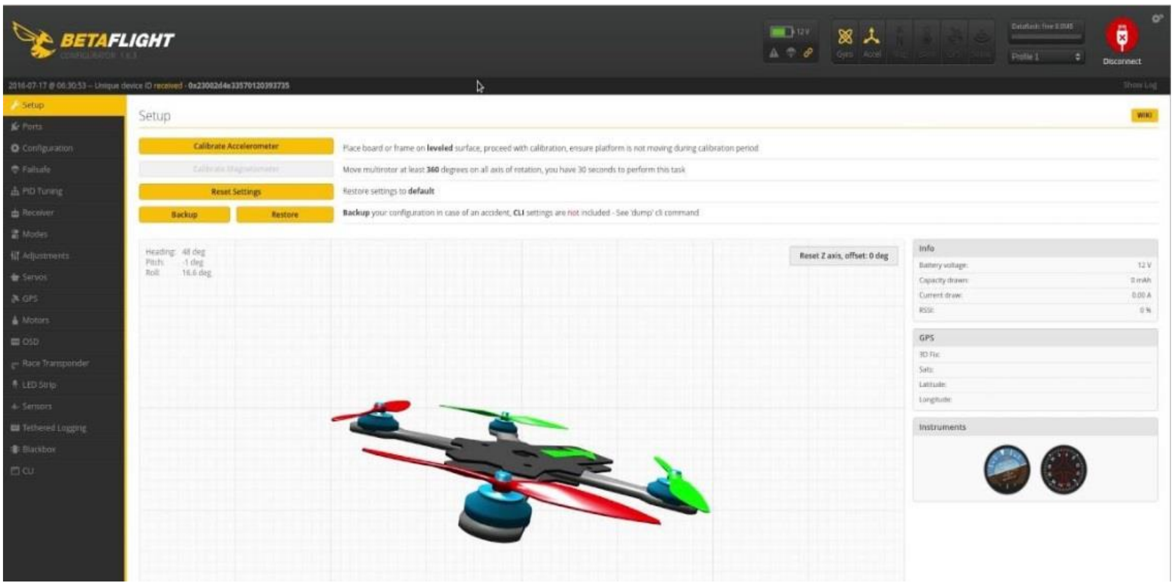

Figure 4. Drone settings to recognize agricultural land

Figure 4 an easy way of tuning PID without being complicated on drones to recognize agricultural land will be carried out or a model is determined in its introduction so that the model can be recognized as with machine learning with PID. From the simulation, drones will be introduced to the agricultural land. that can be simulated is the introduction of defense land related to agricultural data. as a supporter of PID on drones, the formulation in Figure 5.

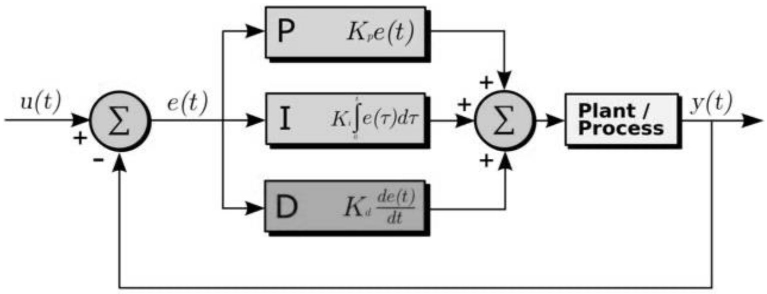

Figure 5. PID model in introduction to agricultural land

Usually before starting to set a new PID, set the default PID first to understand how drone understands agricultural land. With the help of modern FC software such as Betaflight, Raceflight, and KISS, cropland identification values usually work well in most cases. Watch for any bad behavior, then adjust the PID accordingly. Another popular method is to start slowly. Reduce all the scores by at least half or more, then increase each grade again until you see bad behavior. Adjust one axis at a time: turn first, then throw, and last evaporate. I adjust one value at a time on each axis, starting with P, then D, and finally I. You may need to adjust each value back and forth, because changing to one value affects the other. Tuning a quad can take some time, it may take 10 minutes, an hour or even days to get the perfect tone.

3.3. Drone model as an identifier for agricultural land

As discussed previously, the PID value determines how good the drone feels when flying for further tuning in this paper. A drone which is an unmanned aircraft will fly where it is based on the center of gravity. The center of gravity process is shown in Figure 6.

