Silantro Flight Simulator v0.5

User Manual

Thank you for purchasing this asset. This document will guide you on how each component works and how to setup and use them.

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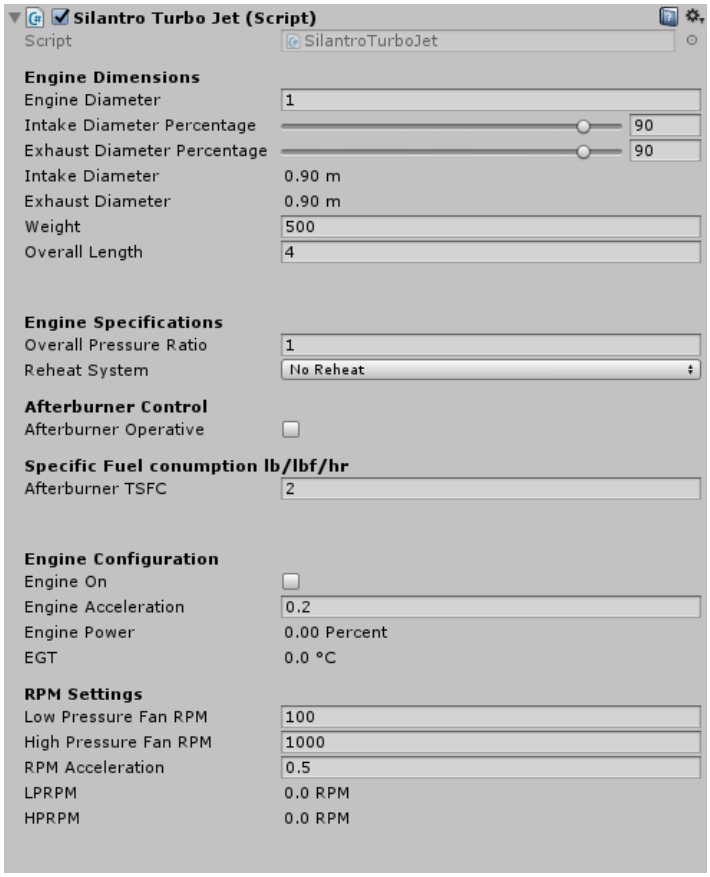
Simulator Components

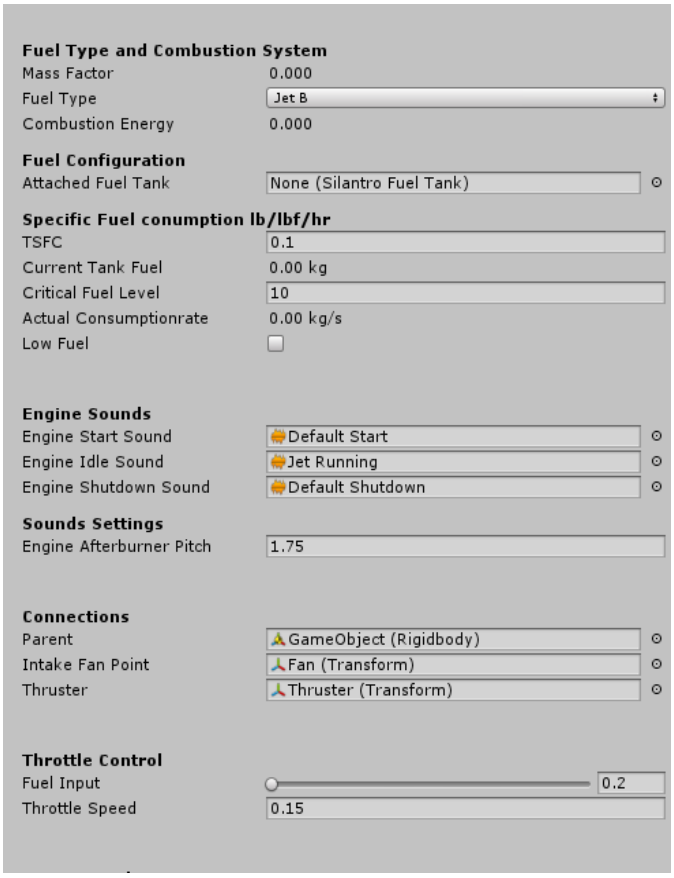
1. **Propulsion System**: these components provide thrust or lift to any aircraft they're attached to. Comprises of;
   - Engines
   - Fuel Tanks
   - Fuel Distributor

Engines

- **Turbojet Engine**

  The *Turbojet Engine*: provides horizontal thrust to the aircraft. The component should only be added to a new gameobject in the scene from the toolbar and has to be parented to a rigidbody to function properly.



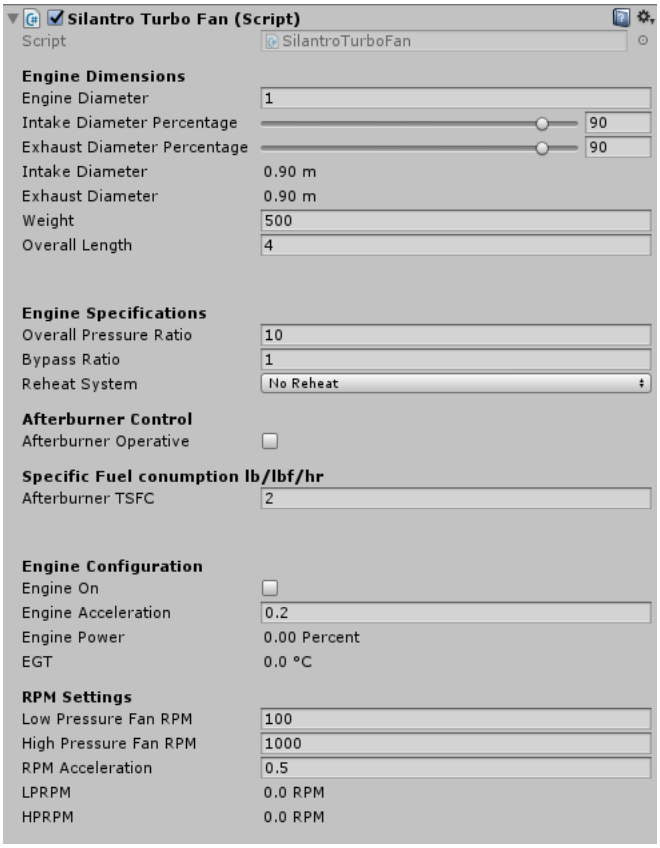


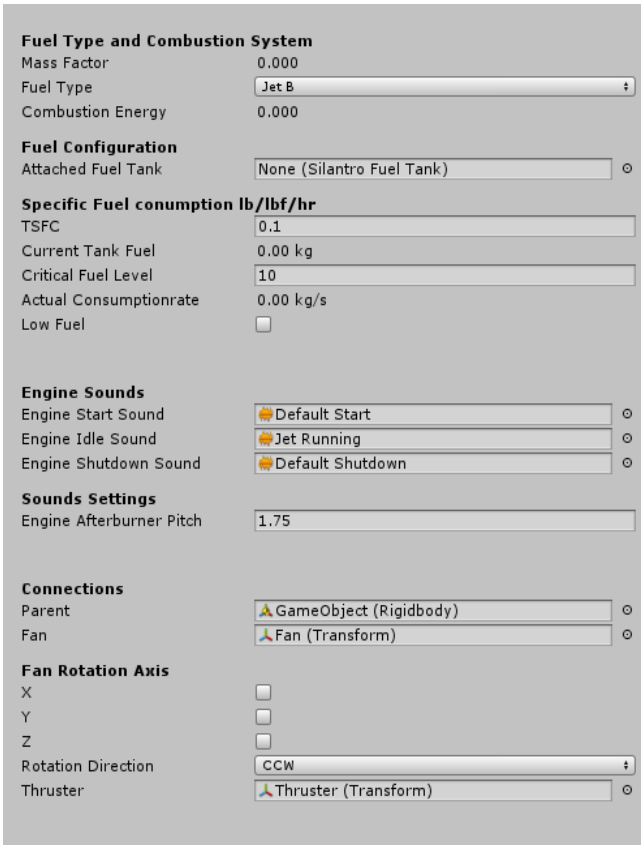
Properties

Property:	**Function:**
Engine Dimensions	
Engine Diameter	This is the total diameter of the engine in meters
Intake Diameter Percentage	This is the diameter of the engine intake relative to the total engine diameter expressed as a percentage. It is depicted by a blue circle in front of the engine to aid adjustment. *Note: This should closely match the intake fan model if available.*
Exhaust Diameter Percentage	This is the diameter of the engine exhaust relative to the total engine diameter. Depicted by a red circle at the back of the engine. *Note: This value would be adjustable for variable nozzle engines in coming update.*
Weight	Weight of the engine in kg. ***Note: this value is only used if engine model is detachable.***
Overall Length	Length of the engine in meters.
Engine Specifications	
Overall Pressure Ratio	Difference in the pressure after the compressor relative to the pressure before the engine i.e. basic aeronautical pressure ratio. E.g. 26 for the GE F404 used in the F117 Nighthawk.
Reheat system	Whether or not the engine uses afterburners. No reheat means no afterburner.
Afterburner Operative	On when the afterburner is activated.
Afterburner TSFC	Thrust specific fuel consumption in lb/lbf.hr when afterburner is active.
Engine Configuration	
Engine On	Determines if engine is active.
Engine Acceleration	How fast the engine power revs up or down. Value should be between 0.01-0.5 for proper functioning.
Engine Power	Power of the engine expressed as a percentage. 0%-off 100% or greater- fully active.
EGT	Exhaust gas temperature, will be used for detecting the aircraft with the infrared radar system in next update.
RPM Settings	
Low Pressure fan RPM	RPM of the intake or low pressure fan
High Pressure fan RPM	RPM of the turbine or high pressure fan
RPM Acceleration	How fast the RPM moves up or down. Values should be between 0.2 and 0.6.

Fuel Type and Combustion System	
Mass factor	Internal float used for calculations
Fuel Type	Type of fuel used by the engine. Available options: Jet B, Jet A1, JP6, JP8.
Combustion Energy	Specific energy of combustion of the selected fuel in MJ/kg.
Fuel Configuration	
Attached fuel Tank	Fuel tank connected to the engine
TSFC	Thrust specific fuel consumption of the engine during normal operation in lb/lbf.hr
Current tank fuel	Amount of fuel left in the attached fuel tank
Critical fuel level	Minimum fuel required for normal operation, the engine starts behaving erratically if the fuel is lower than this value. *Note: Engine shutdown automatically when fuel reaches 0 kg.*
Actual fuel Consumption	Fuel consumption in kg/s
Low fuel	Low fuel warning
Engine Sounds	
Engine Start Sound	Audioclip to be played when engine is starting.
Engine Shutdown Sound	Audioclip to play when the engine is stopped.
Engine Run Sound	Audioclip played while engine is active.
Engine Afterburner Pitch	Audiosource pitch when afterburner is activated.
Connections	
Parent	Rigidbody airplane which the engine is attached to. *Note: Highly required for the engine to function.*
Intake fan point	Point along the engine where the intake fan is located.
Thruster	Transform at point where the engine thrust is applied to the aircraft.
Throttle Control	
Fuel input	Throttle position of the engine
Throttle speed	How fast the fuel input moves from 0-1 and back.
Engine Display	
Current Engine State	Current State of the engine {Off, Starting, Running}
Air Density	Density of air at current altitude and speed.
Engine Thrust	Total thrust Generated by the engine in Newton.

- **Turbofan Engine:** Based on the turbofan engine, with the proper adjustments. Should also be added to a new gameobject from the toolbar.





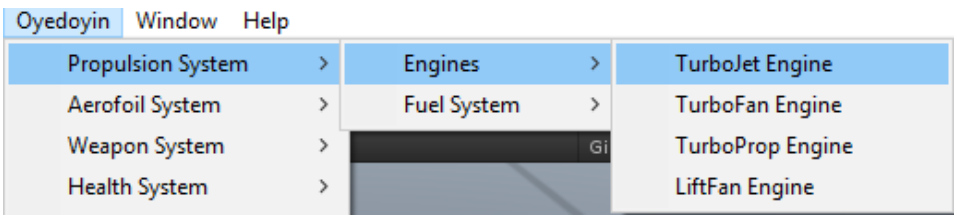
Properties

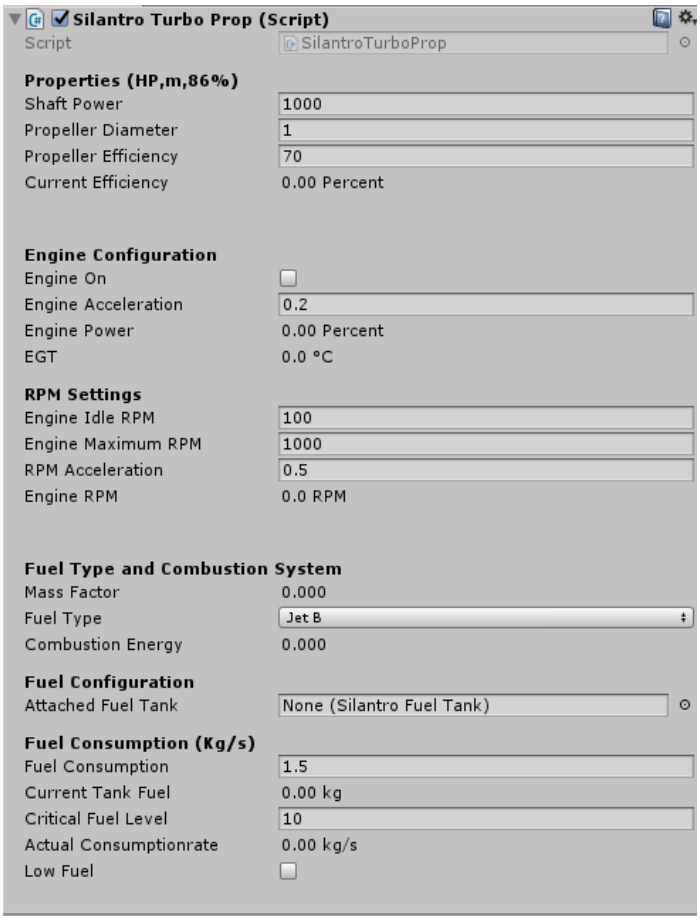
Property:	**Function:**
Engine Dimensions	
Engine Diameter	This is the total diameter of the engine in meters
Intake Diameter Percentage	This is the diameter of the engine intake relative to the total engine diameter expressed as a percentage. It is depicted by a blue circle in front of the engine to aid adjustment. *Note: This should closely match the intake fan model if available.*
Exhaust Diameter Percentage	This is the diameter of the engine exhaust relative to the total engine diameter. Depicted by a red circle at the back of the engine. *Note: This value would be adjustable for variable nozzle engines in coming update.*
Weight	Weight of the engine in kg. ***Note: this value is only used if engine model is detachable.***
Overall Length	Length of the engine in meters.

