Title of Project: **Movable Docking Station.**

Name of Organization: **Aplos Ventures (Parent company: Mahindra Susten.)**

Name of Industry Advisor:

Ninad Watve (Deputy manager),
Pankaj Sanap (Deputy Manager),
Vivek Jagtap (Senior Engineer) .

Nature of Internship

Technical/Automation/Renewable Energy:

Used knowledge based on design Analysis, Drafting and Manufacturing of different components.

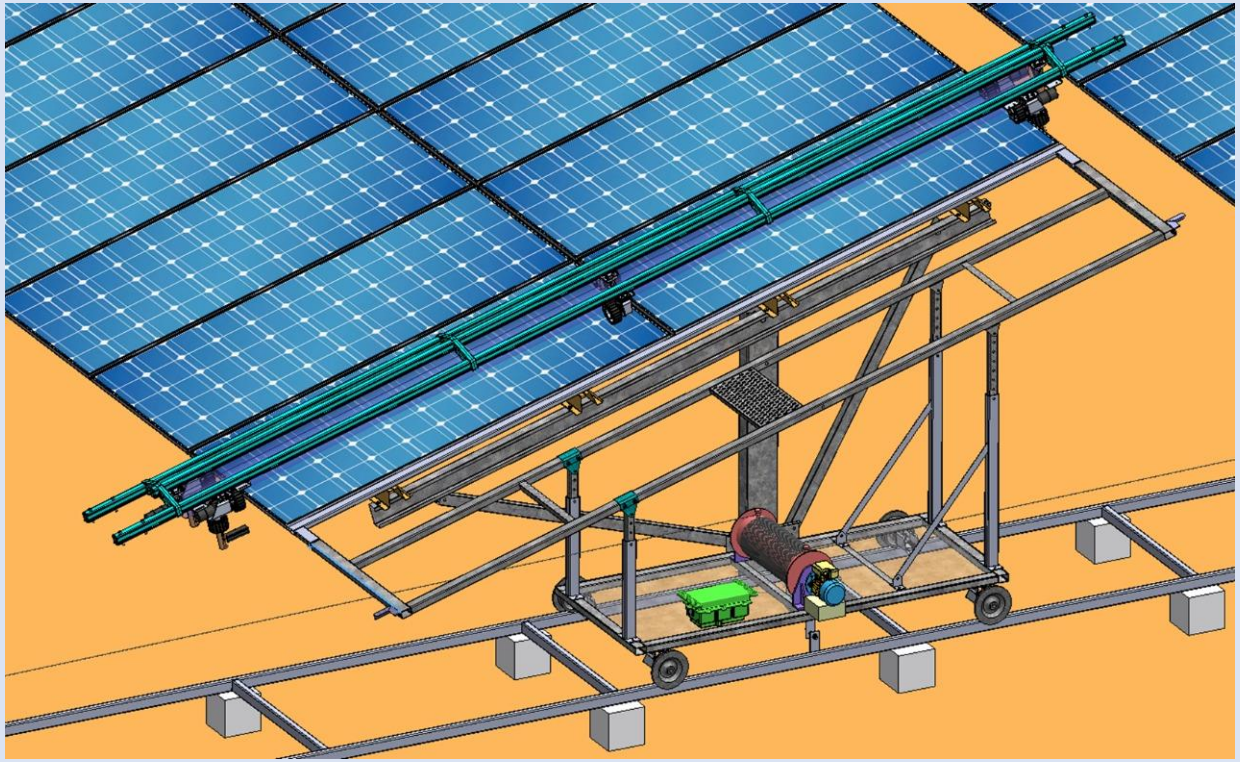
Incorporated Embedded systems and sensors to automate mechanisms to eliminate Human dependency.

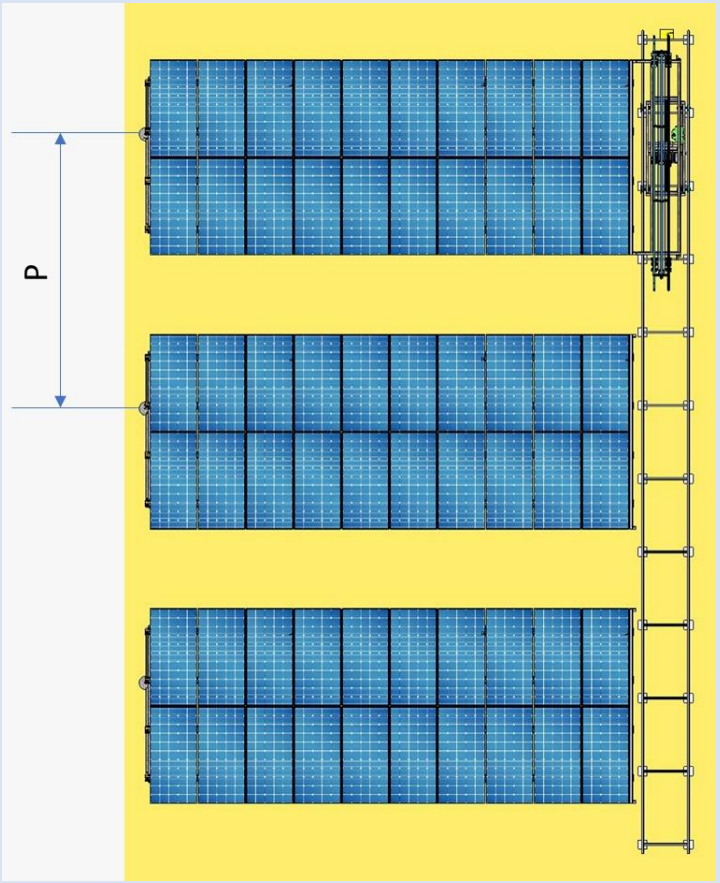
Project/ Work has an indirect effect on renewable energy generation sector reducing dependency upon Non-Renewable energy sources.

