

Airplane Simulator

Gesture Based URI Development for Bsc (Hons) of Science in Computing in Software Development

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**GitHub URL** :

https://github.com/majo-z/Gesture-Based-UI-Project

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*Requirements*

* Development of a Natural User Interface application
* Local implementation of the application using gestures to interact with it (for example, an application using voice control, or implementation of a solution taking advantage of hardware like the Raspberry Pi, Myo Armbands, Leap Motion Controllers, Kinect, HoloLens, Durovis Dive, Arduino, Lego Mindstorms etc.)
* Reproduction of a classic game or system using a gesture-based interface
* The programming language of choice

The project should include the following headings (including all references as evidence of the research):

* Purpose of the application - design of the application including the screens of the user interface and how it works.
* Gestures identified as appropriate for this application - providing a justification for the gestures that can be incorporated into the application
* Hardware used in creating the application – the purpose of each piece of hardware should be given with a comparison to other options available
* Architecture for the solution - the full architecture for the solution, including the class diagrams, any data models, communications and distributed elements that are being creating
* Conclusions & Recommendations – learning outcome from the project and the associated research, different approaches, critical evaluation of the project

*Purpose of the application*

The main aim of this project was to showcase skills we have learned over our 4-year course in GMIT.

The project is a reproduction of a Custom Airplane Physics designed by Indie Pixel (Technical Artist / Programmer / 3D Artist), that can be initially controlled by keyboard or Xbox controller. The project was provided to us and our goal was to implement additional layer of control by using a Myo Armband hardware, so that the airplane could be controlled by the Myo Armband gestures.

The application was created using Unity cross-platform game engine (version 2019.2.19f1) and C# language; and can run locally on a device with Windows 10 installed. The application hasn’t been tested on Apple device.

