Aerospace Engineering Design Portfolio

Shivam Saheb (B.Eng Aerospace)

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Hello and Welcome.
I would like to thank you for taking the time to view my portfolio and hope that it serves to share a deeper insight into my projects and experiences throughout my history.

The goal of this portfolio is to show my capabilities rather than simply what I have done. It is also designed with the hope that you will be better able to assess my skills and their effectiveness pertaining to the role.

As always, I welcome an opportunity to discuss information listed here in greater detail.

My contact information is listed as a footnote throughout this presentation.

ABOUT ME

I am an enthusiastic and passionate aerospace engineering student looking to develop my skills and experience in a professional setting. I am a highly resourceful, reliable, adaptable, and analytical individual and am able to work well individually or collaboratively in teams.

Objective: Seeking a position within an organization that provides me an opportunity to demonstrate and develop my skills and abilities as an aerospace engineer while completing challenging projects in a dynamic work environment.

EDUCATION AND SKILLS

Ryerson University (BEng Aerospace Engineering)

Principal Modules:
CAD/CAM, CAD Lab (CATIA, SolidWorks, AutoCAD)
Programming: C, Python, MATLAB, familiar with VBA
Microsoft Office (Word, Excel, PowerPoint), Project, Outlook
Knowledge of reading and interpreting engineering drawings and electrical schematics.

Related Courses:	Grade
Communications in the Engineering Professions:	A
Materials and Manufacturing:	B
Electric Circuits:	B
Intro to Aerospace Engineering	A
Systems Engineering	A-

INTERESTS, ACTIVITIES, AND WORK EXPERIENCE

Certificate of Aircraft Design — 2017

Offered by the Canadian Aeronautics and Space Institute (CASI) Toronto in partnership with CASI Ryerson

Avionics Specialist, Ryerson Rocketry Club (RRC) — 2016 – 2019

Currently a member of the Ground Station sub team at RRC where I program, conduct troubleshoot tests, and assist in document management.

Deli Worker/Cashier, Metro Inc. — 2013 – 2018

Currently working as at Metro Burlington where I conduct various activities such as organizing inventory shelves, taking customers’ orders, and performing warehouse duties such as material handling and merchandising.

Glider Aircraft and Wing Construction

Project

Glider Aircraft and Wing Design and Construction

Objective

To design, construct, and develop a non-metallic fuselage and a composite wing for use in an unmanned glider airplane

Approach

1. Determined most important parameters of design through an Objective Tree and a Pairwise Comparison Chart (Efficiency, Durability, Manufacturability)
2. Brainstormed initial designs that maximized efficiency by optimizing lift produced and minimizing weight (Large fuselage and Empennage while tail boom was thin)
3. Created composite wing (NACA M22) using processes learned within labs (Wet Layup Construction, Removal of Cured Wing, Performing Integrity Test)
4. Created final CATIA design for aircraft through various factors such as Cl vs Alpha graphs for the wing and Center of Gravity calculations
5. Tested Glider in competition
6. Created report that described all procedural steps and documented all information gathered

Result

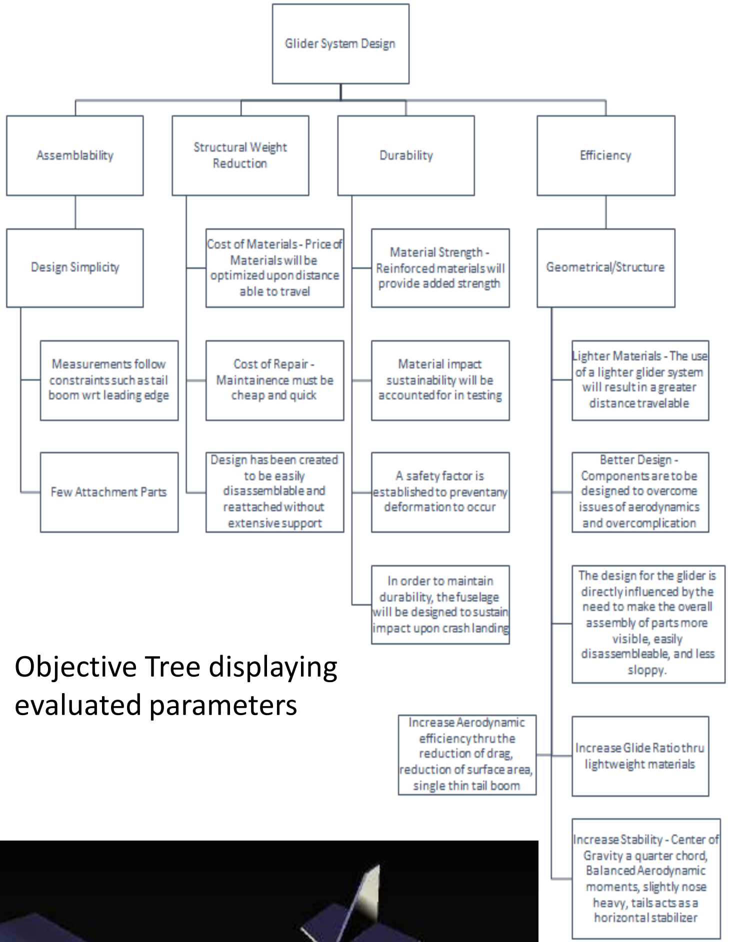
Glider flew 20m and finished in second place

Software

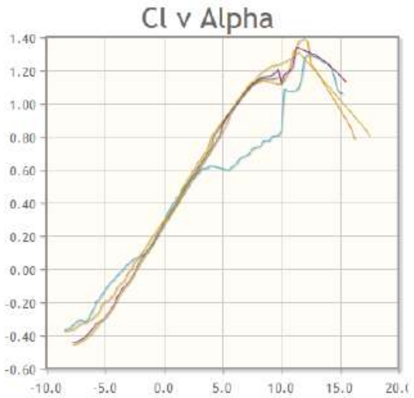
- CATIA
- XFLR5
- Ansys

Other Tools

- CNC Machine (Used to manufacture aircraft body)
- Microsoft Office (Word, Excel)