Details of the work done of Internship

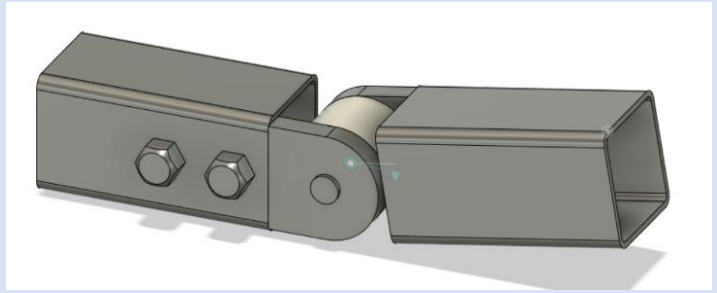
Problem Statement:

To Develop, Design and Deploy automated movable docking station to transfer Solar Panel Cleaning robot from one array to another.

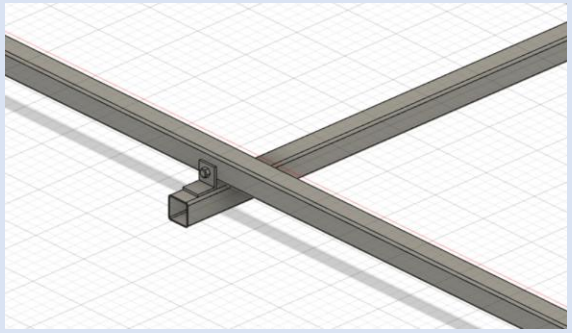




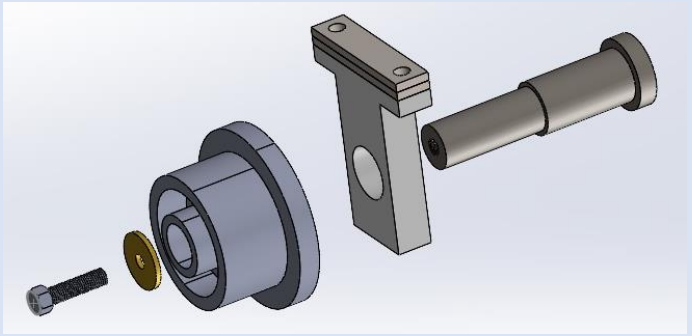
Design Details:



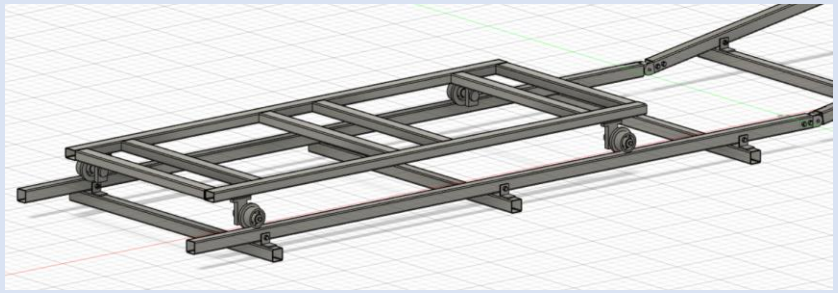
Track joining



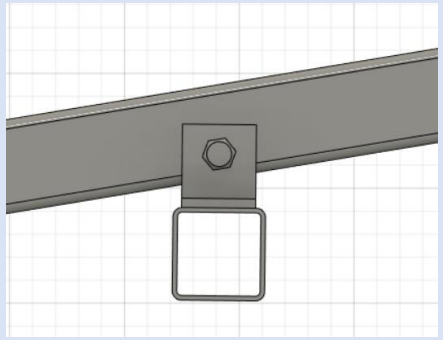
Tracks and cross tie joining using L-Plate

