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An Increased Long Range Of Drones With A Smartnet System

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Keywords

Smart drone, control system, range sunlight receiving conditions.

Abstract. Smart drones are a type of miniature Unmanned Aerial Vehicle (UAV) or can be translated as an unmanned aircraft which is also commonly called a Drone. Drone categories currently consist of fixed wings (drones that use wings) and multirotor (drones that use more than one motor and without wings). Multirotor drones can use 3 motors, 4 motors, 6 motors and 8 motors. Smart drones have a control system to be able to fly according to the wishes of the operator in Ground Control. Power The range of a smart drone with a manufacturer's control system is limited to 100 meters, thus limiting smart drones from flying further. Changing the control system with a stronger signal transmitter on smart drones can increase the drone's range. This research produced an Ardupilot-based control system to increase the drone's range.

1. INTRODUCTION

A UAV (Unmanned Aerial Vehicle) unmanned aircraft is a type of aircraft that is controlled by aremote control system via radio waves. UAV is an unmanned system (Unmanned System), namely an electro-mechanical based system that can carry out programmed missions with the characteristics of a flying machine that functions with remote control by the pilot or is able to control itself, using the laws of aerodynamics to lift itself, can be used back and is capable of carrying both weapons and other cargo. The biggest use of this unmanned aircraft is in the military sector. Even though missiles have similarities, they are still considered different from unmanned UAVs (Unmanned Aerial Vehicles) because missiles cannot be reused and missiles are weapons themselves.

UAV (Unmanned Aerial Vehicle) unmanned aircraft have varying shapes, sizes, configurations and characteristics. The history of unmanned aircraft is drones, unmanned aircraft that are used as shooting targets. The development of automatic control makes a simple target shooting aircraft capable of turning into a complex and complicated unmanned aircraft. There are two main variations in unmanned aircraft control, the first variation is controlled via remote control and the second variation is an aircraft that flies independently based on a program entered into the aircraft before flying. The aircraft control process is completely carried out by the autopilot system by referring to parameters that have been determined by the user before flying. An automatic pilot (autopilot) is a mechanical, electrical or hydraulic system that guides a vehicle without human intervention. In the early days of air transportation, airplanes required constant attention from a pilot in order to fly safely.

This requires a very high level of attention from the flight crew and results in fatigue. The automatic pilot system was created to carry out several tasks from the pilot. The process of landing or landing on a UAV is a complex matter because it requires potential energy and Ardu-based Fixed Wing Unmanned Aircraft Design, quite a lot of kinetic pilot from the aircraft, in addition to the presence of dynamic obstacles such as sudden changes in wind, weight of cargo, as well as height and speed in each direction. In the automatic landing system section, many methods are used to make the plane land automatically. One way is to use the PID method which will later be useful as part of an autopilot system which can make the plane land automatically.

In principle, when a plane is in the air, there are 4 main forces acting on the plane, namely thrust (thrustT), drag (dragD), lift (liftL), and the weight of the plane (weightW). When the plane is cruising at a constant speed and altitude, the 4 forces are in equilibrium: T = D and L = W. Meanwhile, when the plane takes off and lands, acceleration and deceleration occur which can be explained using Newton's Second Law (total force is equal to mass multiplied by acceleration). At the time of take off, the aircraft experiences acceleration in the horizontal and vertical directions. At this time, L must be greater than W, likewise T is greater than D. Thus a large engine power is required at the time of take off. off. Failure to take off can be caused by a lack of engine power (due to various

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things: mechanical damage, human error, external interference, etc.), or problems with the aircraft control system when the aircraft is flying. Most commercial aircraft currently use turbofan engines. Turbofan comes from two words, namely turbine and fan. The fan component is the difference between this engine and a turbojet. In a turbojet engine, the outside air is compressed by the compressor until it reaches high pressure. Next, the high pressure air enters the combustion chamber to be mixed with fuel (avtur). Combustion of the fuel air will increase the temperature and pressure of the working fluid. This high pressure fluid is then passed through the turbine and exits the nozzle at very high speed.