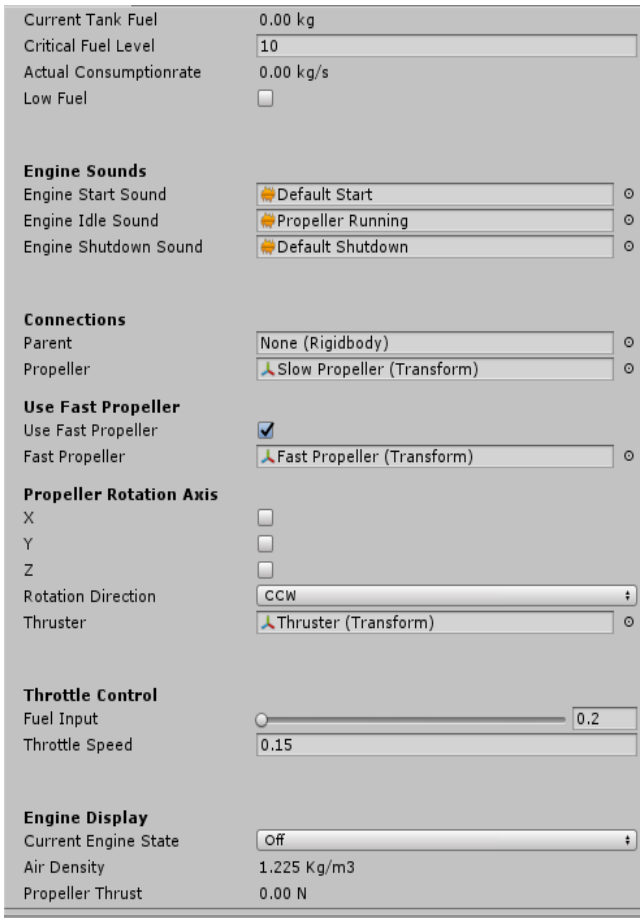
Engine Specifications	
Overall Pressure Ratio	Difference in the pressure after the compressor relative to the pressure before the engine i.e. basic aeronautical pressure ratio. E.g. 26 for the GE F404 used in the F117 Nighthawk.
Bypass Ratio	Ratio between the mass flow rate of the bypass stream to the mass flow entering the engine core e.g. 0.34 for the GE F404.
Reheat system	Whether or not the engine uses afterburners. No reheat means no afterburner.
Afterburner Operative	On when the afterburner is activated.
Afterburner TSFC	Thrust specific fuel consumption in lb/lbf.hr when afterburner is active.
Engine Configuration	
Engine On	Determines if engine is active.
Engine Acceleration	How fast the engine power revs up or down. Value should be between 0.01-0.5 for proper functioning.
Engine Power	Power of the engine expressed as a percentage. 0%-off 100% or greater- fully active.
EGT	Exhaust gas temperature, will be used for detecting the aircraft with the infrared radar system in next update.
RPM Settings	
Low Pressure fan RPM	RPM of the intake or low pressure fan
High Pressure fan RPM	RPM of the turbine or high pressure fan
RPM Acceleration	How fast the RPM moves up or down. Values should be between 0.2 and 0.6.
Fuel Type and Combustion System	
Mass factor	Internal float used for calculations
Fuel Type	Type of fuel used by the engine. Available options: Jet B, Jet A1, JP6, JP8.
Combustion Energy	Specific energy of combustion of the selected fuel in MJ/kg.
Fuel Configuration	
Attached fuel Tank	Fuel tank connected to the engine
TSFC	Thrust specific fuel consumption of the engine during normal operation in lb/lbf.hr
Current tank fuel	Amount of fuel left in the attached fuel tank
Critical fuel level	Minimum fuel required for normal operation, the engine starts behaving erratically if the fuel is lower than this value. *Note: Engine shutdown automatically when fuel reaches 0 kg.*

Actual fuel Consumption	Fuel consumption in kg/s
Low fuel	Low fuel warning
Engine Sounds	
Engine Start Sound	Audioclip to be played when engine is starting.
Engine Shutdown Sound	Audioclip to play when the engine is stopped.
Engine Run Sound	Audioclip played while engine is active.
Engine Afterburner Pitch	Audiosource pitch when afterburner is activated.
Connections	
Parent	Rigidbody airplane which the engine is attached to. *Note: Highly required for the engine to function.*
Fan	Transform of the engine fan model.
Fan Rotation Axis	Rotation axis of the fan model, depending on selection the model can rotate along the x-axis, y-axis or z-axis
Rotation Direction	Direction of rotation of the fan model. Either clockwise (cw) or counter-clockwise (ccw).
Thruster	Transform at point where the engine thrust is applied to the aircraft.
Throttle Control	
Fuel input	Throttle position of the engine
Throttle speed	How fast the fuel input moves from 0-1 and back.
Engine Display	
Current Engine State	Current State of the engine {Off, Starting, Running}
Air Density	Density of air at current altitude and speed.
Engine Thrust	Total thrust Generated by the engine in Newton.

- **Turboprop Engine:** Used to power propeller planes and can also be added from the engine section on the toolbar. Note: even during testing propeller transforms need to be assigned, use an empty gameobject if propeller model is missing







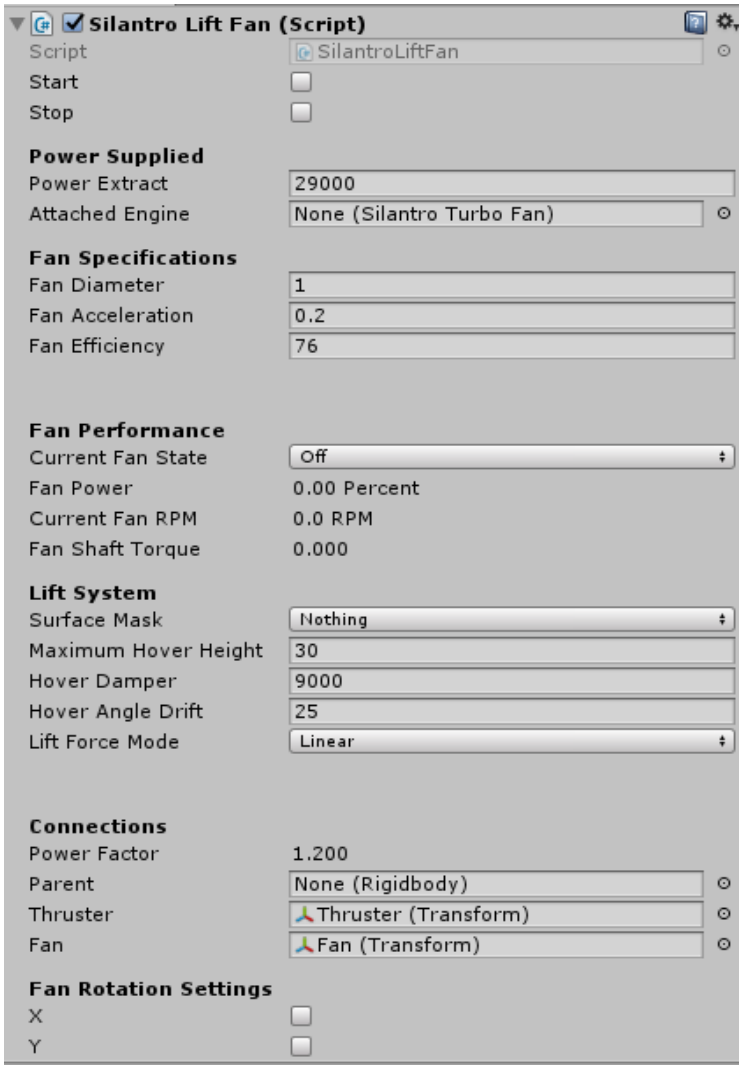
Properties

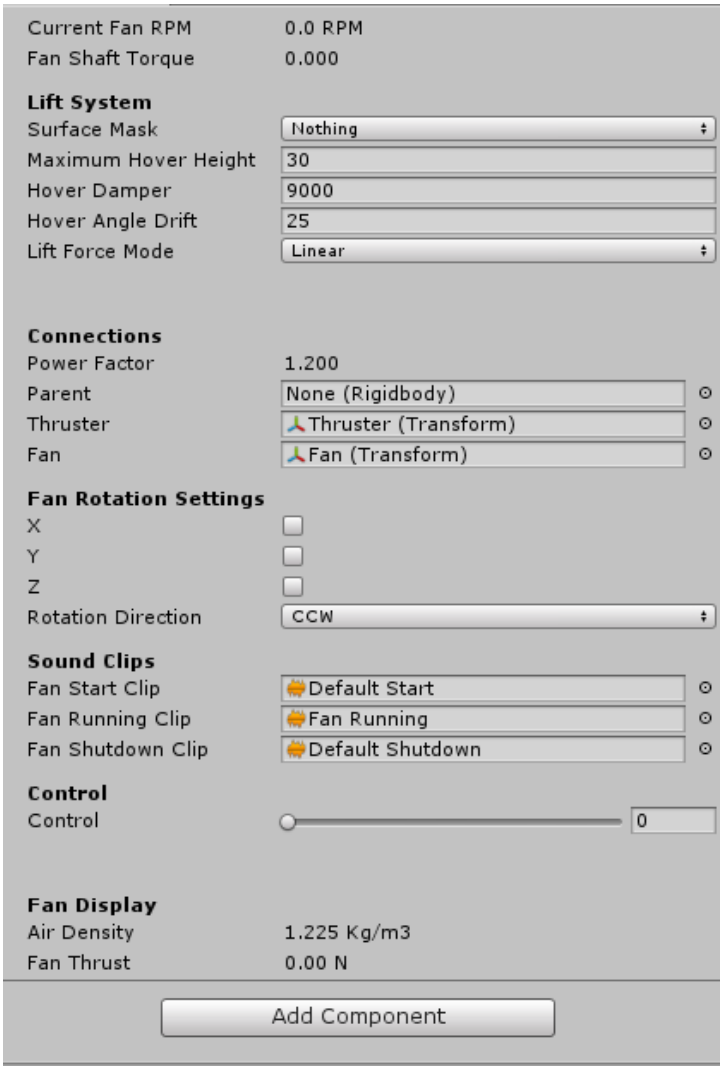
Property:	Function:
Engine Properties	
Shaft Power	Power of the turboprop engine in HP
Propeller Diameter	Diameter of the propeller in meters
Propeller efficiency	Efficiency of the attached propeller in percentage. Note: Just like in real life the current value varies with air density, speed and altitude.
Engine Configuration	
Engine On	Determines if engine is active.
Engine Acceleration	How fast the engine power revs up or down. Value should be between 0.01-0.5 for proper functioning.

Engine Power	Power of the engine expressed as a percentage. 0%-off 100% or greater- fully active.
EGT	Exhaust gas temperature, will be used for detecting the aircraft with the infrared radar system in next update.
RPM Settings	
Engine Idle RPM	RPM of the engine in the idle state
Engine Maximum RPM	Engine RPM at maximum power
RPM Acceleration	How fast the RPM moves up or down. Values should be between 0.2 and 0.6.
Fuel Type and Combustion System	
Mass factor	Internal float used for calculations
Fuel Type	Type of fuel used by the engine. Available options: Jet B, Jet A1, JP6, JP8.
Combustion Energy	Specific energy of combustion of the selected fuel in MJ/kg.
Fuel Configuration	
Attached fuel Tank	Fuel tank connected to the engine
Fuel Consumption	Amount of fuel consumed per second in kg/s. *Note: unlike jet engines, this value is not dependent on the thrust generated.*
Current tank fuel	Amount of fuel left in the attached fuel tank
Critical fuel level	Minimum fuel required for normal operation, the engine starts behaving erratically if the fuel is lower than this value. *Note: Engine shutdown automatically when fuel reaches 0 kg.*
Actual fuel Consumption	Fuel consumption in kg/s
Low fuel	Low fuel warning
Engine Sounds	
Engine Start Sound	Audioclip to be played when engine is starting.
Engine Shutdown Sound	Audioclip to play when the engine is stopped.
Engine Idle Sound	Audioclip played while engine is active.
Connections	
Parent	Rigidbody airplane which the engine is attached to. *Note: Highly required for the engine to function.*
Propeller	Transform of the attached engine propeller model.
Fan Rotation Axis	Rotation axis of the propeller model, depending on selection the model can rotate along the x-axis, y-axis or z-axis
Rotation Direction	Direction of rotation of the fan model. Either clockwise (cw) or counter-clockwise (ccw).

Thruster	Transform at point where the engine thrust is applied to the aircraft.
Throttle Control	
Fuel input	Throttle position of the engine
Throttle speed	How fast the fuel input moves from 0-1 and back.
Engine Display	
Current Engine State	Current State of the engine {Off, Starting, Running}
Air Density	Density of air at current altitude and speed.
Propeller Thrust	Total thrust Generated by the propeller in Newton.

- **Liftfan Engine:** Generates vertical thrust (lift) when connected to a Turbofan engine. Actually developed for my STOVL system.





Properties

Property:	**Function:**
Power Settings	
Power Extract	Amount of power in HP extracted from the turbofan engine
Attached Engine	Turbofan engine to which the Liftfan is attached to.
Fan Specifications	

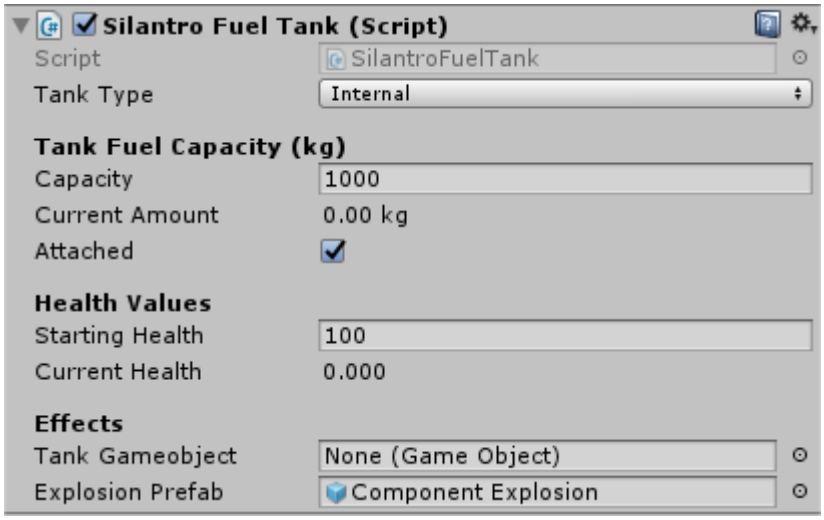
Fan Diameter	Diameter of the lift fan propeller
Fan Acceleration	Acceleration or how fast the fan power moves up or down. Expected range (0.1 – 0.6).
Fan Efficiency	Efficiency of the lift fan propeller.
Fan Performance	
Current Fan State	Current state of the lift fan {Off, Clutching (starting) and Running}.
Current Fan RPM	RPM of the lift fan propeller.
Fan shaft torque	Torque of the lift fan propeller shaft in Nm
Lift System	
Surface Mask	Surface layer on which engine can work while generating lift
Maximum Hover Height	Maximum height at which aircraft can hover and stay.
Hover Damper	Value used to control vertical stability and reduce oscillation.
Hover Angle Drift	Balance angle relative to the engine, so as to regain balance and correct tilting.
Lift force Mode	Smoothness of lift force application relative to the ground, i.e. how lift force varies with altitude
Fan Sounds	
Fan Start Sound	Audioclip to be played when fan is starting.
Fan Shutdown Sound	Audioclip to play when the fan is stopped.
Fan Run Sound	Audioclip played while fan is active.
Connections	
Parent	Rigidbody airplane which the engine is attached to. *Note: Highly required for the engine to function.*
Fan	Transform of the engine Liftfan propeller model.
Fan Rotation Axis	Rotation axis of the Liftfan propeller model, depending on selection the model can rotate along the x-axis, y-axis or z-axis
Rotation Direction	Direction of rotation of the Liftfan propeller model. Either clockwise (cw) or counter-clockwise (ccw).
Thruster	Transform at point where the engine thrust is applied to the aircraft.
Fan Control	
Control	Throttle position of the Liftfan engine
Engine Display	
Air Density	Density of air at current altitude and speed.

Fan Thrust	Total thrust/Lift Generated by the liftfan in Newton.

Note: Liftfan is still in development and balance might be a little hard to archive. It is only include in this package for testing purposes, please test and feel free to report any problems or possible suggestions.