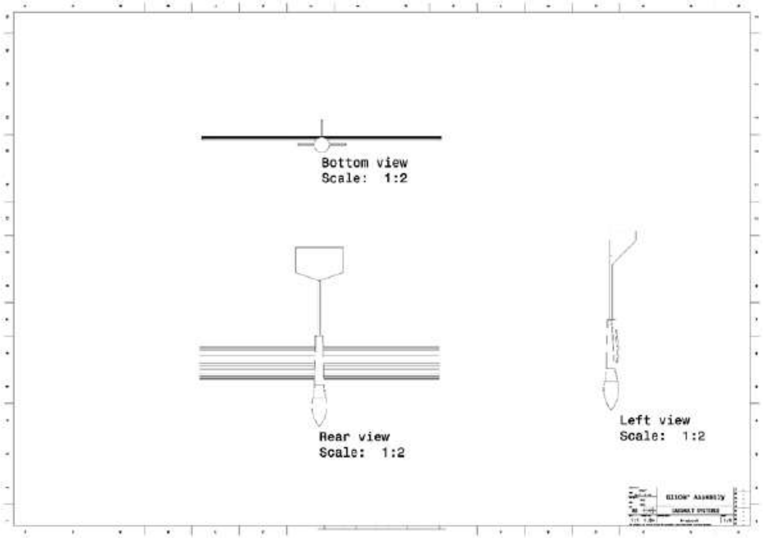


Objective Tree displaying evaluated parameters

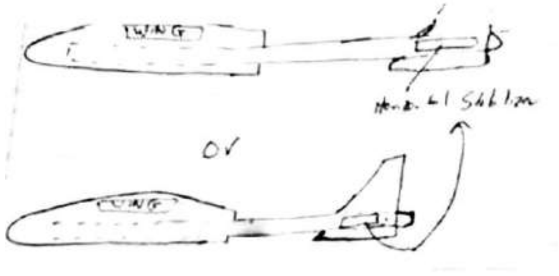


Lift Coeff. Vs. Angle of Attack

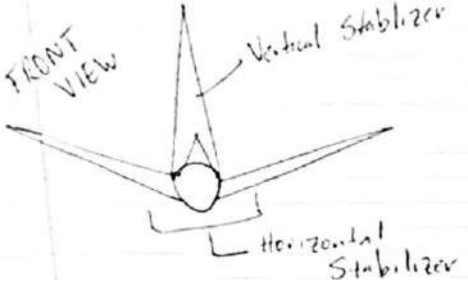
Our plane displaying the price of a second place victory



Technical Drawing of Full Glider Assembly



Early Designs for Glider



Rendered CATIA model for Glider

	Weight	Efficiency	Durability	Manufacturability	Rank
Weight	-	0	1	0	2
Efficiency	1	-	1	1	1
Durability	0	0	-	1	2
Manufacturability	1	0	0	-	2

Pairwise comparison chart used for determining most important parameter

Control Mechanism for Aircraft Flap

Project

Design a control mechanism to control a flap

Objective

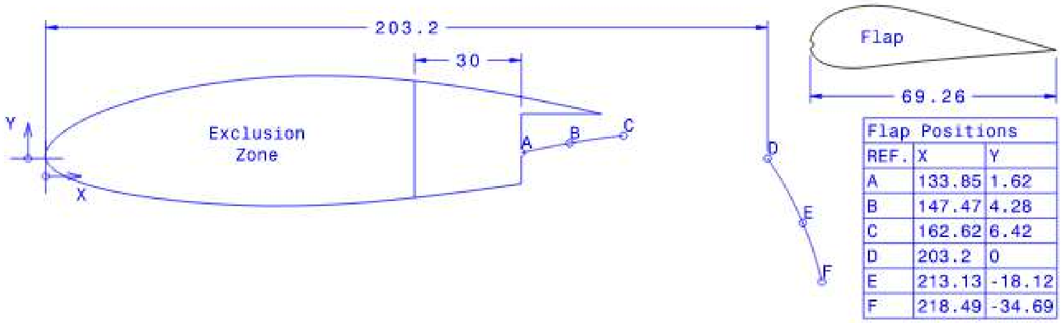
To design a mechanism that controls the positioning and motion of a wing flap

Outline

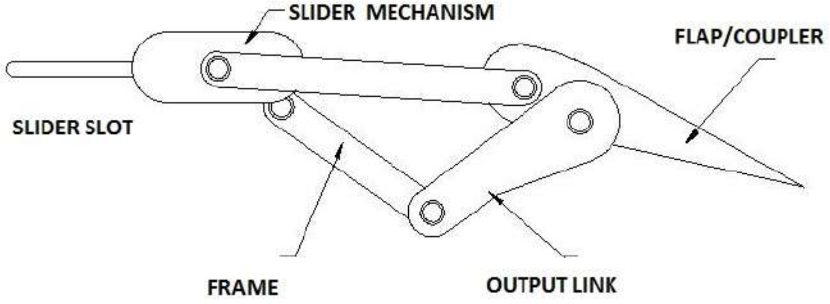
A. Requested a design for a new single – slotted flap mechanism to be attached to the end of a wing for a plane in development

B. Design given was to stay within a list of dimensional constraints

C. Prototype was required to display the working mechanism positioned at 0%, 50%, and 100% extension.



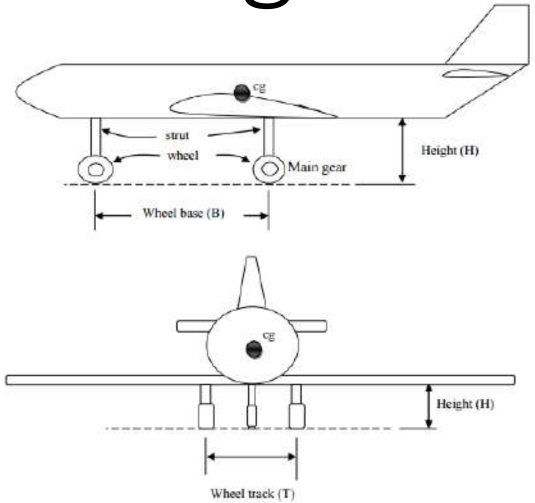
Flap Positions		
REF.	X	Y
A	133.85	1.62
B	147.47	4.28
C	162.62	6.42
D	203.2	0
E	213.13	-18.12
F	218.49	-34.69



