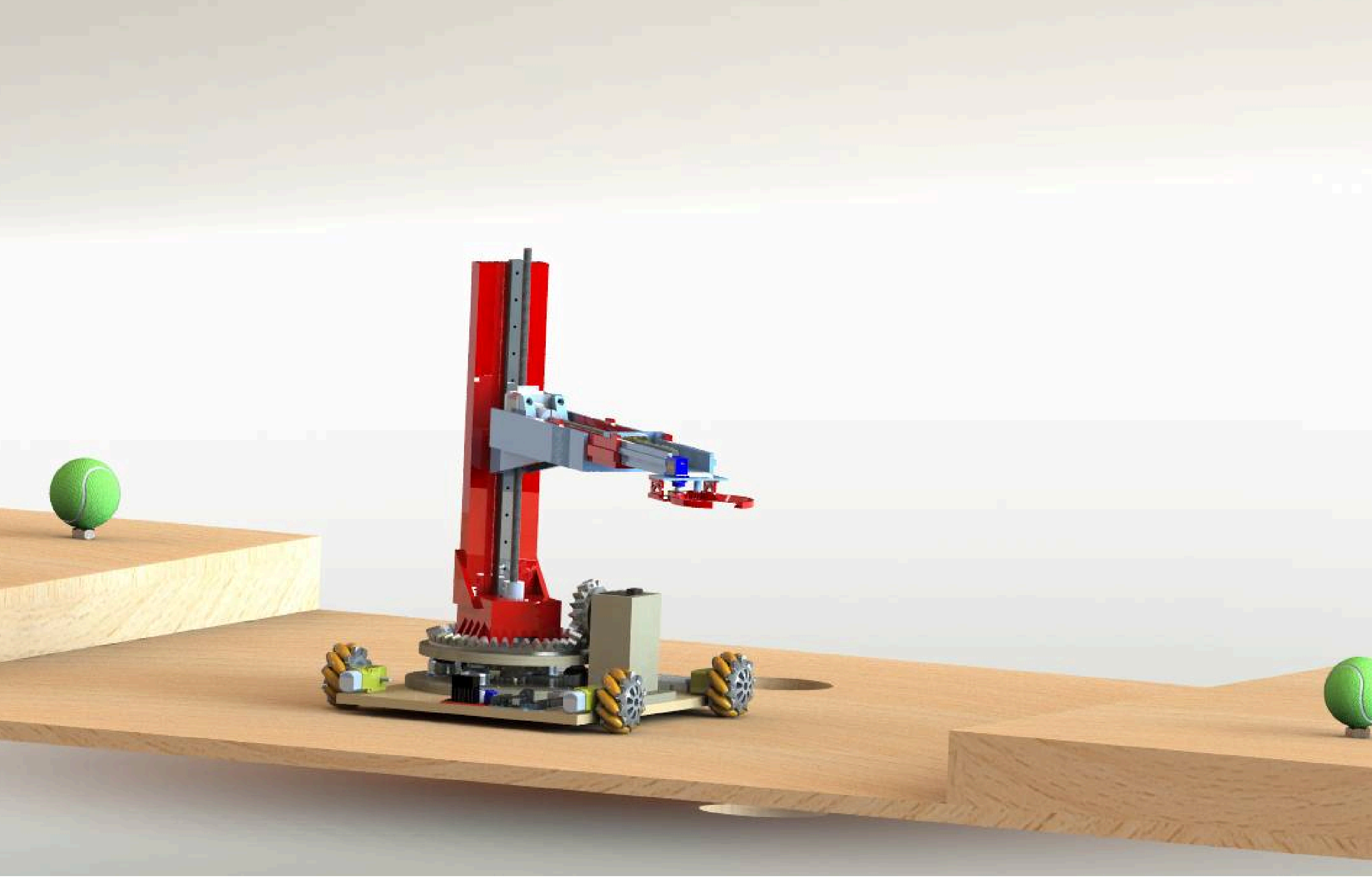
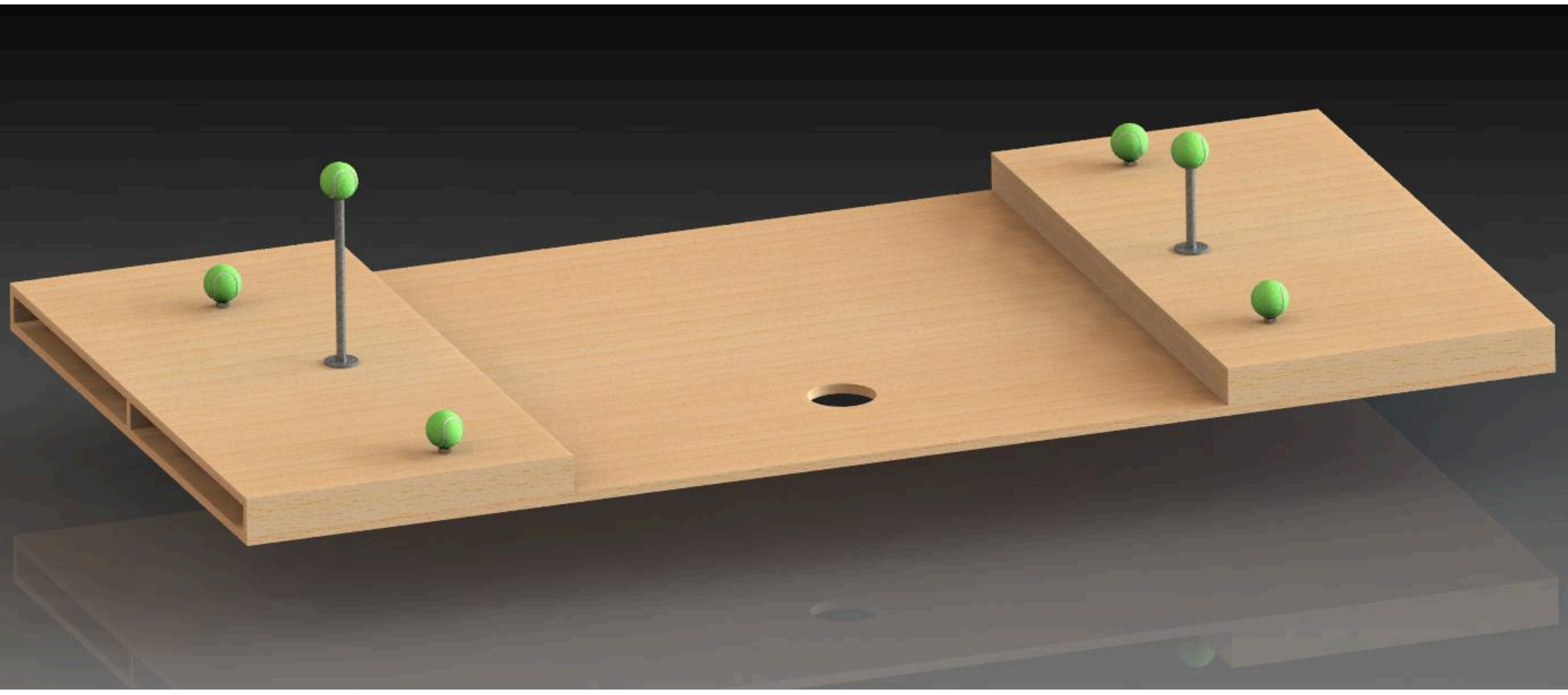