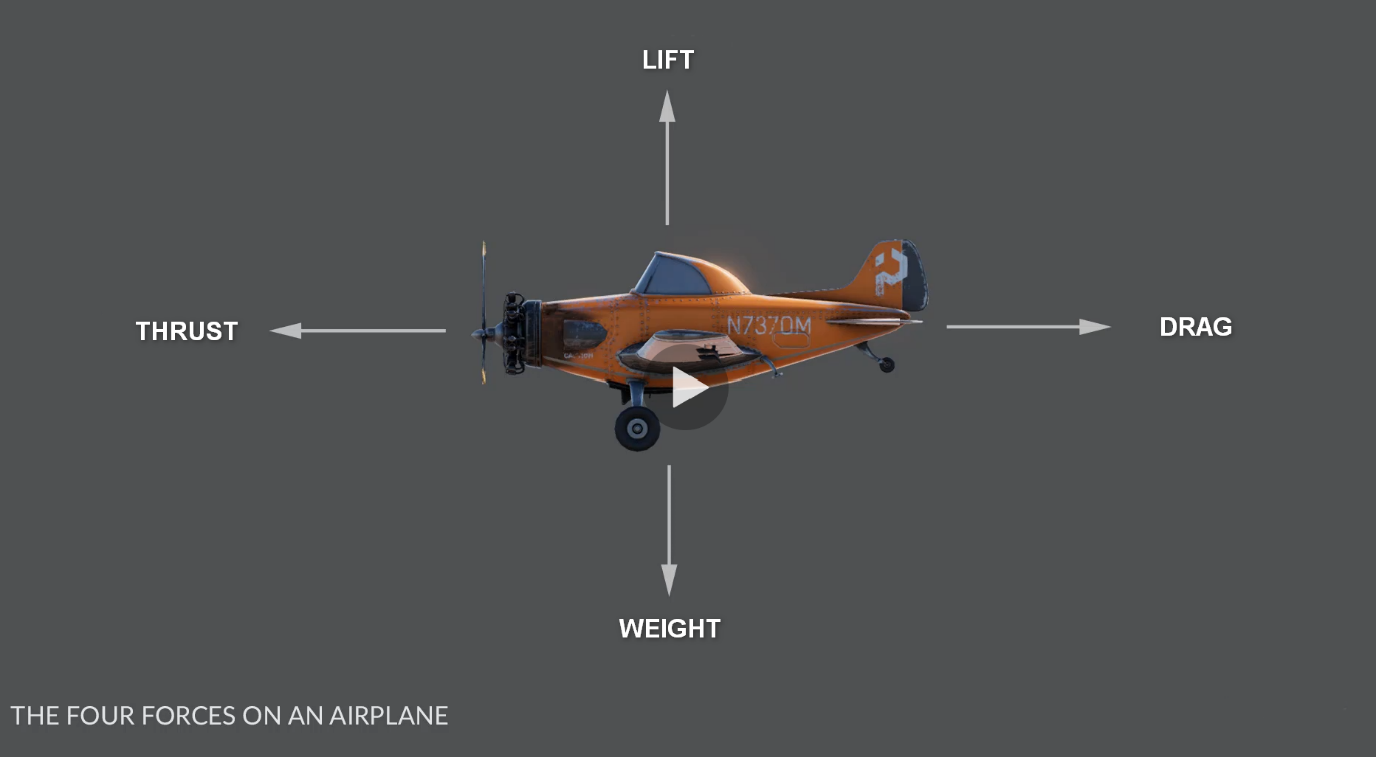
**About flying**

Flying a plane can be a difficult task as the pilot has to, besides controlling the airplane, learn to understand the weather, master crosswind and gusty wind landings, learn to tune in the correct radio frequencies, understand regulations, aircraft specifications and limitations etc. The pilot must always be attentive and notice what is going on around at all times, as being situational will help to avoid many aircraft accidents.

**Four acting forces on an airplane**

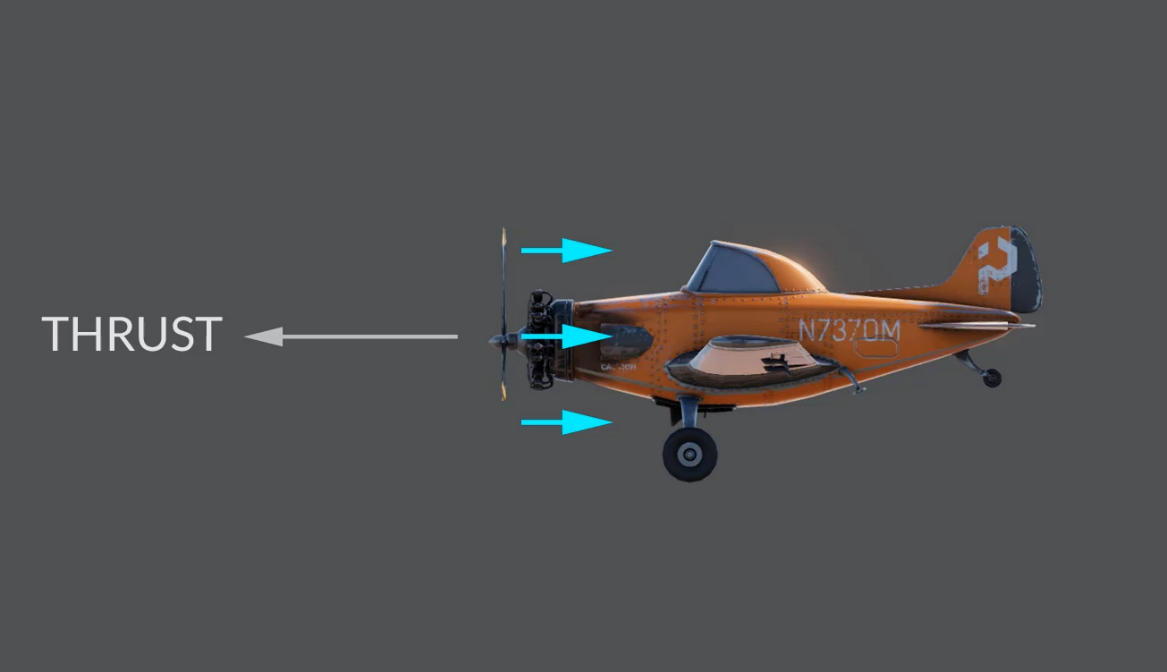
There are four acting forces on an airplane - lift, drag, weight and thrust. Maintaining a steady flight requires a balance (equilibrium) of all the forces acting upon an airplane. In a straight level flight, lift equals weight and thrust equals drag when the plane flies at constant velocity. It means that the opposite forces of flight are equal.