- **Fuel Tanks**

  The fuel tanks are designed to be independent of each other and can be individually attached to each engine (Not advised though). The fuel tanks can either be **internal** or **external.** External tanks can have a model attached to it and can be detached from the aircraft.
  Finally, with another component **Fuel Distributor**, fuel from the tank can be dumped to reduce aircraft weight and can also be refilled. *Note: Only the internal tank can be refilled, but fuel can be dumped from the external and internal tank.*



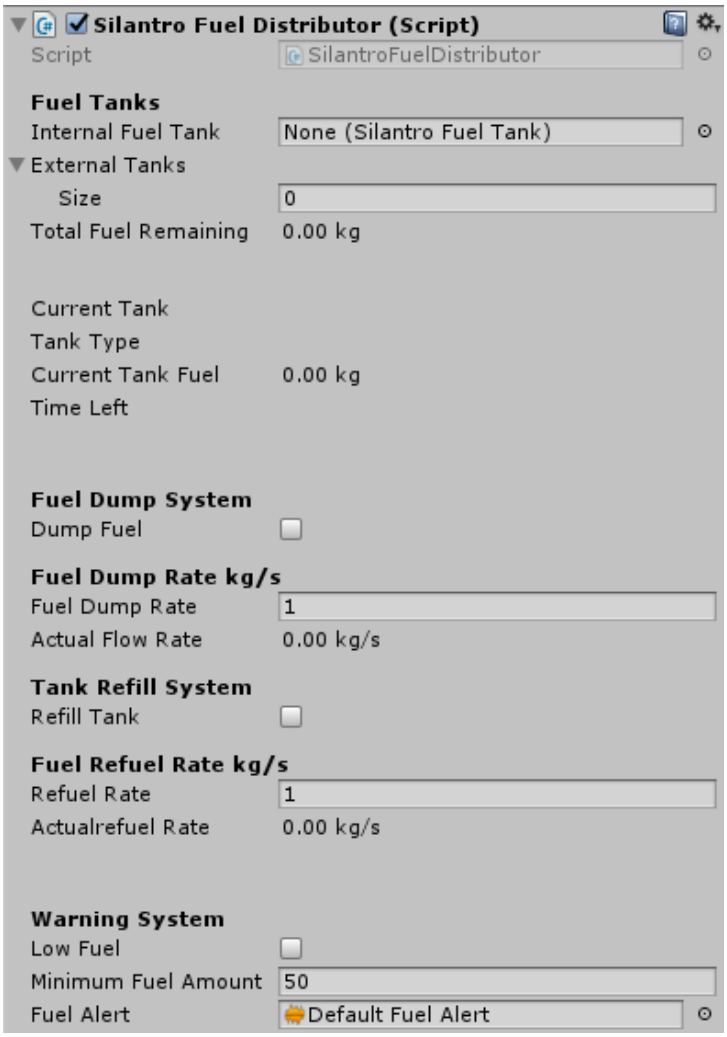
Properties

Property:	**Function:**
Tank Settings	
Capacity	Maximum amount of fuel the tank can contain in kg.
Current Amount	Amount of fuel currently in the tank
Attached	Bool to control if tank is attached to the aircraft.
Health Values	
Starting Health	Health value of the tank at start
Current Health	Current health value of the tank

Effects	
Tank Gameobject	Model of the external tank.
Explosion Prefab	Explosion gameobject to be instantiated when tank health is destroyed.

- **Fuel Distributor**

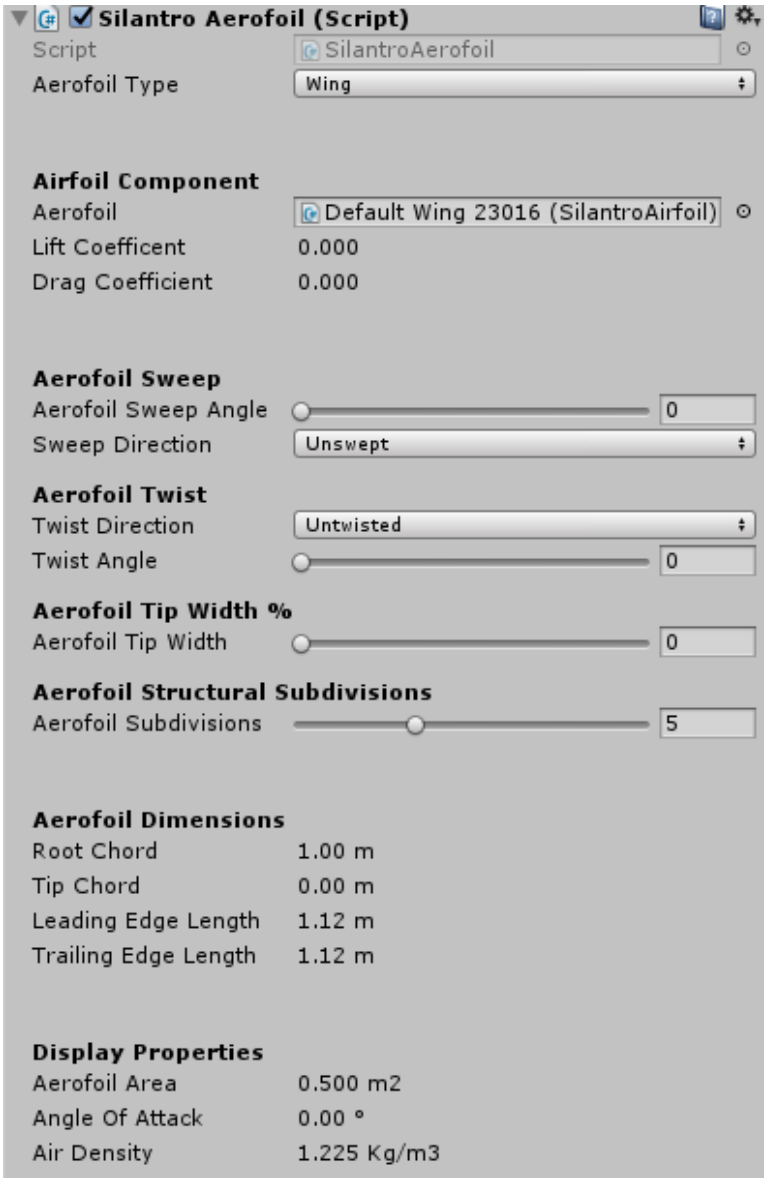
This component is used to control fuel distribution in the aircraft and allow it to use multiple tanks. It is designed in such a way that the fuel in the internal tank is used first before that in the external tanks. It can also be used to dump and refill the tanks.



Properties

Property:	**Function:**
Fuel Tanks	
Internal Fuel Tank	Internal tank located inside the aircraft body. *Note: it is used first even if external tanks are attached.*
External Tanks	List of external tanks attached to the aircraft.
Total Fuel Remaining	Total amount of fuel remaining in all the attached fuel tanks combined.
Tank Selection Display	
Current Tank	Current tank selected for use by the distributor
Tank Type	Indicates whether the selected tank is **internal** or **external.**
Current tank Fuel	Amount of fuel remaining in the selected tank
Time left	Amount of time left before the fuel in the selected tank is completely depleted.
Fuel Dump System	
Dump Fuel	Switch to activate and deactivate fuel dump
Fuel Dump Rate	Rate at which fuel is released from the tank in kg/s
Tank Refill System	
Refill Tank	Switch to activate and deactivate tank refill
Refuel Rate	Rate at which fuel enters the tank in kg/s. *Note Only the internal fuel tank can be refilled.*
Warning System	
Low Fuel	Indicates if the total fuel remaining is lower than the specified minimum amount.
Minimum Fuel Amount	Least amount of total fuel permissible for normal flight. Warning system is activated when the fuel amount goes beyond this amount.
Fuel Alert	Audioclip to be played by the warning system

2. **Aerofoil System:** Component which generates lift and control for the aircraft. Can either be controllable or stationary; Controllable surfaces can have controls attached to them while stationary surfaces can't.
   Controls can either be: Aileron, Elevator, Rudder, Flap and in the next update Slat.

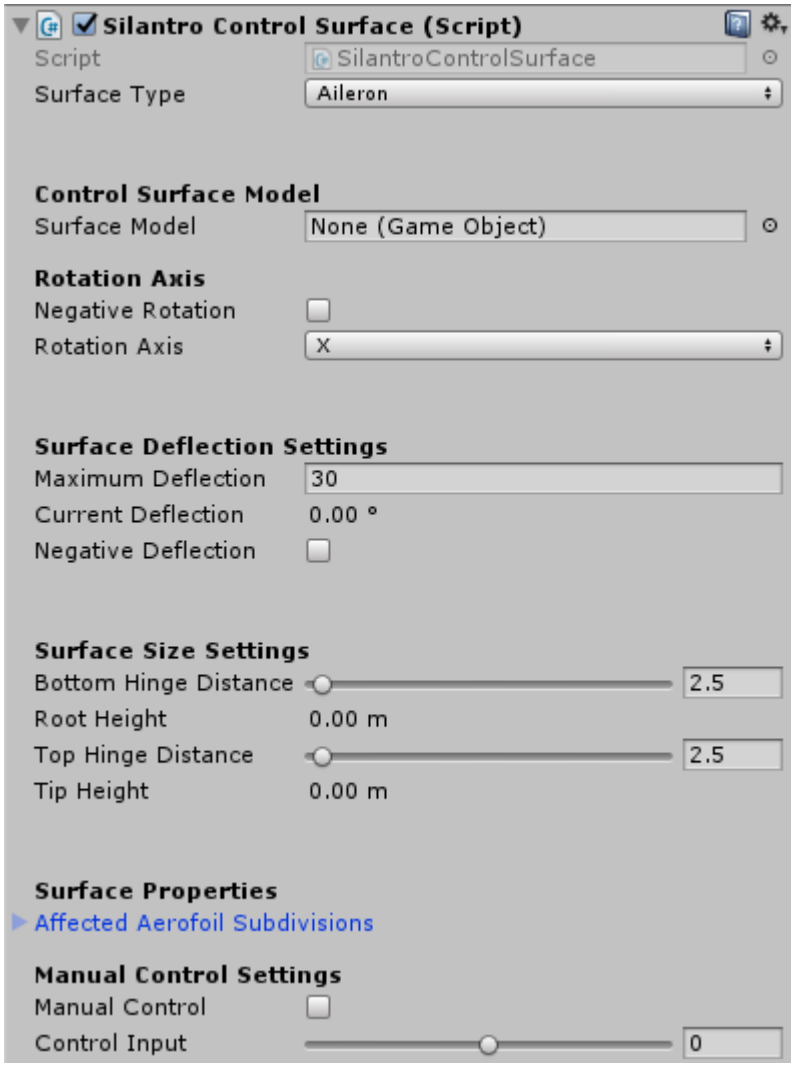


Properties

Property:	Function:
Aerofoil Properties	
Aerofoil Type	Type determinant of the aerofoil either Wing or Tail.
Airfoil Component	
Airfoil	Component containing lift and drag coefficient at different angles of attack.
Lift Coefficient	Coefficient of lift at current angle of attack

Drag Coefficient	Drag coefficient at current angle of attack.
Aerofoil Settings	
Sweep Direction	Determines if the aerofoil is swept or not. Options; Unswept, Backwards or Forward.
Sweep Angle	Angle to which the aerofoil is swept.
Twist Direction	Determines if the aerofoil is twisted or not. Aerofoil can be untwisted, twisted upwards or downwards.
Aerofoil Tip Width	Ratio of aerofoil tip to root expressed as a percentage. 100% means root width and tip width are equal which gives a completely rectangular aerofoil.
Aerofoil Subdivisions	No of sections which the aerofoil is divided and determines how smooth the lift generation system is. *Note: Higher values reduces performance, therefore values between 3-6 is advisable. High Performance systems can definitely go higher.*
Aerofoil Dimensions	
Root Chord	Length of aerofoil root.
Tip Chord	Length of aerofoil tip.
Leading edge length	Length of the aerofoil along the leading edge.
Trailing edge length	Length of the aerofoil along the trailing edge
Display Properties	

- **Control Surface:** If the created aerofoil is controllable a variety of control can be added to the aerofoil, such as Elevator, Aileron and Rudder.



Properties

Property:	**Function:**
Surface Properties	
Surface Type	Type determinant of the control surface either Elevator, Aileron or Rudder.
Surface Model Settings	
Surface model	Gameobject containing the control surface. *Note: Model pivot must be correctly setup in a 3D Application before importing into unity.*

Negative Rotation	Determines if the model rotates in the opposite direction. *It'll be changed to cw and ccw rotation in next update.*
Rotation Axis	Axis of rotation of the gameobject pivot either x, y or z-axis.
Surface Deflection Settings	
Maximum Deflection	Maximum angle to which the surface can be deflected.
Negative Deflection	Determines if the control surface deflects in the opposite direction.
Surface Size Settings	
Bottom hinge distance	Length of the bottom control surface relative to the aerofoil root chord expressed as a percentage.
Tip hinge distance	Length of the tip control surface relative to the aerofoil root chord expressed as a percentage.
Surface Properties	
Affected Subdivisions	Selected bools determine which sections of the aerofoil subdivisions is occupied by the control surface. *Note: It is depicted by red identifiers in the scene for easy placement and adjustment.*
Manual Control Settings	
Manual Control	When activated the slider below is used to control the aerofoil deflection.
Control Input	Slider to control the defection of the control manually. *Note: It is only for testing purposes, disable after use.*

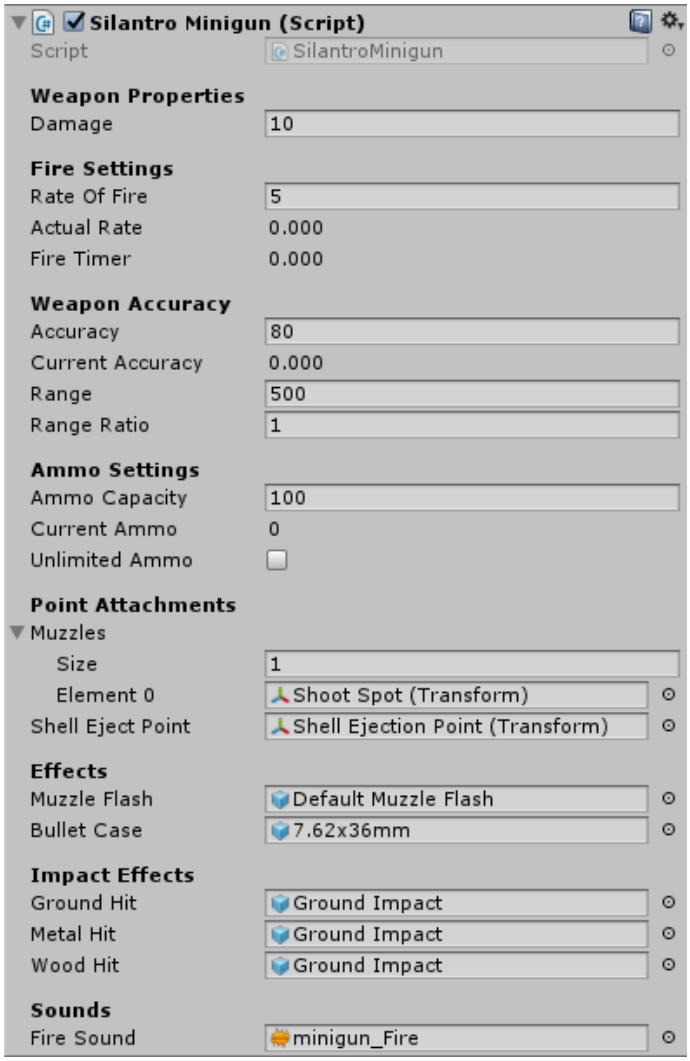
Note: Flap settings are exactly the same as any other control surface.

- **Left Structure:** To reduce complexity of setup, this component can be used to create left Aerofoils (default aerofoils created from the toolbar are right sided). The component allows two options Bound and Unbound. The bound option creates a left aerofoil and the position and rotation in ever update frame is based on the selected right aerofoil, whereby the unbound option allows for total freedom and creates a left aerofoil completely independent of the selected right aerofoil.

Note: A right aerofoil must be selected to create a left structure.

3. **Weapon System:** Currently in the early development stages and only a minigun is currently available, Missiles and bombs will be added in the next update.

- **Minigun:** Designed after the normal Gatling guns used in attack aircrafts and helicopters. Model support with rotating muzzles will be added soon.