Engineering Design Portfolio

Mechanical Design Fundamental Studio 1

Aurelien Pons
250 451 94



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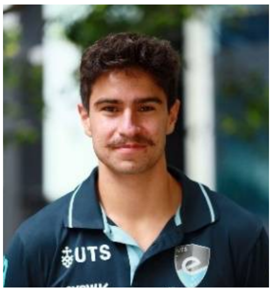


Figure 1 Professional photo

Introduction

My name is Aurelien Pons. I am an aspiring engineer volunteering as the aerodynamics lead at UTS Motorsports Electric.

Hands-on experiences and application of practical knowledge have enriched my academic journey at the University of Technology Sydney. Specialising in mechanical engineering has allowed me to develop a strong base in computer-aided designs, particularly SolidWorks, and my volunteering position as the lead of aerodynamics at UTS Motorsports Electric has provided me with an understanding of team leadership and collaboration. My skills include mathematics, thermofields, and following design processes throughout a project.

Application of Engineering Knowledge

In Mechanical Design Fundamental Studio 1, I aim to apply my engineering knowledge to real-world projects. I am looking to learn about the integration of mechanical and mechatronics systems in more detail, how to lead a team of engineers with different majors, improve my skills in SolidWorks and elaborate my understanding if engineering design documentation and process. I am motivated to enhance my skills as they are vital to being a successful engineer in a professional context.

Introduction to project

Throughout this portfolio, I will share the systems I have developed and the experience I have gained. Displaying my passion through artifacts from my studio subject.

