DESIGN OF A FLIGHT CONTROL SYSTEM RUDDER SIMULATOR ON AN ARDUINO UNO-BASED BOEING 737-900ER AIRCRAFT AS A SUPPORTING FACILITY FOR PRACTICAL ACTIVITIES AT THE SURABAYA AVIATION POLYTECHNIC

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Abstract

Which may be completed properly however the author wants to upload a simulation tool inside the form of a rudder, the rudder is placed at the vertical stabilizer. Rudder is the manipulate location while the aircraft yaws or turns. The rudder actions on a vertical axis (the axis extends perpendicular to the middle of gravity of the aircraft). The rudder is controlled from the cockpit using the rudder pedal. The form of balance that the rudder plays is to stabilize the plane in a directional route. The motion of the rudder is deflected to the left or right. On most plane, the rudder is attached to the rear quit of the horizontal stabilizer. Airplanes have a system or often referred to as flight manage that is divided into 2, namely primary flight manipulate and auxiliary flight manipulate. number one flight manipulate includes ailerons, rudders and elevators, whilst auxiliary flight manage includes flaps, slats, slots, spoilers, horizontal stabilizer and vertical stabilizer. Method utilized in planning the design of this rudder system starts offevolved from the design, as well as the producing substances as nicely. with the aid of using the Arduino microcontroller it'll ship commands to the servo motor, the servo motor will pass clockwise or counterclockwise to the desired rudder position. rotary potentiometer which capabilities as a function determiner. checks had been performed on the aircraft rudder and succeeded in using the servo motor to rotate clockwise or counterclockwise, supplying records on the appropriate rudder position of the plane. results within the design of the simulator rudder machine this is to help lecturers or instructors for you to easily deliver material concerning flight manipulate machine specifically on primary flight manage that is rudder, Can realize the value carry and drag that is as a result of the angle, can design the simulator rudder machine based arduino uno microcontroller,can recognise the motion of the joystick with a positive tilte angle and create simulator rudder arduino uno can pressure servo vehicles.

Keywords: Rudder, servo motor, Arduino, Mikrokontroller, potensiometer

INTRODUCTION

Aircraft have many systems, certainly one of that's the flight manage machine that regulates the motion of the plane at some stage in flight. in the previous technology, flight control turned into absolutely driven through pilot power the usage of a mechanical system consisting of rods, pulleys, and cables, beginning to broaden by means of the usage of hydraulic systems, electric structures or better known as fly through cord to make it less difficult for pilots to function flight control. Flight control is divided into two sorts, particularly primary flight control and secondary flight control. number one flight control usually consists of 3 components among others, ailerons, elevators, rudders that alter roll, pitch, and yaw actions at the aircraft. Secondary Flight control serves to stabilize the motion of the aircraft and support the movement of the primary flight control.

primary flight control consists of ailerons, elevators, and rudders, whilst secondary flight control consists of tabs, then auxiliary flight control consists of flaps, spoilers, trim tabs, stability tabs, slats, slots, and many others.

primary control is a group of three major components that play a position in transferring the plane whilst the aircraft is in flight. The 3 components work on every of their very own axis or imaginary line that stretches straight (axis). this is, the rudder at the vertical axis, the elevator on the lateral axis, and the aileron at the longitudinal axis. Rudder is a hinged control floor a part of the aircraft that movements as a controller of the yaw

axis motion of the plane. In designing the rudder structure, a lightweight and robust design is needed to withstand the structural hundreds and external hundreds acquired by way of the rudder. Rudder is placed at the vertical stabilizer. The rudder movements on the vertical axis (longitudinal axis perpendicular to the middle of gravity of the plane). The rudder is managed from the cockpit the usage of the rudder pedal. The kind of balance executed by the rudder is to stabilize the aircraft within the directional route. The movement of the rudder deflects to the left or right.