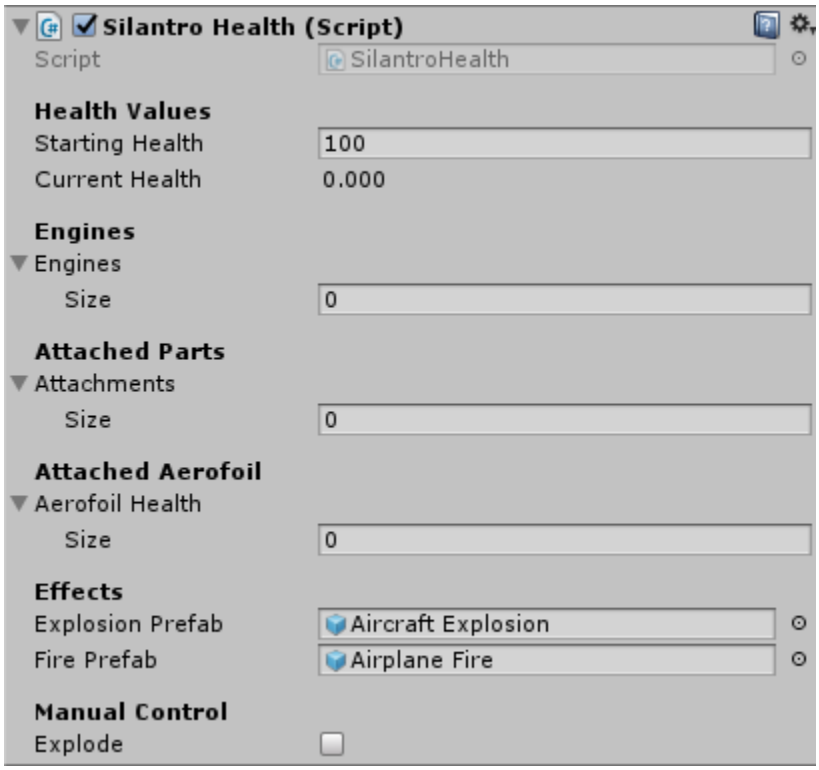


Properties

Property:	**Function:**
Weapon Properties	
Damage	Amount of health subtracted when a component is hit
Rate of Fire	Rate of fire of the minigun. *Note: 1 Unit = 15 Rounds per minute.*

Accuracy	How accurate the raycast shot is. 100 means the raycast lands on exactly the point selected
Range	How far the weapon can shoot to hit a component.
Range Ratio	Only used if your default distance scale is not in meters.
Ammo Capacity	Amount of bullets which the aircraft is loaded with on start.
Unlimited Ammo	If selected, available bullet is unlimited and is not depleted.
Point Attachment	
Muzzles	List of transforms from with bullets can be ejected from. *Note: The weapon cycles through each transform one after the other in a circular fashion.*
Shell Eject Point	Transform point from which bullet shell prefabs is ejected from.
Effects	
Muzzle Flash	Flash prefab when bullet is ejected.
Bullet Case	Prefab of bullet shell to be ejected.
Impact Effects	
Ground Hit	Prefab to be instantiated when bullets hits a gameobject with "Ground" tag.
Metal Hit	Prefab to be instantiated when bullets hits a gameobject with "Metal" tag.
Wood Hit	Prefab to be instantiated when bullets hits a gameobject with "Wood" tag.
Fire Sound	Audioclip to be played when weapon is fired

4. **Health and Destruction System:** A lot of components with not internal health system can have their own individual health attached and this can be destroyed. If the component or system has other models attached, they can be connected to the health system to separate when the component is destroyed.
   - **Health:** This is the main aircraft health component and should only be added to the main aircraft gameobject. When this component destroyed all engine children are also destroyed along with all aerofoil components attached.

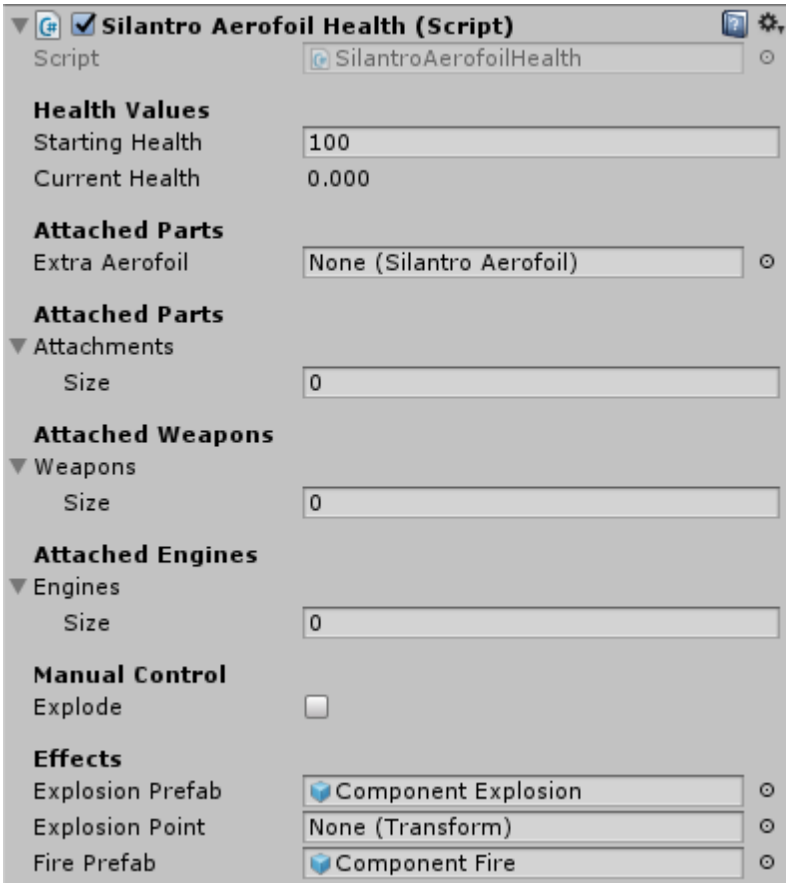


Properties

Property:	**Function:**
Health Properties	
Starting Health	Aircraft health at program start
Current Health	Current health value of the aircraft
Components	
Engines	Engine gameObjects attached to this aircraft. *Note: should only be used when dealing with engines not attached to the wings e.g. single engine prop aircrafts.*
Attachments	Models attached to the aircraft that can be separated, such as wheels, axles, fuselage etc. *Note: These models must already be separated from the aircraft body in a 3D application.*
Attached Aerofoil Health	Health component of each aerofoil attached to this aircraft that **can be destroyed/that should be destroyed with the aircraft.**
Effects	
Explosion	Main explosion prefab to be instantiated when the aircraft is destroyed.
Fire Prefab	Burning fire prefab to also be instantiated.

Manual Control	
Explode	Switch to manually destroy from the inspector.

- **Aerofoil Health:** Can be attached to any aerofoil (wing or tail) to make it destructible.

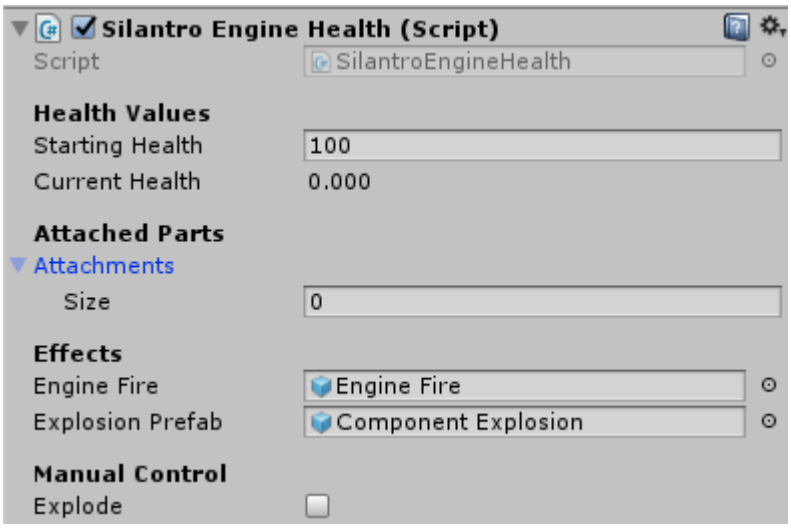


Properties

Property:	**Function:**
Health Properties	
Starting Health	Aerofoil health at program start
Current Health	Current health value of the aerofoil
Components	
Attached Engines	Engine gameObjects attached to this aerofoil e.g. engines attached to the wings or tail.
Attached Aerofoils	Extra aerofoils (used for complicated wing structures) which should be destroyed together with this aerofoil.

Attachments	Models attached to the aircraft that can be separated, such as aileron or flap models and the main wing model too *Note: These models must already be separated from the aircraft body in a 3D application.*
Attached Weapons	Weapon models attached to this aerofoil. *Note: will become much more functional in the next update*
Effects	
Explosion	Main explosion prefab to be instantiated when the aircraft is destroyed.
Explosion Point	Transform indicating where the aerofoil separates from the aircraft. The fire and explosion prefab are instantiated at this point.
Fire Prefab	Burning fire prefab to also be instantiated.
Manual Control	
Explode	Switch to manually destroy from the inspector.

- **Engine Health:** Health component designed to make the engines destructible.



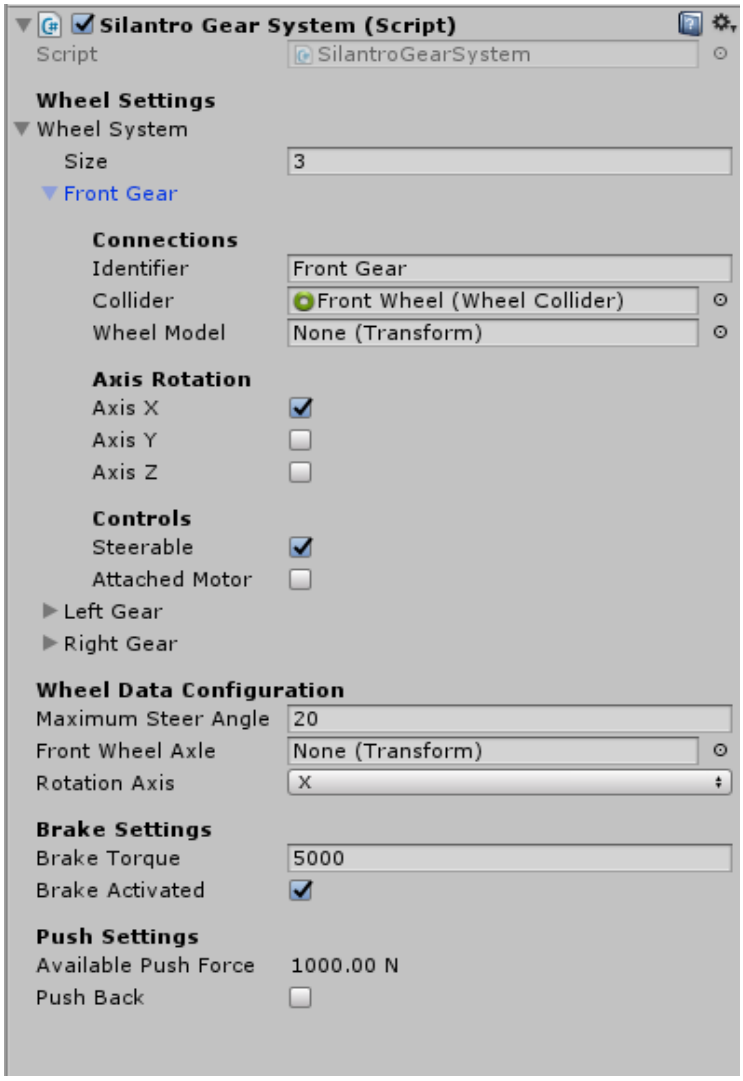
Properties

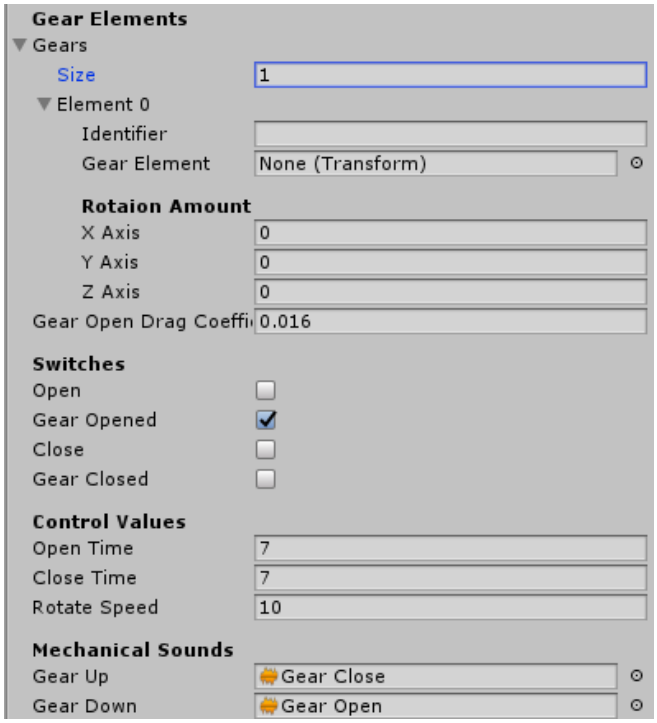
Property:	**Function:**
Health Properties	
Starting Health	Engine health at program start

Current Health	Current health value of the engine
Components	
Attached Parts	Models attached to the engine that can be separated, such as propeller or fan. *Note: These models must already be separated from the aircraft body in a 3D application.*
Effects	
Explosion	Main explosion prefab to be instantiated when the engine is destroyed.
Fire Prefab	Burning fire prefab to also be instantiated. Note this fire is automatically instantiated when the engine health is less than 50.
Manual Control	
Explode	Switch to manually destroy from the inspector.

5. **Hydraulic and Gear System:** This can be used to open and close **very simple gears** and any kind of door on the aircraft e.g. canopy, cabin door or with little programming the gear door.

    - **Gear System:** Controls the operation of the gear wheels and the opening and closing of the gear too. It makes sure that the wheel model is correctly positioned with the wheel collider and it rotates correctly. *Note: The gear system is provided with a tricycle gear system by default.*



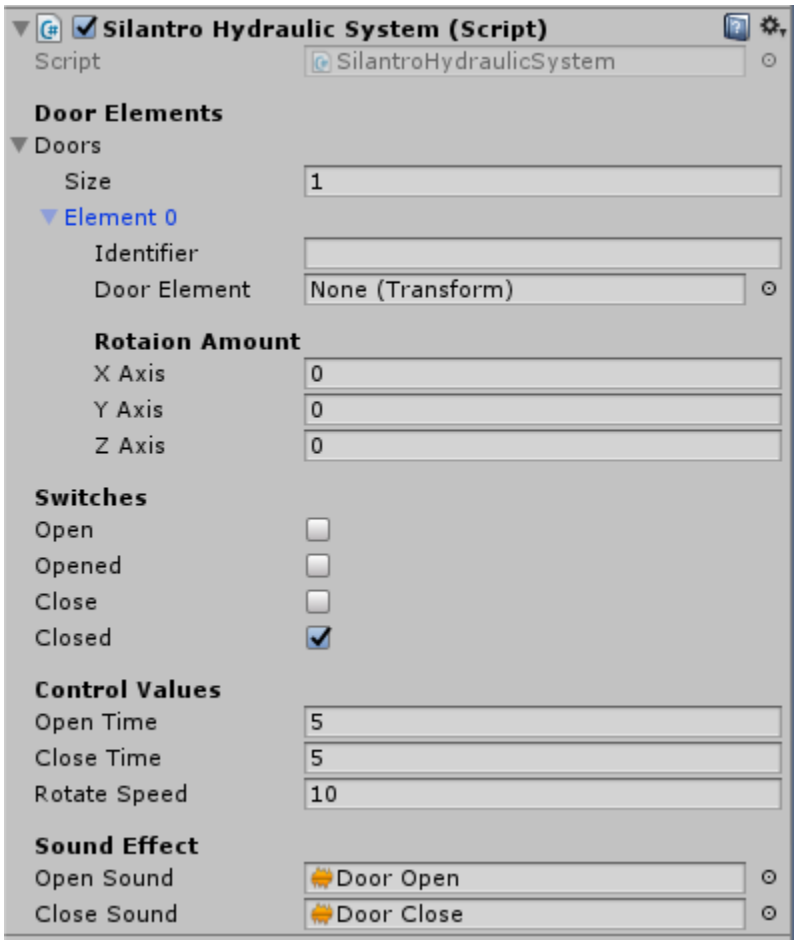


Properties

Property:	Function:
Wheel Settings	
Identifier	Name of this current wheel e.g. Front, Left-Back etc.