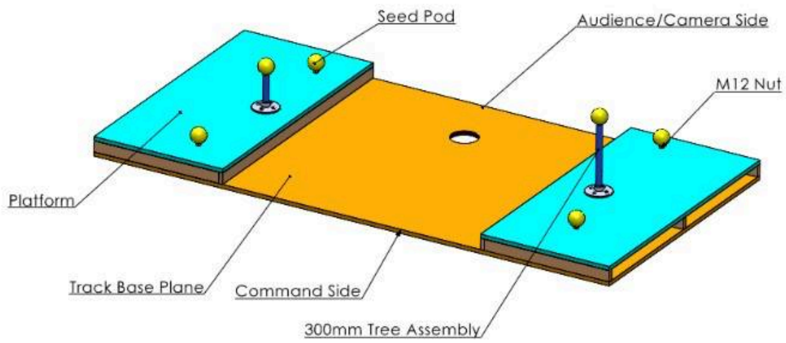


Figure 4 Warman track model

The thirty-seventh **Warman Design and Building Competition** is a yearly competition for second-year mechanical engineering students requiring students to devise an innovative solution. The context of the task this year revolves around students designing a system meant to replicate the retrieval of six capsules lost in space. Time efficiency is critical as famine rises, and capsules must be retrieved before the full moon.

Tennis balls are found spread asymmetrically throughout the track, simulating the lost capsules. The middle platform is where the system will be placed; this robot will need to retrieve the six tennis balls and drop them in the hole in under 2 minutes.

Artefact 1

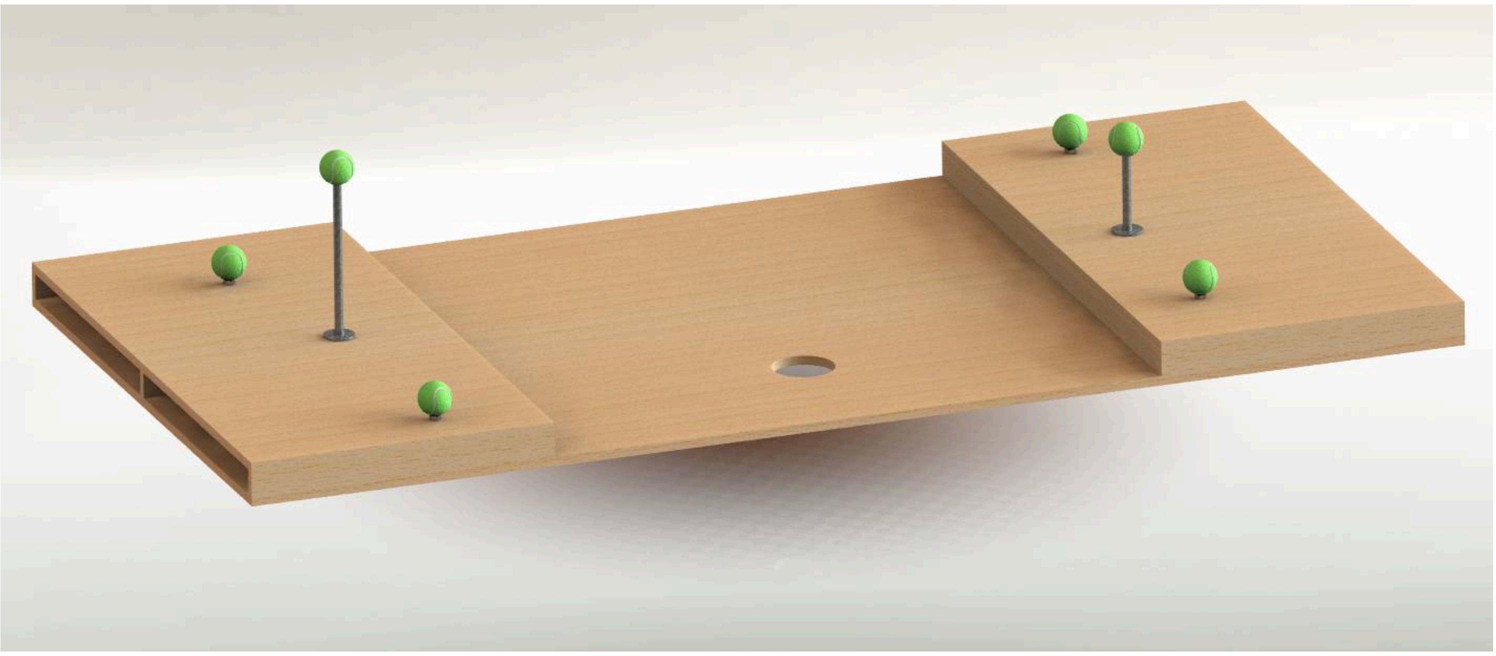


Figure 3 Warman track assembly 2024

Figure 2 AI-generated Image sustainability

Engineer Australia Code Of Ethics (4.2)

To be a successful engineer requires a high standard of professional conduct. Engineers Australia developed a Code of Ethics that includes demonstrating integrity, practising competently, exercising leadership, and promoting sustainability. [1]

Promote Sustainability (4.2) focuses on fostering the health, safety, and well-being of the community and the environment in engineering tasks. A proposed change to the ‘Warman track’ involves substituting materials in the initial structure with sustainable options as the challenge changes yearly. This promotes sustainability and aligns with Engineers Australia's ethical codes.