A simulator is a tool to create a real or realistic surroundings. The reason of the use of a simulator is for training and gaining knowledge of. Simulators are very beneficial in the world of aviation to simulate activities round the arena of aviation. Flight simulator is a simulation in flying an aircraft and also can simulate flight control of plane actions while taking off or known as takeoff. every flight control on the aircraft has special actions in step with its characteristic, as an example flight control at some stage in takeoff.

The aircraft takeoff section is divided into two stages, at the floor and in the air. the first takeoff segment at the ground begins whilst the brakes are launched and full energy is followed by means of rotational movement and there's a sign that the aircraft is beginning to fly. There are 4 forces that work when an plane moves straight, flat, and does not experience acceleration, particularly thrust, elevate, weight, and drag. within the takeoff section, the simulator actions to mimic the situation of the plane and suggests what forces are at work at some point of takeoff. at the same time as the plane is in flight inside the takeoff segment, the simulator additionally works to imitate the movement of the plane because it actions on the runway till it is airborne within the cruise section.

The cruise section is a country of flight in which the aircraft makes use of the most low cost gasoline and technically most effective layout situations. primarily based on the above heritage, to apprehend the running concept of the rudder device, a teaching useful resource is needed as a way and support for practicum in Hangar AMTO 147D/010 Aviation Polytechnic Surabaya, so the writer raises the difficulty on this final challenge with the title "DESIGN OF A RUDDER FLIGHT CONTROL SYSTEM SIMULATOR ON ARDUINO UNO-BASED BOEING 737-900ER AIRCRAFT AS A SUPPLEMENT TO PRACTICE ACTIVITY FACILITIES IN Aviation Polytechnic of Surabaya ".

To find out whether this research is in accordance with the objectives, the author provides the following questions:
1.   How to design an Arduino uno microcontroller-based rudder system simulator?
2.   How is the working principle of the Arduino Uno microcontroller so that it can drive the servo motor on the rudder simulation?

METHOD

Primarily based on the outcomes of observations made at Hangar Amto 147D/010 plane Engineering Polytechnic Aviation Surabaya, this Rudder system making plans starts offevolved from the layout of the design, as well as the purchase of materials. in this studies approach, the writer also includes a studies layout flowchart of the rudder simulator as follows:
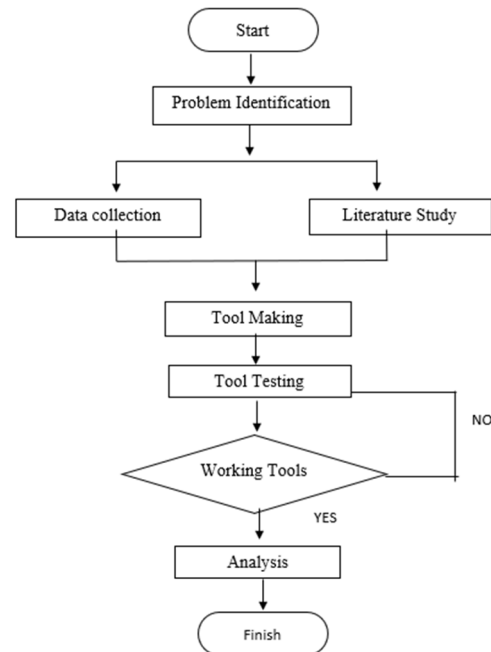

Figure 1 Flowchart of Research Design

Within the Flight control gadget Practicum procedure that is portable, efficient and makes a procedure that isn't always but inside the existing instructor. because at this time, in particular within the method of practicing the Flight control device, the cadets of the plane Engineering take a look at software nevertheless sense problems in wearing out the exercise. To conduct studies and comprehend a device as a learning media mainly for the aircraft gadget Practicum system as an application of the cloth that has been received.
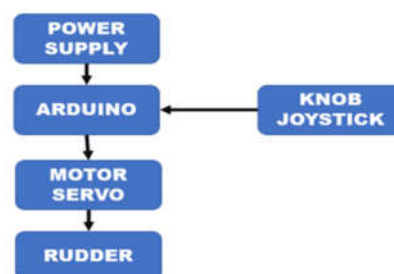

Figure 2 Tool Beam Diagram

Within the picture above explains how the

power supply can switch on the Arduino Uno, so that the

Arduino Uno that has been given enter or programming. After that the joystick knob is moved in order that Arduino Uno can deliver direct instructions to the servo motor so that it is able to perform the actions which have been set up. Arduino Uno can retain to provide instructions to the servo motor in order that the rudder can move.

