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Design of an Anti-Tank Rocket Launcher Drone

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ABSTRACT:

Reconnaissance is an effort, work, activity to collect information about a target object/opposing party accurately and safely. The information obtained is really needed by the commander in taking decision-making steps. Reconnaissance will fail when the unit's movements are known by the opposing party/enemy, this can create vulnerabilities for the troops themselves because there is a possibility that contact will occur earlier and can thwart the main task and there is a possibility of casualties on their own side. UAV technology continues to be developed by developed countries to support the military sector, especially to support reconnaissance operations through aerial photography and real-time (direct visuals). The types of UAV technology products that have been produced include the fixwing type using an engine, electric fixwing, electric rotary wing, both manual and auto pilot. The Rotary wing UAV type is more advantageous for obtaining information in difficult terrain about target objects because its shape and maneuvers allow it to be used in terrain that is difficult for reconnaissance units to reach and its confidentiality is maintained. Research on rotary wings using anti-tank rocket launchers is a development of previous research, namely anti-personnel drones equipped with small caliber rocket launchers. For further research and development, this type of drone or rotary wing UAV is equipped with a C90 type anti-tank rocket launcher. With the anti-tank rotary wing system, it is hoped that it can support infantry units in optimizing the power to destroy targets, especially shooting enemy tanks through the rotary wing (drone).

1. INTRODUCTION

Research on rotary wings using anti-tank rocket launchers is a development of previous research, namely anti-personnel drones equipped with small caliber rocket launchers. For further research and development, this type of drone or rotary wing UAV is equipped with a C90 type anti-tank rocket launcher. With the anti-tank rotary wing system, it is hoped that it can support infantry units in optimizing the power to destroy targets, especially shooting enemy tanks through the rotary wing (drone). Anti-Personnel Drone is a rotary type unmanned aircraft or four helicopters equipped with an anti-personnel rocket launcher system. Where this drone was made in 2017 by Lt. Col. Nur Rachman Supadmana Muda from Poltekad with the aim of helping troops penetrate enemy territory. The target of destruction is enemy personnel, while this research still needs to be developed due to its short range and the 5 mm caliber rocket used. A UAV is an unmanned aircraft made in the form of a fixed wing or rotary wing model. Currently, many specifications of UAV products are being produced, especially helicopter or rotary wing drones, both in the form of toys, public services and even to support the military. The function that can be carried out is currently widely used by photographers for aerial photography, while in the military it is used for mapping, reconnaissance and combat.

2. LITERATURE REVIEW

Yun Hao et al (2023) The RVIO module uses a downward-facing monocular camera, LRF, and IMU to estimate relative motion between consecutive UAV frames. The image registration based geo-localization module consists of two steps: coarse matching and fine matching. During the coarse matching step, assisted by LRF, the corresponding map tiles are retrieved from the database generated through satellite image segmentation. These corresponding map plots serve as potential candidates for further registration.

Tri Bien Minh et al (2023) The Octocopter is a type of multirotor vehicle (a rotor aircraft with more than two rotors), which has recently received a lot of attention in both the scientific and commercial fields. With a larger number of rotors, multirotors are highly maneuverable and powerful. Multi-copters made an important contribution to the technological revolution in the fields of military, industry, transportation, mapping and especially agriculture. Currently, we are heading towards the fourth industrial revolution as well as the application of new technologies in agriculture such as precision farming, mapping and monitoring. Due to the latest advanced technologies of sensors, electronics, 3D printing, high performance batteries, multi-copters can be produced at low cost.

Materials and Methods

Materials

The drone materials used consist of: frame, flight control, ESC, IMU, Brushless Motor, GPS, Propeller, 14.8 Volt 10000 mAH Lipo Battery, Frsky Receiver, Taranis 2.4 GHz Remote Control, Camera, 5.8 GHz Video Sender, Video Receiver, Glass VR.

Flight control is an aircraft component control system to synchronize with the controller. The control system can be carried out automatically or on autopilot or through an operator control system. The flight control system can be filled with programs and equipped with a gyro system for balance and accelerometer. Some of the newest FCs even have air pressure sensors (barometer, compass (magnetometer) and GPS. The barometer sensor functions to maintain the height of the multirotor at a certain height then the magnetometer and GPS are used to maintain the orientation, autopilot and failsave features. As shown in Figure 1 flight control.