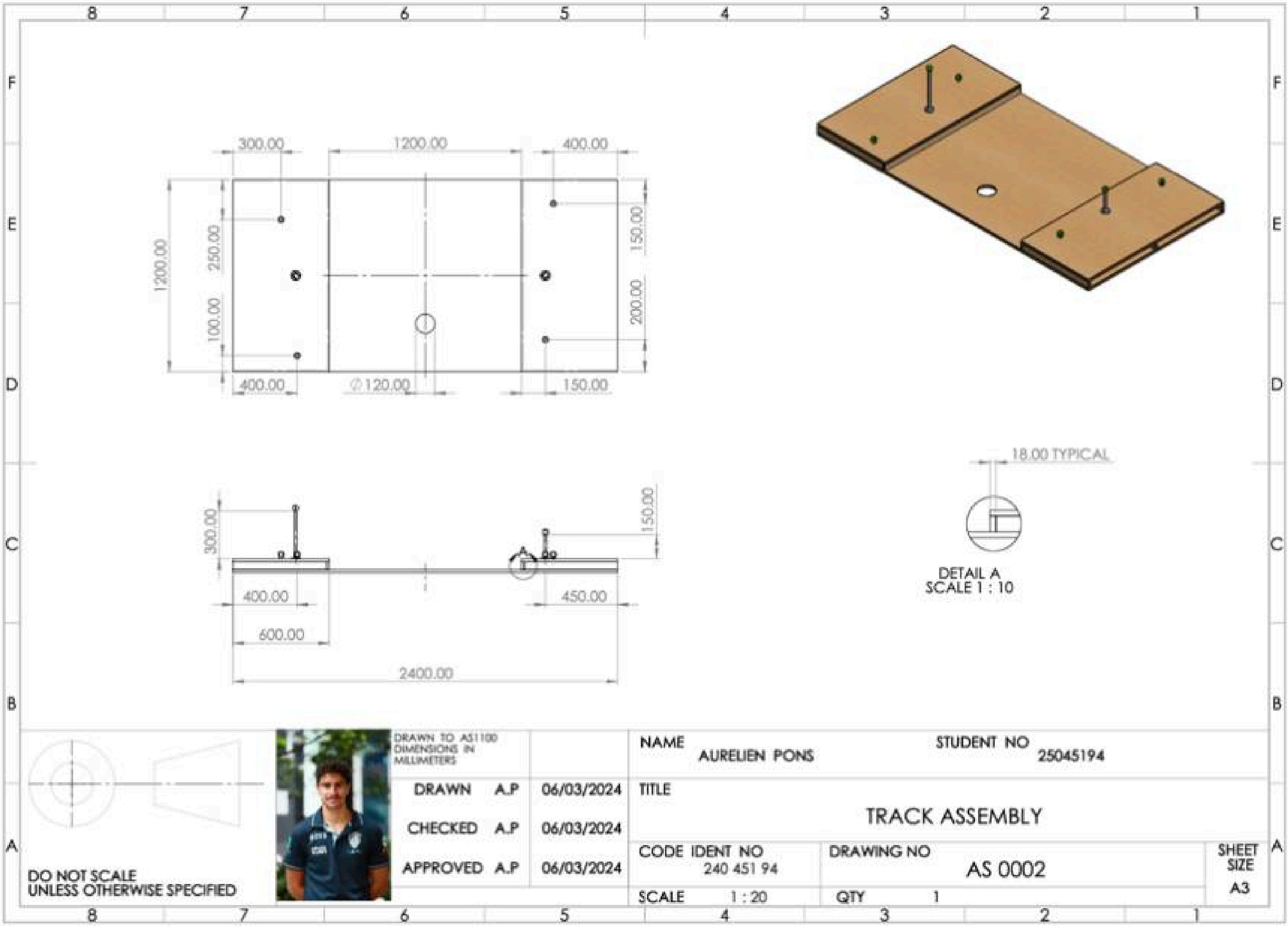