Within the picture under explains how the writer prepares a 2D rudder system simulation design on a Boeing 737-900ER aircraft and a 3D rudder gadget simulation design on a Boeing 737-900ER aircraft as a supporting means of practical sports at the Surabaya Aviation Polytechnic. the following are 2D and 3D images of the Rudder simulator design:
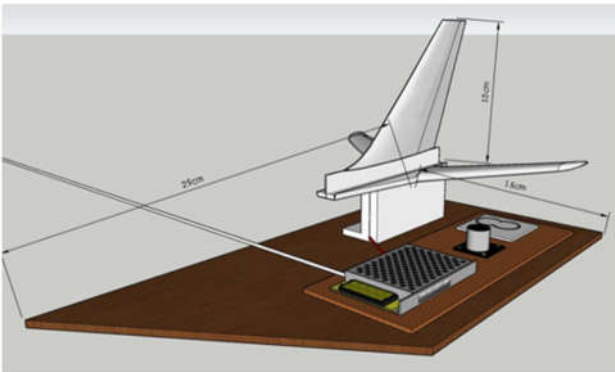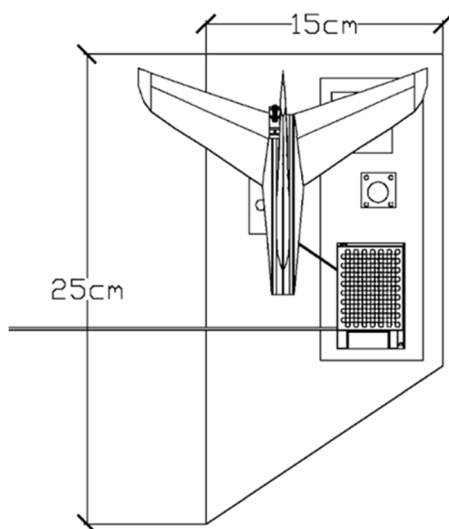

Figure 3 3D design of simulation tool

Figure 3 2D design of simulation tool

Here is the simulator design that the author designed from 3D and 2D images as follows: (1) Power, (2) Arduino uno, (3) Joystick Knob, (4) Servo Motor, (5) Rudder.

In the design of this rudder simulator, it is explained how the tool works. In the picture below is how the rudder simulator tool works.
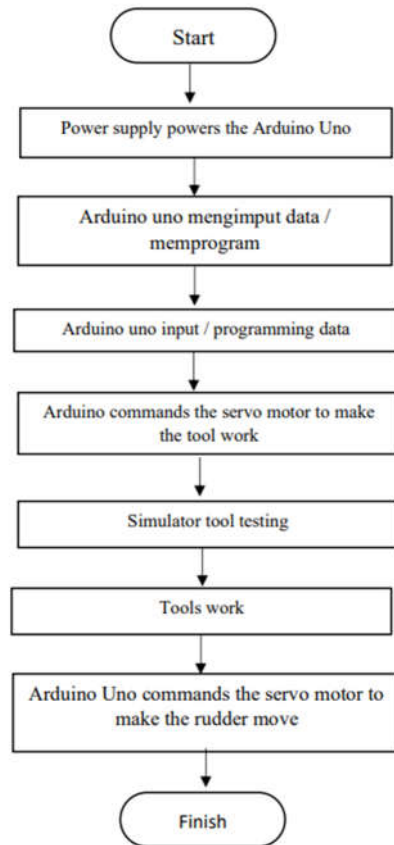

Figure 5 Flowchart How the Tool Works

In the design of this rudder simulator, it begins from a power supply that could switch on the Arduino Uno, in order that the Arduino Uno has been given enter or programming. After that the joystick knob is moved so that Arduino Uno can supply an instantaneous command to the servo motor so as to perform the motion that has been installed. so that Arduino Uno can preserve to offer instructions to the servo motor so that the Rudder can move.

