Analysis of Performance of 433 MHz Telemetry Devices for Data Transmission in Unmanned Aerial Vehicle (UAV)

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Abstract—Telemetry systems are a method of distance measurement that utilizes telecommunications facilities and computer systems for access control. The telemetry system on unmanned aerial vehicles is used to provide information such as position (coordinate point), altitude, direction, and some information that shows the condition of the aircraft in real time when the air vehicle operates. Telemetry systems in UAVs consist of hardware and software. Hardware in the form of IMU flight controllers and sensors. While the software used is a ground control station that is used to receive and process data. In software equipped with aircraft instrumentation systems. This paper examines the use of the 433 MHz radio system as a remote device link. In the test results, the telemetry device can send data from the aircraft to the ground control station, and vice versa well.

Index Terms—Telemetry, 433 Mhz, Baudrate, LOS Data

I. INTRODUCTION

On Unmanned Aerial Vehicle (UAV) aircraft a motion sensor is needed to detect trajectories and attitude when flying. The Inertial Measurements Unit (IMU) measurement unit sensor is applied to UAV aircraft as a dynamic payload sensor. In addition, the Global Positioning System (GPS) is used to determine the location of the plane, which is a coordinate point.

Data from IMU and GPS is needed to determine the condition of the aircraft. To monitor from a ground control station, an antenna is required to send data through electromagnetic waves. The use of 433 MHz radio frequency is very useful for telemetry systems in UAVs.

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The sending and receiving of this data takes place in realtime. So that an adequate device is needed. For this reason an analysis of the performance of 433 MHz radio stations on UAV aircraft is analyzed.

II. LITERATURE REVIEW

A. Telemetry Tranceiver System

The transmitter / receiver system called the Transceiver basically functions as the sender and receiver. The remote tranceiver sends data from the image processing with the gray image encapsulated by the serial communication protocol to the ground segment.

B. Serial Communication

Serial communication offers some advantages compared in parallel communication, including [1]:

- Many embedded systems use serial communication, making it easier to interface.
- Serial communication cables can be longer with fewer cable fibers.

C. Unmanned Aerial Vehicle (UAV)

Unmanned aerial rides or commonly called UAVs, are more than just models of air vehicles because they are operated without the flight crew members in the vehicle. The UAV is an unmanned aerial vehicle which is operated by remote control. UAVs can be in the form of aircraft or helicopters that use a standalone navigation system. Basically a plane, or helicopter can be considered to be an air vehicle that can carry out missions that are useful and can be controlled remotely or have the ability to fly automatically. [Unmanned Air Vehicle, 2007]

Fig. 1. Unmanned Aerial Vehicle.

D. Inertial Measurement Unit (IMU) System

The Inertial Measurement Unit (IMU) is a unit in an electronic module that collects angular acceleration data and linear acceleration, which is then sent to the main processing unit. IMU consists of a combination of an accelerometer (acceleration sensor) and a gyroscope (angular sensor) to track the existence and movement of an object. An accelerometer is used to measure the acceleration of an object and a gyroscope is used to measure the rotation of an object. A study of the IMU instrumentation system can be done using an accelerometer sensor and a gyroscope sensor [3]. A position / distance information can be obtained from the accelerometer sensor output through a particular algorithm process. Inertial Measurement Unit (IMU) is the main component in the GNC (Guidance, Navigation, and Control) system that functions to capture the signal parameters needed in the navigation system.

E. Global Positioning System (GPS)

GPS is a satellite network consisting of about 24 satellites that surround the earth twice a day at an altitude of 11,000 miles.

Fig. 2. GPS Navigation [4].

III. RESEARCH METHODOLOGY

The telemetry system developed in this study is a wireless telemetry system, using radio waves as a data transmission medium, and the data sent is the location data of coordinates, altitude, slope, direction and other data from UAV aircraft. The telemetry system modeling as shown in Figure 3.

Fig. 3. Telemetry system modeling [2].

A. Configuring Telemetry Devices

The configuration that will be carried out in this study includes the configuration of the device used both on hardware and software.

On the ground station side involves configuration between a computer with a serial USB port (433 MHz 3DR radio module), test configuration, and analysis software configuration. This configuration is shown in Figure 4.

Fig. 4. Telemetry Devices Configuration [5].

B. Direct Connection Analysis

Direct connection testing is used using a USB cable that is directly connected to a telemetry antenna. Comparison of the results of connection tests based on baudrate by using a 4 hour test to detect sent data:

Fig. 5. Direct Connection testing in Baudrate 9600.

C. GUI Connection Analysis

Tests were carried out to find out the success of data that was read by Bada GUI ground control station. Comparison of connection test results on the GUI based on baudrate by using testing for 10 hours to detect data displayed in the GUI:

Fig. 6. Direct Connection testing in Baudrate 57600.

Fig. 7. Direct Connection testing in Baudrate 15200.

Fig. 8. GUI Connection testing in Baudrate 9600.

Fig. 9. GUI Connection testing in Baudrate 57600.

Fig. 10. GUI Connection testing in Baudrate 15200.

D. Connection Analysis Against Distance

This test is carried out to determine the relationship of the radio connection to the distance of the LOS shown in Figure 7. Showing good results up to a distance of 2.8 km while still connected using baudrate 57600.

Fig. 11. Connection Against Distance in Baudrate 9600.

Fig. 12. Connection Against Distance in Baudrate 57600.

E. LOS Data Analysis

Tests are carried out by changing the distance between the sending and receiving devices shown in Figure 8. From the test results, there is a decrease in signal quality along the distance of the GCS to the aircraft rides. Until at a distance of 3 km the connection is lost.

F. Data Display Results in the GUI

The data received by the telemetry antenna which is on the side of the GCS, will then be displayed in the GUI.

Fig. 13. Connection Against Distance in Baudrate 15200.

Fig. 17. GUI Display.

Fig. 14. LOS Data testing in Baudrate 9600.

Fig. 15. LOS Data testing in Baudrate 57600.

Fig. 16. LOS Data testing in Baudrate 15200.

IV. CONCLUSION

It can be concluded that the 9600 baudrate has the farthest distance range. But by using 9600 baudrate, sending data is slow so the observations are not completely real time. Because there is a difference in the amount of time that is quite a lot between sending one data to another data, so the 9600 baudrate is not recommended for sending real time data. For this reason, it is advisable to use a 57600 baudrate because it has a fairly remote range, with fast data transmission .

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