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Robot Seed Planter based on Distance

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Abstract The precision and time play an important role on the outcome of the yield. This paper is about to introduce the autonomous vehicle system in the agriculture system. This will help in increasing productivity and also reduce time consumed to plant seeds in agriculture. Planting seeds on larger scale using manual method will consume time, less precision and also labor-intensive. Thus, the objective of this project is to design an autonomous robot and also a system that approximately move the vehicle to a place that had been set. In this project, the microcontroller that is used are the ArduPilot, GPS module, Telemetry kit and also a mission planner application. The scope of the project is the positioning and also localization of seeds planted between each other. The system had been tested and was conducted to find its accuracy by acquiring the distance of the car moved using the system designed and differentiate it with the set distance. The design of the autonomous robot was successful and the test for the system had shown the accuracy of the system and also the average accuracy of the system are very low that has an error of 1.11%. In conclusion, the design of the robot and the system is successful. But for the in the real-world situation, it is not ready due to the large error. For future work we, need to use a different type of microcontroller that is more advance. Other than that, we need to change the GPS module that is more precise so it can detect the distance more precise. Other than that, we need to use a higher frequency telemetry kit to have a better connection from the device to the application controller.

Keywords: Robot, Seed Planter, Mission Planner, Microcontroller

1. Introduction

The advancement in micro-controller technology had made robot technology can be widely used in almost our everyday life not to mention the working sector [1]. Robots are designed to help humans in increasing productivity and outcome. This had helped humans to solve problems, such as agriculture [2], medical [3], transportation and logistical [4], monitoring [5]. In agriculture, planting seeds is an easy task and can be done manually. The problem comes when the planting of seeds is done on a larger scale. This will make the tasks time consuming and labor-intensive. In this study, the robot will perform the task to plant the seeds based on the distance between each seed. So that, each plant get enough

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nutrients and their growth will not be stunted. So this will maximize the production of the plant at the end of the day [6]. So by implementing robots in agriculture to help farmer to plant the seeds will be more helpful and increase efficiency [7]. Although planting seed can be done manually it will take time and also the precision in the distance of plant will be not precise and the type of seeds use also play an important role in the nutrient's intake [8]. If the nutrient is not enough, this can cause the plant growth will be limited and the plant will lacked of nutrients due to competition to get enough nutrients. This will cause some of the plant will be dead due to lack of nutrient. This will make the production will decrease [6]. Besides that, another problem is aging farmers. This is because the lack of technological aspect that can affect teenagers is not there [7].

The objective for this project is to design an autonomous vehicle. Secondly, to design a system that can approximately move the robot to the place that had been set automatically. Other than that, to evaluate the system in real world.

2. Materials and Methods

The project objective is to achieve the design and system of an autonomous vehicle for seed plantation in the agriculture sector. This project will greatly help the farmers to plant the seeds precisely within the distance that are required. The autonomous vehicle will use a microcontroller that is ArduPilot APM 2.8. The software that is used are QGroundController.

2.1 Design of the robot

Figure 1 shows a block diagram of how the system of the autonomous robot will work. There will be 4 components will be involved in the system which is the QGroundControl unit GUI, telemetry kit transmitter, telemetry kit receiver, and also the APM 2.8 ArduPilot the system will function when the Graphical User Interface (GUI) that is the QGroundControl send the data mission. The data will be transmitted from the radio module one of the telemetry kits that is connected to the device that is running the GUI. Then the radio module telemetry kit that is connected to the APM ArduPilot 2.8 on the vehicle will receive the data that was transmitted. After that, the data that have been received and will be transferred to the APM ArduPilot to execute the task.