Figure 1. Flight Control

The Global Positioning System (GPS) is a system for determining location on the earth's surface with the help of satellite signal synchronization. This GPS drone is in the form of an antenna and receiver module which is used to receive satellite data as shown Figure 2. Drone GPS

Figure 2. GPS drone

Motor brushless motor is a brushless DC motor, where the way it works depends on the PWM signal. The PWM signal affects the rotational speed of the motor, the denser the PWM signals are, the faster and the rarer the signal density affects the reduced motor speed as shown figure 3.motor brushless.

Figure 3. Motor Brushless

Electronic Speed Control is a component used to regulate the speed of a brushless motor, provide a large current to the motor, and provide a 5-volt dc to dc converter facility for a 5-volt supply voltage to the frsky receiver component. The ESC component on the output section is connected to a brushless motor and the input section is connected to flight control as shown figure 4. ESC

Figure 4. ESC drone

Rockets are air vehicles which are the result of propulsion, where the propellant fuel used can be in liquid or solid form. In this research, the dummy rocket propellant used was a composite solid propellant, namely HTPB as a binder, Ammonium Perchlorate as fuel and aluminum as a catalyst. While the shape of the rocket design resembles a 90mm caliber anti-tank rocket. As shown in figure 5. Rocket Dummy.

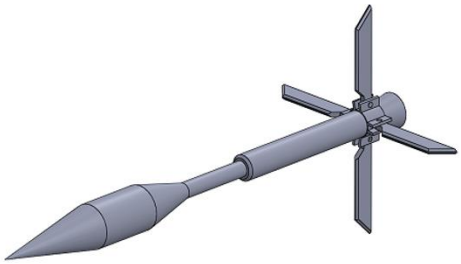

Figure 5. Rocket Dummy

Rocket launcher is a device/equipment for launching rockets with a special size that is designed according to the specifications of the carrying capacity and maneuverability of the rotary wing carrying the rocket launcher. The rocket launcher is mounted on the bottom of the rotary aircraft, and can be fired remotely via radio control. As shown in figure 6. Rocket launcher.

Figure 6. Rocket Launcher

Radio Control is a transmitter that functions as a tool that can generate transmitter signals, in this study the RC carrier frequency used is 2.4 GHz. Information or data frequencies are used by channel 1 throttle to regulate motor speed, channel 2 pitch to regulate forward or backward motion, roll channel 3 to roll left or roll right, yaw to turn left or turn right, and channel 4 to activate the rocket trigger. As show in figure 7. Radio Control

Figure 7. Radio Control

The camera is a component used to capture image and video objects to be converted into image or video data which will be sent via video sender. Pixel resolution and optical zoom capability determine image quality, and the speed of converting video signals into digital video data depends on the capability of the camera's analog to digital data converter. As shown in figure 8. Camera.

Gambar 8. Camera

Batteries are used as a voltage source to supply equipment for both aircraft and remote control drones. Lithium ion batteries (commonly called Li-ion Batteries or LIB) are a member of the rechargeable battery family. In these batteries, lithium ions move from the negative electrode to the positive electrode when discharged, and back when recharged. As shown in figure 9. Lithium Battery.

Figure 9. Baterai Li

The data link is point to point data communication between the state of the drone and the laptop, information about the drone such as speed, coordinates, altitude, direction in real time is sent to the laptop to monitor information about the drone. As shown in Figure 10. Data link

Figure 10. Data Link

A laptop is a device used to monitor and display a program about the position of the aircraft and the images sent from the camera. The mission planner application has been programmed in the laptop, namely a program to display the results of the telemetry data link between the drone and the laptop. As shown in figure 11. Laptop of program.

