# SELF MANOEUVRING GLIDER

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## ABSTRACT

*A self-manoeuvring glider is an autonomous aircraft that can control its flight path without human intervention. It uses sensors, such as accelerometers, to detect and respond to changes in its environment. The glider's on board computer analyse this data and adjusts the control surfaces, such as the flaps and rudder, to maintain the desired flight path. The glider's ability to self-manage makes it an ideal platform for a variety of applications, including aerial surveillance, environmental monitoring, and scientific research. However, the development of such technology requires a significant investment in research and development, as well as advanced engineering and manufacturing techniques. Nonetheless, the potential benefits of autonomous gliders make it an exciting area of exploration for the aerospace industry.*

**Keyword : -** *Self maneuvering, flight path control, Control Surfaces, Accelerometers*.

## 1. INTRODUCTION

A glider is a special kind of aircraft that has no engine. A self-manoeuvring glider is an innovative type of aircraft that is capable of controlling its flight path without human intervention. It is an autonomous aircraft that uses advanced sensors and computer technology to analyse and respond to changes in its environment. The glider's on board computer receives data from sensors such as and accelerometers, and uses it to determine the glider's position and movement. This information is then used to adjust the control surfaces, such as the flaps and rudder, to maintain the desired flight path.

The development of self-manoeuvring gliders requires significant investment in research and development, engineering, and manufacturing techniques. Nonetheless, the potential benefits of autonomous gliders make it an exciting area of exploration for the aerospace industry. These gliders are suitable for a variety of applications, including aerial surveillance, environmental monitoring, and scientific research. Additionally, self-manoeuvring gliders can operate in areas that are difficult or dangerous for humans to access, making them an invaluable tool for exploration and monitoring of remote environments.

In this context, the purpose of this article is to provide an overview of self-manoeuvring gliders, including their features, functions, and potential applications. We will discuss the technology behind these gliders, their advantages, and the challenges associated with their development.

## 2. LITERATURE REVIEW

Recent advances in technology have made it possible to develop self-manoeuvring gliders This technology is expected to have a significant impact on the aerospace industry, as it offers a wide range of potential applications, including surveillance, environmental monitoring, and scientific research.

[1] According to a study of Single Axis Stability Autonomous Glider Control. The glider measures bank angle and roll rate information from an accelerometer and gyro, before it relays the data to an equipped microcontroller.

Programmed on the microcontroller is a control law to take the input from the sensors and issue a command to a single servo that controls both ailerons, allowing for the vehicle to autonomously correct its bank angle. The glider has proven to recover up to 15° in a relatively straight path. Although at higher initial bank angles the system is able to correct, the path is less straight as the small angle approximations and other assumptions become less accurate, leading to a greater amount of lateral drift.

[2] According to a study by Zhang et al. (2021), self-manoeuvring gliders can significantly improve the efficiency and accuracy of environmental monitoring, particularly in remote or hard-to-reach areas. The authors note that autonomous gliders can be equipped with a range of sensors, such as temperature and humidity sensors, that can provide valuable data for climate modeling and environmental assessment.

[3] In another study, Bu et al. (2020) explore the use of self-manoeuvring gliders for maritime surveillance. The authors note that gliders can be deployed for extended periods of time, allowing for more extensive surveillance and data collection than traditional manned aircraft or satellites. The study also suggests that autonomous gliders can be used for search and rescue operations in maritime environments.

## 3. METHODOLOGY

The self-manoeuvring glider project involved the development of an unmanned glider that could perform various flight manoeuvers autonomously. Essentially there are 4 aerodynamic forces that act on an airplane in flight

These are:

a) lift: upward force(generated by wing)
b) gravity: downward force(due to weight of the plane)
c) thrust: forward force(power of the airplane's engine
d) drag: backward force(resistance of air).
The methodology for self-manoeuvring gliders involves the integration of various components and subsystems that enable the glider to navigate, control its flight path, and perform its mission objectives without human intervention. The following are the main steps involved in the methodology for self-manoeuvring gliders:

**3.1 Design and fabrication**: The first step in the methodology for self-manoeuvring gliders is the design and fabrication of the glider. This involves selecting the appropriate materials, aerodynamic design, control surfaces, and avionics systems necessary for the glider's mission objectives.