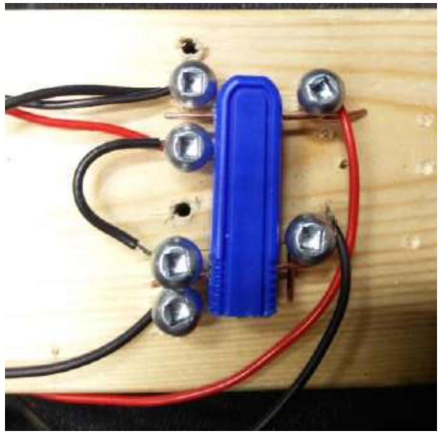
Functionality

- A hydraulic slider pushes the input link that connects the wing and the flap. As the slider pushes, the wing flap deploys outwards in the horizontal direction.
- A secondary frame fixes on the bottom side of the wing's trailing edge that connects to an output link and finally the flap. Provides a guiding pivot motion for vertical deployment as well as structural integrity for the mechanism.
- Mechanism is strengthened by using the flap as the coupler.

Landing Gear Mechanism



General landing gear location



Integrated switch for
mechanism to retract/extend

Project

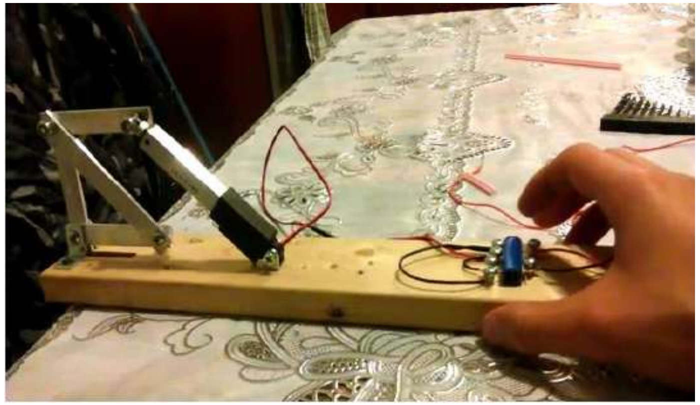
Design a landing gear mechanism

Objective

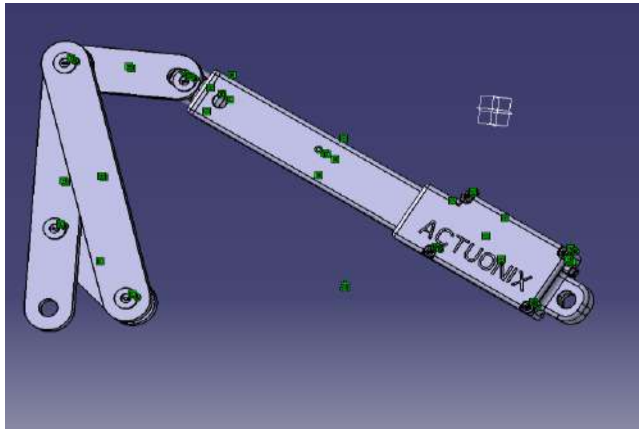
Design a mechanism for a landing gear to
lift the greatest amount of weight possible

Result

The final prototype of the landing gear was a four-bar mechanism that was able to successfully deploy and retract the landing gear. A switch to control the actuator was incorporated into the design making deployment and retraction of the landing gear simple. During the competition, the prototype was able to lift two kilograms of weight. Overall the project was successful as the designed landing gear mechanism functioned well.



Mechanism in action



CAD of Mechanism with
Actuator shown

Gearbox System Redesign

Project

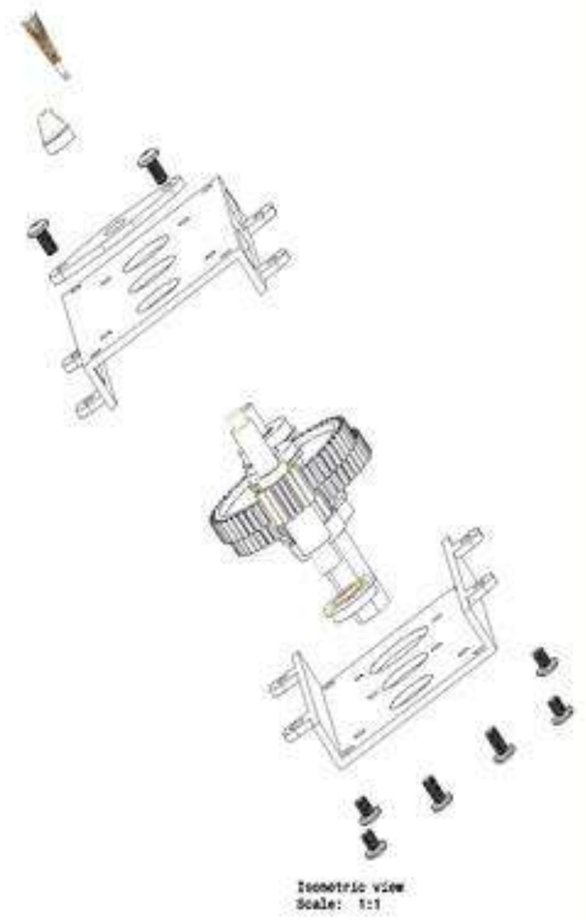
Explore the design and engineering process of a gearbox

Objective

To redesign a gearbox to be used in robots meant for combat in an area.

Outline

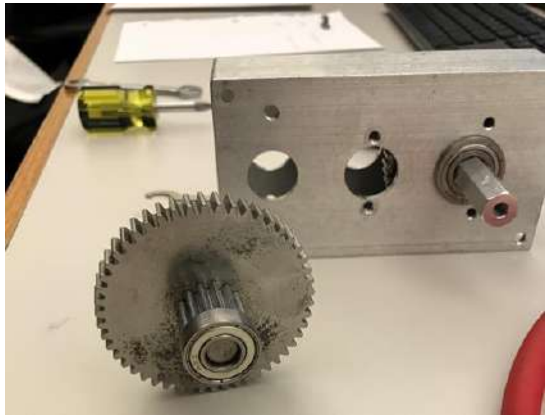
- Redesigned a more efficient and lightweight gearbox given a previous design and a new set of parameters.
- The existing design included a compartment case made of Aluminum 2024 with the gears made of Steel 4041.
- Certain components were taken out (screws, bolts) while others were added (crank handle, crankshaft, and a spur gear).
- The case was redesigned to be from a laser cut MDF board along with several components such as pillow bearings and the crank handle while other components such as bolts and struts were to be 3D printed.
- The new gearbox was redesigned of operate with a reduced weight while still maintaining functions from the earlier design.