* If the lift becomes greater than weight, then the plane will accelerate upward
* If the weight is greater than the lift, then the plane will accelerate downward
* If the thrust becomes greater than the drag, the plane will accelerate forward
* If the drag becomes greater than the thrust, the plane will decelerate



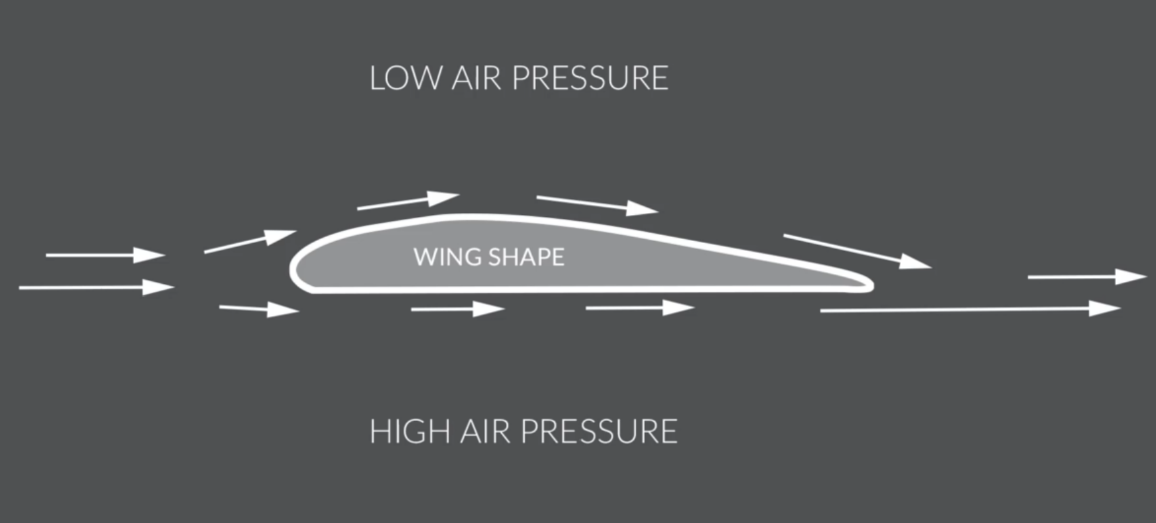
To put it simply, **thrust** force acting opposite to the **drag** force (and vice versa) and **lift** force acting opposite to the **weight** force (and vice versa).

The engine creates thrust and moves the plane forward. When thrust is greater than drag, the plane accelerates according to Newton's Law of motion, “The acceleration of an object is directly proportional to the net force acting upon it. The constant of proportionality is the mass.”. By the design an airplane must be able to accelerate vertically upwards, meaning the thrust must be greater than the weight and drag combined. When the thrust is lowered or engines of an airplane quit, drag slows the plane down.

