


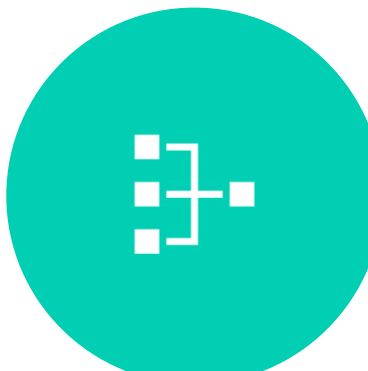
## Objective

Create a set of low-cost F-35 flight controls that integrate with Lockheed Martin's Prepar3D flight simulator software


## Key Goals




Create finished, working prototype



Integrate with the simulation software



Keep costs low



Design for desktop or cockpit use

## Purpose

It costs the military ~\$42K per flight hour in fuel and maintenance to train with the F-35. Developing a frugal alternative will allow more training with less risk to pilots.



Desktop Setup

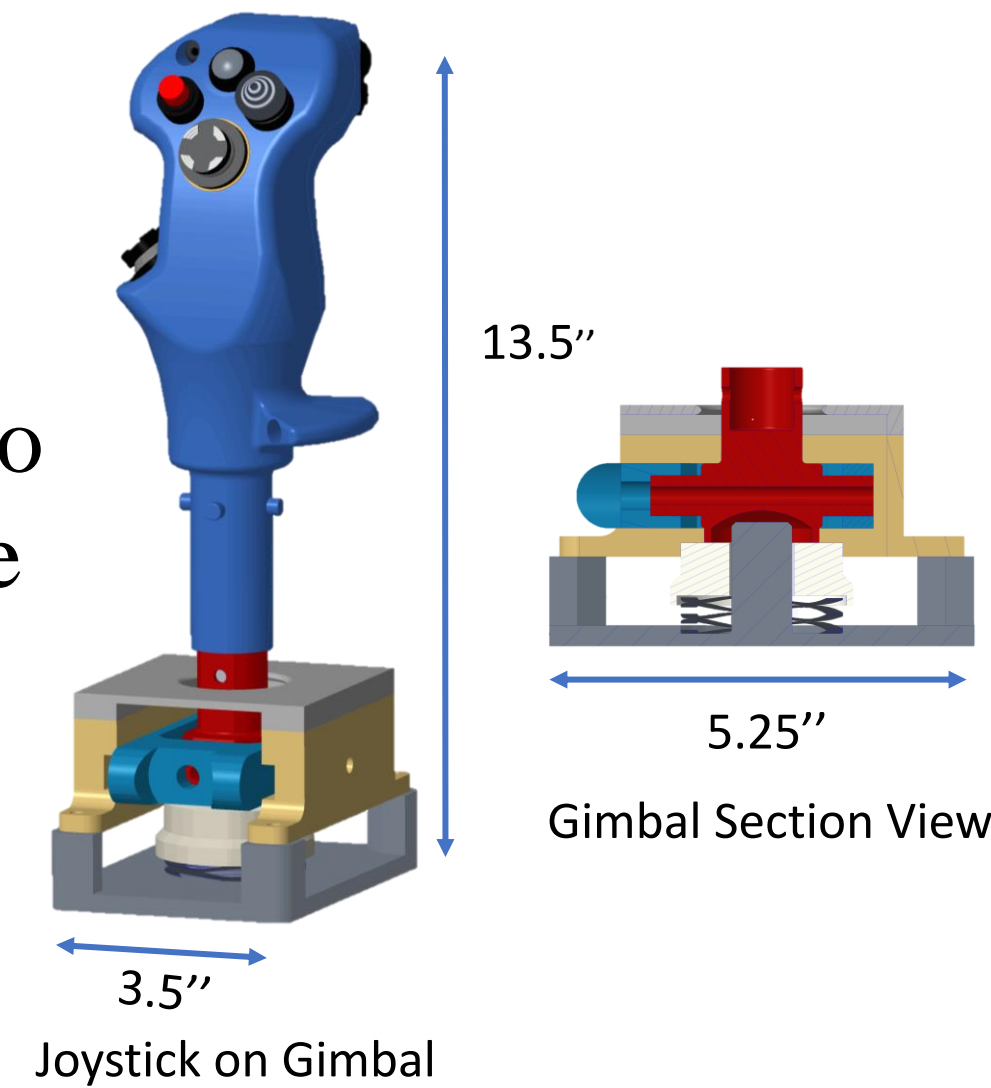


Cockpit View

## Design

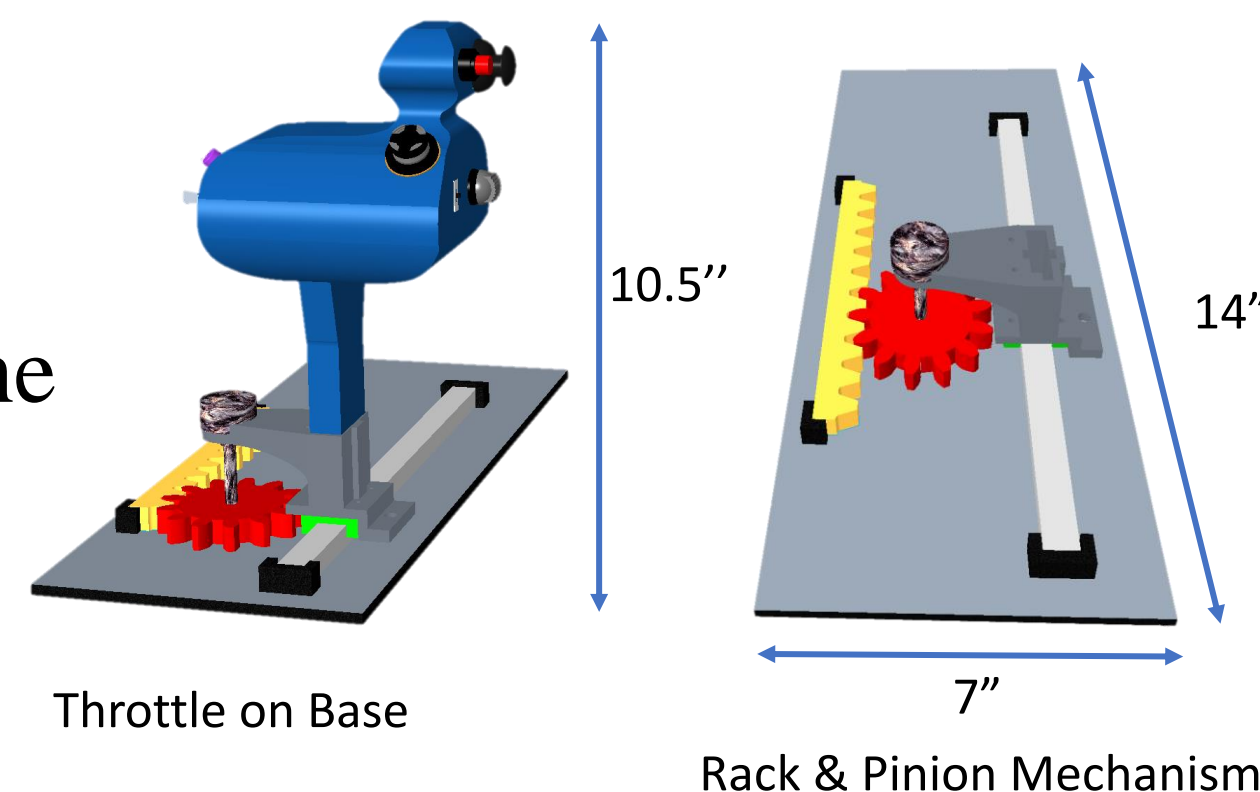
### Joystick

The joystick uses a multiplane gimbal joint to allow rotation in multiple directions. The assembly has 10 buttons and 2 rotary sensors.