Literature Review

Smart Drones

Smart drones are a type of Unmanned Aerial Vehicle (UAV) or what is usually called a Drone. smart drones do not have wings and consist of multi-rotators. Smart drones have been widely applied in various fields, including the military. Smart drone operation can use remote control or autonomously. In the aeromodelling field, remotes are commonly used control for flying the smart drone. In the academic field, research institutions and educational institutions improve the performance of smart drones by improving technology and control systems as well as communication transmission between smart drones and operators in the field.

Smart drones have four motors that are used to rotate the propeller so they can fly in the air. The dimensions of smart drones vary depending on the function of the smart drone. In the middle of the smart drone there are several electronic components, such as the flight controller, Global Positioning System (GPS), Electronic Speed Controller (ESC), battery, camera, radio telemetry and sensors. Flight controller

functions to control the quadcopter by providing a Pulse Width Modulation (PWM) signal to the ESC, then the ESC regulates the speed of the four motors, two motors move clockwise and two motors move clockwise. Based on this configuration, the quadcopter can fly in the x, y and z axes. The rotational movement towards the x-axis is influenced by roll torque, the rotational movement towards the y-axis is influenced by pitch torque, the vertical movement is influenced by thrust force, and the rotational movement towards the z-axis is influenced by yaw torque. The quadcopter's movement is influenced by the four rotors which are owned.

The four rotors have independent speeds, meaning that the speed of one rotor is different from that of the other rotors. When moving, the quadcopter uses speed variations on its four rotors. On the four rotors, two rotors rotate clockwise (clockwise) and two more rotors rotate anti-clockwise (counter clockwise). Quadcopters have four movements, namely roll motion (maneuvering movement to the left or right in the direction of the y axis), pitch motion (maneuvering movement to the front or back in the direction of the x axis), gaz motion (up and down maneuvering movement in the direction of the z axis), and yaw motion (rotating movement to the left and right based on the z axis).

Forces That Influence Airplane Flight.

Thurs is the thrust created by the engine working which pushes the air backwards so that the plane can move forward. This force is created by the performance of the aircraft engine which creates propulsion and pushes the aircraft. This pushing force is influenced by Newton's laws 2 & 3 which say that the acceleration caused by a force acting on an object is directly proportional to the magnitude of the force and inversely proportional to the mass of the object. If the first object exerts a force on the second object, then the second object will exert a force on it. the first object that has the same magnitude, but opposite direction.

Drag When the plane starts to be pushed by the engine, there is a force that works against or inhibits the plane's movement by producing a frictional force, thereby holding back the plane's speed. Drag is also called resistance or opposite. The thing that influences drag in the world of aviation is the fuselage or aircraft body itself, but drag can also be generated by spoilers, flaps and slats. Drag can be

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very detrimental because it can hinder the speed of the aircraft, but it can also be very beneficial if the aircraft is braking. Aircraft designers try to minimize this force by designing the air path so that it is not too obstructed by the aircraft body itself.

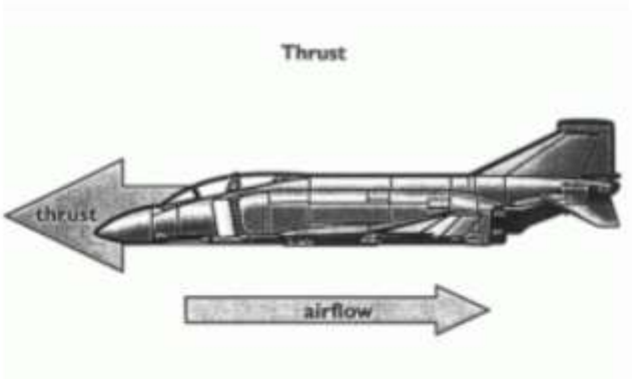

Figure 1. Trust Model

The science that studies air movement is called aerodynamics. It can be seen in (Figure 1)
Lift is the force that influences how the plane can be lifted into the air. By utilizing the drag force generated by the wings and channeling air to the bottom of the wings to produce lift and fly the plane. With the wing shape that has been designed, the air speed above the wing is higher than the air speed at the bottom of the wing so that the air pressure at the top of the wing is lower than at the bottom of the wing. This causes the air to lift the plane upwards, this is a slight violation of Bernoulli's law which is true. is the basis of reference for the aircraft's lifting force.