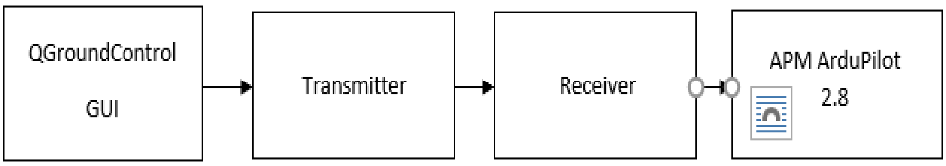

Figure 1: System block diagram of autonomous vehicle

The circuit design of the robot is as shown in Figure 2. The connection of the component is the motor server from the RC car will connect to the output pin 1 and 3 at the APM. At the APM input pin, it will be connected to the receiver by connecting input pin 8 to receiver channel 5, input pin 3 to receiver channel 2, and input pin 1 to receiver channel 1. The GPS module will be connected to the GPS port at the APM and also the I2C port. Meanwhile, the telemetry will be connected to the power port.

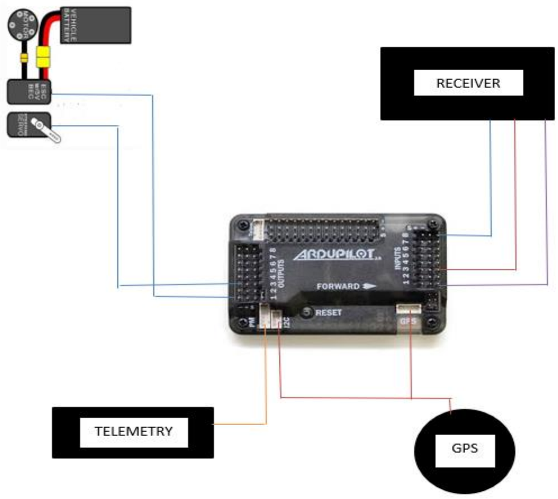

Figure 2: Circuit diagram of the robot

2.2 The QgroundControl application system

The system of the plantation of seeds are by using the application QGroundControl. The system is designed by planning the route of the seeds plantation. Other than that, the system will also set the distance between each seed based on the seeds best preference. The setting will be set through the QGroundControl application as in Figure 3.

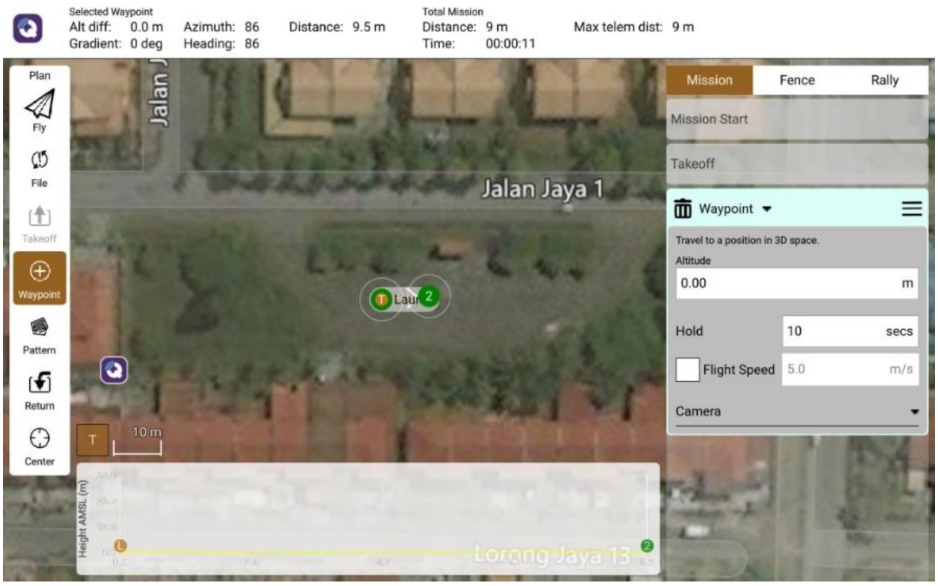

Figure 3: System setting in QGroundControl

2.3 Testing and evaluation

The testing of the robot will be conducted in an open space that has 2 checkpoints. Each checkpoint will indicate the exact place for the oil palm seed will be planted. The distance for each checkpoint will be 9 meters as it is the optimum range for the oil palm to grow as shown in Figure 4.