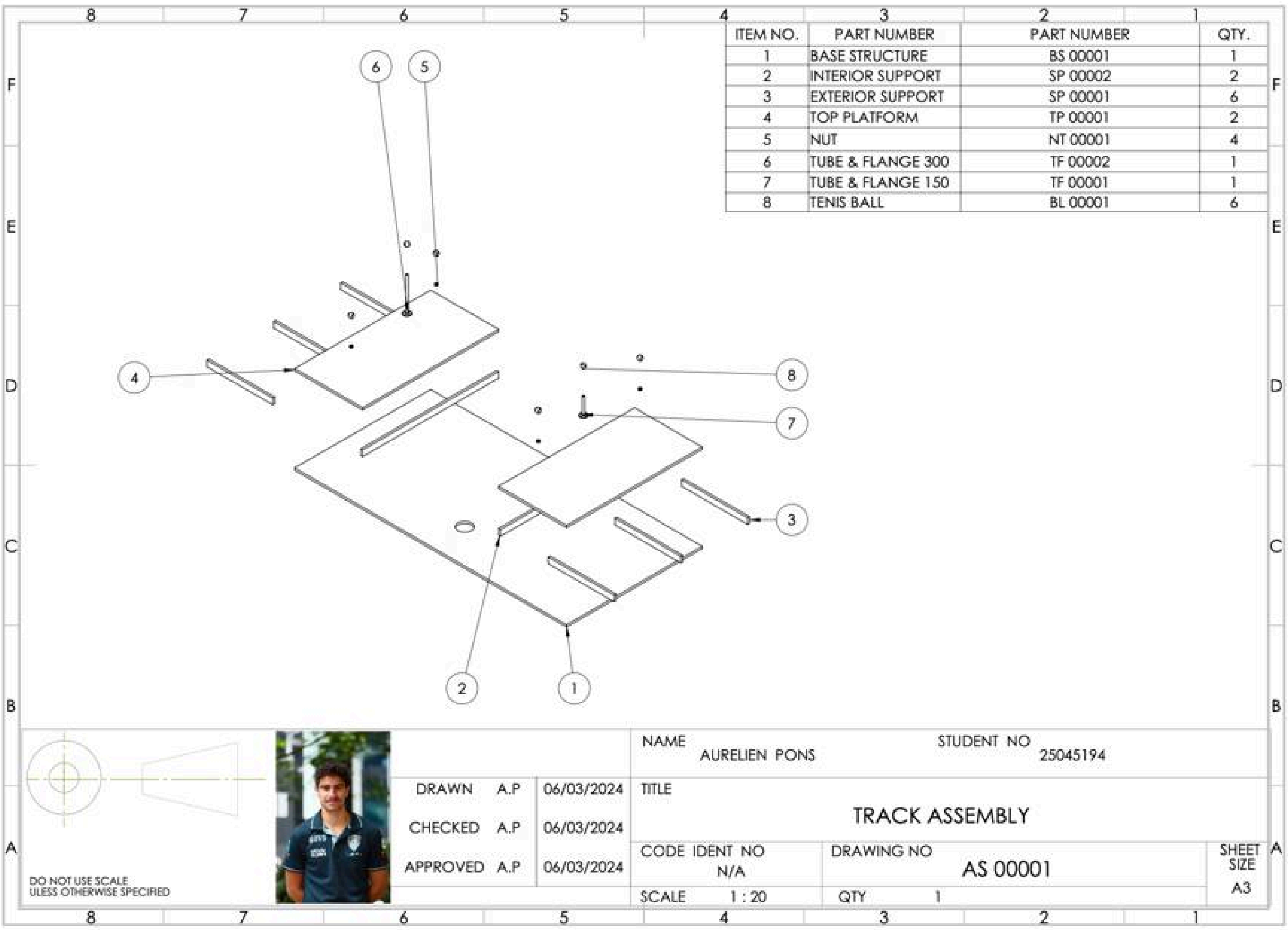