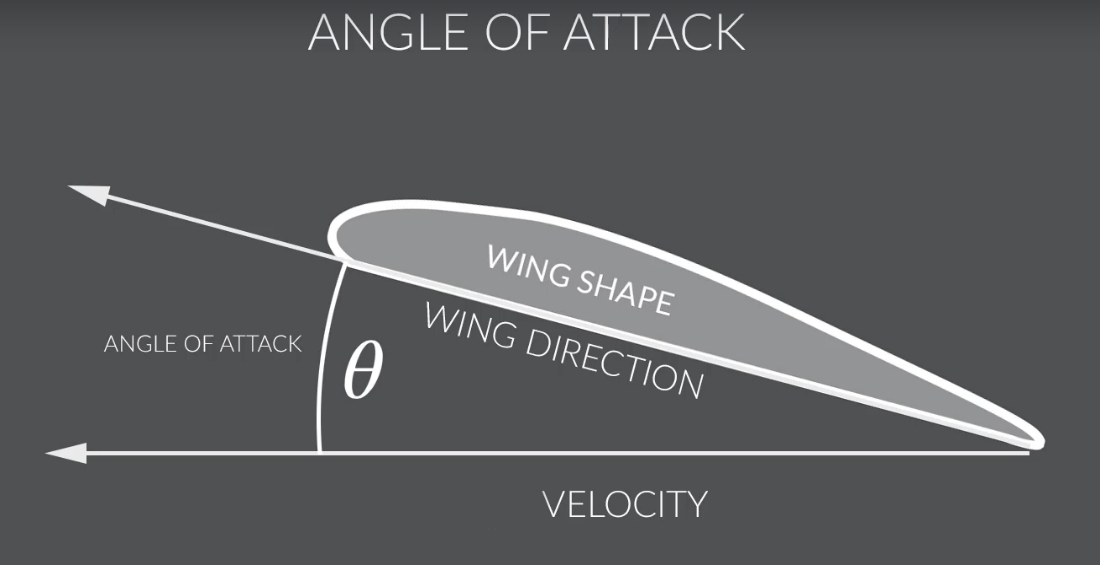


Newton's Laws and Bernoulli's Principle generate lift. When lift equals weight, the airplane can fly. Excess weight requires more lift, so heavy airplanes are more difficult to get off the ground. Lighter airplanes with less weight require less thrust. According to Newton's Laws of weight, mass and gravity, “The weight of an object is defined as the force of gravity on the object and is calculated as mass times the acceleration of gravity, w = mg, its SI unit is the newton.”

Bernoulli's Principle helps explain that an aircraft can achieve lift because of the shape of its wings. They are shaped so that the air flows faster over the top of the wing and slower underneath. Fast moving air equals low air pressure while slow moving air equals high air pressure. The high air pressure underneath the wings will therefore push the aircraft up through the lower air pressure.



Another important property in aerodynamics is angle of attack. It specifies the angle between the chord line of the wing of a fixed-wing aircraft and the vector representing the relative motion between the aircraft and the atmosphere. When the angle of attack is too great, in relation to the velocity of the aircraft, lift on the wing is reduced.



**Controlling the flight of an airplane**

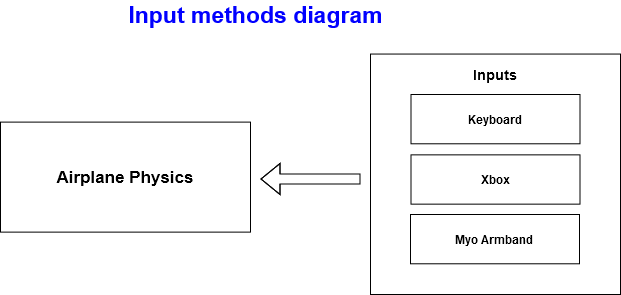
Rudder, elevators, flaps and ailerons are 4 parts of a plane that are very important. They make the plane to change the direction, descend or lift.

**How to control the airplane in our application**

Our application is a Cessna 152 airplane simulator with its design, physics, characteristics and performance. The user can interact with the

The user interacts with this airplane by using Myo Armband hardware attached to the forearm, that sends a signal to the application. Based on the implemented gestures the user can than control the airplane by using following distinguishable movements – waving left and right, double tapping, fingers spreading, making a fist, raising the arm forward and backward, sideways and rotating the arm.

*Gestures identified*

**

*Hardware used in creating the application*

**What is Myo Airband**

*Conclusions & Recommendation*

*References*

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*Appendix A*

**GitHub URL** : <https://github.com/majo-z/Gesture-Based-UI-Project>

**Unity version:** 2019.2.19f1

**Other software:** MS Visual Studio 2017 & 2019, MS Visual Studio Code, FastStone Image Viewer, MS Word 365, XODO PDF Viewer

**Hardware:** Myo Armband,Laptop (OS Windows 10)

*Appendix B*

Implementing Gesture Control for a Quadcopter.pdf