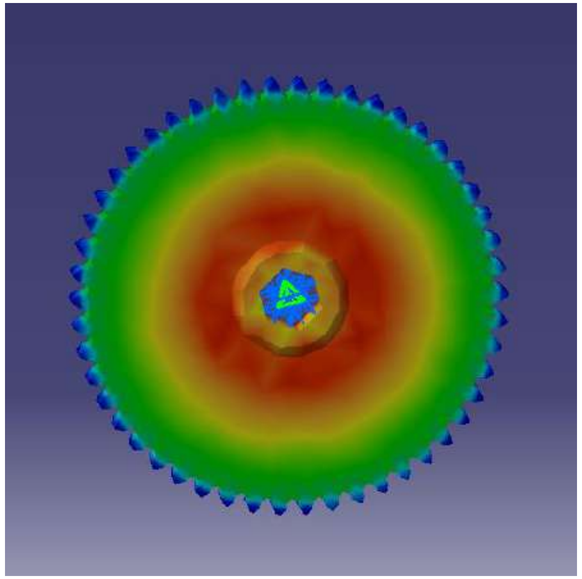
Exploded Isometric of Gearbox

Functionalities

- Durable
- Efficient
- Compact
- Easy to assemble and disassemble
- Light
- Composed of inexpensive materials
- Manufactured in bulk to reduce the cost



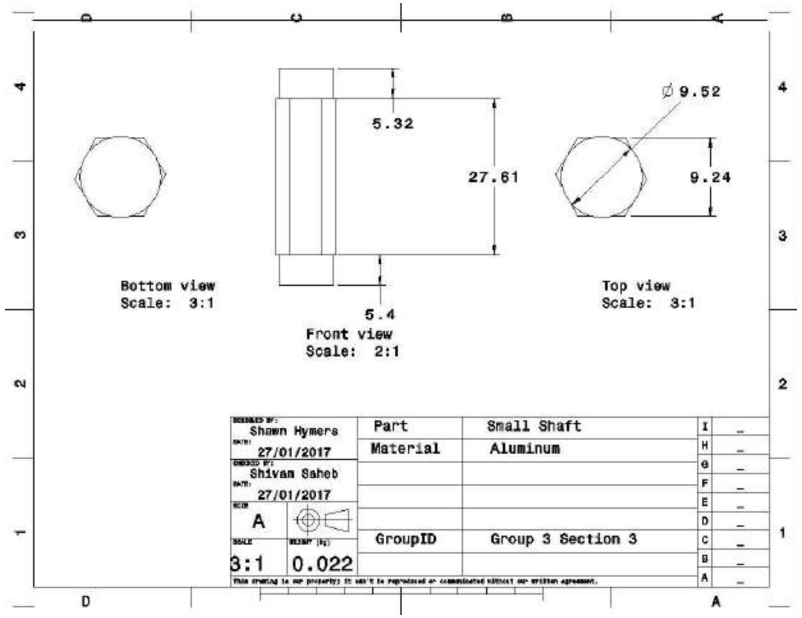
Original Gearbox with Gear, shaft, and Case shown



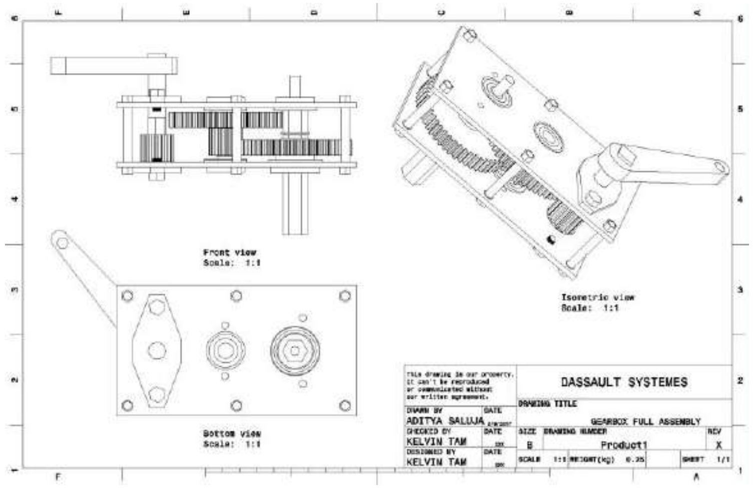
Stress test conducted on Gear

		Manufacture Technique (Prototype)			Final Product
Drawing Reference	Component	MDF (Wood)	3D Printing (Plastic)	Unchanged	Manufacture Material
1	Bolt (Pillow-bearing) x4			X	Steel
2	Nut x6			X	Steel
3	Coupling		X		Plastic
4	Handle	X			Wood
5	Cluster Gear x2			X	Steel
6	Pillow Bearing x2	X			Wood
7	Extended Axle		X		Steel
8	Small Spur Gear x2	X		X (1)	Steel
9	FR8ZZ			X	Steel
10	FR6Z x3			X (3)	Steel
11	Input Shaft			X	Aluminum
12	Gearbox Face Plate 1	X			Aluminum
13	Gearbox Face Plate 2	X			Aluminum
14	Axle Shaft			X	Steel
15	Ering			X	Steel
16	Plastic Washer			X	Plastic
17	Struts x6		X		Plastic