Collider	Wheel Collider of this wheel.
Wheel Model	Transform component of this wheel.
Axis Rotation	Rotation axis of the wheel.
Steerable	If activated, this wheel can be steered on the ground with the rudder pedals.
Attached Motor	Used to mark rear wheels with brake attached.
Wheel Data Config	
Maximum Steer angle	Maximum angle to which the front wheel can be steered.
Front Wheel Axle	Axle of the front wheel which turns when the wheel is rotated.
Rotation Axis	Axis of rotation of the front axle.
Brake Settings	
Brake Torque	Torque applied to the wheel when brake I activated.
Brake Activated	Brake control switch.
Push Settings	
Available push force	Amount of force applied to the rear wheels to make the aircraft start moving. *Note: It is set to the total available thrust by default.*
Push back	**Not available yet** (Switch to activate reverse thrust and push the airplane back).
Gear Elements	
Identifier	Name of the gear
Gear Element	Transform of the gear to be rotated into the aircraft.
Rotation Amount	Angle to be rotated so as to close the gear and move into the aircraft.
Gear Open Drag Coefficient	Drag coefficient when the gear is open and out of the aircraft.
Control Values	
Open time	Time it takes for the gear to open and rotate downwards.
Close time	Time it takes for the gear to close and rotate upwards.
Rotate Speed	Speed of rotation of the gear.
Mechanical Sounds	
Gear Up	Audioclip to play when the gear closes.
Gear Down	Audioclip to play when the gear opens.

- **Hydraulic System:** This component can be used to open and close any door or element on the aircraft such as canopies, vents, speed brakes etc.

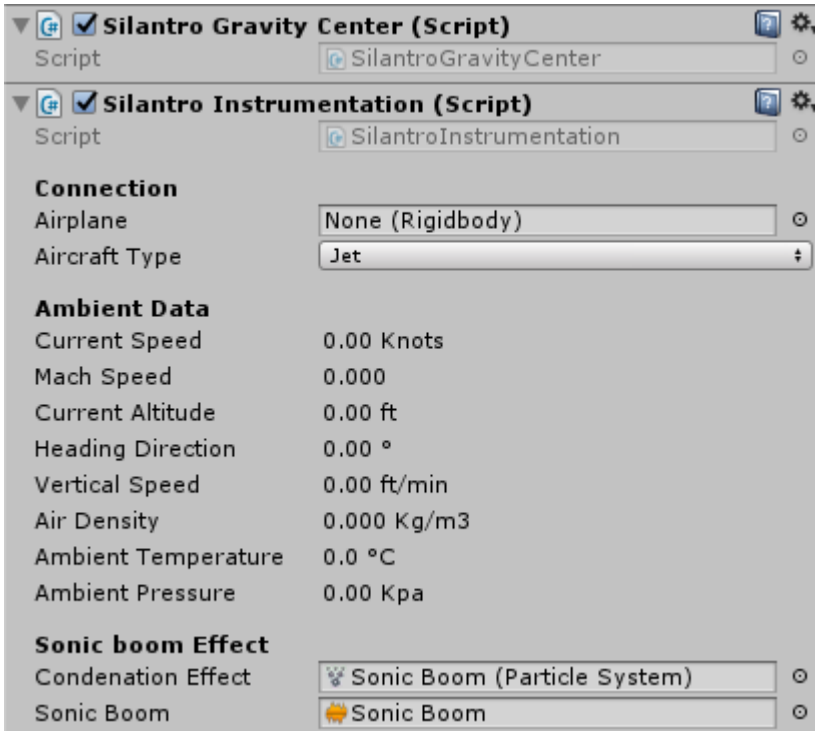


Properties

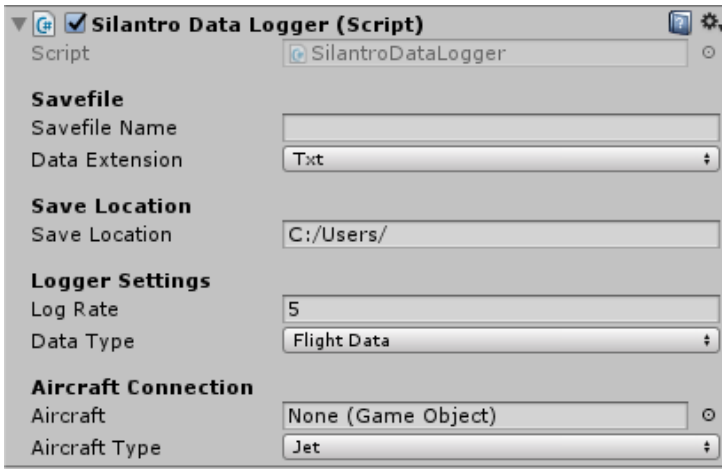
Property:	**Function:**
Door Elements	
Identifier	Name of the element e.g. Top Vent
Door Element	Transform of the element to be opened and closed
Rotation Amount	Angle to be rotated so as to close the door or element.
Control Values	
Open time	Time it takes for the element to open.
Close time	Time it takes for the door to close.
Rotate Speed	Speed of rotation of the element.
Sounds Effect	
Open Sound	Audioclip to play when the door or element opens

Close Sound	Audioclip to play when the door is closed.

6. **Utilities:**
   - **COG:** determines the centre of gravity of the aircraft. Note another component.
   - **Instrumentation:** Displays, records and calculates different values for the aircraft such as air density, altitude, air pressure etc.



   - **Black Box:** Used to record and save different flight parameters into either a .txt or .csv file which can be reviewed later.

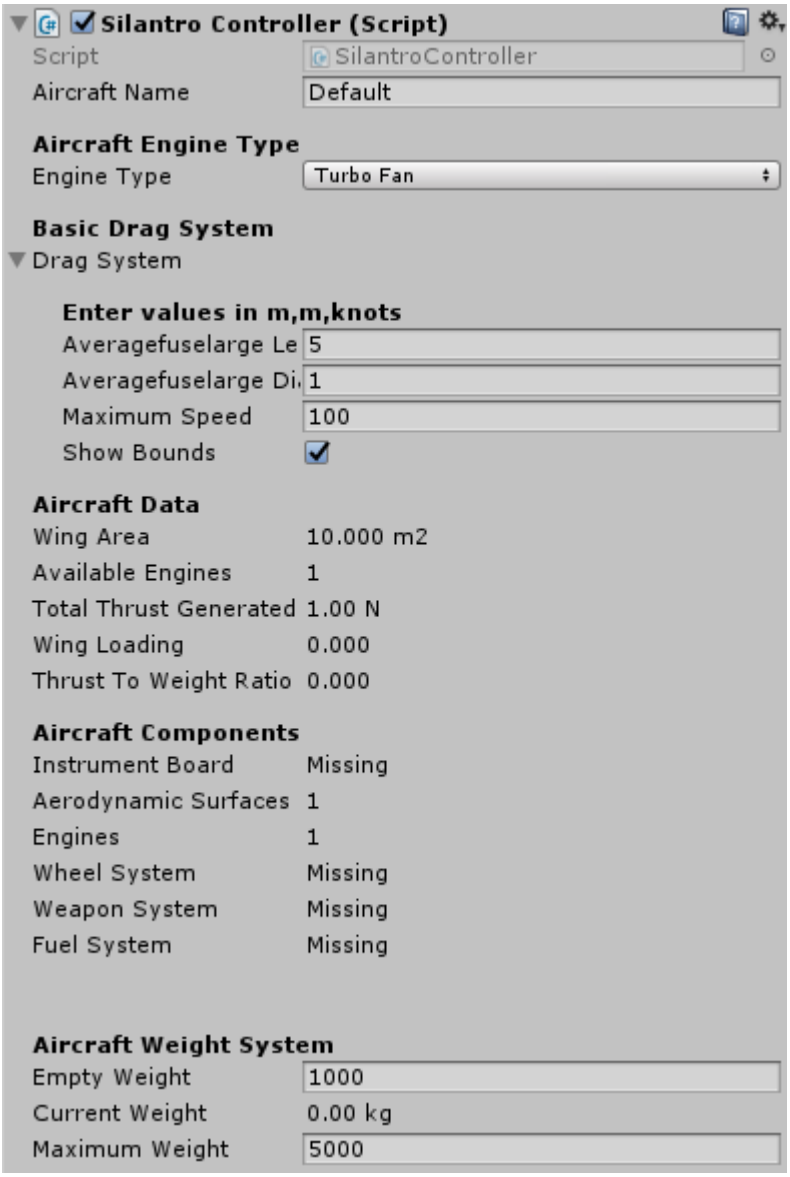


Properties

Property:	**Function:**
Properties	
Savefile name	Name of the file
Data Extension	Extension to save the file in either .txt or .csv
Save Location	Location to save the flight data at on the PC.
Log Rate	Time interval between each save or log.
Data Type	Currently only flight Data can be saved, but engine and other data would be available in future updates.
Aircraft	Gameobject of the aircraft to document.
Aircraft Type	Jet airplane or Propeller plane.

7. Components:

- **Controller:** Main aircraft controller. Practically brings all the aircraft components together.

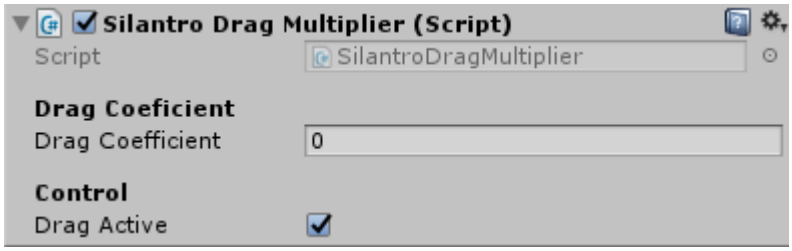


Properties

Property:	Function:
Aircraft Properties	
Aircraft Name	Identifier or name of this aircraft.

Engine Type	Type of Engine used by the aircraft: Turbojet, Turboprop or Turbofan.
Drag System	
Average Fuselage length	Length of the aircraft fuselage if assumed to be a perfect cylinder in meters.
Average Fuselage Diameter	Diameter of the largest part of the fuselage in meters.
Maximum Speed	Maximum speed of the aircraft in knots.
Weight System	
Empty Weight	Weight of the aircraft without fuel. *Note: It includes the weight of the engines and other components except weapons and fuel tanks.*
Maximum Weight	Maximum take-off weight of the aircraft.

- **Drag Multiplier:** Component to mark parts which generates extra drag for the aircraft. *Note: Still in its simplest form*



Properties

Property:	**Function:**
Properties	
Drag Coefficient	Extra drag coefficient to add due to this component. *Note: Values should be in the range 0.01-0.03 to avoid excessive drag.*
Drag Active	Select if drag is to be considered.

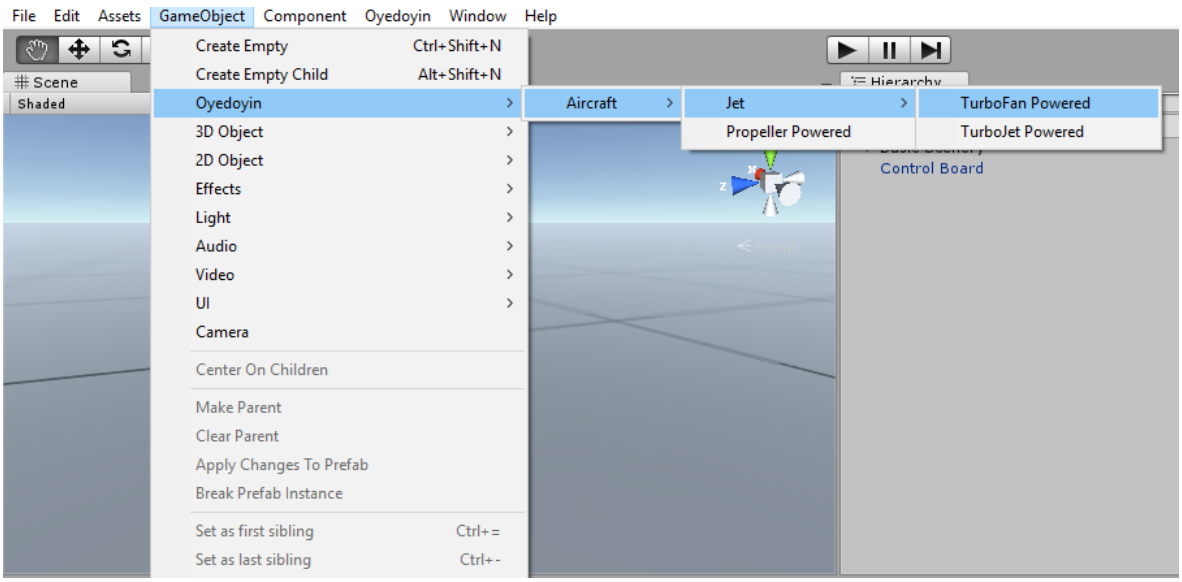
Note: Because of the current simplicity of the drag system, the drag from the multiplier is only considered for stationary components and parts. I hope to develop a more sophisticated and realistic drag system before the next update.

SETUP

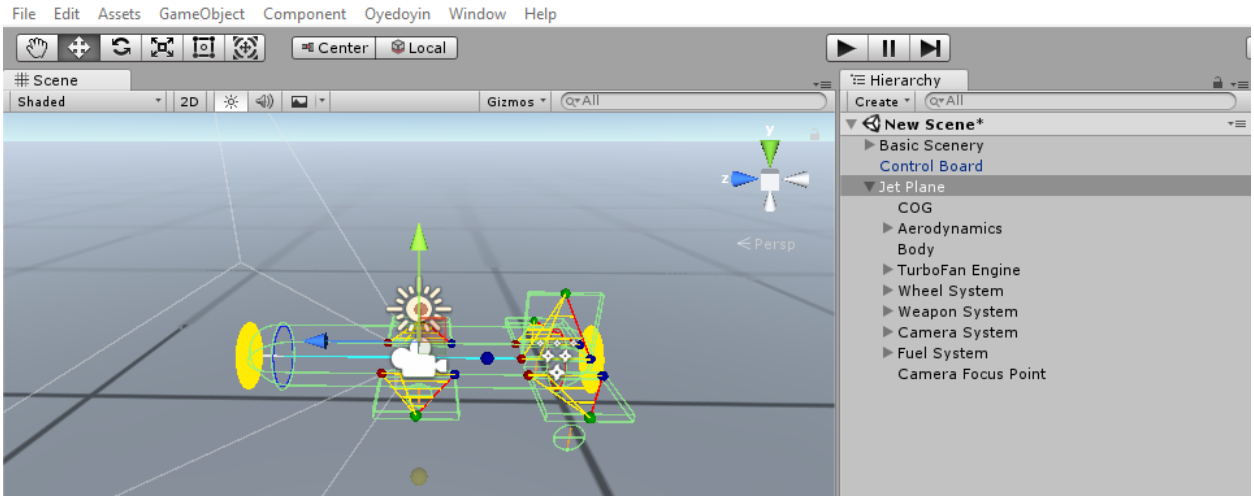
- **Basic Aircraft Setup**: This system is designed in such a way that a new almost fully working aircraft can be created from the gameobject menu. The newly created aircraft requires just a few adjustment to complete the setup and make it fly.