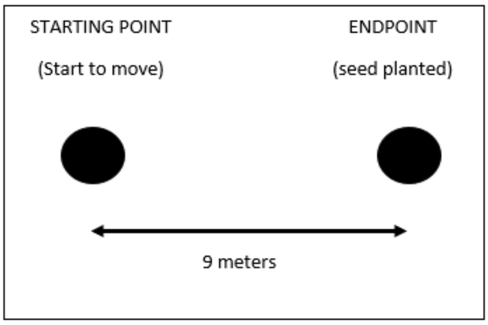

Figure 4: Testing distance method

The test will be run 10 times to get the optimal value of error in the distance of the system. This will show if the system is accurate or not.

2.5 Equations

The equation that are going to be used are to calculate the Accuracy of the system based on the distance and also to calculate the average accuracy of the system. The formula are as shown below:

Accuracy of the system based on the distance, %:

$$\frac{|Measured\ Distance - Set\ Distance|}{Set\ Distance} \times 100\% \qquad Eq.1$$

The average accuracy of system, %:

$$\frac{Summation\ of\ Accuracy(\%)}{No.of\ test\ conducted} \qquad Eq.2$$

3. Results and Discussion

The project has been developed and also had been tested to get the accuracy of the system. The data and information are explained in this part.

3.1 Results

The autonomous vehicle was successfully design by using the APM 2.8 ArduPilot, Ublox GPS module, Telemetry kit and a 4 6V of DC motor as in Figure 5.

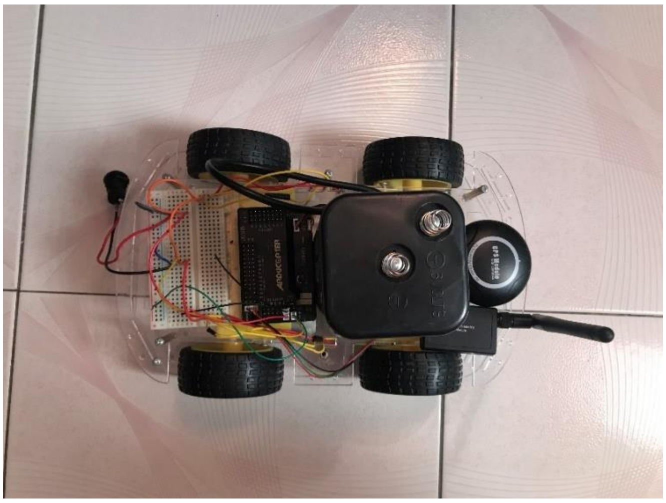

Figure 5: The design of autonomous vehicle

As for the application calibration. It was set in the QGroundControl as in Figure 6. The distance was set to application will show the selected waypoint distance from the waypoint before, max telemetry distance, the time taken for the robot to reach the next waypoint the altitude difference, and also movement the robot is heading at the top panel of the application. On the left side panel it shows the button to start the flight, file that have been saved in the application for the robot setting, the waypoint where the setting of robot behavior for each checkpoint, the pattern button which is used to set the pattern of the mission panning, the return button for the robot to return to its starting point, and also center button to center the application screen to where the vehicle position. As for the right panel its show the mission of the robot that is been set. Which there will be setting of the takeoff and the waypoint. In the waypoint, the altitude will be set, the time taken for the robot to stop at the checkpoint, the flight speed setting, and also how the camera view from the robot if there is any. The fence and rally is the pattern that can be set at the waypoint. For the two green point in the middle of the application that has number 1 and 2 are the waypoint that had been set.