Figure 7 Track model dimensions



ITEM NO.	PART NUMBER	PART NUMBER	QTY.
1	BASE STRUCTURE	BS 00001	1
2	INTERIOR SUPPORT	SP 00002	2
3	EXTERIOR SUPPORT	SP 00001	6
4	TOP PLATFORM	TP 00001	2
5	NUT	NT 00001	4
6	TUBE & FLANGE 300	TF 00002	1
7	TUBE & FLANGE 150	TF 00001	1
8	TENIS BALL	BL 00001	6

Figure 6 Exploded view

General Requirements

No.	Description/ Requirement	Value			Unit
1	Functions	Min	Exact	Max	
1.01	The system shall be able to retrieve all balls	-	-	-	-
1.02	The system should be able to retrieve multiple balls whilst the chassis of the system remain stationary	-	-	-	-
1.03	The system shall incorporate an arm that should actuate both vertically and horizontally and not diagonally	-	-	-	-
1.04	The system shall be initiated to complete all functions from the press of a button or flick of a switch	-	-	-	-
1.05	The system shall have movement across the track	-	-	-	-
1.06	The system should complete functions through the programming of a single Arduino	-	-	-	-
1.07	The system shall incorporate a claw that collects the tennis ball from underneath its mount	-	-	-	-
1.08	All system operations must be completed within time limit	-	-	120	sec
1.09	The system shall be fully supported by the competition track at all times	-	-	-	-
1.1	The system shall incorporate a tennis ball storage compartment	-	-	-	-
2	Geometry/ Positioning	Min	Exact	Max	
2.01	The system shall fit within the dimensions of a 400x400x400mm cube	-	-	-	-
2.02	The chassis shall leave enough distance from the 400mm boundary width to accommodate wheels positioned on either side	30	-	50	mm
3	Design	Min	Exact	Max	
3.01	The system shall weigh less than 6 kilos	-	-	6	kg
3.02	Centre of mass of system shall not be offset past the edge of the chassis	-	-	-	-
3.03	Sub-systems should be wired to have the ability to actuate simultaneously	-	-	-	-
3.04	The arm should resist deflecting more than specified amount	-	-	5	mm

Figure 8 General requirements table

Engineer Australia Code Of Ethics (3.3)

The current Code of Ethics 3.3 emphasises honest and effective communication and acknowledges the reliance others place on engineering expertise.

I agree with the current Code of Ethics 3.3, highlighting the importance of honest and effective communication in engineering practices.

Figure 9 AI-Generated image EA 3.3

As engineers, we should strive to communicate transparently and tailor our messages according to the stakeholders' backgrounds and expertise. Prompt and accurate information is essential to prevent decision-making delays, maintain project progress, and ensure safety.

Additionally, it is our responsibility to openly display any potential hazards, risks, or conflicts of interest. Based on integrity and accountability, these changes aim to improve professional communication and lead to safer, more informed, and ethically sound engineering practices.

I have taken into account the Code of Ethics in my artifact 2 by clearly displaying my thought process in a transparent and tailored manner. Decision matrices and Pros and Cons tables are shared, displaying the improvements made throughout my engineering process. I also included design constraints and considerations as I developed this subsystem. [1]

Artefact 2 Height Variation System

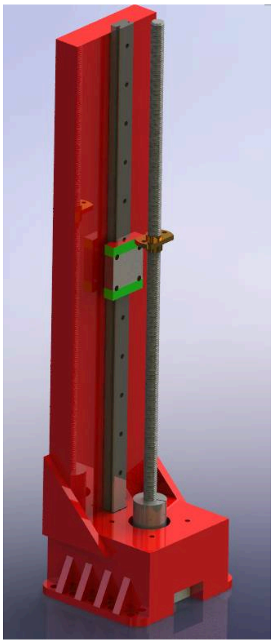


Figure 10 Final Height Variation

Problem Statement:

Develop a platform with precise and reliable control to efficiently retrieve tennis balls within a designated area by travelling vertically at high speeds.

Subsystem function

The track has multiple platforms at different elevations, along with a tube and flange that elevates two tennis balls to heights of 300mm and 150mm above the highest platform. To operate effectively, the robot requires a height variation mechanism, a subsystem included in my design that needs to be precisely and reliably tuned according to the problem statement provided.

