Aeromodeling System Design as an Identifier Receiver in Navigation Equipment

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ABSTRACT

The aeromodeling system design as an ident receiver on navigation equipment at the Makassar Aviation Polytechnic focuses on the reception of ident transmissions (Receiver) on aircraft for NDB simulations and monitoring of ident signals transmitted to remote control aircraft located in different places from the signal transmission. This is intended to support educational facilities in the learning and teaching activities of cadets at the Makassar Aviation Polytechnic, to broaden their knowledge and is expected to be further developed in the future. From the simulation conducted, it can be seen how the device works as an Ident receiver simulation, where the Ident signal is transmitted using FM frequency to the aircraft and transmitted back to the ground so that it can be monitored whether the aircraft receives the Ident transmission or not. The testing of this design consists of several stages, starting from testing each supporting component to testing the entire system. From the test results, the performance of each program forming the design system that interacts with each other can be analyzed, thus forming the design of the receiver system in aeromodeling as an Ident receiver for navigation equipment for learning.

Keywords: *"Receiver, RC Aircraft, ident"*

1. INTRODUCTION

The Makassar Aviation Polytechnic is an institution that provides education in the field of aviation with the aim of meeting the needs for human resources in the aviation sector. Makassar Aviation Polytechnic offers four study programs at the Diploma 3 level, namely Air Navigation Technology (TNU), Aircraft Maintenance Technology (TPPU), Airport Technology (TBU), and Air Traffic Management (MLLU). In implementing its educational programs, the institute utilizes several facilities to support education, including classrooms, laboratories, workshops, hangars, and a library.

In the world of aviation, fixed-wing aircraft can be used as passenger and cargo transport aircraft. To meet human needs in utilizing aircraft, navigation equipment is required so that aircraft can fly according to the routes set by the navigation equipment. This aims to regulate air traffic and prevent collisions between aircraft.

In KP-103 of 2015 and SKEP/113/VI/2002, a Non-Directional Beacon (NDB) is an Air Navigation Facility that operates using low frequency and is installed at a specific location inside or outside the airport environment according to its function. NDB equipment transmits information in the form of radio wave signals in all directions through an antenna. The signal is received by aircraft equipped with an Automatic Direction Finder (ADF), which is an NDB receiver device on the aircraft, so that the pilot can determine their position (azimuth) relative to the location of the NDB.

In technological development, aircraft can also be used as learning materials. Small aircraft that can be controlled using remote control are called aeromodeling. Aeromodeling can be used as a simulator to demonstrate how aircraft can fly and be controlled by remote control. The principles of aeromodeling use the principles of aircraft to enable flight.

The aeromodeling system design as an identifier receiver in navigation equipment at the Makassar Aviation Polytechnic will focus on the reception of identifier transmissions (Receiver) on aircraft for NDB simulation and monitoring of identifier signals transmitted to remote control aircraft located in a different place from the signal transmission. This research aims to fulfill the supporting facilities for education in the learning and teaching activities of Makassar Aviation Polytechnic cadets, as a means of broadening their knowledge, and it is hoped that it can be further developed in the future.

2. METHOD

2.1 Research Design

The research design aims to provide clear and structured guidance to researchers in conducting their research. The flowchart of the research stages can be seen in the image below :

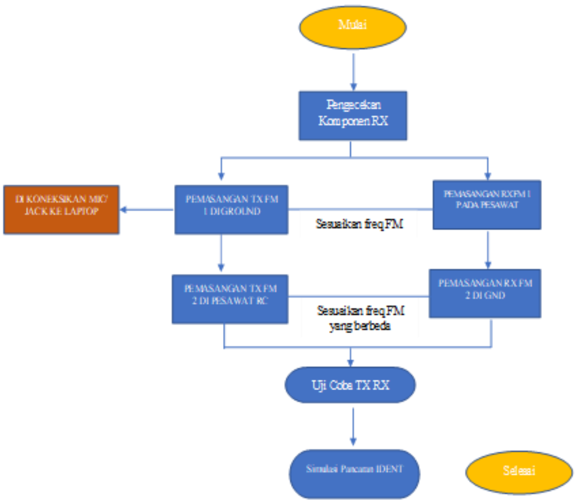

Figure 1 Research Design Diagram

2.2 Tool Design

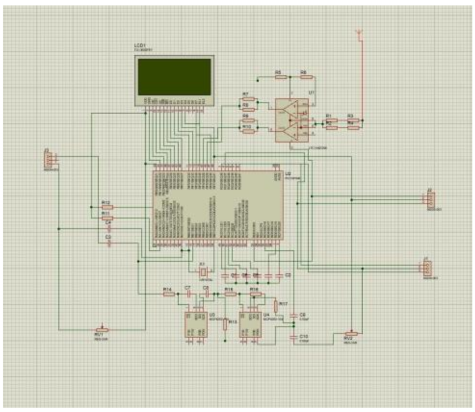

Figure 2 FM DSP PLL Receiver Diagram Blog

The following are the functions of an FM receiver block diagram:

1) Antenna: functions to capture modulated signals originating from the transmitter antenna.
2) RF Amplifier: functions to amplify the signals captured by the antenna before they are forwarded to the Mixer block.
3) Local Oscillator (OSC): functions to generate a higher frequency vibration than the RF output signal frequency. The result is then forwarded to the mixer block.
4) Mixer: Serves to mix the two frequencies originating from the RF Amplifier and Local Oscillator. The result of the mixer is an Intermediate Frequency (IF) of 10.7 MHz.
5) IF Amplifier: Used to amplify the Intermediate Frequency (IF) before it is forwarded to the limiter block.
6) Limiter: functions to reduce the amplitude of modulated waves (signals sent by the transmitter) to form a pure FM signal (with even amplitude).
7) FM Detector: used to detect changes in modulated frequency, converting it into an information signal (audio).
8) De-emphasis: functions to suppress excessive (high) audio frequencies transmitted by the transmitter.
9) AFC (Automatic Frequency Control): functions to automatically adjust the local oscillator frequency to remain stable.
10) Stereo Decoder: used to process stereo signals, so that the results are forwarded to 2 AF amplifiers (FM Stereo).
11) Audio Amplifier: used to rectify AF vibrations/signals and increase the audio signal level, which is then forwarded by the AF amplifier to a loudspeaker.
12) Speaker (loudspeaker) used to convert AF frequency electrical signals or vibrations into sound vibrations that can be heard by the human ear.

2.3 How the Tool Works

From the simulation conducted, it can be seen how the device works as an Ident receiver simulation, where the Ident signal is transmitted using FM frequency to the aircraft and then transmitted back to the ground so that it can be monitored whether the aircraft receives the Ident transmission or not. The Ident signal used in this simulation is in the form of audio (sound) taken from the Ident with the code “ANY” (Semarang), which when converted to Morse code becomes “dot dash dash dot dash dot dash dash” (.--.-.--).

2.3.1 Tool Component

The components used to conduct simulation tests of aeromodeling designs as navigation equipment receivers are as follows:

1. Aircraft RC

A small aircraft controlled remotely by an operator on the ground using a handheld radio transmitter. The transmitter communicates with the receiver by sending signals to servo mechanisms (servos) that move the control surfaces based on the position of the joystick on the transmitter. The control surfaces, in turn, affect the orientation of the aircraft.

2. Laptop

Laptops are used as signal transmitters to replace NDBs (Non Directional Beacons), whereby the transmitted signals are converted into recorded NDB audio.

3. Mic/Jack

A mic or jack is a component used to transmit the recording to Tx 1.

4.Transmitter

A transmitter is an instrumentation device that has the ability to process sensor signals and convert them into currents.

5.Receiver

Receiver is a method of transmitting information via a carrier wave by varying the frequency.

2.4 Testing Techniques

At this stage, the author tested the design that had been created to determine the success of the Aeromodeling Design as a Receiver of Navigation Equipment at the Makassar Aviation Polytechnic simulation. The testing stage was deemed successful when the RC aircraft was able to run properly and capture the transmitted signal.

3. RESULT AND DISCUSION

The testing of this design consists of several stages, starting from testing each supporting component to testing the entire system. From the test results, the performance of each program that forms the design system can be analyzed as they interact with each other, resulting in the design of a receiver system in aeromodeling as a receiver for navigation equipment for learning. Testing the overall design is useful for determining the performance and success rate of the system.

From the testing and analysis conducted on the receiver that will be used as the identifier receiver, the following results were obtained:

1. The receiver used on the aircraft is a Ham Radio phase-locked loop (PLL) Digital Stereo Wireless Microphone. This receiver is used to assist the aircraft because it is small and has a long range.

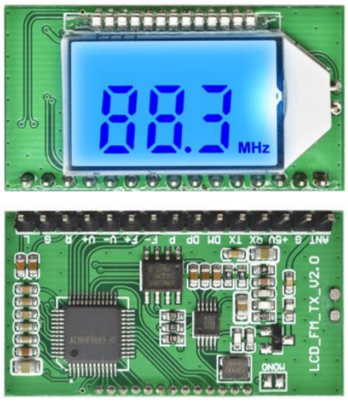

Figure 3 Ham Radio Receiver Phase-Locked Loop (PLL) Digital Stereo Wireless Microphone

2. The receiver used on the ground is a Digital FM Radio 87-108mhz DSP & PLL LCD Stereo + Serial Control. This receiver is used because it utilizes Digital Signal Processor (DSP) technology and FM phase-locked loop (PLL) modulation to produce more realistic sound, more stable performance, and long operating hours without frequency offset. The LCD screen is more intuitive and accurate, with very low power consumption and minimal noise.