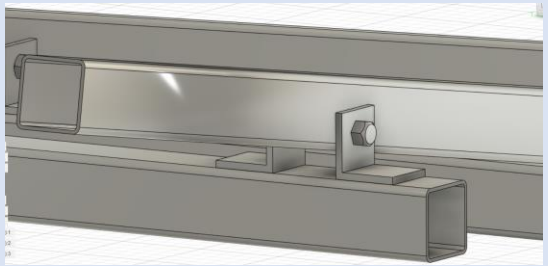


Wheel assembly

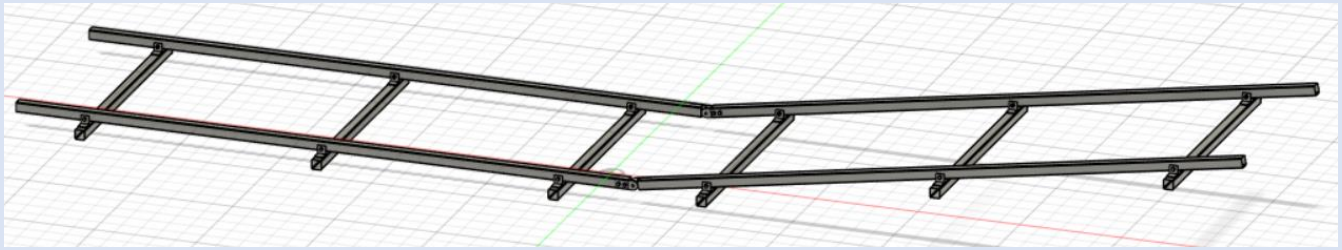


Track with trolley



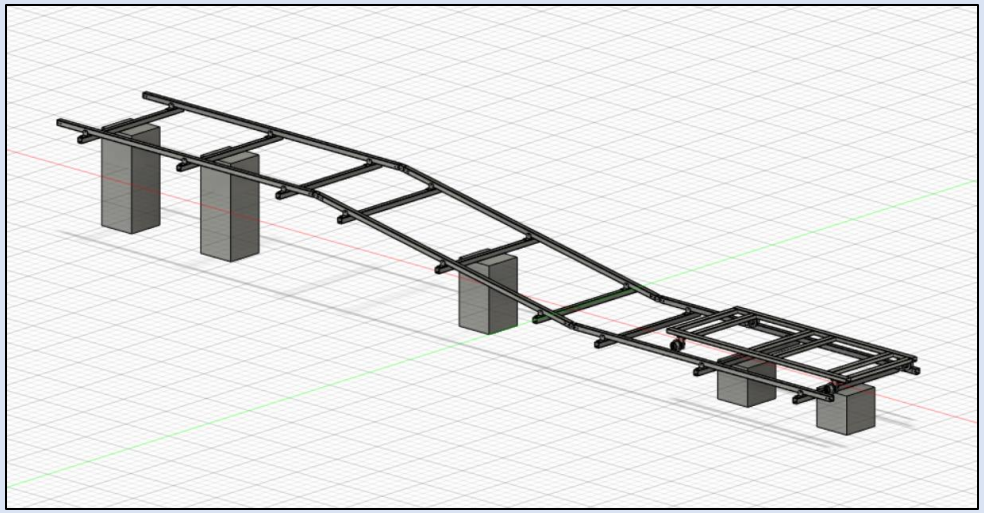


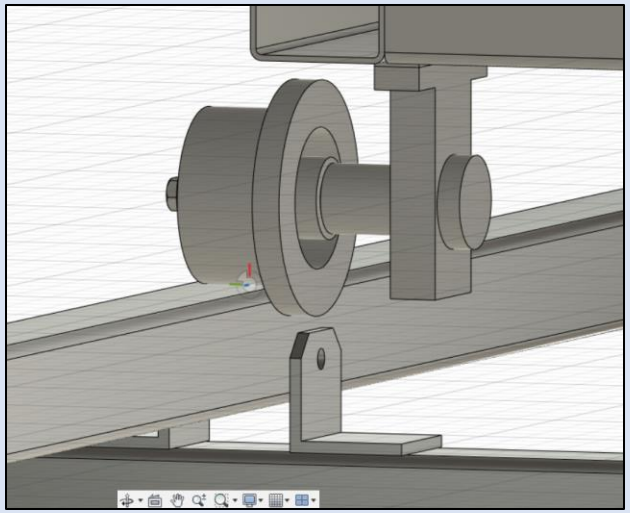
Track at inclination



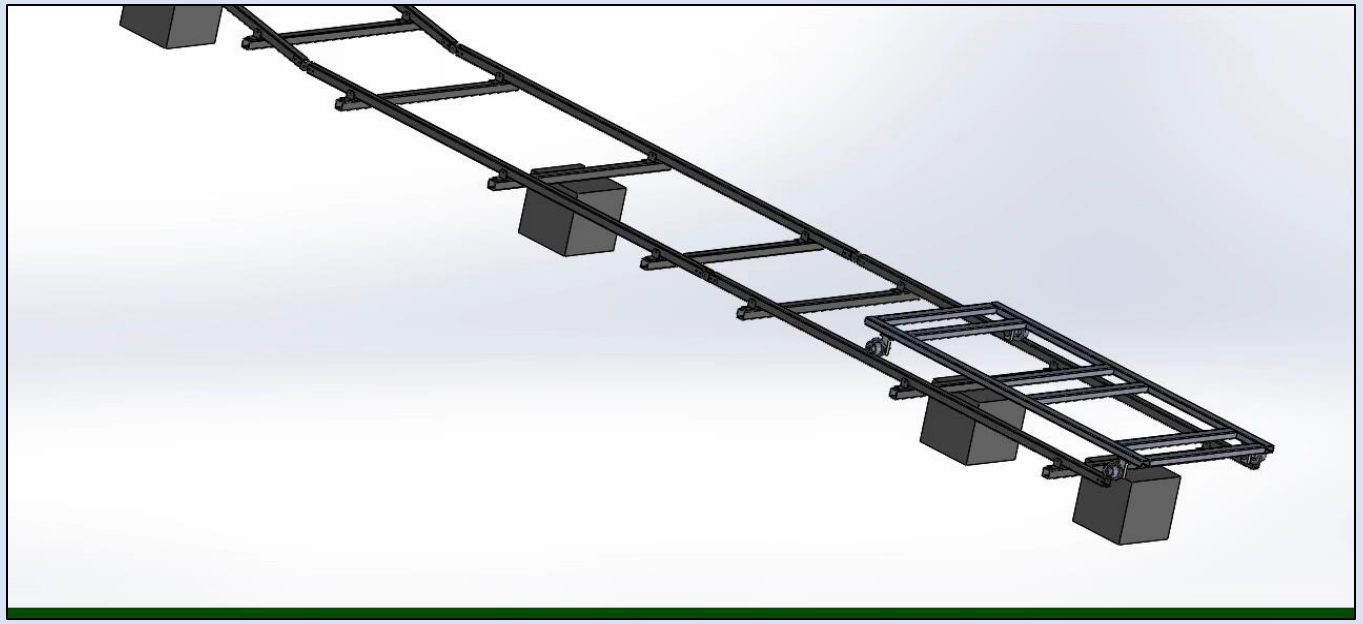
Track assembly

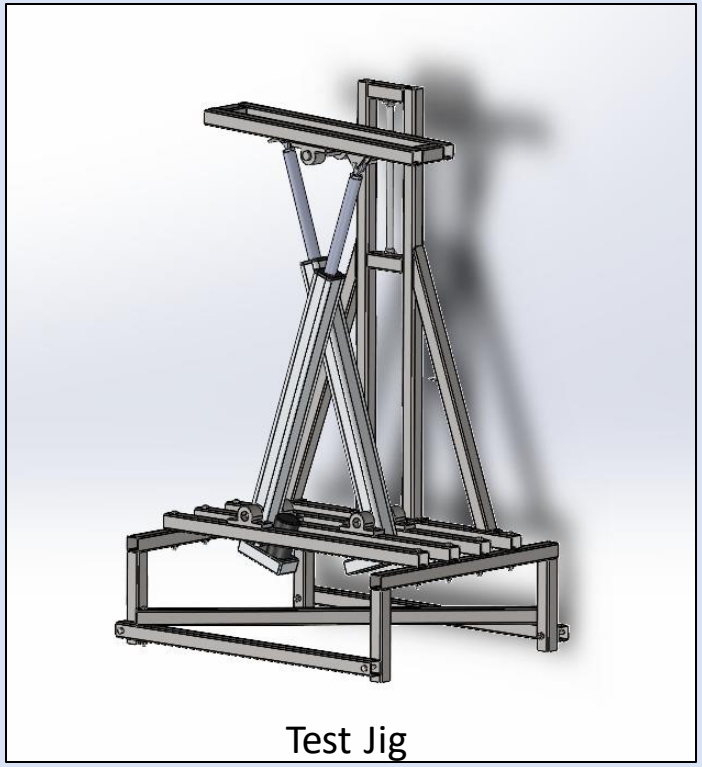
Track with trolley





Checking clearance between L-Bracket and Wheel flange





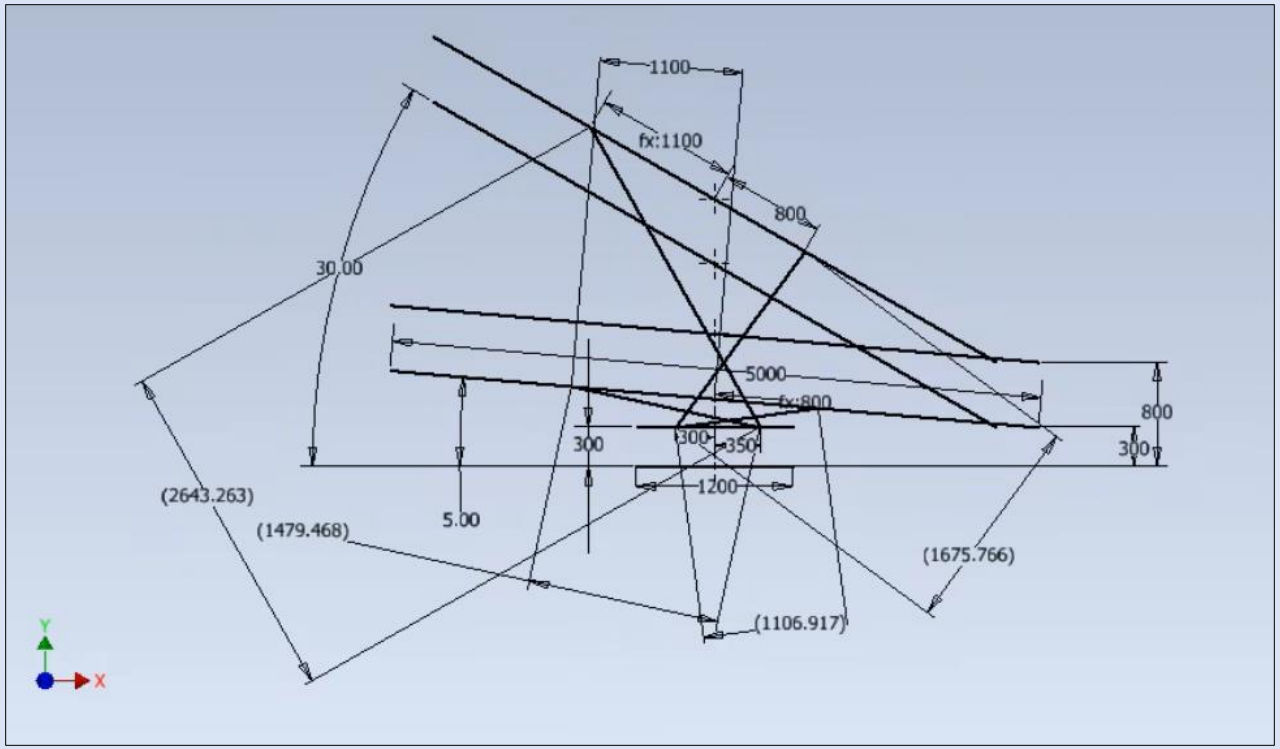
Test Jig

Automation Details:

PROBLEM STATEMENT:

To calculate the velocity and positioning of linear actuator such that,

- It can simultaneously adjust Tilt angle and Height of Carriage.