Design Selection

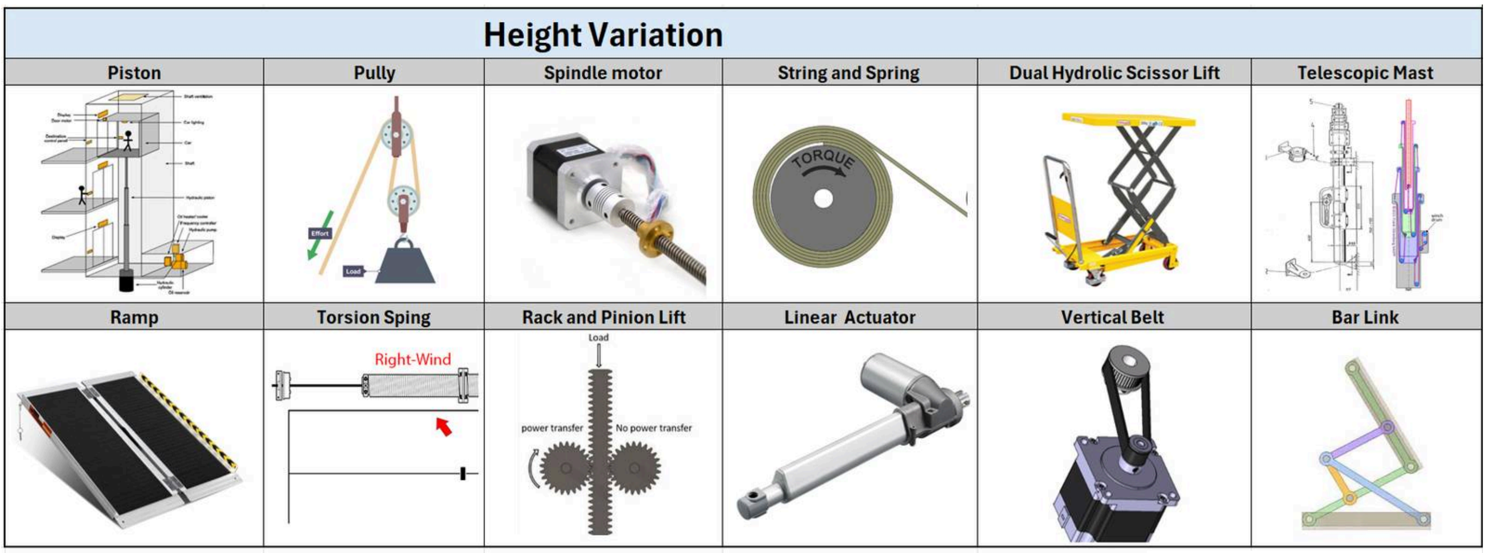


Figure 12 Morphological Table

Morphological table

The morphological table shown in Figure 12 was created earlier to help us identify options for ideation. Before proceeding with a decision matrix, half of the systems were eliminated due to unavoidable constraints such as accessibility and regulations.

Decision matrix

Height Variation													
Selection Criteria	Importance	Solutions											
1= Not Viable 10= perfect	1= Not Viable 10= perfect	Hydraulic Piston		Pully		Spindle Motor		String and Spring		Telescopic Mast		Dual Hydraulic Lift	
		Rating	Importance	Rating	Importance	Rating	Importance	Rating	Importance	Rating	Importance	Rating	Importance
Weight	6	4	24	8	48	7	42	9	54	6	36	3	18
Accuracy	9	5	45	6	54	7	63	5	45	8	72	5	45
Speed	8	4	32	6	48	7	56	6	48	4	32	4	32
Energy Consumption	5	7	35	8	40	7	35	8	40	4	20	3	15
Ease of Setup	7	5	35	7	49	7	49	7	49	2	14	3	21
SUM			171		239		245		236		174		131
Rank			5		2		1		3		4		6

Figure 11 Height Variation Decision Matrix

All viable systems are considered and ranked using selection criteria weighed based on their importance. The criteria were determined through constraints and helped determine the best possible system.

Selection criteria were determined based on our general requirements and constraints; each was weighed depending on its importance. By following this process, I chose the most viable option unbiasedly.

The decision matrix improved collaboration and minimised conflict by evaluating options against multiple criteria and ensuring accountability through a documented process. This ultimately saved time and enhanced decision-making efficiency.

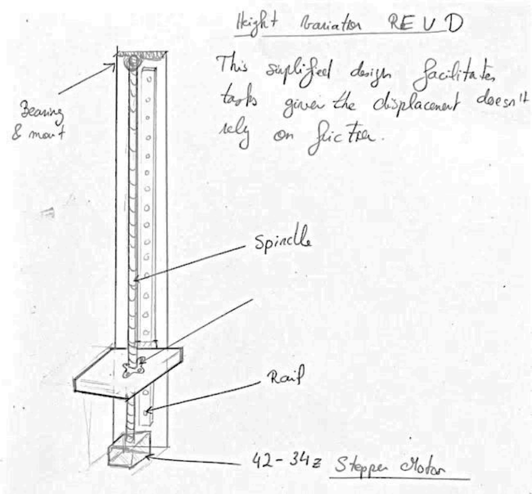


Figure 13 Drawing Concept 1

Functional Requirement

Requirment ID	Sub System	Descriotion / Requirement	Details	Who	Time relevancy
		Height requirments			
CGSML 1	Height Variation	The platform's height shall not be more than 350 mm to accommodate for all systems	Systems should fir in 400mm cube	A.P	week 6
CGSML 2	Height Variation	The platform's height shall not be less than 300 mm to accommodate the vertical movement system and allow for effective ball retrieval within the designated area.	reach top ball	A.P	week 6
		Performance and Motor Capability Requirements			
CGSML 3	Height Variation	The motor driving the platform must possess sufficient torque capabilities to overcome the weight of the telescopic arm, ensuring smooth and reliable movement during operation.	maxium torque on motor should not be exceeded	A.P	week 8
CGSML 4	Height Variation	The vertically displaced platform must exhibit high speed to guarantee that the performance will be complete within time restriction	Perform within 120 seconds	A.P	week 6
CGSML 5	Height Variation	Vertical movement shall be smooth and accurate, maintaining stability during operation.	Perform within 120 seconds	A.P	week 6
		Dimensional and Intergration Requirements			
CGSML 6	Height Variation	The dimensions of the platform shall not exceed the confines of an 80x90 mm box to ensure compatibility with existing infrastructure or deployment specifications.	integration to roatating base	A.P	week 6
CGSML 7	Height Variation	bolts shall be utilized for securing the platform onto the rail system to guarantee robust attachment and prevent dislodgement during operation.	fit purchased rail	A.P	week 8