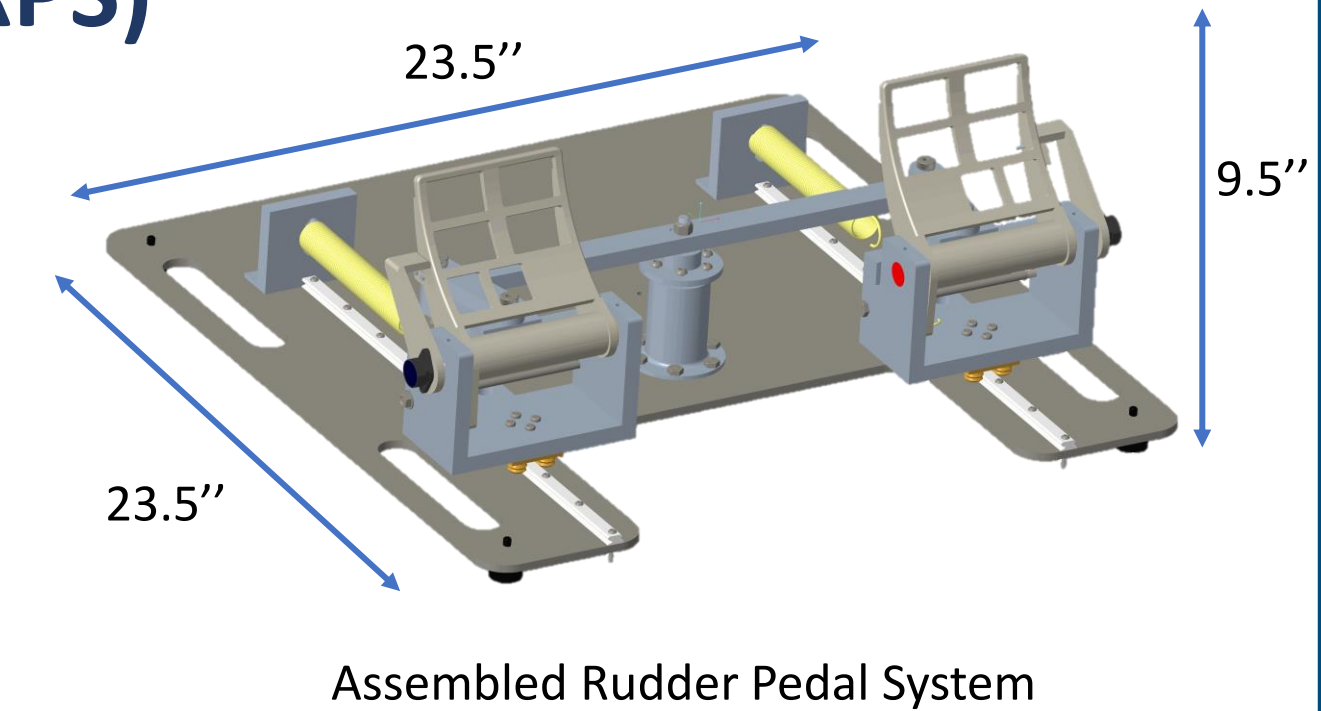
### Throttle

The throttle has a rack and pinion along rail. The assembly has 12 buttons and 4 rotary sensors.