- Maintain the CG on a vertical line throughout its motion.



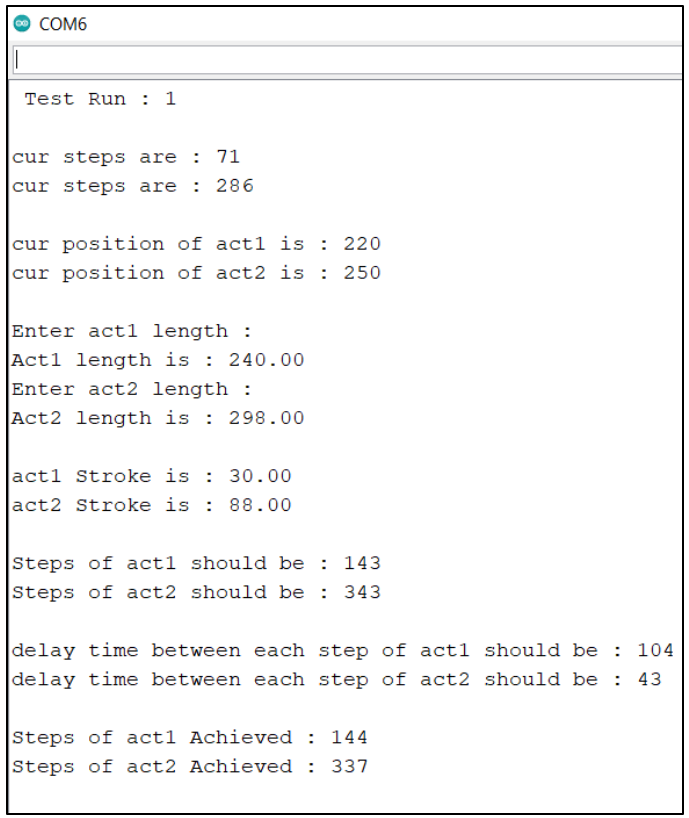
	A	B	C	D	E	F	G	H	I	J	K	L
1	HEIGHT		ANGLE		ACT1		ACT2		ACT1 Displacement		ACT2 Displacement	
2	0		5		1106.917		1479.468					
3	0		10		1127.188		1563.684		20.271557		84.216459	
4	0		15		1159.468		1692.148		32.279577		128.463586	
5	0		20		1201.771		1852.175		42.302649		160.027355	
6	0		25		1251.755		2031.989		49.984886		179.814125	
7	0		30		1306.978		2221.9		55.22283		189.910868	
8	5		5		1107.597		1480.536					
9	5		10		1128.508		1565.69		20.910985		85.153632	
10	5		15		1161.375		1694.906		32.8664		129.216259	
11	5		20		1204.198		1855.503		42.823071		160.596677	
12	5		25		1254.632		2035.736		50.434317		180.232894	
13	5		30		1310.236		2225.953		55.603656		190.217001	
14	10		5		1108.3		1481.621					
15	10		10		1129.848		1567.709		21.548857		86.088083	
16	10		15		1163.299		1697.674		33.451005		129.965795	
17	10		20		1206.64		1858.838		43.340964		161.163248	
18	10		25		1257.522		2039.487		50.881212		180.649546	
19	10		30		1313.504		2230.009		55.982136		190.521605	
20	15		5		1109.024		1482.721					
21	15		10		1131.209		1569.741		22.185144		87.019795	
22	15		15		1165.243		1700.453		34.033373		130.712197	
23	15		20		1209.099		1862.18		43.856322		161.727076	