Weight. After the aircraft is successfully in the air, there is one final force which becomes the resistance for the lift, namely weight which influences the weight of the aircraft itself plus the gravitational force which pulls the aircraft body back to the ground. This is related to Einstein's general law of relativity regarding gravity. The heavier the plane, the opposite force will force it to work harder, namely by increasing lift, which in other words increases thrust. So it can be concluded that the heavier the plane or the greater its weight, the greater the thrust and lift required by the plane to keep it flying. D. Design Used An airplane is a device made using air as a medium.

Consists of aerodynamic aircraft, namely aircraft that are heavier than air (Heavier Than Air) and aerostatic aircraft, namely aircraft that are lighter than air (Lighter Than Air). Aerodynamic aircraft consist of 2 groups, namely motorized and non-motorized aircraft. Motorized ones consist of fixed wing (Fixed Wing) And Rotary Wing (Rotary Wing). Fixed Wing Motorized Aerodynamic Aircraft Consist of airplanes, airplanes and amphibians.

The rotary-winged ones consist of helicopters and gyrocopters. Non-motorized aerodynamic aircraft that only glide are called (glider) type aircraft, glider aircraft are called (sailplane) and kites. There are also aerostatic aircraft consisting of airships or hot air balloons. In this final project, the design used is a glider shape design. A glider aircraft is a type of aircraft designed for training and air sports purposes. This aircraft is usually not equipped with a propulsion engine, so to be able to fly it must be towed by a vehicle or airplane with an engine. However, there are several types of glider aircraft that are equipped with propulsion motors to increase range or even for take-off and landing. The materials of the glider aircraft structure are made from components that are light but have high strength and stiffness. The glider aircraft is also equipped with landing equipment and flight control devices such as rudders, ailerons and elevators for maneuvering. The number of passengers can be two or one, depending on needs. For training purposes, it is usually designed with tandem seats (front and (rear) because the aircraft body is small. Important instruments such as altimeter, compass, turn and bank indicator and airspeed indicator are standard equipment for this sports equipment. In general

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cases the glider will be pulled by another aircraft to a certain height using a steel cable. Once it reaches the planned height, the cable will be released so that the glider will be free to float in the air according to the pilot's wishes.

UAV Remote Sensing Sensor

UAVs carry payloads consisting of integrated equipment such as various sensors, cameras, surveillance equipment and the like which have the capability to carry out various types of remote sensing missions. One commonly used UAV sensor is a non-metric (small format) digital pocket camera equipped with GPS to produce still images with additional location and time of capture information (Figure 2).Unmanned Aircraft Data Acquisition Technology and Utilization to Support the Production of Remote Sensing Information.

Figures 2. Concept Control

2. METHODS

Description of the research stages carried out to produce the expected results is as follows:

a. Study of literature
This section will explain the research process starting with a literature search (library) with extensive material related to the topic of this research. The sources obtained come from several existing materials, including books, journals, articles and websites that have relationship with this research. Conduct studies on supporting theories and knowledge that have been previously obtained and then take them as reference material to conduct research.

b. Design and Manufacture of Control Systems
This stage is the stage of designing and manufacturing the control system for take-off, vertical landing and flight maneuvers of the Quadcopter.

c. Control System Testing
Design and manufacture of control systems. Design of Quadcopter communications to the Ground Station. At this stage, testing is carried out to see whether the circuit designed and made embedded can function according to design.

d. Quadcopter Communication Design to Ground Station.
At this stage, the communication system between the quadcopter and the ground station will be designed. This system is intended so that the quadcopter can fly a long distance from the groundstation.

e. Communication system testing
At this stage, testing is carried out to see whether the communication system can be used to control the quadcopter from a long distance.

f. Video System Testing
This stage is carried out to display video data on the device at the ground station.

g. Results and Conclusions

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This stage will obtain distance data from testing by sending video from the quadcopter to the groundstation.