Figure 11. Laptop of program

Programming using mission planner is used to activate the flight control of the PIXHAWK drone so that it can function as a rotary system controller, GPS reading, Gyro settings and calibration of drone stability from propeller rotation to flight, reading direction angles, altitude, battery usage and speed when flying. As shown in figure 12.Mission Planner

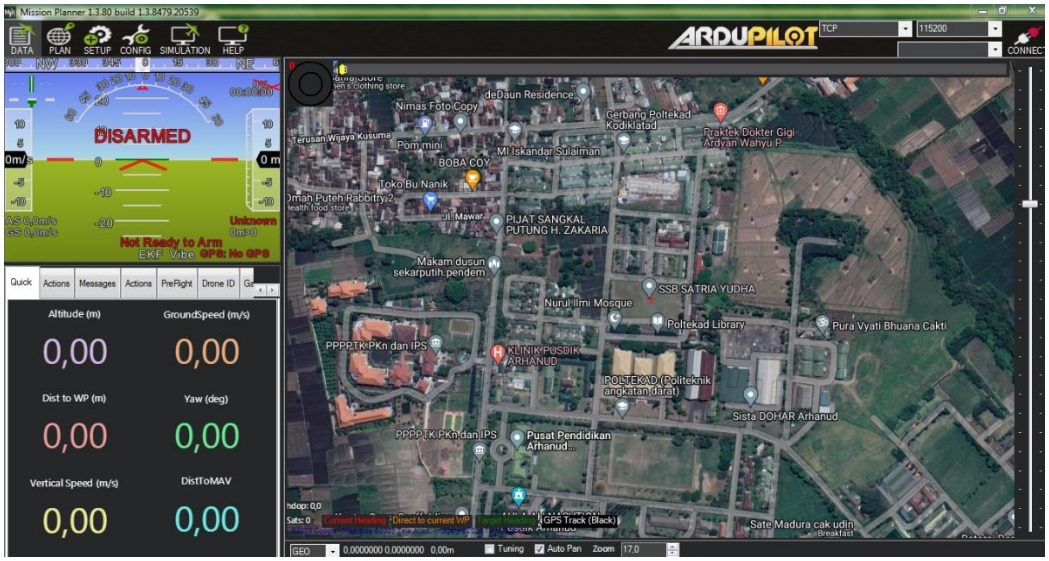

Figure 12. Mission Planner

Methods

In general, the planning equipment used has main parts. The electronic circuit in the drone and the control system are both manual and autonomousas shown in figure 13. Design of Drone section and figure 14. the controller section.

