



University of Minho
School of Engineering

Reconstruction of the Avionics System of the Hangar 9 Solo Trainer Aircraft

Systems Definition and Requirements



Master's in Aerospace Engineering

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1 System Definition

The Avionics System is crucial for ensuring the safe and efficient operation of the aircraft. This system integrates a wide range of components, including:

- **Servos:** In this system we will use four servos, in order to operate the different axis of the aircraft's movement (Pitch, Yaw and Roll) and the power of the motor. They are responsible for the movement of the ailerons, the rudder and the elevator:

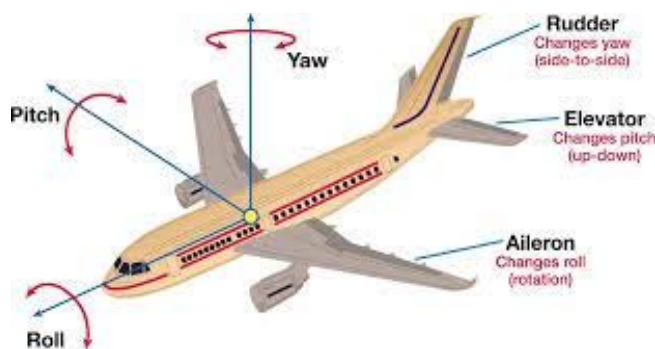


Figure 1. Representation of the axis movements.

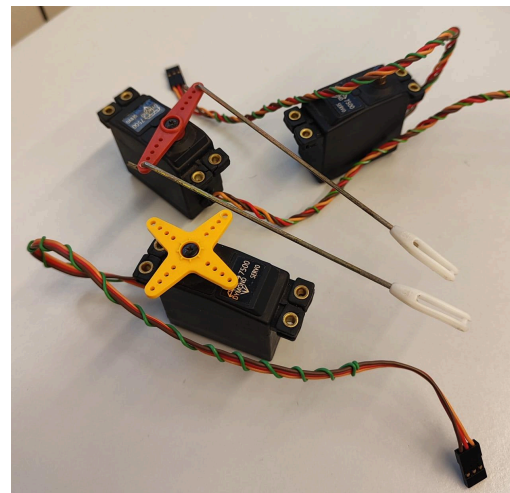


Figure 2. Servos.

Ailerons: Ailerons control the roll of the aircraft. By moving the ailerons in opposite directions, the airplane rolls left or right. One servo is used that controls both ailerons.

Rudder: The rudder is located on the vertical stabilizer of the tail, and it controls the yaw of the aircraft. Moving the rudder left or right causes the nose of the plane to yaw in that direction. One servo is used to control the rudder, and it also controls the wheel direction in ground movement.

Elevator: The elevator is located on the horizontal stabilizer of the tail, and it controls the pitch of the aircraft. Moving the elevator up or down causes the nose of the plane to pitch up or down. One servo is used to control the elevator.

- **Controller:** The controller's function is interpreting the inputs from the pilot, and then generating appropriate signals to control the various components of the aircraft.



Figure 3. Radiomaster TX16S Controller.

- **Receiver:** We will use one receiver that is responsible for connecting the remote control and the servos. When an action is implied in the remote control, it will trigger the servos in order to make a movement. To make this system more complete we will opt for a receiver that includes telemetry sensors. Telemetry sensors are crucial for providing real-time data to the pilot. Common sensors include those for monitoring battery voltage, altitude, GPS position, and motor RPM.

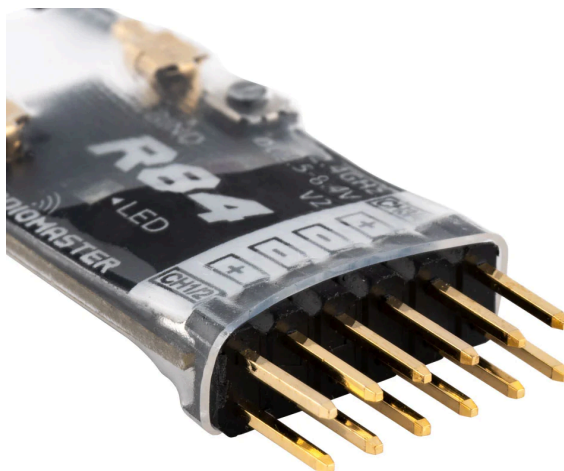


Figure 4. Receiver with 4 channels.