3. RESULT AND DISCUSSION

Result Control

The assessment of criteria for selecting the best drone was carried out using the onemethod. The method can create a weighted sum and comparative scale of applications based on alternative values of predetermined criteria. Based on the results of these calculations, a ranking can be obtained which can be a recommendation to decision makers who recommend the option with the highest preference value. The SAW assessment is influenced by several criteria as follows: Distributing the Required Criteria:

1. Camera
2. Flight Time
3. Speed
4. Reach
5. The weight lifted from this initial data is normalized into a SAW value by dividing the category value by maximum.

In this research, the control system will use the Ardupitlot microcontroller as the drone controller. The following is a picture of the Quadcopter type drone components used.

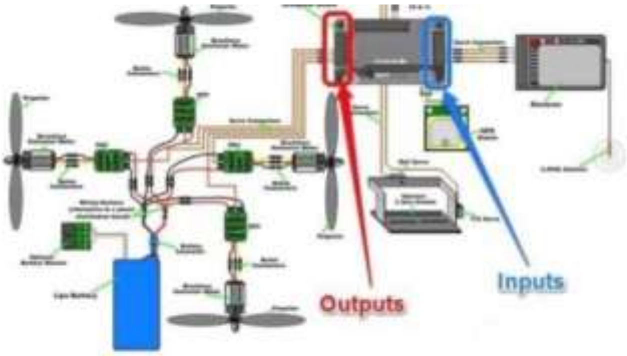

Figure 3. Quadcopter UAV Block Diagram

The UAV equipment used in this research consists of:

1. Brushless DC Motor and Electronic Speed Controller

A brushless DC motor is a motor that is powered by direct current (DC) and has an electronic commutator system, does not use a mechanical commutator and brushes. (brushes). Electronic speed control (Electronic speed controller/ESC) is an electronic circuit with the aim of varying the speed of an electric motor, its direction and can function as a dynamic brake. ESC is often used in electrically powered model toys that are controlled by remote control. In Figure 4 you can see the Brushless motor and blade which are controlled to fly the drone.

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Figure 4. Brushless Motor and Blade

2. Inertial Measurement Units

An inertial measurement unit (IMU) is an electronic device that measures and reports the speed, orientation and gravitational force of a vehicle. Using a combination of one/more accelerometers and gyroscope. IMUs are commonly used in maneuvering aircraft, including unmanned aircraft, and spacecraft, including space shuttles, satellites, landing modules.

3. Digital Compass (Magnetometer)

A compass uses the effect of the Earth's magnetic field which influences a free magnetic needle so that the needle can show the direction of field lines, namely the direction of the north and south magnetic poles. Earth's north magnetic pole is not exactly at the geographic north pole, or on its rotational line. Each direction obtained from the magnetic form must be corrected for accurate north/south indication.

4. Atmospheric Pressure (Barometer)

The barometer sensor is used to determine the height of the vehicle, using the principle of different air pressure at different heights. However, the sensitivity level is low and is easily disturbed by wind.

5. Distance Sensor (Sonar)

The sonar (Sound Navigation And Ranging) sensor in the quadrotor functions to detect the distance between the quadrotor and the ground. Sonar can be applied for automatic take *off and landing.*Sonar can also be used for low altitude hold (low altitude hold) with limits smaller than 6.45 meters. For heights of more than 6.45 meters, the sensor used is a barometer.

6. Flight Controller

This module is the brain for the UAV Quadrotor, reading all the sensors and then processing them all to then order the four motors to rotate. ArduPilot Mega can be programmed for autopilot mode.

System Design

The control system used in this research uses an Ardupilot microcontroller installed on the quadcopter frame. The system will be tested to see whether it can carry out the function of an air monitoring system, then a controlled Roll, Pitch, Yaw stability test and altitude hold mode consisting of controlled roll, pitch, yaw and altitude will be carried out. The shape and dimensions of the drone used for the air monitoring system in this research can be seen in Figure 5.