**3.2 Sensor suite:** The glider's sensor suite is a critical component of the methodology. It includes sensors such as accelerometers, magnetometers, and gyroscopes that provide real-time data to the on board computer system.

**3.3 On board computer system:** The on board computer system is the brain of the self-manoeuvring glider. It receives and processes data from the sensor suite and uses it to control the glider's flight path.

**3.4 Control algorithms:** The control algorithms are used to process the sensor data and adjust the control surfaces to maintain the desired flight path. These algorithms are designed to account for various factors such as wind conditions, turbulence, and other environmental variables.

**3.5 execution:** Once the glider is airborne, the mission execution phase begins. The glider's on board computer system uses the sensor data to determine the optimal flight path and adjust the glider's control surfaces accordingly.

1) **Sensor Integration :** The glider was equipped with various sensors to enable it to navigate and manoeuver autonomously. These included Inertial Measurement Unit (IMU): The IMU included accelerometers, gyroscopes, and magnetometers to detect the glider's position, orientation, and angular velocity.
2) **Flight Control System:** The flight control system included a microcontroller and various actuators, including servos for the control surfaces. The flight control system received the sensor data from the IMU, and generated control commands for the actuators to achieve the desired manoeuvers.
3) **Design Consideration:** Here are some general guidelines for designing such a glider:

- Size
- Weight
- Wing Design
- Control System

- ➢ Construct the glider airframe according to your design specifications. It should be lightweight and aerodynamic, with a stable center of gravity.
- ➢ Install the gyroscope/accelerometer sensor on the glider. The gyroscope/Accelerometer sensor should be mounted in a position that allows it to measure the orientation and rate of rotation of the glider.
- ➢ Connect the gyroscope sensor to the Microcontroller according to the manufacturer's instructions
- ➢ Write software for the microcontroller that read data from the gyroscope. calculates the glider's desired pitch and heading. The software should then send commands to control the glider's movements based on the desired pitch and heading.
- ➢ Test the glider in a safe, open area with no obstacles. Monitor the glider's performance and adjust the software as needed.

Glider is built based on the standard Design of DELTA WING GLIDER considering the below parameters

Wing span: 2.5 ft.

Length: 4ft.