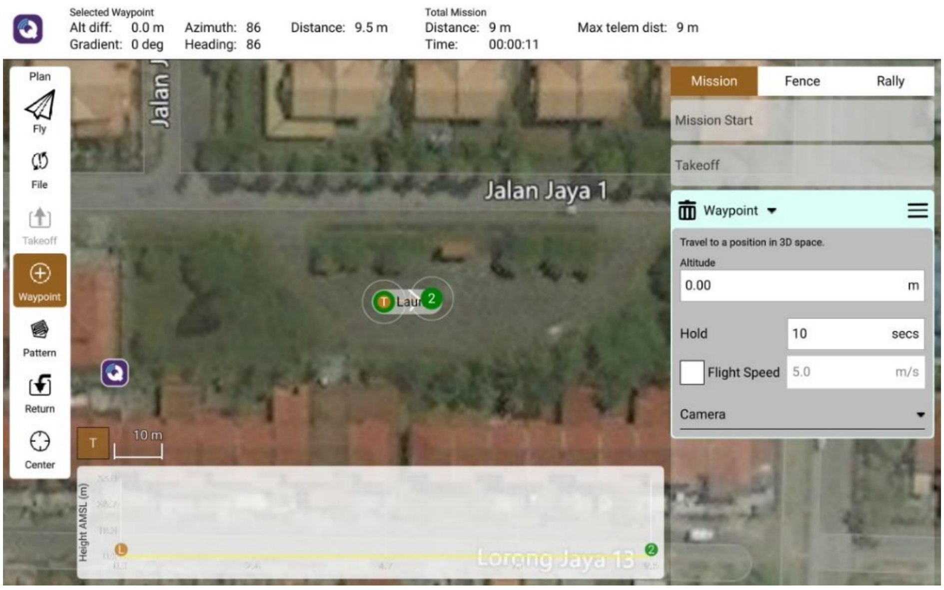

Figure 6: The application calibration for the autonomous vehicle

The test was done in an open space and the distance from the starting point to the checkpoint are 9 meters apart. The test was done about 10 times. The distance of where the robot stopped at the checkpoint from the starting point and also the difference where the robot stop with the checkpoint were recorded as in Table 1.

Table 1: Distance of where the robot stopped at the checkpoint from the starting point and also the difference where the robot stops with the checkpoint

No	Distance (meter, m)	Difference from target distance (meter, m)
1	9.22	0.22
2	9.12	0.12
3	9.07	0.07
4	9.08	0.08
5	8.91	-0.09
6	9.02	0.02
7	9.18	0.18
8	9.11	0.11
9	9.09	0.09
10	8.98	-0.02

Then, the accuracy of the system was calculated by using the formula as shown in Table 2.

Table 1: Accuracy of the system based on distance, %

No. Test	Accuracy of the system based on distance, %
1	2.44
2	1.33
3	0.77
4	0.88
5	1.00
6	0.22
7	2.00
8	1.22
9	1.00
10	0.22

As from Table 2 we can say that the higher error is at the first test that is 2.44% that shows that it is the most, not accurate value that was getting from the test. The lowest error that shows the highest accuracy is at test numbers 6 and 10 which give 0.22% error. Why u get lower value. Please state it

After the accuracy of the system of each test was calculated, the average accuracy of the system can be calculated. The average value accuracy of the system is as calculated below.

$$(11.08\%)/10=1.11\% \qquad \textit{Eq.3}$$

The average value of accuracy of the system is 1.11%. The average accuracy is got by summing all of the accuracies of the system and divided it by the number of tests conducted.

The autonomous vehicle was successfully designed. that can help in moving the vehicle to a certain distance that was set on the application. The application can help the agriculture sector to plan the course of their yield according to their suitable distance. Due to the old model of the microcontroller that is the APM ArduPilot 2.8, there were some problems finding suitable firmware. Other than that, the GPS module also does not give the most accurate positioning. Which can be replaced with a more precise GPS module to get a better result.

4. Conclusion

In conclusion, in this project, the designing of the autonomous vehicle has been achieved that was the first objective of this project. The vehicle was designed by using an APM ArduPilot as the microcontroller in the project. Other than that, a design of program that can approximately move the robot to the place that been set automatically also been done. But the system was not accurate and have a significant amount of error was shown. Finally, the system have been evaaluated in the real world. By running the test on the autonomous vehicle that was designed. The result shows that the system is not ready to be used in real situation.

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