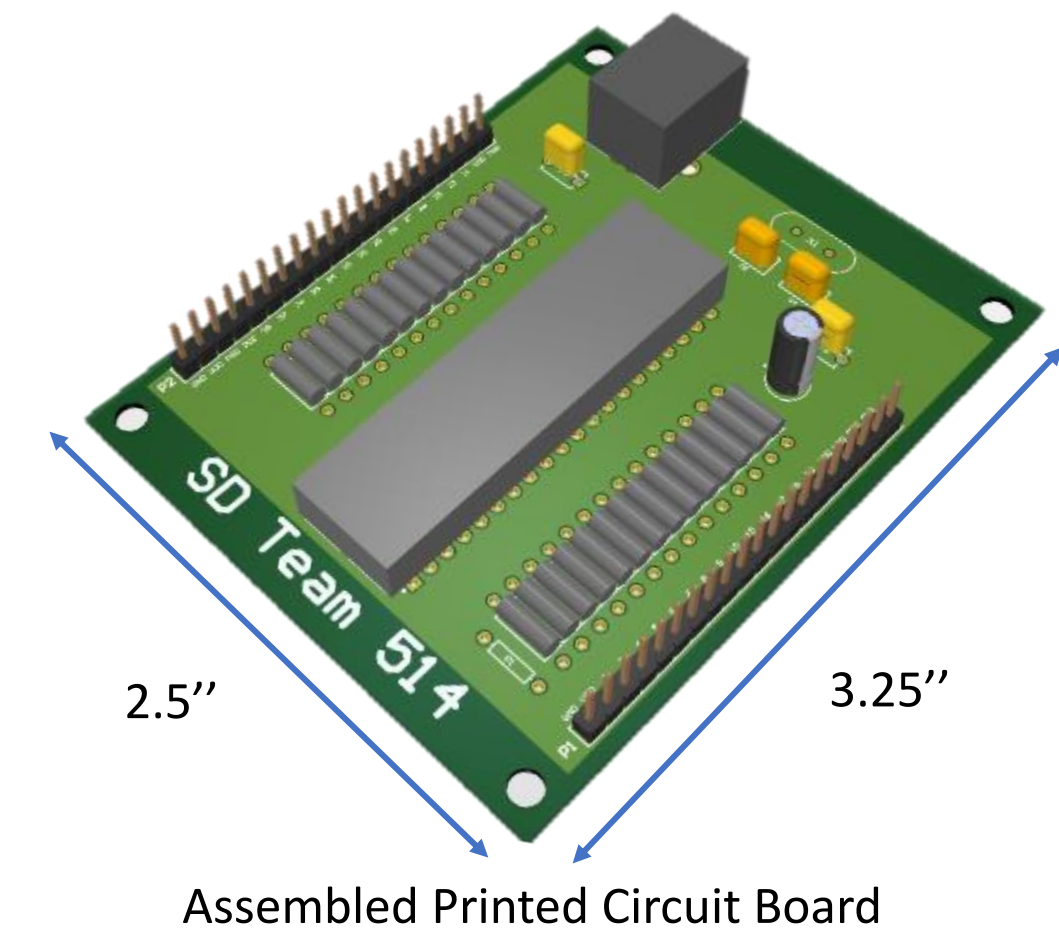
### Rudder Pedal System (RPS)

The pedals slide along two rails and have toe-brakes. The assembly has 3 rotary sensors.



### Custom Printed Circuit Board

Each PCB contains circuits and a microcontroller to process and send signals to the Prepar3D simulator.



## Flight Control Concepts

### Joystick

Pitch: Nose up or down  
Roll: L/R bank angle

### Rudder Pedals

Yaw: L/R heading  
Wheel Brakes

### Throttle

Engine propulsion



## Validation

Joystick deflection angle:  
Throttle travel:  
RPS Weight:  
Throttle & Stick Weight:  
Force to deflect joystick:  
Force to move throttle:  
Force to move RPS:  
Latency:  
Cost:

**Target**  
13°  
6 in  
<35 lbs  
<35 lbs  
<7.5 lbf  
<7.5 lbf  
<15 lbf  
<350 ms  
<\$2000

**Testing Data**  
13.6°  
6.06 in  
25 lbs  
12.6 lbs  
1.3 lbf  
1.5 lbf  
11.2 lbf  
180 ms  
\$1987.53