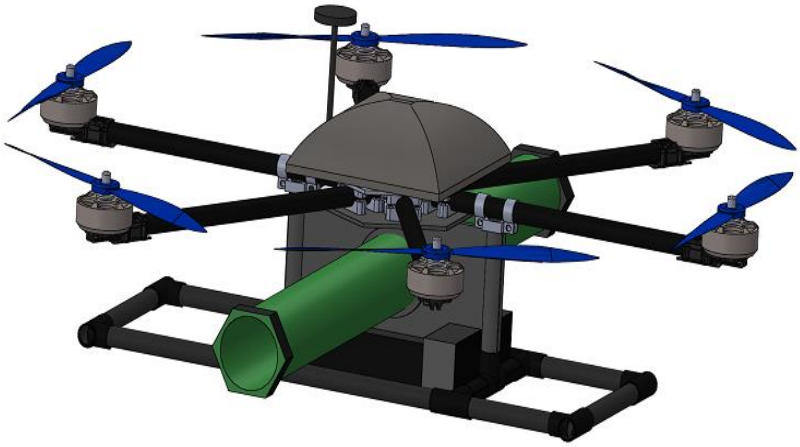

Figure 13. Design of Drone Section

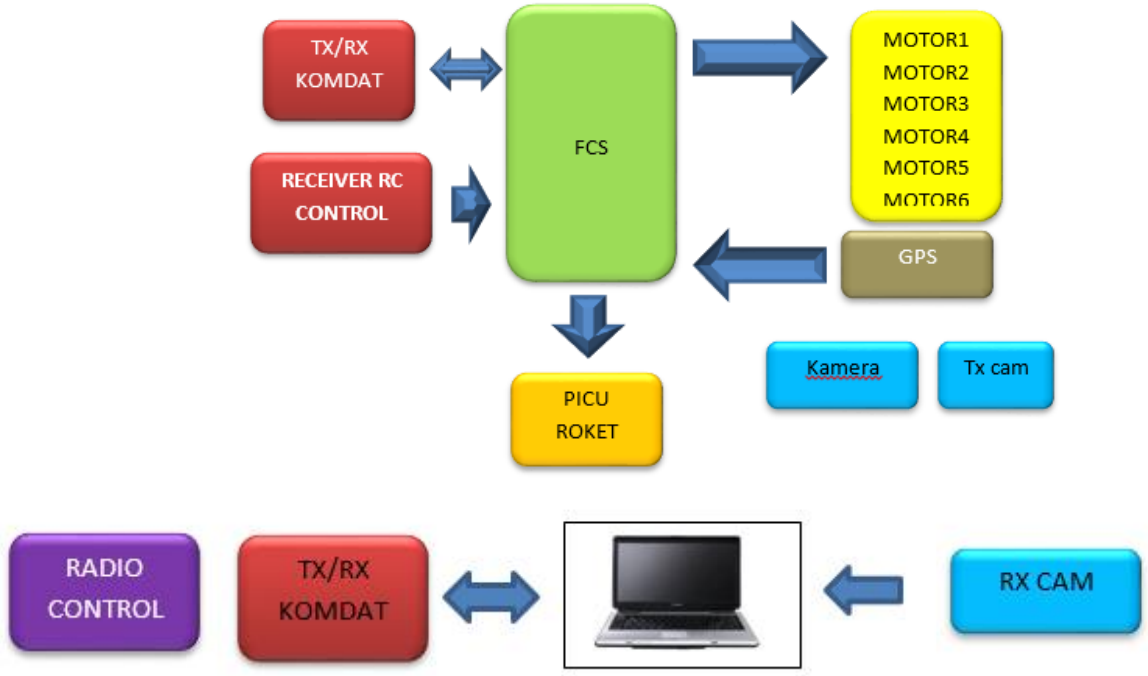

Figure 14. The Controller Section

Manufacture of frames and assembly of rocket launcher drone components based on predetermined designs. The way the drone system works depends on the mode used. If manual mode is used, the drone will work under radio control by the operator. However, if autopilot mode is used, the drone can be programmed in the flight control system via the mission planner. The autopilot program can be activated by programming waypoints in the mission planner.