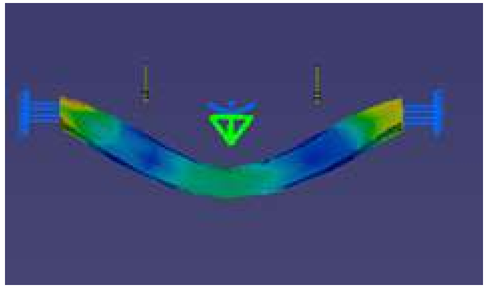
Final Component Material List



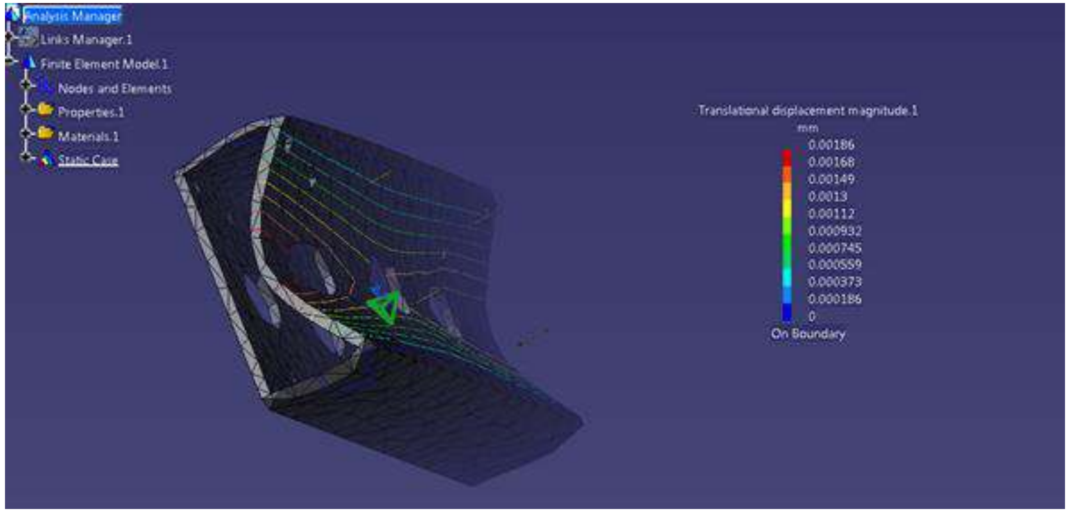
CAD Drawing of Aluminum Shaft



Gearbox Full Assembly

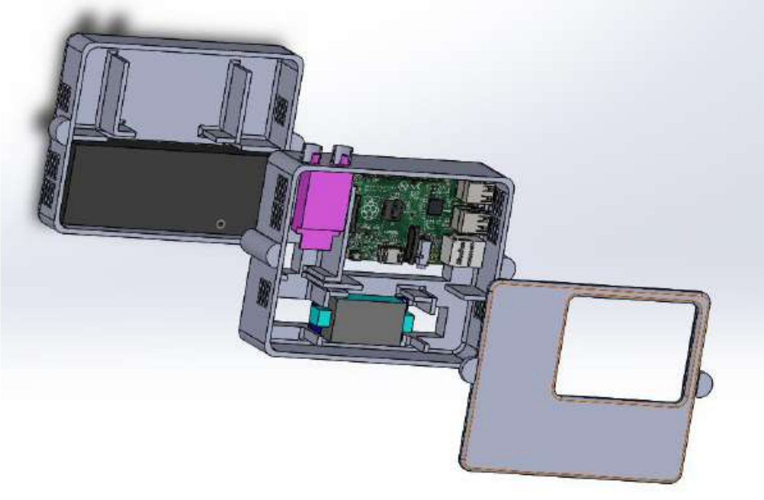


Stress test conducted on Strut



Stress test conducted on Compartment Case

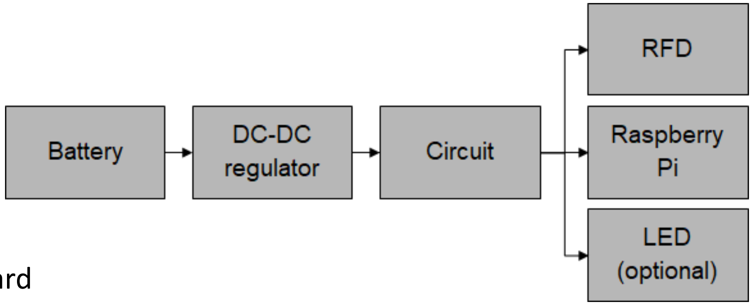
Avionics System Design



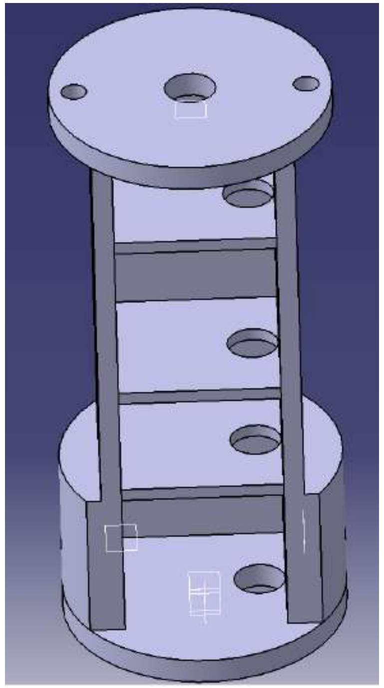
Exploded view of enclosure

Hardware Design Overview

- Consists of four subsystems: power, processing, communications, and user interface.
- Power subsystem consists of a lithium-ion battery, a step-down switching regulator and a circuit board.
- The processing system includes a Raspberry Pi B+.
- The communications system is composed of an RFD900 module.
- All of these subsystems will be enclosed in a 3D printed case.



Block diagram of ground control station



Avionics Bay

Current Tasks

- Enclosure design and prototyping
- CAD Modelling
- Code to receive and store data
- Testing

Components

- Raspberry Pi B+
- Touchscreen (3.5”)
- Switching regulator
- Circuit board
- RFD900 module
- 3D-printed case