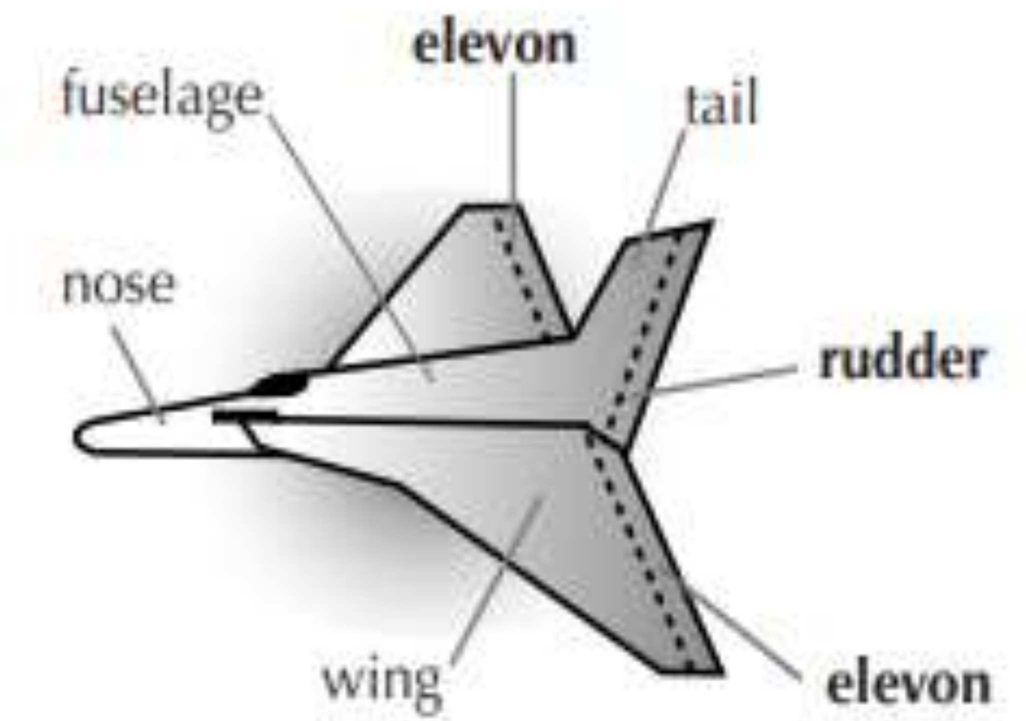


Fig: 3.1 Delta design

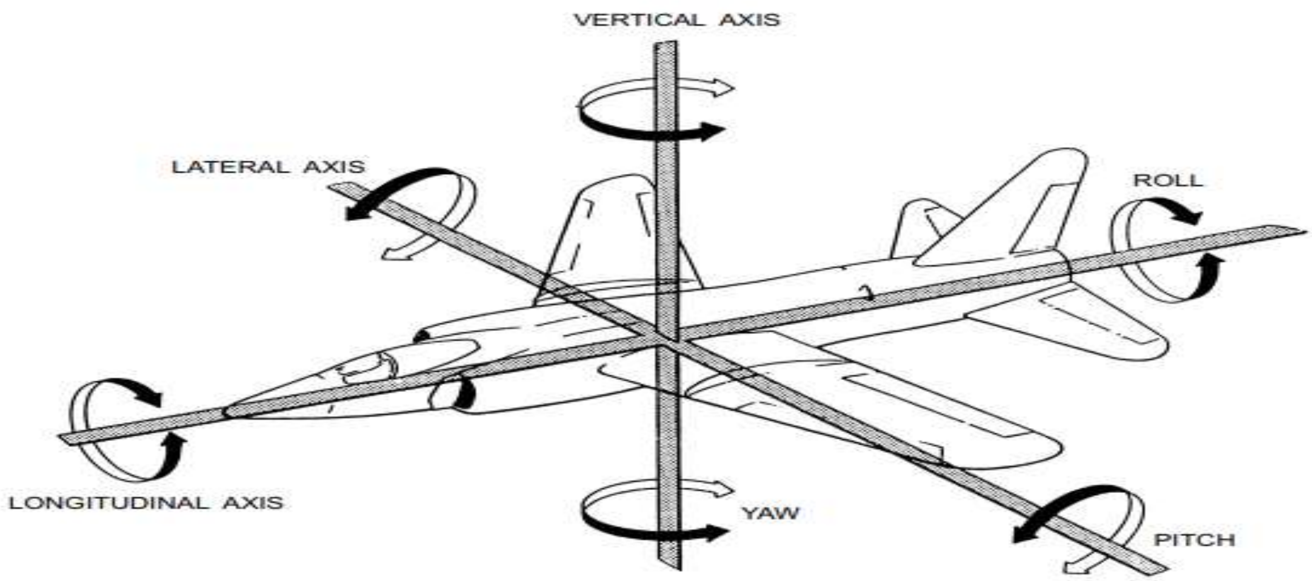


Fig 3.2 : Glider Basics

## 4. BLOCK DIAGRAM

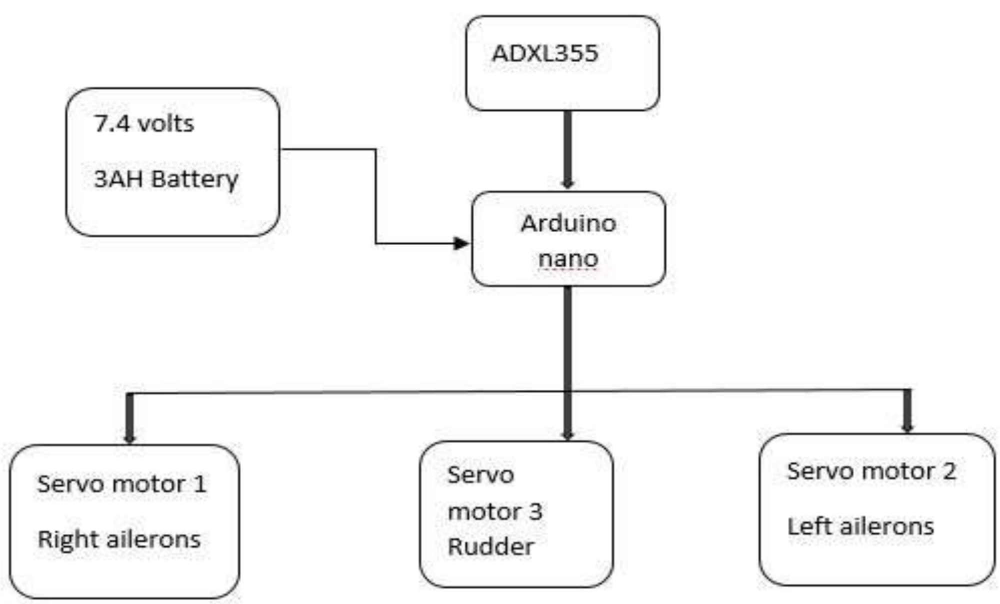


Fig 4.1: Block diagram

Our self-manoeuvring glider is equipped with a three-axis accelerometer that measures the acceleration of the glider in three directions: left/right, and up/down. The accelerometer data is processed by a microcontroller that uses a PID controller to adjust the glider's control surfaces to correct any deviations from the desired flight path. The glider is launched manually and left to glide freely, while the accelerometer data is recorded and transmitted wirelessly