Sheet1

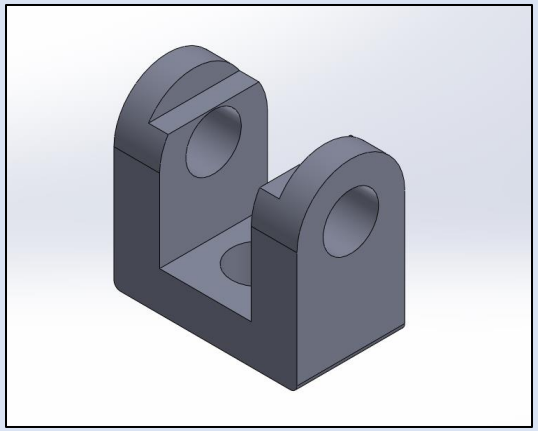
Ready

WROTE A PROGRAM FOR ARDUINO TO CONTROL ACTUATORS

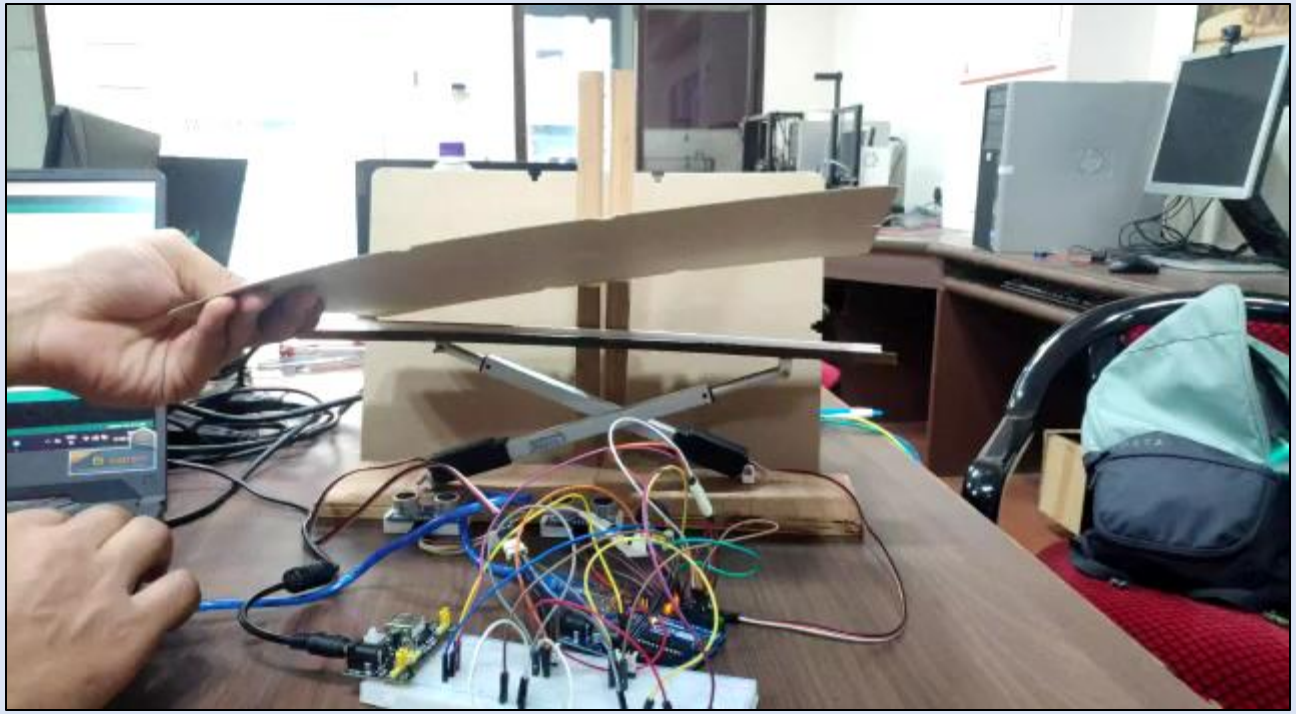
- Programmed such that both Actuators will reach desired position in given time.
- Both work simultaneously with different velocities. But Velocities for respective actuator are constant.