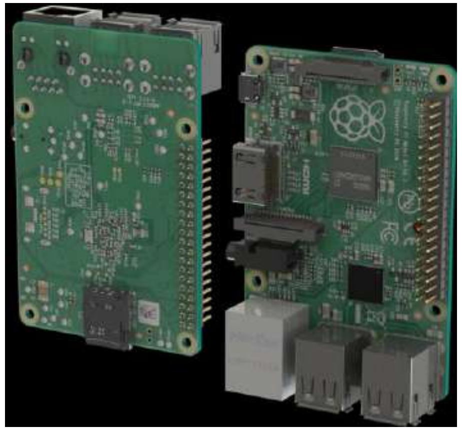
Python Script for Rocketry GUI

Software Design Overview

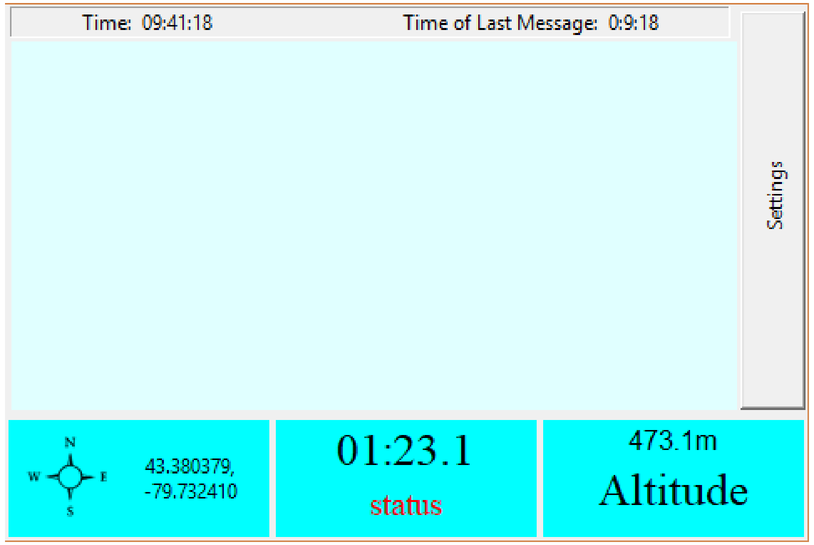
- Developed with python using tkinter, a library, to build a user interface to display telemetry data.
- Has a back end to communicate with the microcontroller on the rocket. The back end code stores data received from rocket for later review.
- The plan is to give the user to look into more details when clicking on each blue frame.
- Displays location of the rocket, the status information, and a separation signal.
- Includes settings button to set specific serial ports which can be used for testing purposes.

Functional Requirements

- Able to send and receive data from the rocket
- Able to process, store and display data
- Able to be operated by a single user
- Ability to operate in diverse locations



Raspberry Pi

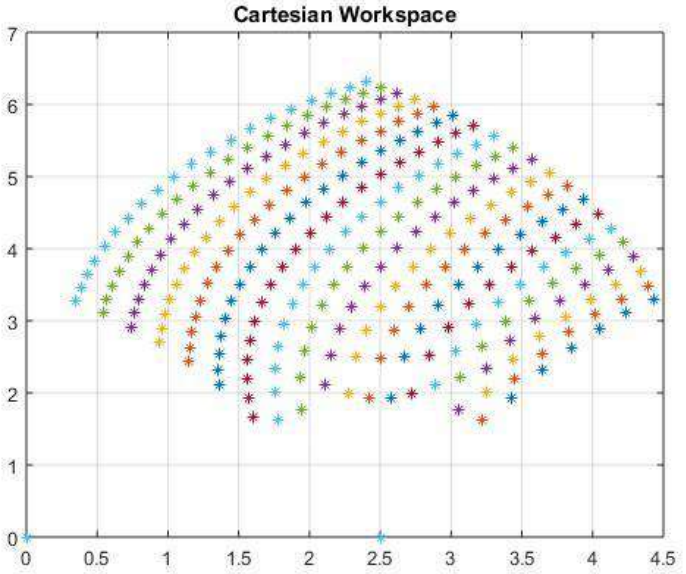


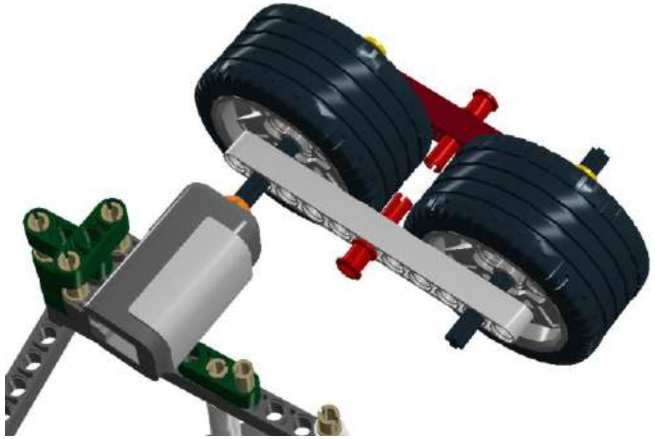
Initial Startup screen of application

Closed Link Planar Manipulator Arm

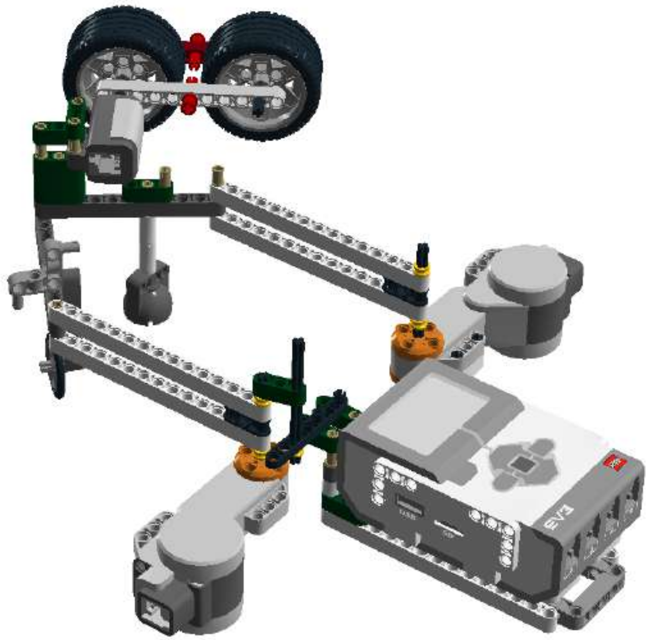
Design Overview

- Designed a manipulator arm with a drawing instrument as the end effector
- Used to create three distinct drawings for evaluation purposes
- 5-bar linkage system with two motors on either end of the base/reference frame
- Used MATLAB to accept inputs which commanded the manipulator to execute joint motions