  STEPS:

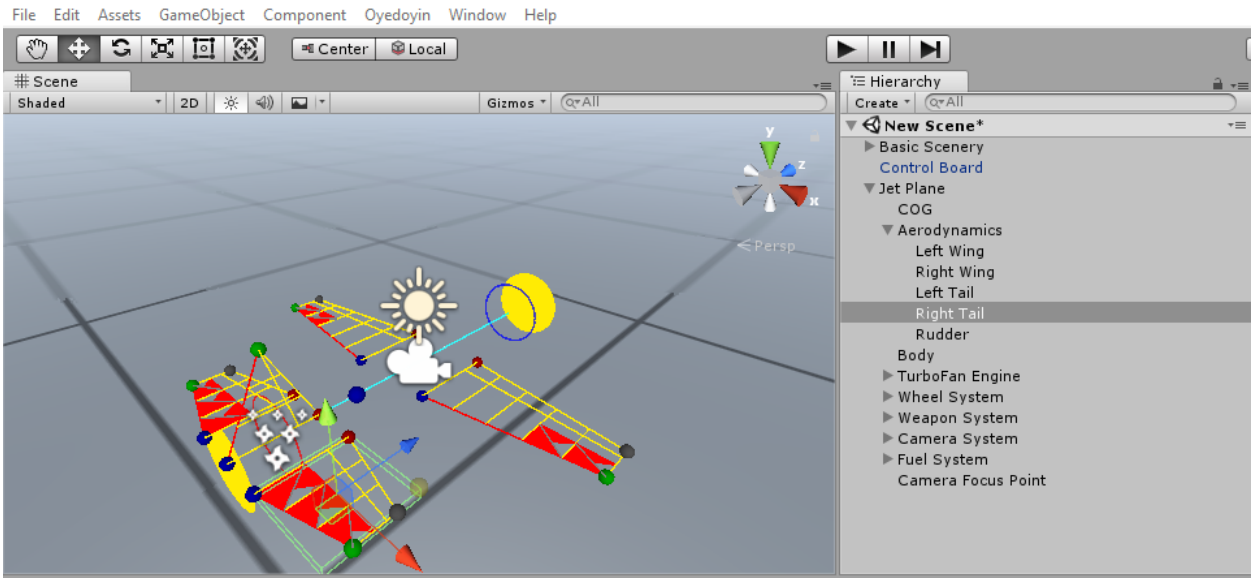
Create new aircraft from Gameobject menu



The new aircraft will have the selected engine type, the required component for normal functioning and the basic aircraft setup control.



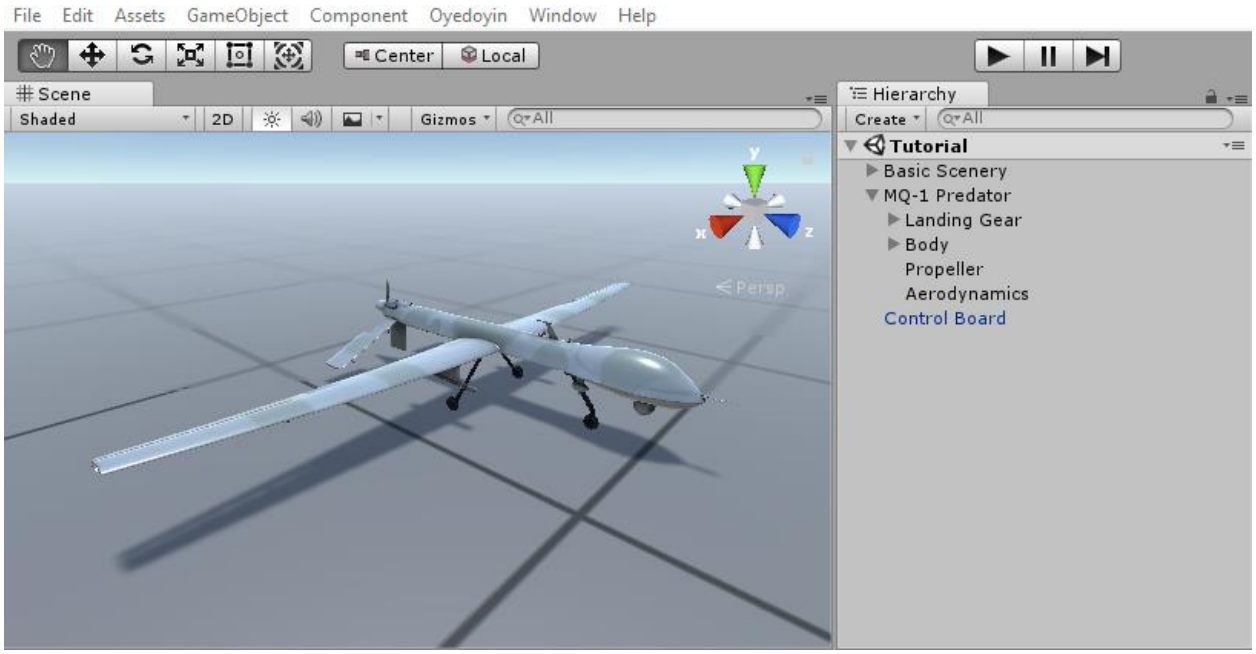
At this point all that is left is to adjust the wing shape, size, control. Also models can be added to the setup but this is not required to make it fly. Also the engine properties can be tweaked to make t more powerful and produce more thrust.



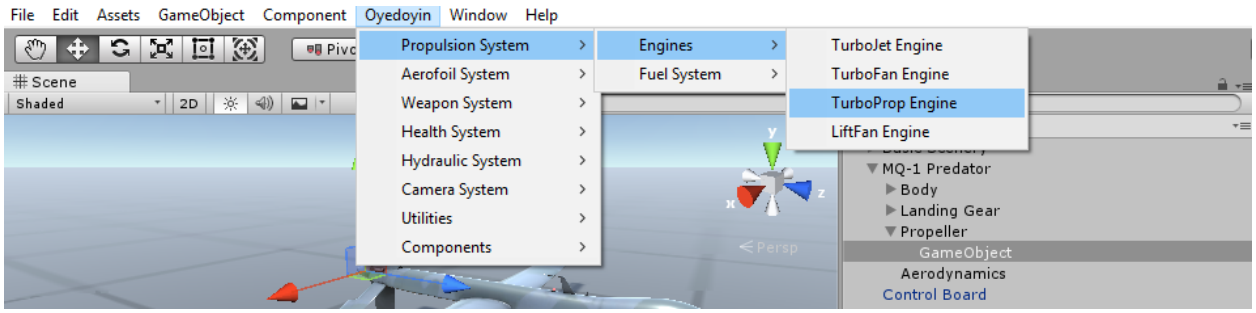
Here is the sample aircraft after the wings and controls have been adjusted. Even in its very basic state, the aircraft is ready to fly.

- **Advanced Aircraft Setup:** This part will show how to setup the aircraft component by component from the dedicated toolbar. Please read the component section to understand what each component does before continuing with this part.
  STEPS:

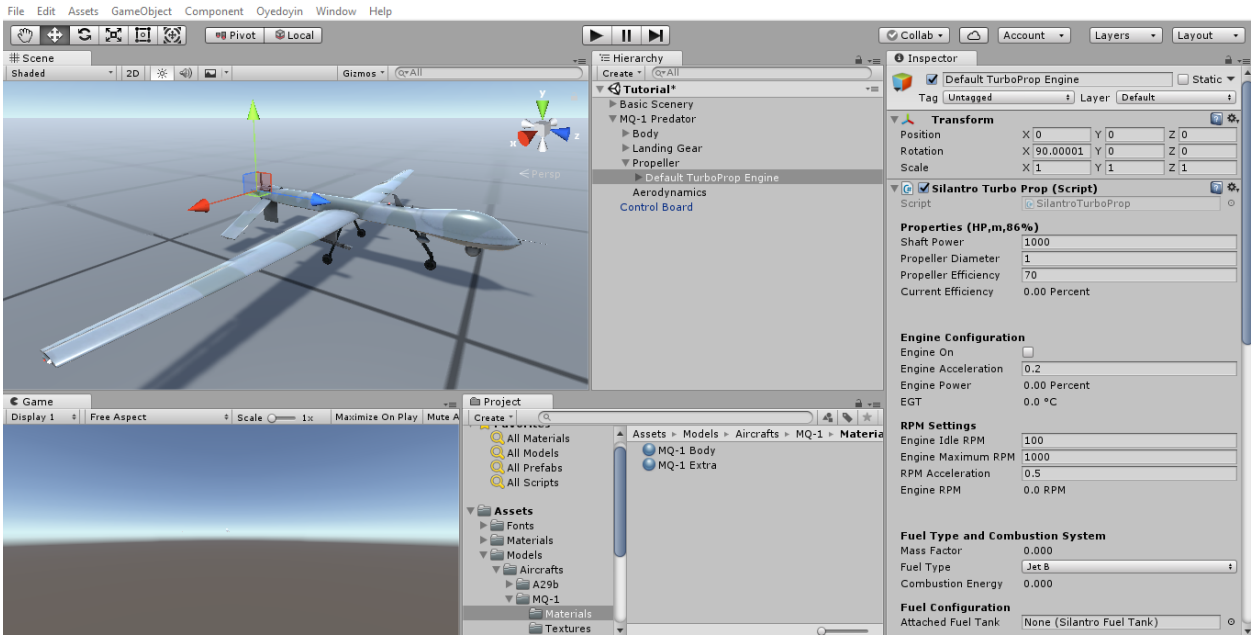
i. *Open Tutorial Scene:* Open the tutorial scene located in Assets/Scenes/Tutorial which contains a MQ-1 Predator aircraft model and the necessary scene objects.



ii. *Create Turboprop Engine*: To do this, you have to create a new gameobject, parent it to the aircraft and position it where the engine is supposed to be located in the airplane. After this is done, add the Turboprop engine component to the new gameobject from the dedicated toolbar.



A new fully functional Turboprop engine is then created on the gameobject. This engine can now be further improved and customized. *Note: The system is designed around real world values, therefore information required for the engines and aircraft can be gotten from external sources, such as Google or Wikipedia.*



The main values required by the engine;

- Engine Name
- Engine Shaft Power
- Propeller Diameter
- Maximum Propeller efficiency
- Rough RPM values (*Not as essential for this engine, Unlike for Turbofan and turbojet engine*)

The MQ-1 Predator properties as outlined by Wikipedia;

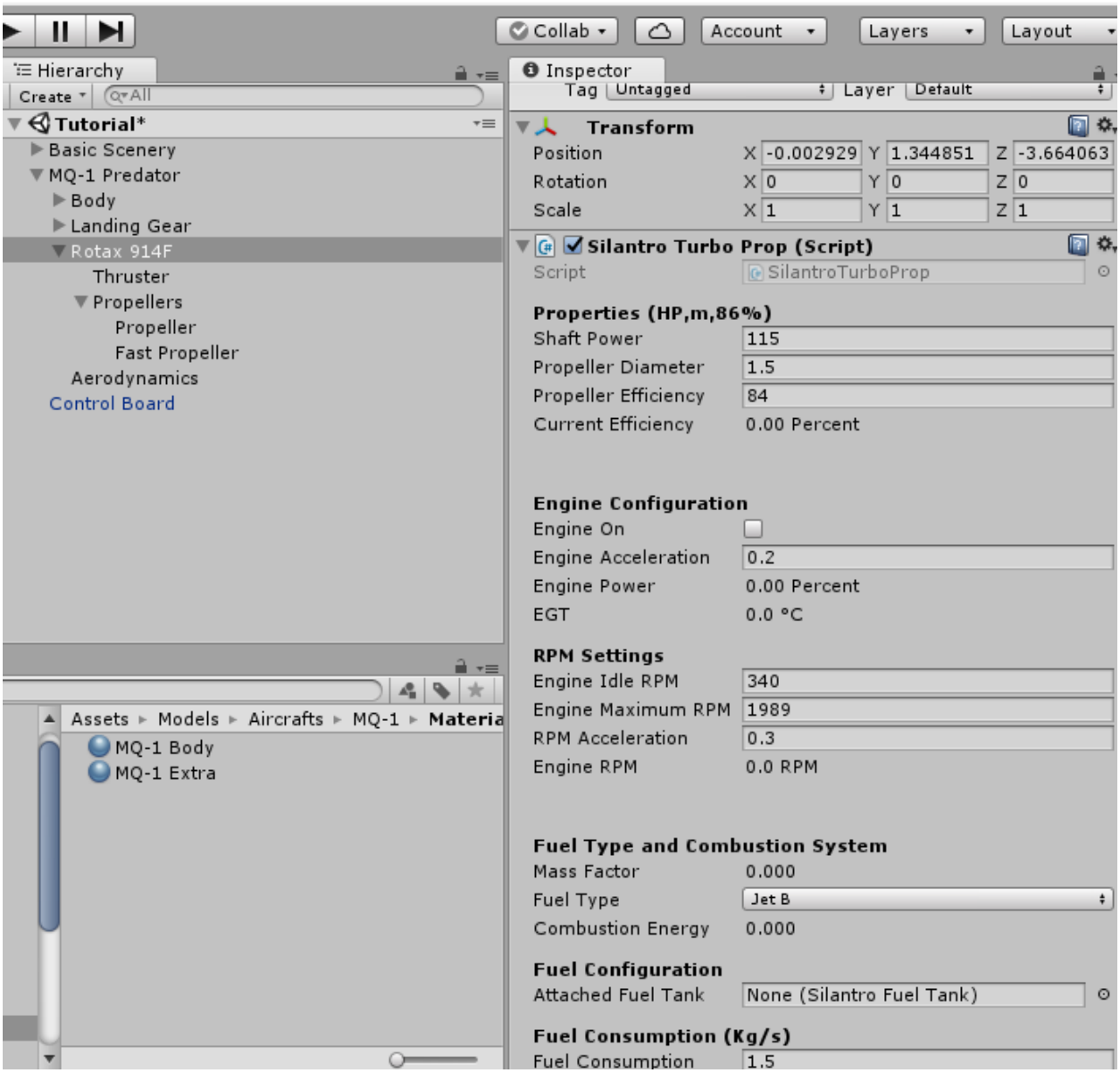
General characteristics

- **Crew:** none on-board, three on ground (pilot, sensor operator, intelligence analyst)
- **Length:** 27 ft (8.22 m)
- **Wingspan:** 48.7 ft (14.8 m); *MQ-1B Block 10/15:* 55.25 ft (16.84 m))
- **Height:** 6.9 ft (2.1 m)
- **Wing area:** 123.3 sq ft[120] (11.5 m^2)
- **Aspect ratio:** 19.0
- **Empty weight:** 1,130 lb[119] (512 kg)
- **Loaded weight:** 2,250 lb (1,020 kg)
- **Max. takeoff weight:** 2,250 lb[119] (1,020 kg)
- **Powerplant:** 1 × Rotax 914F turbocharged four-cylinder engine, 115 hp[119] (86 kW) (4.8 kW redundant/6.4hp)

Performance

- **Maximum speed:** 135 mph (117 knots, 217 km/h)
- **Cruise speed:** 81–103 mph (70–90 knots, 130–165 km/h)
- **Stall speed:** 62 mph (54 knots, 100 km/h) dependent on aircraft weight
- **Range:** 675 nmi (675 mi or 1,100 km) [121]
- **Endurance:** 24 hours[2]
- **Service ceiling:** 25,000 ft[119] (7,620 m)