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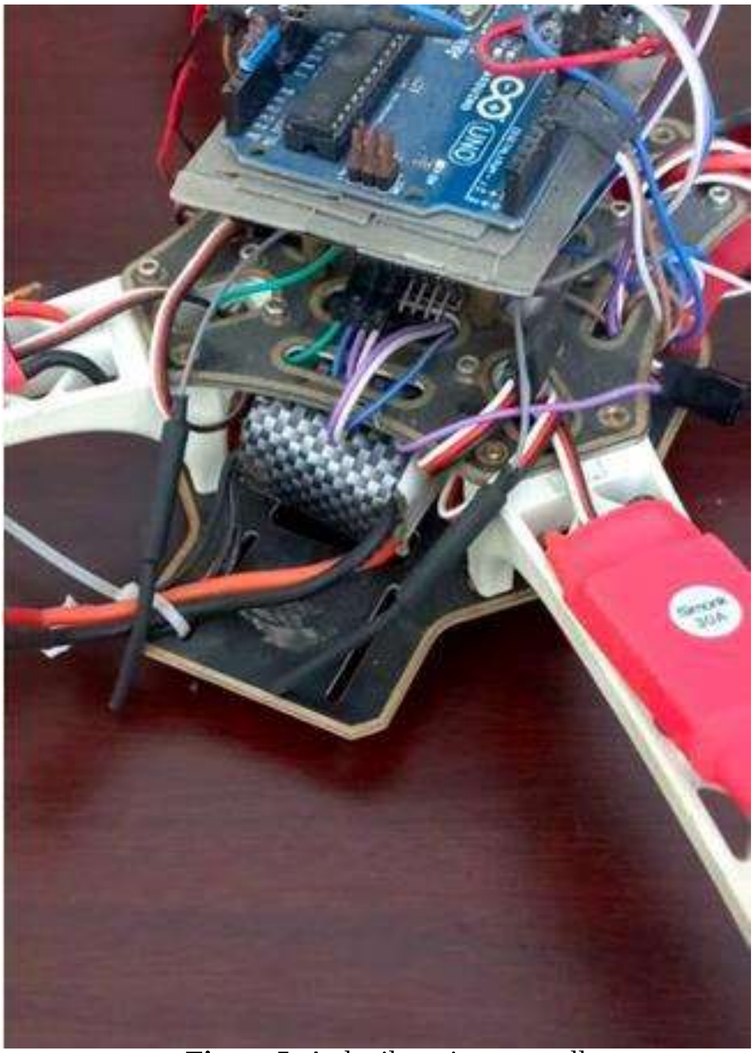

Figure 5. Ardupilot microcontroller

The drone used is a quadcopter type designed to make it easier to transport cameras and other required equipment such as the Global Positioning System (GPS). The technical specifications of this Drone are:

1. Consists of 4 brushless motors with a power of 14.5 watts and has a motor rotation of 28,500 RPM
2. The propeller which functions to produce lifting force is made of light aluminum.
3. The motor control system uses an Ardupilot microprocessor, with 1Gbit memory.

The dimensions of the drone weigh 380g, with dimensions of 517x451cm. An HD camera is installed on the drone to get maximum results. The camera installed has a 720 pixel specification with the ability to record video at up to 30 frames per second. The camera on this drone is on the front of the drone. The drone, which is designed using a quad rotor type, is capable of flying with a GPS and a camera that will be used to monitor from the air with a camera load of approximately 500g and flies for 10 minutes. The results of the tests carried out are divided into two parts.

Table 1. Range Test Results

Reachability	Flying Ability	Video Delivery
100 meters	Stable	Sent
150 meters	Stable	Sent
200 meters	Stable	Sent
250 meters	Stable	Sent

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4. CONCLUSION

Based on measurements on the stationary quadcopter, the average error percentage for roll angle is 0.53%, pitch angle is 1.28%, and yaw angle is 10.96%. These results indicate that the quadcopter achieves good stability, although there is a slight error in pitch and yaw angles. In measuring the stability of the flying quadcopter, the average error percentage for roll is 0.83%, and for pitch is 1.18%. This suggests that the quadcopter successfully flies stably with low error rates in roll and pitch angles. Furthermore, the measurement results show that the average RSSI LoRa signal quality at 0 meters altitude falls into the "Fair" category, while at 5 and 10 meters altitude, it falls into the "Very Good" category. As for the average SNR LoRa signal quality at 0 meters altitude, it is categorized as "Fair," and at 5 and 10 meters altitude, it falls into the "Good" category. These findings indicate that the LoRa signal quality improves with the increase in quadcopter altitude.