Inside the design of this rudder machine, researchers use an arduino uno microcontroller as a element which can provide alerts to servo motors. in order that the servo motor responds to facts from the arduino uno that could move the rudder.

To validate the statistics generated, researchers use the Joystick Analog Module technique which is a part that is fashioned like a lever and can be moved in numerous guidelines to get the preferred role, in standard this module has 2 axes, specifically the X axis and the Y axis used as input signals to the arduino uno to have the ability to reveal the path of motion on the servo motor. the dimensions of the voltage required through the joystick analog module so one can have good performance. the subsequent are the outcomes of joystick measurements with the rudder tilt attitude.

Testing	Joystick axis		Rudder axis		Description
	left	Right	left	Right	
1.	0°	0°	0°	0°	OK
2.	90°	90°	90°	90°	OK
3	80°	80°	70°	80°	OK
4.	75°	75°	75°	80°	OK
5.	50°	50°	50°	60°	OK

Figure 6 Joystick Measurement Results with Rudder Tilt Angle

Analysis of joystick measurements with a rudder tilt attitude the use of a Servo Motor, Servo Motor is a motor this is operated mechanically, according to the input signal from the joystick analog module, code from arduino and incoming electric contemporary. The voltage required by using the Servo Motor to have proper overall performance.

Measurement of Voltage Module Analog Joystick and Servo Motor with 5V joystick analog input Voltage (DC) produces four-6 V DC and 5-6 V DC in this voltage measurement is asserted regular. The attitude length required by using the servo motor to have accurate performance. If the servo motor is moved to the proper and left it have to be identical to an attitude of ninety ranges, the measurement of the attitude of the writer receives the end result that the attitude of the servo motor is according with what is wanted.

RESULTS AND DISCUSSION

Making plans is a process that we do to the device, starting from the circuit work design to the completed end result in order to feature. planning and making equipment is the most important a part of making

this very last project. In precept, good design and systematics will provide comfort in making tools.

With the basic theory that has been explained in chapter II and planning in chapter III, in this chapter the author will discuss the results of the " DESIGN OF A FLIGHT CONTROL SYSTEM RUDDER SIMULATOR ON AN ARDUINO UNO-BASED BOEING 737-900ER AIRCRAFT AS A SUPPORTING FACILITY FOR PRACTICAL ACTIVITIES AT THE SURABAYA AVIATION POLYTECHNIC".

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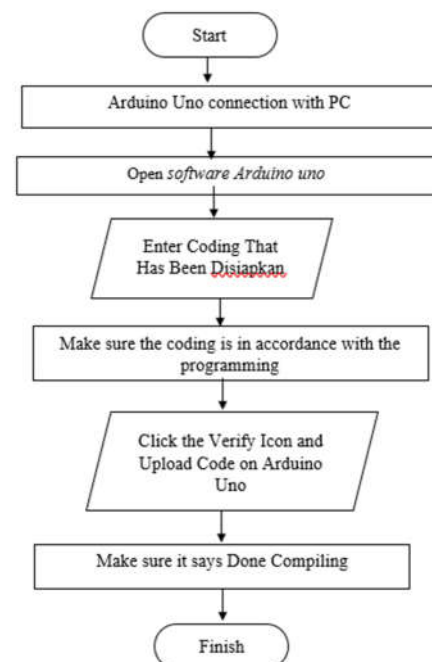

Figure 7 Arduino Uno Testing Flowchart

The flowchart above explains checking out the usage of Arduino Uno by using connecting Arduino Uno with a pc / computer that has the Arduino IDE software program installed, then open the Arduino IDE software program, prepare the previously designed code and copy it to the Arduino IDE software program. make sure the servo motion and analog joystick module are as desired. click the confirm icon within the upper left corner of the Arduino Uno software. ensure the end result show is "executed Compiling" to ensure this system does no longer experience errors. click on the upload icon with an arrow within the Arduino Uno software program.