- **Battery:** It is essential within an aircraft's electrical system, since it is responsible for feeding the electrical system of the aircraft. Therefore, the battery plays an important role in maintaining the functionality and safety of electrical systems, contributing to efficient flight operations. In this project we would like to incorporate an on and off switch for the power supply.
- **Flight Controller:** The flight controller receives input signals from the receiver, which is connected to the transmitter (controller) operated by the pilot. The flight controller processes these signals, and calculates the necessary adjustments to the control surfaces to achieve desired flight characteristics and stability, and sends commands to the servos. In summary, the flight controller plays a crucial role in stabilizing and assisting the pilot in controlling the aircraft, providing a smoother and more manageable flying experience.

This components will be displayed according to this diagram:

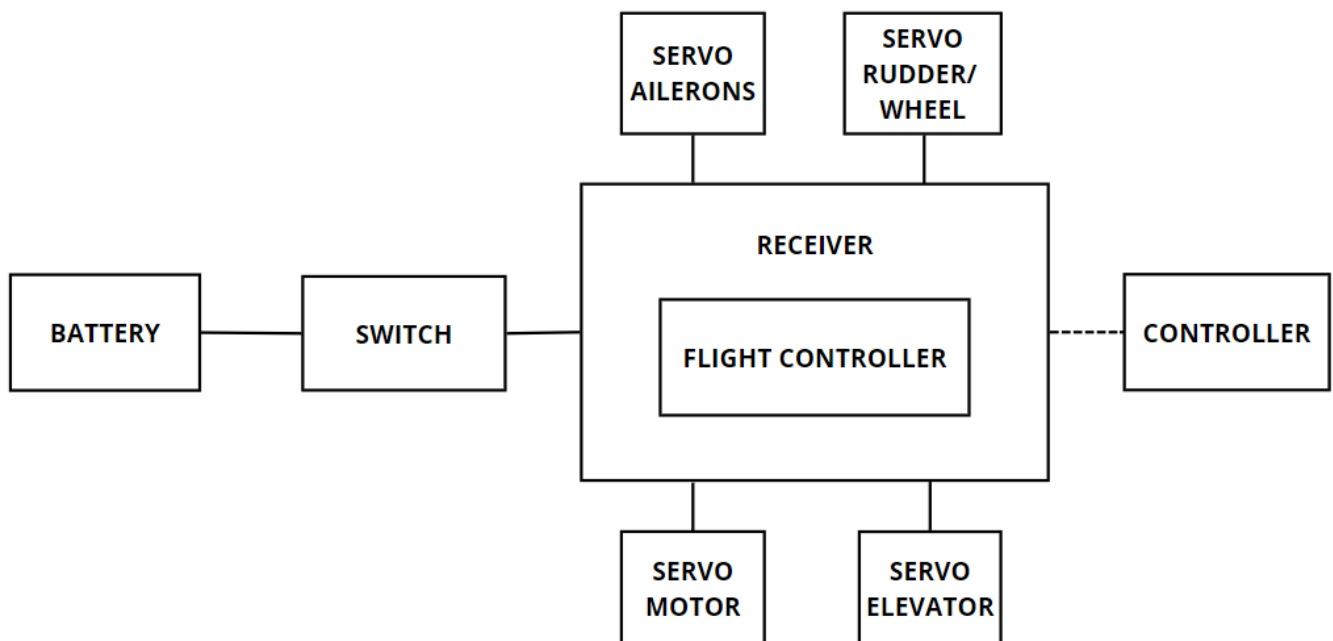


Figure 5. Block Diagram of the System.

2 List of Requirements and Restrictions

REQUIREMENTS

- Allows precise and safe maneuvers, through engine power, ailerons, rudder and elevator;
- All the axis movements of the aircraft are working;
- Integrates a wireless communication system (radio), for effective remote control;
- The aircraft remains stable during flight;
- Transmits real-time data such as battery percentage, altitude, location and motor RPM;
- All components are compatible with each other.

RESTRICTIONS

- Budget;
- Time of arrival and choosing of the components;
- Bad weather;
- Poor communication between the radio and the receiver.

3 Concerns

Due to all the phases our group has to get through, we were faced with some concerns, namely:

- Time of accomplishment of all the phases;
- Compatibility between the components;

- The aircraft's weight and gravity center;
- Excess resources that we won't need, for example, too many channels in the receivers;
- Life time of the batteries.