Figure 6. Center of gravity (COG)

Figure 6 is an example of a drone and the location of its center of gravity, the center of gravity greatly affects the performance of the drone when flying to find out whether or not you can hold the drone with your finger in the middle of the drone between your COG, you can from right side left, front back and diagonal if you find your drone tilted to an angle then you have to change the position of the drone's load (battery, hd camera) or give additional weight to the lighter side to balance, if this is neglected your drone can fly sideways itself to a certain side even without control. Then an introduction or sensor is carried out in introducing drones to get to know agricultural land. The sensor recognition process implemented in COG is shown in Figure 7.

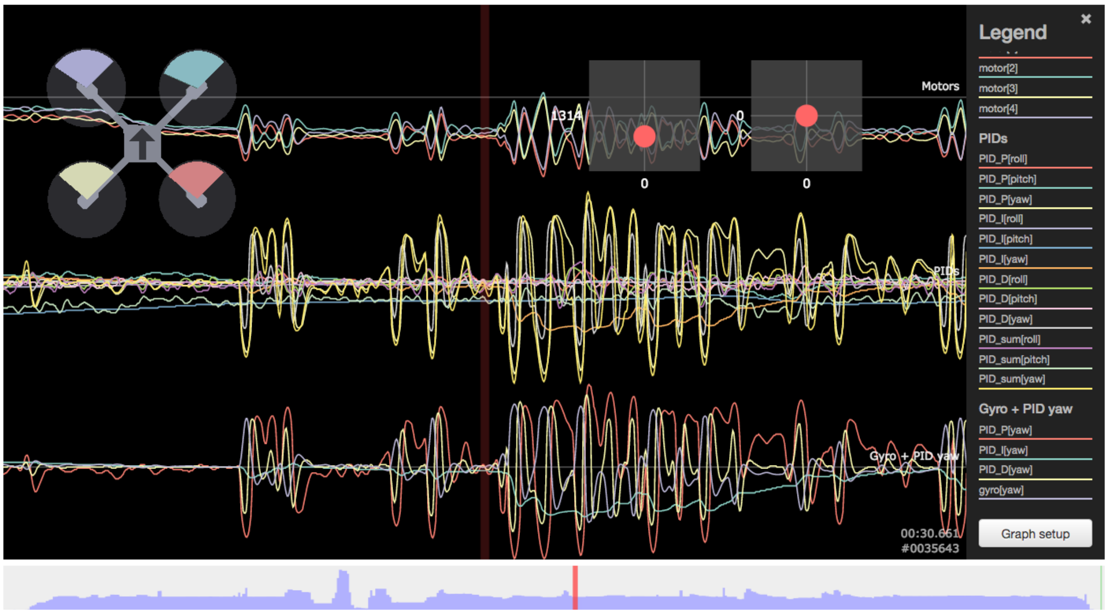

Figure 7. Sensor identification of agricultural land

Figure 7 is a log of betaflight which explains the reading of data from acc and gyro sensors. The result of Figure 7 is a simulation of a moving drone and then an image is captured. A flight controller usually has several sensors, namely accelerometer, gyro, barometer and magneto, at least using two types of sensors, namely accelerometer and gyro. The gyroscope, or shorter gyro, is the only sensor a drone really needs for stable flight. This feeds the flight controller with very important information: how fast the airplane rotates around its own axis: roll, pitch and yaw. The circle in the PID controller uses its information to stabilize the aircraft. When the pilot does not apply deflection to the roll, pitch and yaw sticks (they are in neutral), the drone does not rotate. gyro can maintain current stance, so as not to wobble, has no drift rotation. If it starts rotating, this information is fetched from the gyro and a countermeasure is applied to stop unwanted rotation and event to roll back to the desired position. To make the drone fly smoothly, a filter is needed to filter frequency data from the gyro sensor software such as Betaflight has provided many types of filters such as notch filters and rpm filters that can filter out fluctuating frequencies and noise from the gyro sensor to be processed by the PID controller.

4. CONCLUSION

In this paper, it is known how to treat your drone so that it can fly stably not drift sideways in knowing agricultural land by being given knowledge based on data that is used as information and made based on knowledge by paying attention to the PID, PART, and COG factors as well as how to set up the DJI drone as well as the Betaflight firmware. Technology like this is very necessary for agriculture in Indonesia. So that, agriculture can attract young people to farm and the area has the potential to increase.

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