Make certain the end result display is "done Compiling" to ensure this system does now not experience errors. inside the above test, it is able to be analyzed that the program in the Arduino IDE works nicely and is ready to be uploaded to the Arduino Uno board.

Testing and analysis of power supply Adapter, DC Adapter is part used as an input supply for Arduino Uno 220 VDC. before use, the adapter is tested with the aim of knowing whether the circuit at the DC Adapter is functioning well. trying out the DC Adapter circuit starts from measuring the AC input voltage. Then continue with measuring the DC output voltage. After that, the voltage dimension is accomplished on the Microcontroller output.

After trying out, the results obtained from the input Voltage of the power supply Adapter 220 V (AC) Output Voltage of the power supply Adapter 5 V (DC) and Arduino Uno input Voltage 5 V (DC) from the analysis results After several assessments, the author receives data that the output voltage of the DC Adapter is according with what is wanted.

Testing the Prototype Rudder system on this check is by way of giving power supply and turning on the arduino uno. while the arduino is became on this issue can provide supply to the servo motor and joystick analog module. This take a look at is done to find out that once the analog joystick module is moved consistent with the axis course, the servo motor movements and functions according to the writer's wishes. the subsequent is the process of checking out: (1) make certain the arduino code records has been set in keeping with the favored direction of movement of the servo (ninety degrees) and joystick analog module (left and right), (2) connect the 9 volt battery power supply to the external DC adapter power supply connector, (3) make certain the power supply is set up flawlessly, (4) make sure the indicator mild at the arduino uno is on, (5) move the joystick analog module left and proper, (6) take a look at the adjustments in movement displayed on the simulator tool and record changes in the direction of movement.

DC Adapter Output Voltage measurement results if the joystick analog module then Arduino uno will study (input signal) joystick analog module and drive the left servo motor. And if the joystick analog module is proper course (x axis) then Arduino uno will read (input signal) joystick analog module and drive the right servo motor.

The results of some of the above tests the writer receives the facts as desired. From the arduino uno testing completed, the writer could make a simulation design of the rudder system based at the arduino uno microcontroller, then the rudder system can work normally and the arduino uno automatically drives the servo motor while the analog joystick is moved.

CONCLUSION

After conducting tests of the " DESIGN OF A FLIGHT CONTROL SYSTEM RUDDER SIMULATOR ON AN ARDUINO UNO-BASED BOEING 737-900ER AIRCRAFT AS A SUPPORTING FACILITY FOR PRACTICAL ACTIVITIES AT THE SURABAYA AVIATION POLYTECHNIC" as described inside the previous chapters, the writer could make a simulation design of the Rudder system based on the arduino uno microcontroller, The rudder system can work normally and the arduino uno automatically drives the servo motor while the analog joystick is moved, The ability of this simulator tool can help cadets inside the

getting to know process of flight control practices in the AMTO 147D/010 hangar of the Surabaya Aviation Polytechnic, This simulator tool considers in terms of practicality in terms of design / design in order that it's miles more green whilst used, In testing the arduino uno can run well as implemented.

SUGGESTION

Suggestions that can be conveyed through the writer to expand this rudder simulator design device can be operated with a deflection angle in which the axis at the rudder can be seen if the rudder also moves in step with the angle comparison, on this design to always be considered in terms of maintenance because it is feared that the tool may be damaged, do maintenance and cleaning at least once each weeks, Taking flow visualization data using a documentation tool with high resolution. in order to facilitate the analysis or identity process. taking pictures of visualization results is attempted on the right, left, top, and bottom sides parallel to facilitate data collection for the duration of testing. this design still needs to be further developed, to be able to facilitate using arduino uno testing practices.

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