LDD Model of End Effector Mechanism



LDD Model of Assembled Manipulator

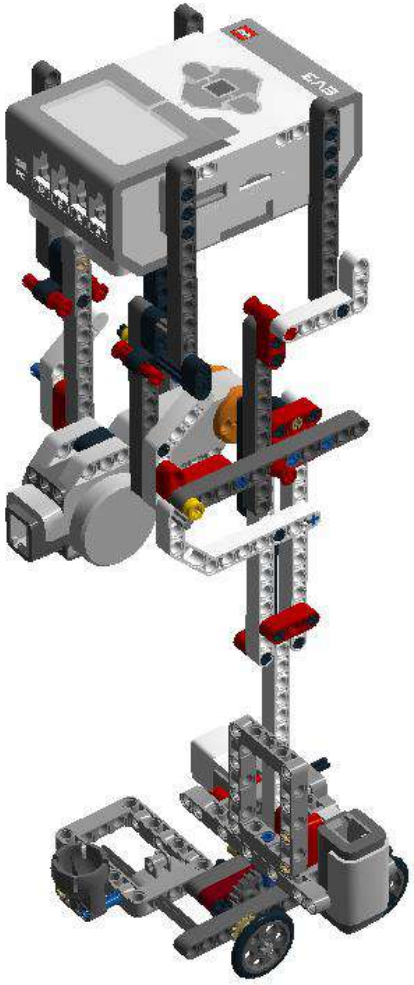
LDD = Lego Digital Designer

Used to design systems on software

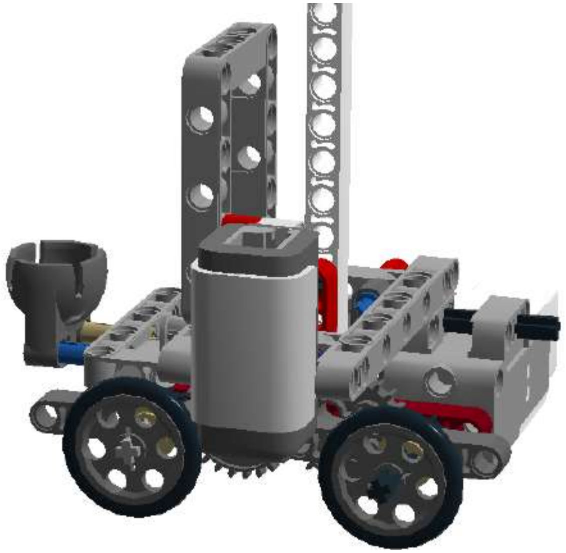
Robotic Block Stacker System

Design Overview

- Designed a robot capable of stacking blocks depending on their colour
- Used to stack green and blue blocks in their respective colour stacks
- Using Tetrix, a gantry system was designed to support the brick through which robot can be operated
- Claw was designed with rubber wheels as grips for increased traction, and two gears to step up the motors output speed.
- End Effector motion was done through an automated MATLAB script which had pre-set commands



LDD Model of Assembled manipulator with Claw

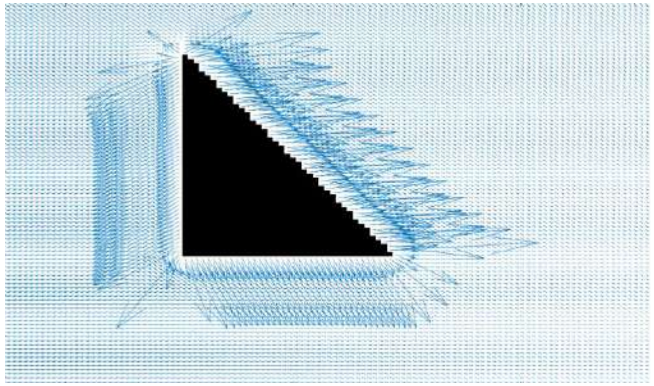


LDD Model of Claw (End Effector)

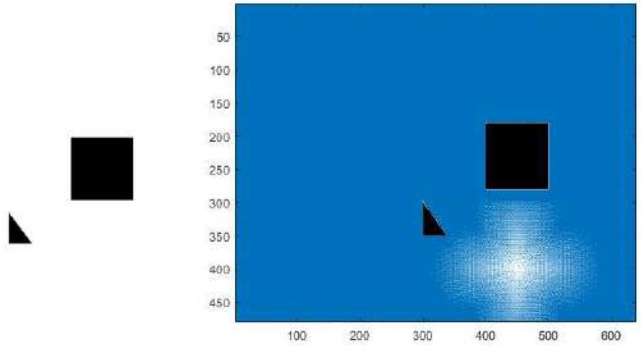
Path Planning Rover

Design Overview

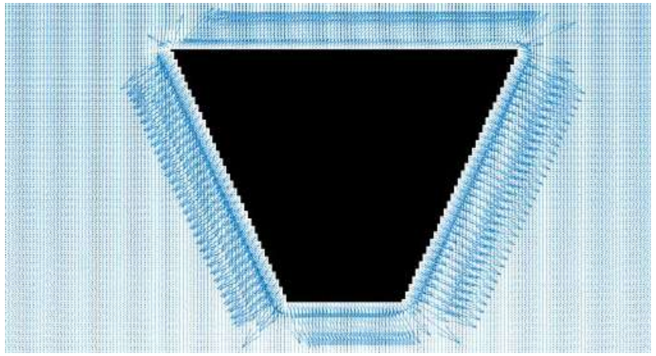
- Designed a rover capable of maneuvering a path obstructed by different obstacles with a Kinect system serving as a vision sensor
- Kinect estimated position and orientation whilst a control system in MATLAB steered the rover through commands
- Developed obstacle map and path planning script involving state space, time, and action.
- The robot was attracted and repelled based on a potential field. The target generated an attractive potential which pulled the robot towards it. The obstacles on the other hand generated a repulsive potential which directed the robot away from them.