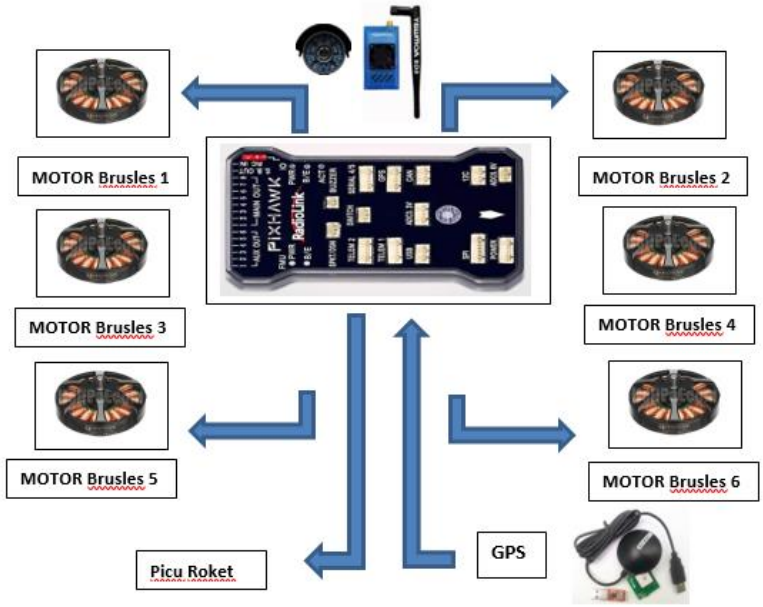

Figure 15. Drone component series

Manufacture of frames and assembly of rocket launcher drone components based on predetermined designs. The way the drone system works depends on the mode used. If manual mode is used, the drone will work under radio control by the operator. However, if autopilot mode is used, the drone can be programmed in the flight control system via the mission planner. The autopilot program can be activated by programming waypoints in the mission planner. The camera system on the drone is used to see targets and send target object data in the form of videos and images via the video sender and will be received by the TV turner on the laptop in the form of visual video data which can be saved in file form. The mission planner program is also used to monitor the drone's position, speed, direction of movement and battery duration, so that the decision to shoot the target can be made properly. The firing system can be done by activating the trigger on channel 4 to send a trigger signal to the rocket trigger. As Shown in figure 15. Drone component series.

Drone Manufacturing and Assembly the process of making a drone platform as shown in figure 16. the process of assembling a drone and in figure.

Figure 16. The process of assembling a drone

Results and Discussions

Results

Measurement of the flight control, electronic speed control and trigger circuit components is as shown in Figure 17. The purpose of this measurement is to obtain the voltage reference required for the FCS, ESC and trigger circuit components when the drone is flying.

(a) (b) (c)

Figure 17. Voltage Measurement (a) FCS (b) ESC (c) Trigger Circuit

Test signal stability. Carried out in the electronics laboratory where the activation of the rocket launcher is shown through the display on the oscilloscope as shown in figure 18. test MK output and data communication working frequency test.

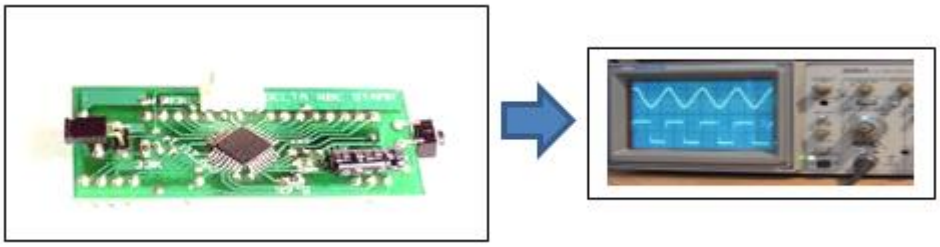

Figure 18. Output data of microcontroller

Result of drone component measurement : Time response output data MK tiap port 8 µs, communication frequency data is 2.4 GHz, crystal frequency is 3.57 MHz.

Discussion:

From the static test results data as shown in Figure 19. data link communication measurements :1) With a microcontroller output response time of 8 us, the hardware is able to respond well to the program for every command issued from the microcontroller to move other devices, in this case to control the speed of the four brushless motors. 2) The data communication frequency of 2.4 GHz has very good data quality for long distance interface communication lines, but is prone to obstacles around the operational area, due to line of sight. 3) The crystal frequency on the 3.57 MHz microcontroller is fast enough to set the I/O data line.

The field test is to test the rocket when it is launched from the rotary wing and the aircraft's position information can be monitored via a laptop. As shown in figure 20 field trials (flight test and firing test). In Figure 20 it is shown that the drone is able to fly stably when maneuvering and firing rockets. The ability of the drone to fly stably is due to the role of the IMU (intertial measurement unit) component in the drone which is working properly. Meanwhile, the camera system in real time can capture the target object properly as shown in Figure 19. This shows that the camera system can send data in a stable and good manner. Rocket launches can be well controlled when shooting towards targets and rocket launchers can be controlled up to a distance of 1500 meters.

Figure 19. Measurement of Data Link

(a) (b)

Figure 20. Flight and Firing Tests

Figure 21. Waypoint of Autopilot mode

As shown in Figure 21, drones can be programmed with a waypoint system on the mission planner, so that drones can fly following coordinate routes that have been plotted and can be directed to targets according to the program.

Conclusion

In This drone system equipped with a rocket launcher has the capability of a control distance of 1000-1500 meters, a flight duration of 40 minutes, stabilized flight, loiter and altitude hold to shoot targets well, a real time camera system that can be received on a laptop well up to a distance of 1500 meters, and the system mission planner program to display the plane's position waypoint. With this capability, drones can be used to support combat in order to search for, approach and destroy targets.

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