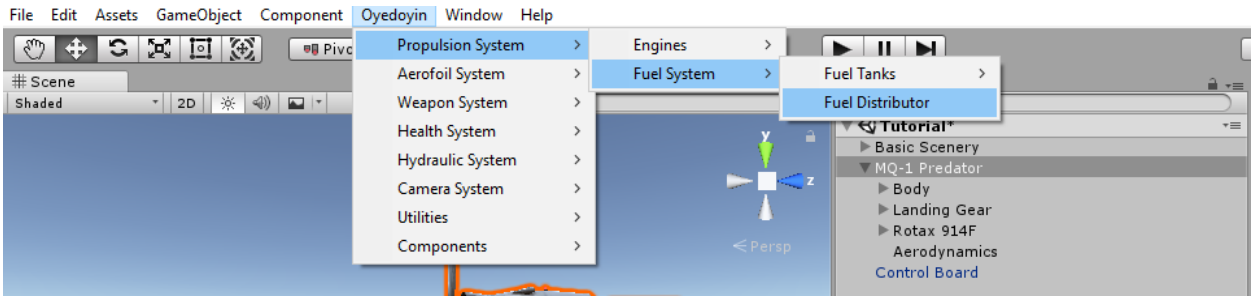
The newly obtained values are then entered into their respective slots on the engine



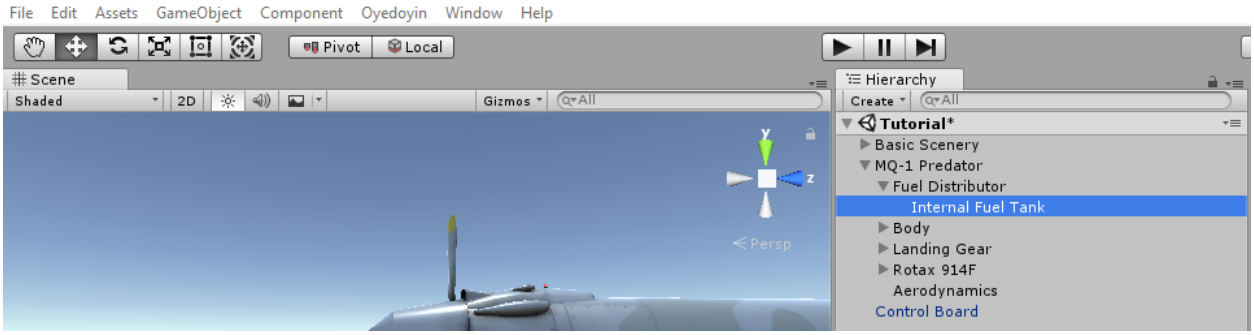
Note: Essential for the engine is the Normal propeller model and a Fast propeller model (Which will be used to replace the normal model at high RPM to imulate propeller blur).

iii. *Setup Fuel System:* For the engine to function propeller it needs a fuel source. Just for testing purposes, a Fuel tank can be assigned to the engine dirrectly but this highly unrecommended.

Firstly, create a fuel Distributor componet from the dedicated toolbar. As described in the components ection this manages and organize fuel tank usage, fuel and dump and tank reffill.

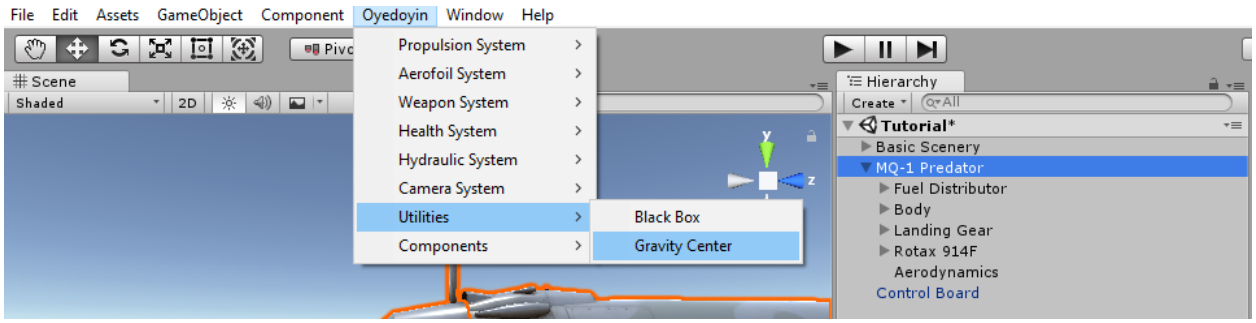


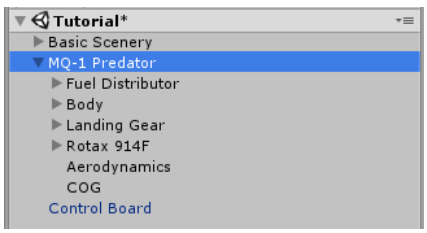
New fuel tanks internal or external can now be created and parented to the distributor. But the Predator only has the Internal fuel tank,Therefore we're going to create a single tank (internal) from the toolbar.



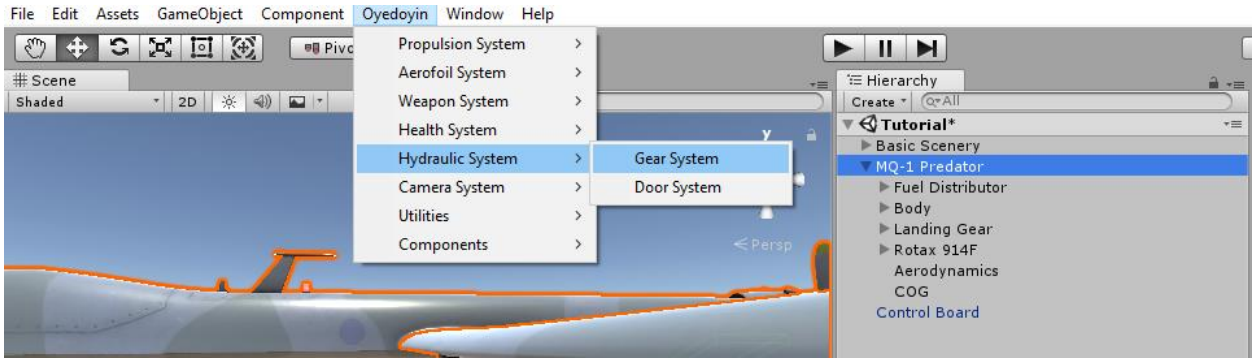
The predator internal tank capacity is 204kg. Therefore change the capacity value in the internal tank componet to 204.

iv. *Setup Gravity Center Component:* This component serves two important functions. A) Indicate the Center of Gravity of the Aircraft i.e. The Aircraft center of gravity is located in this transforms position. B) Serve as the instrumentation board which records and calculate differnet flight parameters for each aircraft componet and in the future will carry the autopilot component.
To setup the aircraft gameobject is selected, then navigate to Oyedoyin/Utilities/Gravity Center. A COG gameobject is created and parented to the aircraft. Move this transform to where the aircraft center of gravity is suppoed to be located.

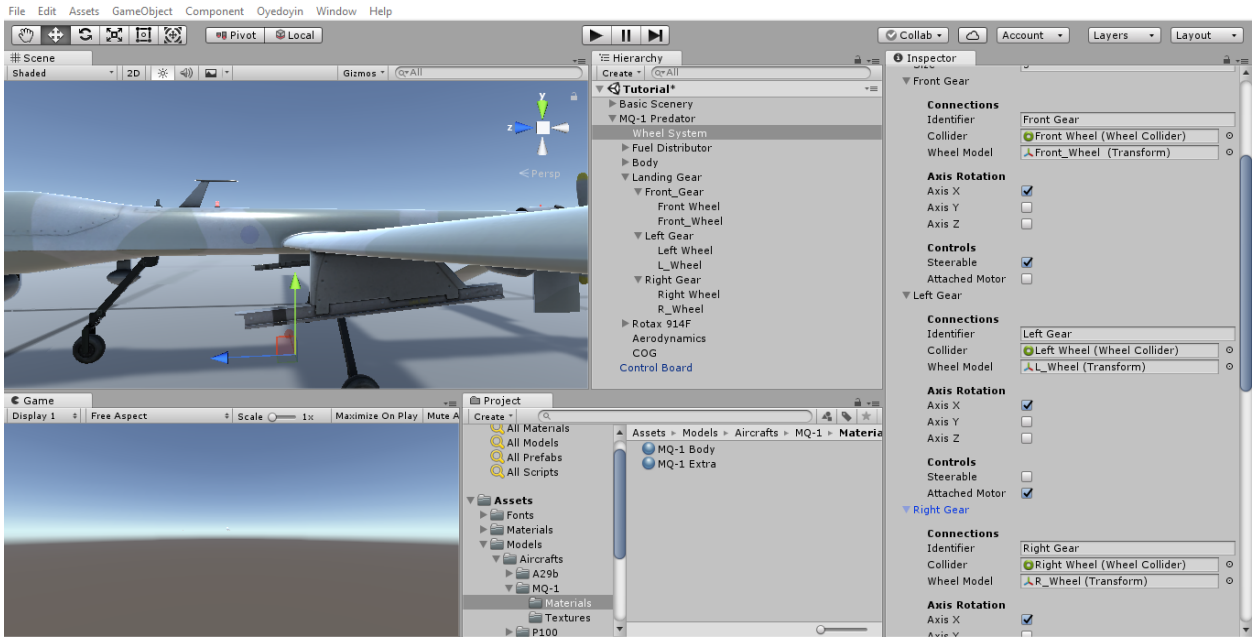




v. *Setup Gear System:* This component takes care of the normal opration of the gear wheels i.e correct rotation and position relative to the wheel collider. This component can be added from the hydraulics section of the system toolbar.

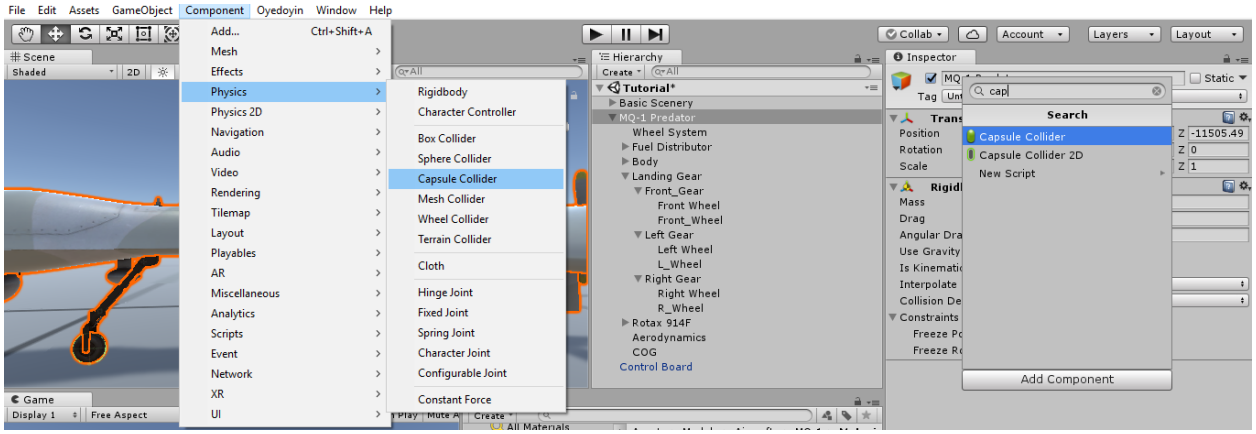


The Component is setup to provide a Tricycle gear system(3 colliders) by default. All there is to do is just to reposition the newly created wheels and adjust the radius and suspension distance of the colliders.

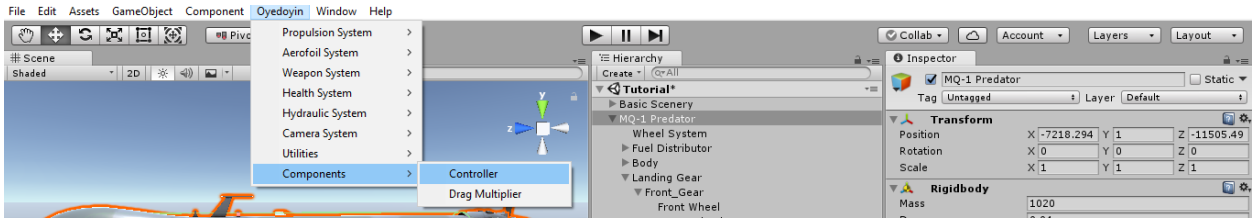


vi. *Setup Controller:* Even though each component of the sytem is completely independent of each other, the **Controller component** brings everthing together.

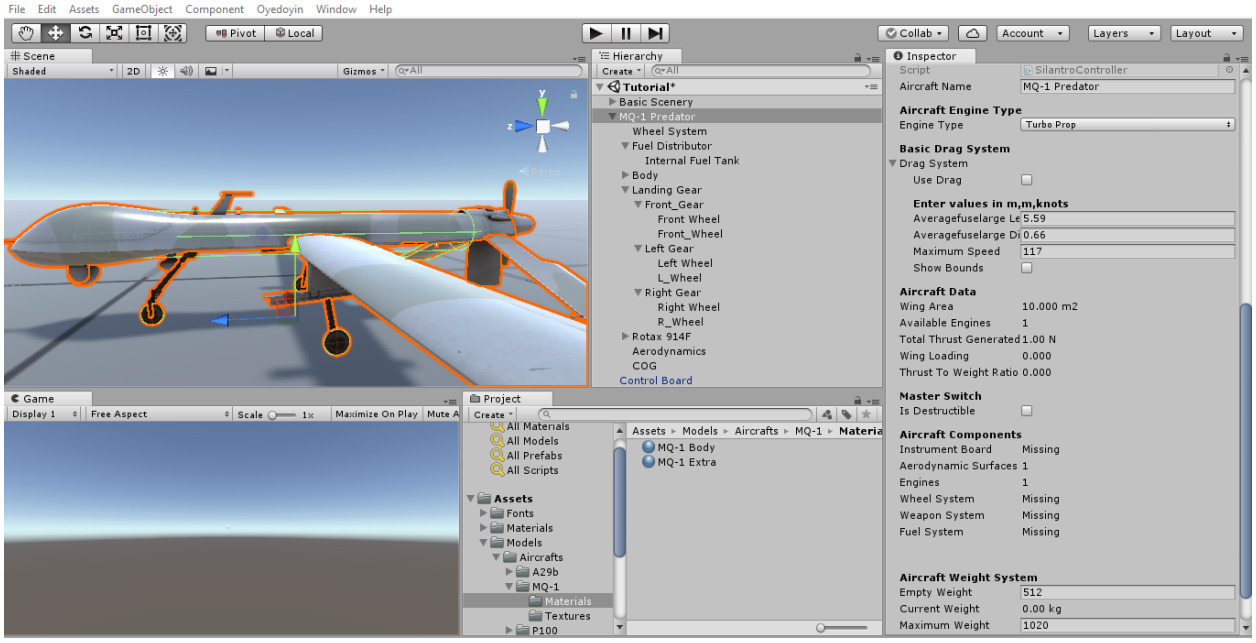
To start, add a capsule controller to the main aircraft gameobject.



Then add the controller component from the toolbar to aircraft body



After…..



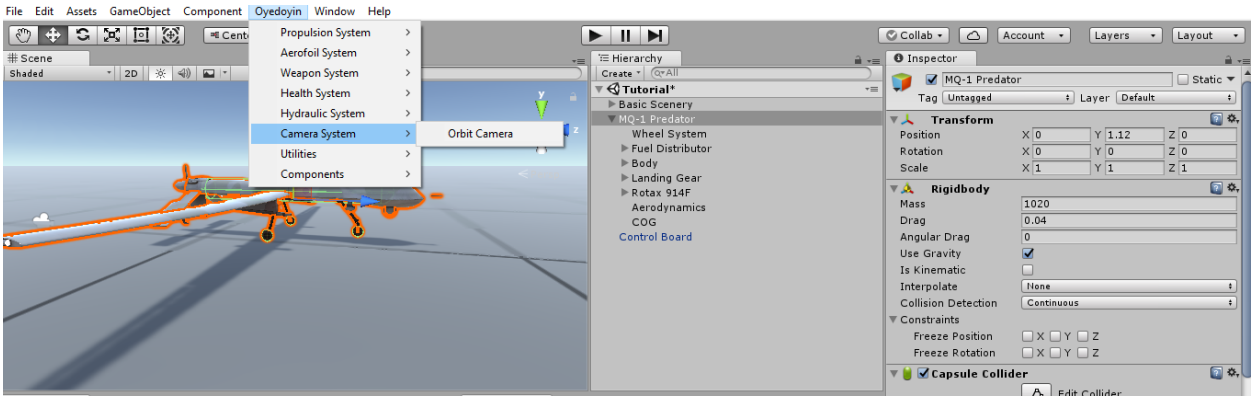
Set the correct engine type, since the Predator uses a Turboprop engine set to Turboprop.