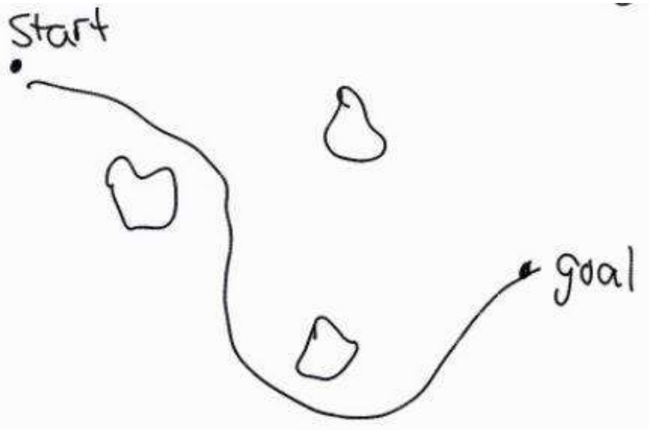
Magnified path planning graphic for triangular obstacle

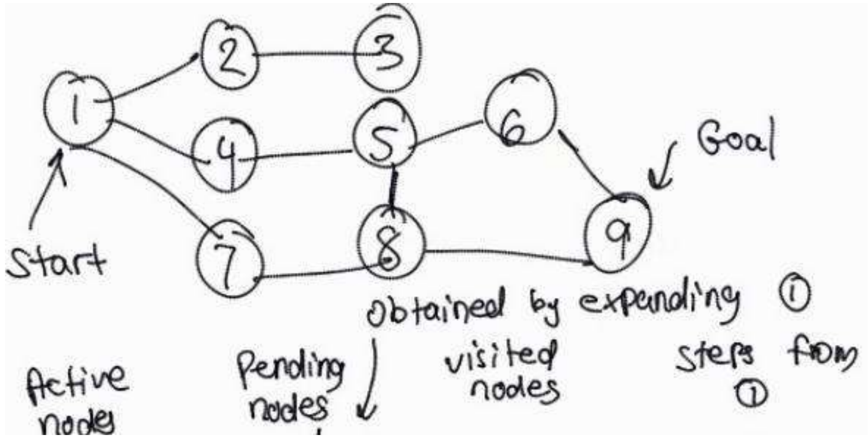


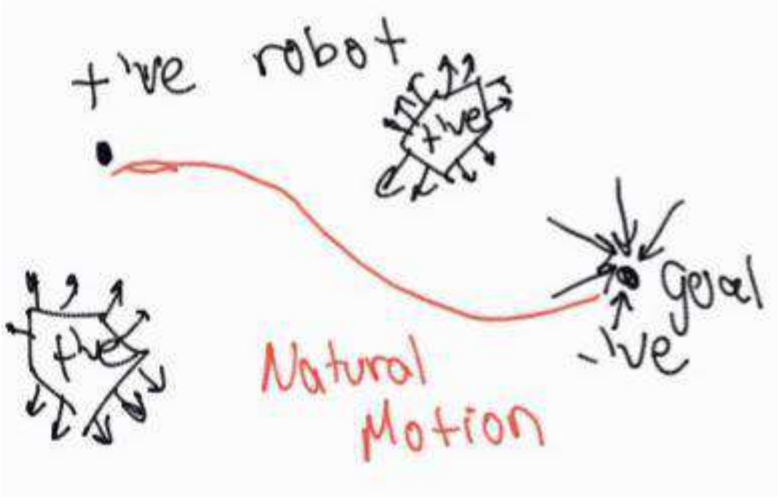
Obstacle map with and without potential flow. Crosshair depicting target destination around obstacles

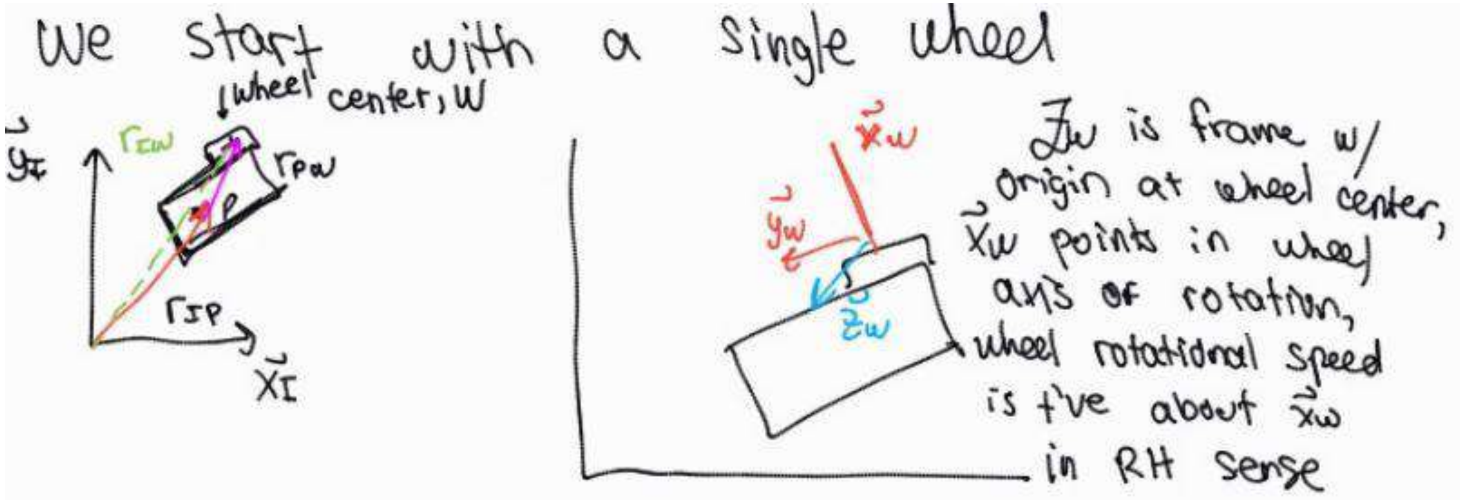


Magnified path planning graphic for trapezoidal obstacle


Start
goal


1
2
3
4
5
6
7
8
9
Goal
Start
Obtained by expanding 1
Active nodes
Pending nodes
visited nodes
steps from 1


+'ve robot
+'ve
+'ve
-'ve
goal
Natural Motion


We start with a single wheel
wheel center, W
rIW
rPW
rIP
P
yI
XI
xW
yW
zW
ΣW is frame w/ origin at wheel center, xW points in wheel axis of rotation, wheel rotational speed is +'ve about xW in RH sense

The goal is to improve systems through reliability, predictability, and efficiency

Thank you for viewing for this presentation

Application is the key to learning, but communication is the key to innovation