REFERENCES

1. Aryza, S., Irwanto, M., Lubis, Z., Siahaan, A. P. U., Rahim, R., & Furqan, M. (2018). A Novelty Design Of Minimization Of Electrical Losses In A Vector Controlled Induction Machine Drive. In IOP Conference Series: Materials Science and Engineering (Vol. 300, No. 1, p. 012067). IOP Publishing.
2. Dr. Junaidi, S.Si., M.Sc,dkk 2013, Project Sistem Kendali Elektronik Berbasis ARDUINO Penerbit AURA CV. Anugrah Utama Raharja Anggota IKAPI No.003/LPU/2013 ISBN: 978-602-5636-46-2
3. Hamdani, H., Tharo, Z., & Anisah, S. (2019, May). Perbandingan Performansi Pembangkit Listrik Tenaga Surya Antara Daerah Pegunungan Dengan Daerah Pesisir. In Seminar Nasional Teknik (Semnastek) Uisu (Vol. 2, No. 1, pp. 190-195).
4. Hery Setyo Utomo,dkk 2017 BERKALA SAINSTEK 2017, V (1): 45-49 ISSN : 2339-0069
5. Ida Fitri Leksanawati,dkk 2021 JURNAL KESEHATAN MASYARAKAT (e-Journal) Volume 8, Nomor 6, November 2020 ISSN: 2715-5617 / e-ISSN: 2356-3346 http://ejournal3.undip.ac.id/index.php/jkm
6. Maslahatul Irfani,dkk 2021 Buletin Ilmiah Sarjana Teknik Elektro Vol. 3, No. 1, April 2021, pp. 50-61 ISSN: 2685-9572, DOI: 10.12928/biste.v3i1.2829
7. P A R Arimbawa 1,dkk 2016 Teknologi Elektro, Vol. 15, No.2, Juli - Desember 2016 p-ISSN:1693 – 2951; e-ISSN: 2503-2372
8. Putri, M., Wibowo, P., Aryza, S., & Utama Siahaan, A. P. Rusiadi.(2018). An implementation of a filter design passive lc in reduce a current harmonisa. International Journal of Civil Engineering and Technology, 9(7), 867-873.
9. Rahmaniar, R. (2019). Model flash-nr Pada Analisis Sistem Tenaga Listrik (Doctoral Dissertation, Universitas Negeri Padang)
10. Ritha Sandra,dkk 2017 Jurnal Teknologi Elektro, Universitas Mercu Buana Vol. 8 No.1 Januari 2017 ISSN : 2086-9479
11. Rudi Susanto,dkk 2018 JUPITER (Jurnal Pendidikan Teknik Elektro) Volume 03, Nomor 01, Edisi Maret 2018, 7-16 P-ISSN: 2477-8346 E-ISSN: 2477-8354
12. Suprapto,MT 2012, Aplikasi Dan Pemrograman Mikrokontroler AVR Dicetak dan diterbitkan Oleh: UNY Press, ISBN978-979-8418-79-2 Perpustakaan Nasional: Katalog dalam terbitan (KDT) 12+249 Hlm; 16x23 cm
13. Sura Eka Pratama Pagan,dkk 2018 KITEKTRO: Jurnal Online Teknik Elektro Vol.3No.4 2018: 19-23 e-ISSN: 2252-7036
14. Tarigan, A. D., & Pulungan, R. (2018). Pengaruh Pemakaian Beban Tidak Seimbang Terhadap Umur Peralatan Listrik. RELE (Rekayasa Elektrikal dan Energi): Jurnal Teknik Elektro, 1(1), 10-15.
15. Yanto Indra,dkk 2020 Jurnal Teknik Informatika Unika St. Thomas (JTIUST), Volume 05 Nomor 01, Juni 2020, ISSN: 2548-1916, e-ISSN: 2657-1501

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