To make the simulation more realistic, I tried to develop my own drag system instead of using the default unity engine drag system. The system uses the maximum speed and average fuselage aera as a reference point for drag calculation. It can be disabled using the bool in the drag system.

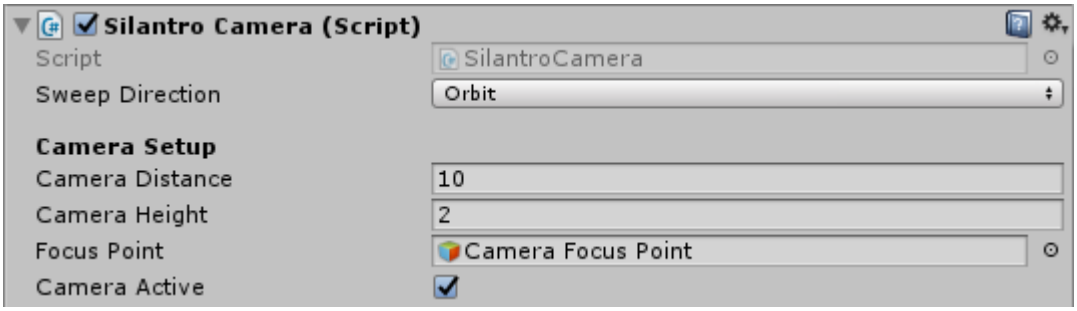
Set the correct weight amounts, empty weight and maximum takeoff weight.

vii. *Setup Camera System:* Currently only the orbit camera is available in this current version, I'm going to develop better cameras for the next update especially high speed cameras for upersonic airplanes.

To add the camera, select the aircraft and select orbit camera from the system toolbar



Camera Settings



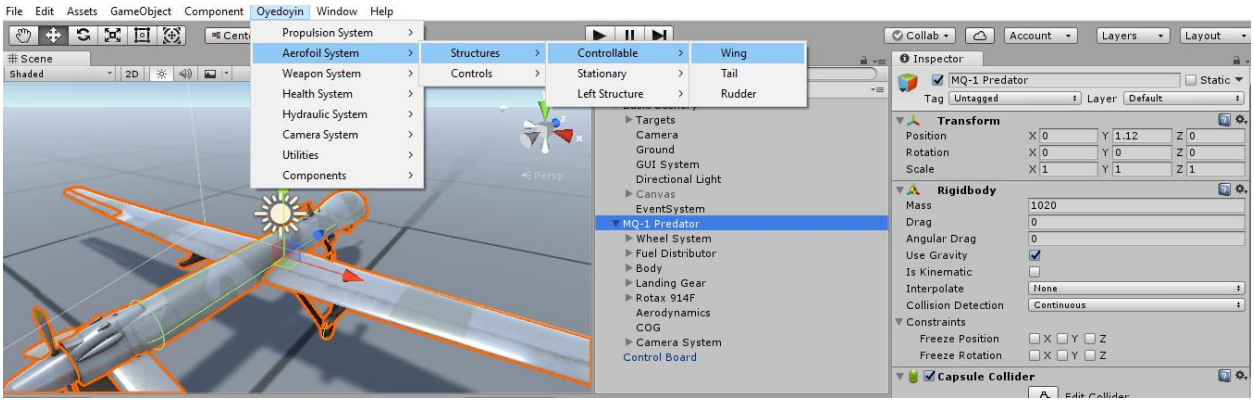
Camera Distance: how far the camera is from the aircraft.

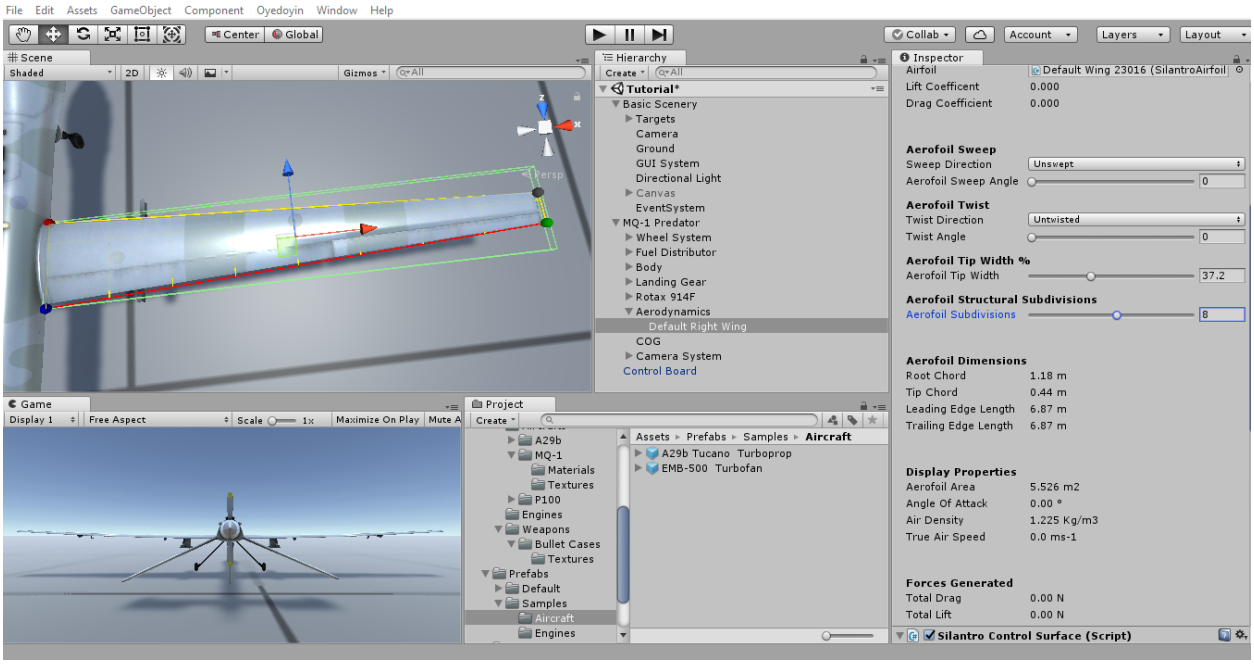
Camera Height: how height the camera is above the aircraft.

viii. *Setup Aerofoil surfaces:* This is probably the most important part of the setup. Here you can setup the wings,tails and rudder.

The predator has 5 aerofoil surfaces: 2 wings, 2 tails and 1 rudder.

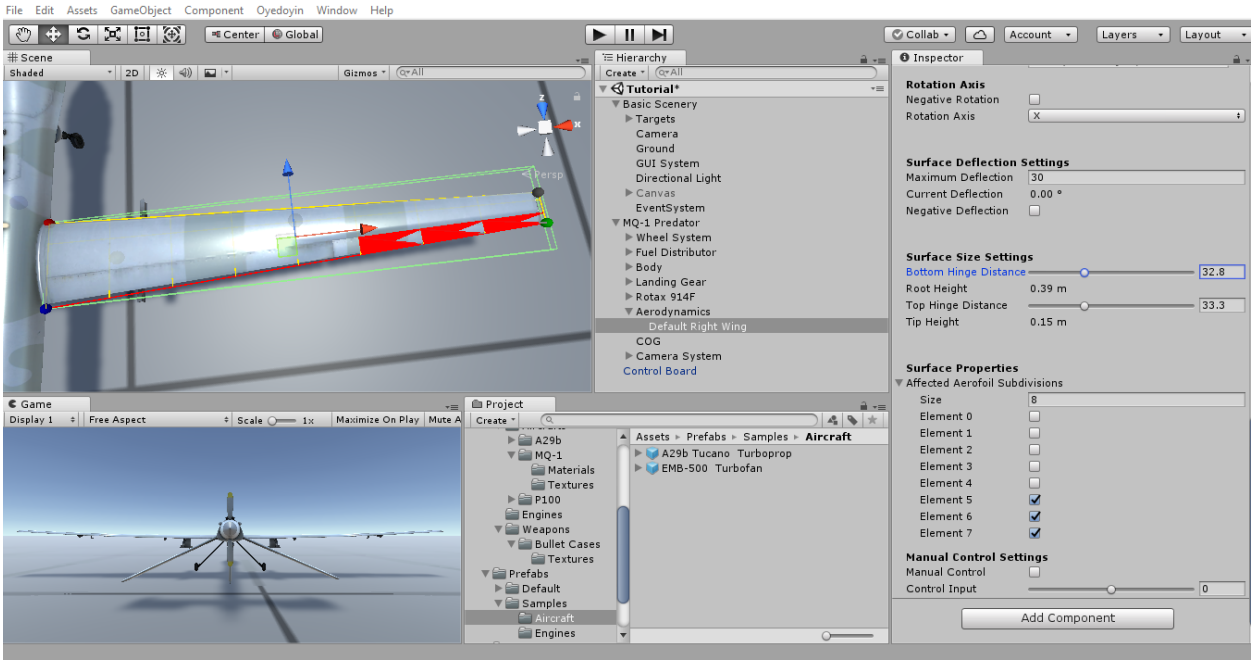
To setup the wings, Create a wing from controllable section of the system toolbar. A controllable wing is created with an aileron control already attached.





The wing needs some adjustment. First scale the aerofoil to match the length of the wing, increase the aerofoil tip width and increase the aerofoil subdivisions.

After this, the control needs adjustment too.



Firstly, assign the control surface model and set the correct rotation axis. Next, select the bools repreenting the sections affected by the control surface; as depicted in the image the control surface affects the first 3 sections.

After this adjust the control surface hinge distances to match the control surface model. Note the red marker are provided for guidance.

//

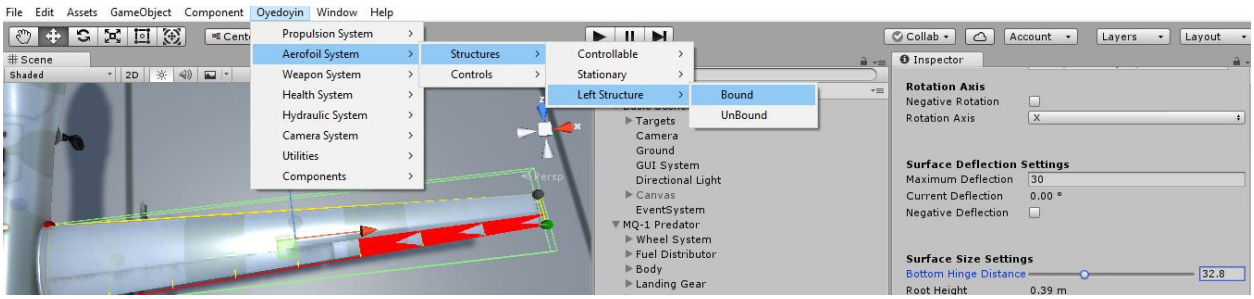
//

//

<u>Setup the Left Wing</u>

The left wing can be created in two separate ways;

- From the component toolbar: to create the left wing from here you have to first select the correponding right wing, navigate to the **Left Structure** component on the toolbar. The left structure can be of two types: Bound and Unbound.



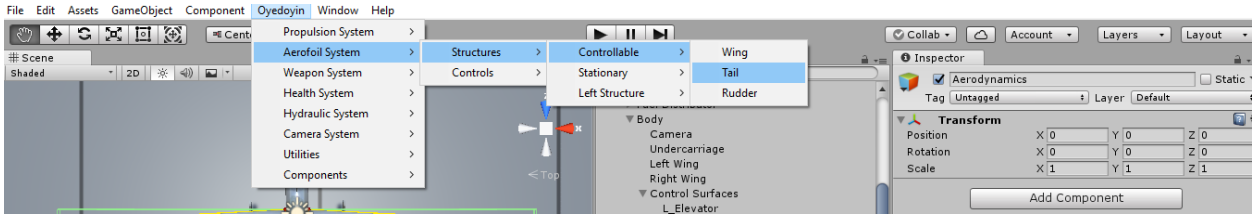
The **Bound** Left structure creates a left wing and the position is updated based on the position of the right wing on the opposite side.

While the **Unbound** left structure create a left wing which is compltely independent of the right wing. This is only advisable for asymetric wing setups or for really advanced users.

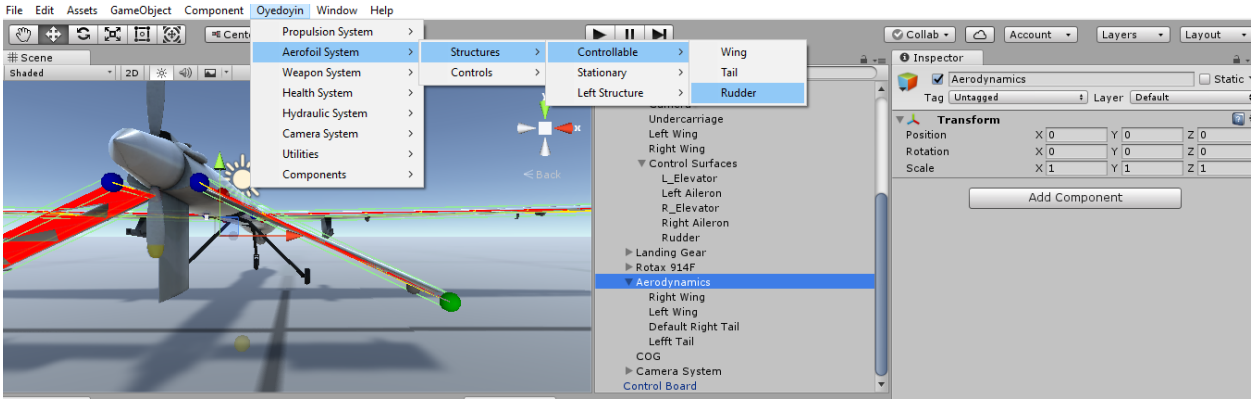
- Manually: to create the left wing manually, duplicate the already setup right wing, then assign the ***Silantro Mirror Transform*** component to the duplicate wing.

Note: The left tail aerofoil should have the negative deflection bool selected. Adjust the rotation direction as deired. The left wing should have the model negative rotation bool selected.

- *Setup the Tails:* Create the tails just like the wings, and adjust the settings accordingly.



- *Setup the Rudder:* Create the rudder just like the wings, and adjust the settings accordingly.



SCRIPTING HINTS

Note: This part will be constantly updated to inculde new changes.

- The wheel push/brake release system is not as responsive as it should be. The braking code is in FixedUpdate(), to make it more responsive.. move the code to Update(). But the aircraft veers off a little so you will have to steer with the rudder pedals a lot

```
151    void Update()
152    {
153        //SEND BRAKING DATA
154        foreach (WheelSystem system in wheelSystem) {
155            BrakingSystem (system);
156        }
```

- To destroy the aircraft, engine or aerofoil simply call the Disintigrate() void in the health system or simply activate the Explode bool in the health component

```
70     //
71     //DESTRUCTION SYSTEM
72     public void Disintegrate()
73     {
74         if (isDistructible) {
75             if (transform.root.GetComponent<Rigidbody> ()) {
76                 dropVelocity = transform.root.GetComponent<Rigidbody> ().velocity;
77             }
78             destroyed = true;
```

- To open or close the hydraulic door system, activate the **open** or **close** bool in the hydraulic system

```
27     [Header("Switches")]
28     public bool open;
29     [HideInInspector]public bool opened = false;
30     bool activated;
31
32     public bool close ;
33     [HideInInspector]public bool closed= true;
34     //
```