L16 Specifications	
Gearing Option	35:1
Peak Power Point	50N @16mm/s
Peak Efficiency Point	24N @24mm/s
Max Speed (no load)	32mm/s
Max Force (lifted)	50N
Back Drive Force	31N
Stroke Option	50mm
Mass	56g
Repeatability (-P & LAC)	0.3mm
Max Side Load (extended)	40N
Closed Length (hole to hole)	118mm
Feedback Potentiometer	6kΩ±50%



3D Printed Mounts



Small Scale prototype

Methodology followed during Internship/Mini Project

- **Team Management and Task distribution:**
- **Generation of Development Stage Plan:**
- **Using Chunk Technique:**
- **Weekly Review with CEO:**
- **Brainstorming Sessions:**
- **Incorporating Ideas into CAD:**
- **Optimising Design Ideas:**
- **Finalising and Drafting Ideas:**
- **Prototype Testing and Manufacturing:**

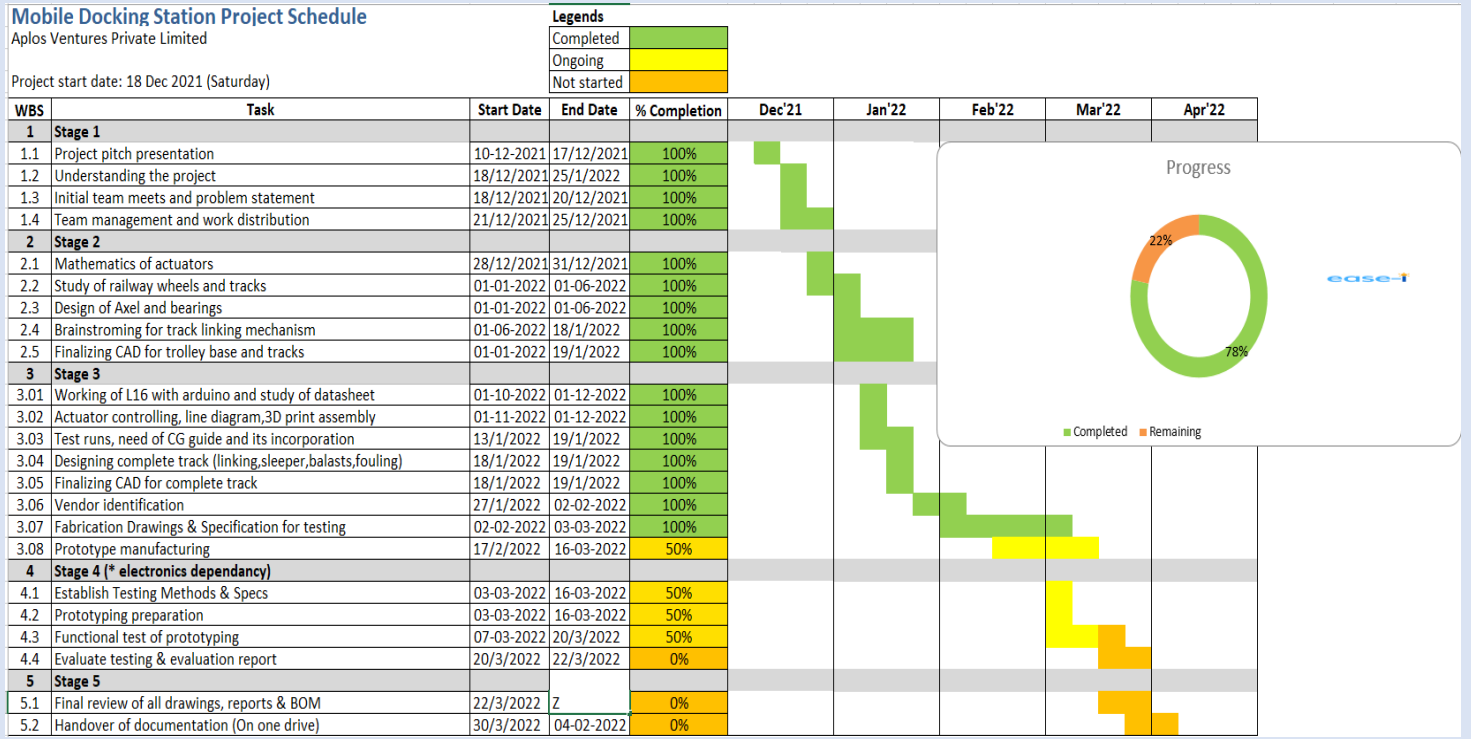
Mobile Docking Station Project Schedule

Aplos Ventures Private Limited

Project start date: 18 Dec 2021 (Saturday)