## 4.1 DESIGN FLOW

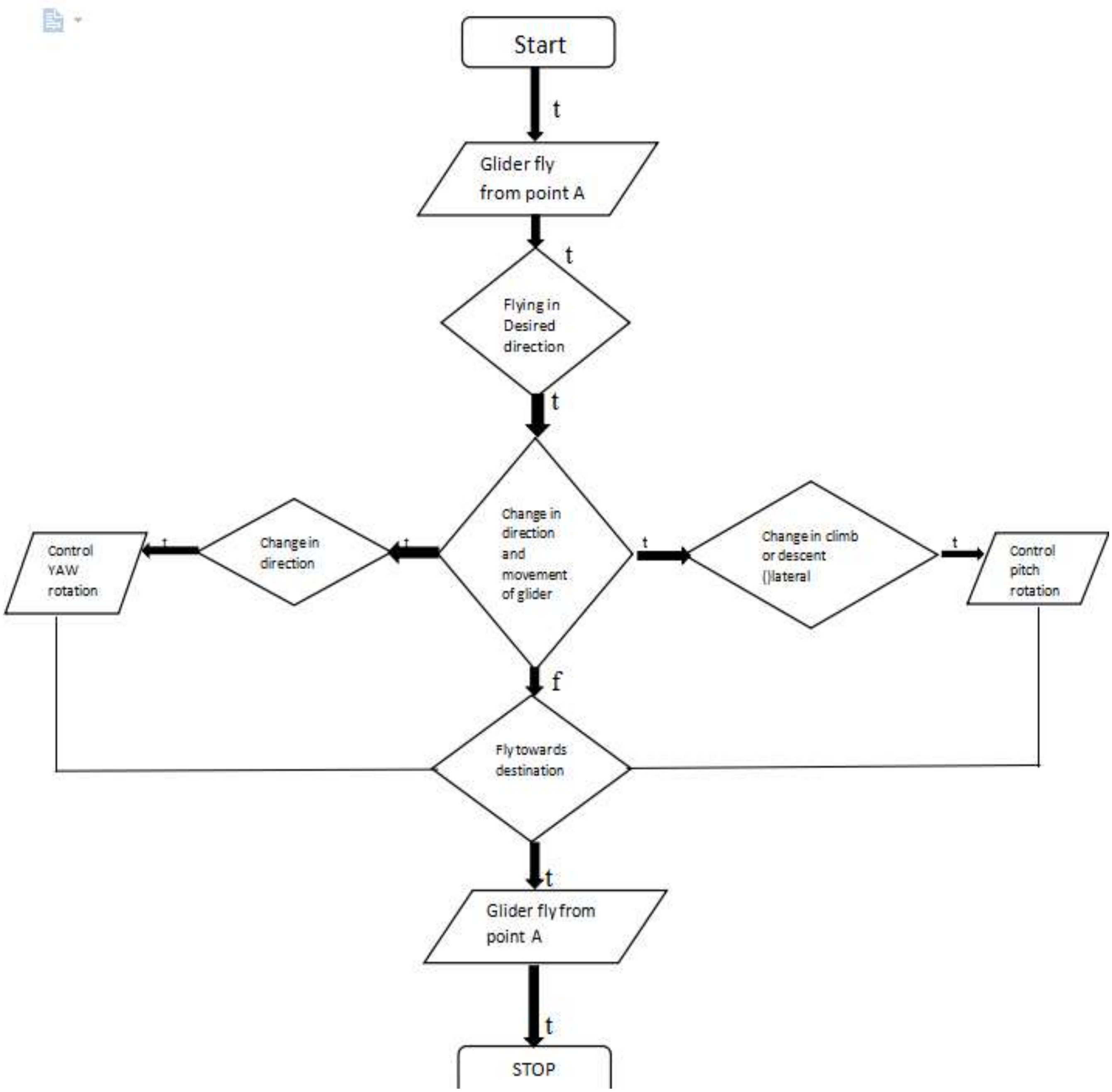


Fig 4.2 Design Flow

## 5. IMPLEMENTATION

The implementation details of a self-manoeuvring glider depend on several factors, including the specific design and control system used. However, here are some general implementation details that are commonly used for self-manoeuvring gliders:

**Sensors:** Self-manoeuvring gliders use a variety of sensors to collect data on the glider's environment and performance. These sensors can include gyroscopes, accelerometers, and magnetometers.

### 5.1 HARDWARE DESCRIPTION

**ARDUINO NANO*:***

The Arduino Nano is a small, complete and breadboard-friendly board based on Atmega328 microcontroller. The Arduino Nano contains 30 male I/O headers, in a DIP-30 like configuration, which can be programmed using the Arduino Software Integrated Development Environment (IDE), which is common to all Arduino boards are available both online and offline. The Arduino Nano contains 30 male I/O headers, in a DIP-30 like configuration, which can be programmed using the Arduino Software Integrated Development Environment (IDE), which is common to all Arduino boards are available both online and offline. The I2c and SPI communication

**ACCELEROMETERS :** sensor is used to measure the orientation and rate of rotation of the glider. You will need to choose a accelerometers sensor that is compatible with your microcontroller and provides the necessary accuracy and sensitivity for your application. Examples of compatible sensors are the ADXL335

*Fig:5.1 ADXL 335*

**SOFTWARE:** You will need to write software that reads data from the gyroscope and calculates the glider's desired pitch and heading. The software should then send commands to control the glider's movements based on the desired pitch and heading.

## 6. RESULTS

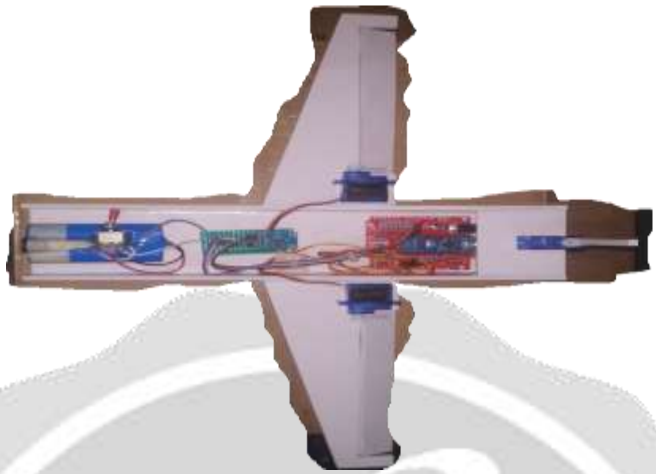

Fig: Result

Our experiments showed that our self-manoeuvring glider was able correct any deviations from the desired path based on the accelerometer data.

## 7. CONCLUSION

In conclusion, we have developed a self-manoeuvring glider with a control system implementation that can maintain a stable flight path and correct any deviations from the desired path. Our glider has potential applications in various fields, such as environmental monitoring, wildlife observation, and search and rescue operations. The use of a control system that includes an accelerometer, microcontroller, and servo motors provides a promising approach for the development of autonomous gliders. Further research is needed to improve the performance of our glider and explore its full potential.

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