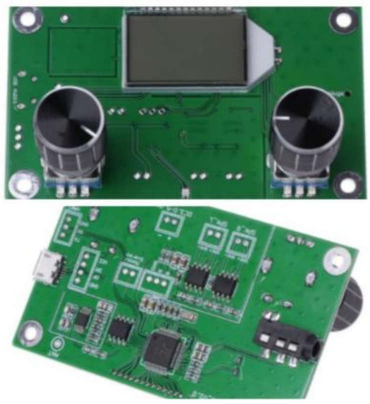

Figure 4 Digital FM Radio 87-108 MHz DSP & PLL LCD

The tool's operating system can be seen in the flowchart below :

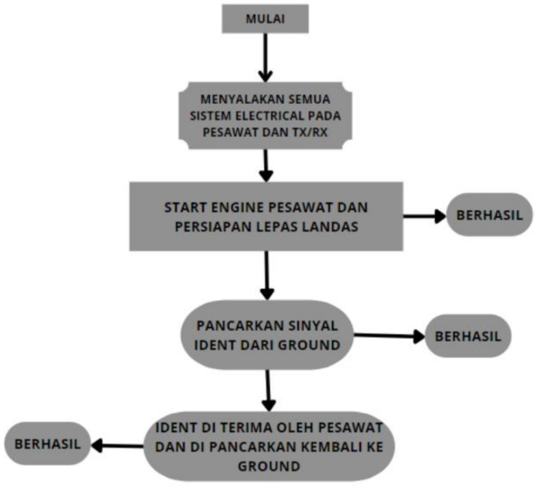

Figure 5 Workflow System Flowchart

1. First, prepare an assembled RC aircraft. The aircraft should be fully assembled and ready to fly on a large flat field. Turn on all electrical systems on the aircraft and transmitter/receiver. The electrical devices to be turned on are brushless motors. Brushless motors are synchronous motors that use permanent magnet rotors and stator windings as their magnetic field. This brushless motor is placed at the rear of the aircraft's wing as a propulsion device that assists the aircraft during takeoff. This brushless motor is placed at the rear in accordance with the specifications of this aeromodeling aircraft.
2. Once all electrical systems are turned on, slowly move the left analog stick on the remote control upwards so that the aircraft's engine can rotate, thereby generating thrust for the aircraft. The remote control used in the design of this RC aircraft is Flysky. This remote control can be used by connecting the Transmitter (Remote Control) and Receiver (Flysky i6b). The left analog stick on the remote control is used to rotate the motor on the aircraft, and the right analog stick on the remote control is used to move the servo on the aircraft.
3. When the RC aircraft takes off, push the right analog stick on the remote control upward. The right analog stick on the remote control functions to move the servo on the RC aircraft's flaps so that it can lift the aircraft during takeoff. During the rolling takeoff, the rotational speed of the motor helps lift the aircraft. At the point where the wings are connected, there is a piece of wood on the wings that helps support the weight of the aircraft during takeoff.
4. When the aircraft is flying at a certain altitude, Taruna sends an identification signal via a transmitter on the ground at a frequency of 103.1 FM. In this process, the identification signal sent will be transmitted continuously using audio transmitted to the remote control aircraft. During the transmission of this identification signal, the transmitter on the ground cannot send an identification signal if the aircraft being flown is within the transmitter's range.
5. The identification signal is sent and received by the RC aircraft and transmitted back to the ground. The identification signal sent by the remote control aircraft is received by the receiver on the ground via a frequency of 90.0 FM. The identification signal received on the ground is in the form of audio that is monitored through a speaker. In this identification reception system, a different frequency is used. This is done so that the frequency used to send the identification signal does not directly transmit to the receiver on the ground. The main function of the receiver on the ground is to monitor the identification signal entering the aircraft.
6. When the identification signal has been successfully received by the cadets on the ground, the RC aircraft lands back on the ground..

4. CONCLUSIONS

This identifier is transmitted by a transmitter that continuously broadcasts on the ground and is received by a receiver. It can only transmit and be received at a distance of approximately 15 meters when broadcasting, and after exceeding 15 meters, the identifier signal can no longer be received. The receiver used in this design can receive identifiers sent by the transmitter at a distance of up to 300 meters, and the received transmission is output through audio media.

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