Legends	
Completed	
Ongoing	
Not started	

WBS	Task	Start Date	End Date	% Completion
1	**Stage 1**			
1.1	Project pitch presentation	10-12-2021	17/12/2021	100%
1.2	Understanding the project	18/12/2021	25/1/2022	100%
1.3	Initial team meets and problem statement	18/12/2021	20/12/2021	100%
1.4	Team management and work distribution	21/12/2021	25/12/2021	100%
2	**Stage 2**			
2.1	Mathematics of actuators	28/12/2021	31/12/2021	100%
2.2	Study of railway wheels and tracks	01-01-2022	01-06-2022	100%
2.3	Design of Axel and bearings	01-01-2022	01-06-2022	100%
2.4	Brainstroming for track linking mechanism	01-06-2022	18/1/2022	100%
2.5	Finalizing CAD for trolley base and tracks	01-01-2022	19/1/2022	100%
3	**Stage 3**			
3.01	Working of L16 with arduino and study of datasheet	01-10-2022	01-12-2022	100%
3.02	Actuator controlling, line diagram,3D print assembly	01-11-2022	01-12-2022	100%
3.03	Test runs, need of CG guide and its incorporation	13/1/2022	19/1/2022	100%
3.04	Designing complete track (linking,sleeper,balasts,fouling)	18/1/2022	19/1/2022	100%
3.05	Finalizing CAD for complete track	18/1/2022	19/1/2022	100%
3.06	Vendor identification	27/1/2022	02-02-2022	100%
3.07	Fabrication Drawings & Specification for testing	02-02-2022	03-03-2022	100%
3.08	Prototype manufacturing	17/2/2022	16-03-2022	50%
4	**Stage 4 (* electronics dependancy)**			
4.1	Establish Testing Methods & Specs	03-03-2022	16-03-2022	50%
4.2	Prototyping preparation	03-03-2022	16-03-2022	50%
4.3	Functional test of prototyping	07-03-2022	20/3/2022	50%
4.4	Evaluate testing & evaluation report	20/3/2022	22/3/2022	0%
5	**Stage 5**			
5.1	Final review of all drawings, reports & BOM	22/3/2022	Z	0%
5.2	Handover of documentation (On one drive)	30/3/2022	04-02-2022	0%



Potential for Further Development of Internship/Mini Project

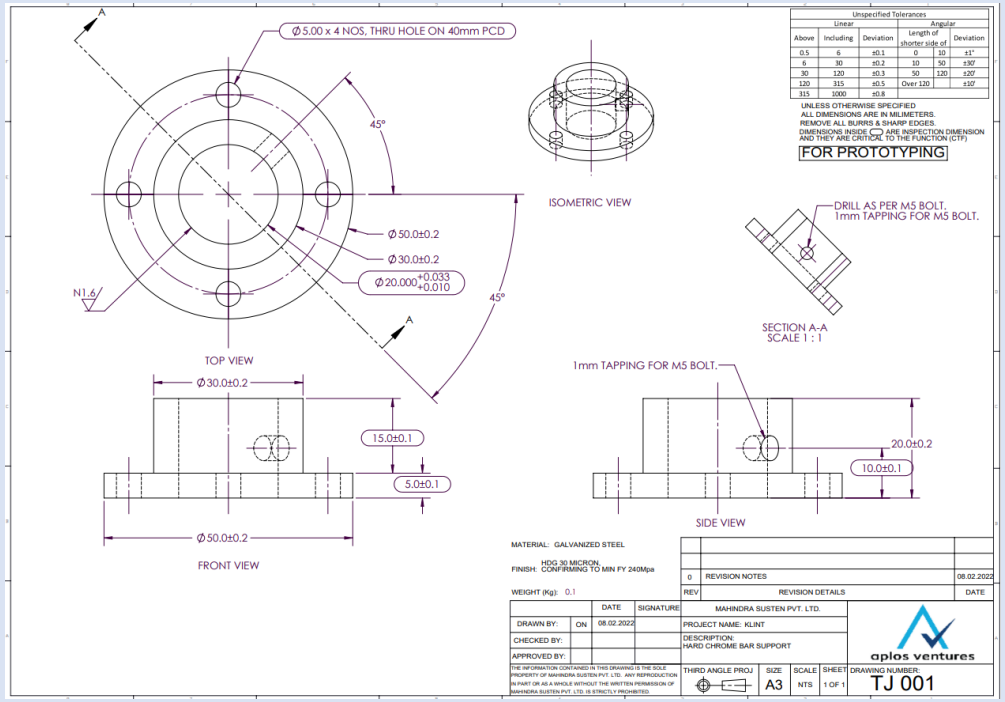
- Working in Renewable and Sustainable Energy Generation Domain which creates job and business opportunities.
- Filing International Patent.
- R&D for Renewable Energy Generation sector.
- Design optimisation of product.

Additional Information If Any

Tools used and skills learned:

- CAD/CAM – Solidworks 2020, Fusion 360.
- FEA- Ansys.
- Embedded systems- Arduino IDE Programming.
- Rapid Prototyping-3D printer LULZ Bot, Cura.

Visit to Karjat Solar Plant of Mahindra Susten.



Sample Production Drawing Sheet.

Conclusion

Knowledge Gained and Quality Work:

- Design of Trolley, shaft, track joints, track, Linear Guide.
- Working with Linear and Roller Bearings.
- Wheelbase and Nose Fouling Checks.
- Brainstorming sessions at almost every stage.
- Working on Electrical Actuators, Embedded Systems (Arduino), Sensors Motion Planning.
- Rapid Prototyping.
- Production/Manufacturing Drawings, GD&T, Fabrication quality checks.
- Preparing Bill Of Quantities and Bill Of Material for Manufacturing, Prototyping and Prototyping Test.
- Team management, Project Plan Development Stage Formation.
- Technical Presentations, Meets with Corporate Personals such as Mahindra Susten CEO Basant Jain Sir.
- Market survey and procurement of quotations and communication with market personals, Negotiations.
- Industry Visit and Visit planning.

THANK YOU!