Figure 14 Functional Requirements Table

Based on my spindle and motor system choice, I further developed the requirements to ensure the solution met the project's performance, reliability, and integration needs. Functional requirements were updated throughout the project, ensuring a **common objective** for the team.

Following the **engineering design process** facilitated the definition of the scope and objective, provided a clear guide through the project's development, and ensured that our final product would align with established benchmarks.

Material Selection

Figure 15 Hyper PLA Fillament

After careful consideration of various materials, PLA (Polylactic Acid) was chosen for the final product due to its lightweight (density of 1.25 g/cm^3) and strong nature (tensile strength of 37 MPa and Young's modulus of 3.5 GPa). While laser-cut wood was considered, it was not selected due to its tendency to flex and add unnecessary weight (density of 0.65 g/cm^3 and flexural strength of 60 MPa). Carbon fiber, although highly suitable in terms of strength (tensile strength up to 2000 MPa) and weight (density of 1.6 g/cm^3), was dismissed due to its high cost (around $10-$20 per pound). PLA's favourable mechanical properties, combined with its cost-effectiveness and environmental benefits, make it the ideal choice for producing a durable and lightweight final product source

Engineering Analysis

Stepper motors are found to be the most beneficial choice of motors as they hold their position without any torque requirements **for filling requirement CGSML 5.** Power requirements need to be taken into account

Pitch and motor RPM affect speed in a Lead Screw system. Choosing the right motor and screw ensures optimal performance and energy utilisation. The Lead Screws and Motors on 3D printers are made to displace masses at high speeds. **Will they accommodate our need to displace 1.5kg at 200mm/s?**

Lead Screw Calculations:

10/04/2024

$$\begin{aligned}
&\text{Starts : 4}\\
&\text{Pitch : 2 mm}\\
&\text{Lead : Pitch} \times \text{Starts} = 0.008\,\text{m}\,(8\,\text{mm})\\
&\text{Major diameter, } d_m = 8\,\text{mm}\\
&\text{Root diameter, } d_r = 6.7\,\text{mm}\\
&\alpha = \frac{1}{2}\cdot\theta = 15^\circ\\
&\text{Mass} = 1.5\,\text{kg} \quad (\text{Estimate Arm mass } (\geq 1.5\,\text{kg}))\\
&\text{Force, } F = \text{mass}\cdot g = 14.715\,\text{N}\\
&\text{Friction Coefficant : } 0.19\ (\text{Lubricated})
\end{aligned}$$

Torque to raise

$$Tr = \frac{F\cdot d_m}{2}\left(\frac{\pi\cdot f\cdot Dm\cdot \sec(\alpha)}{\pi\cdot Dm - f\cdot l\cdot \sec(\alpha)}\right) = 0.032Nm$$

Torque to Lower

$$Tl = \frac{F\cdot d_m}{2}\left(\frac{\pi\cdot f\cdot Dm\cdot \sec(\alpha)}{\pi\cdot Dm + f\cdot l\cdot \sec(\alpha)}\right) = -0.007Nm$$

Aurelien Pons

Figure 15 Engineering Analysis Torque Calculations

Power Calculations

10/04/2024

$$\begin{aligned}
&\text{Current, } I = 1.5A\\
&\text{Nominal Volage, } V = 4.83V\\
&\text{Aim speed, } v = 200mm/s
\end{aligned}$$

Find Turn

$$turn = 2\cdot\pi\cdot rad$$

Find Angular Velocity

$$\omega = \frac{v}{l/turn} = 157.08rad/s$$

Required Power

$$P = Tr\cdot\omega = 5.066W$$

Theoretical Motor Power

$$P = V\cdot I = 5.76W$$

Aurelien Pons

Figure 16 Engineering Analysis Power Calculations

Engineering Analysis Conclusion

My required torque findings of 0.032Nm are within the range of the 0.4Nm rated torque [2]. Furthermore, the motor's theoretical power output is 5.57 Watt, which is greater than our required power at the maximum rated vertical speed of 2000 mm/s. These findings are aligned with our requirements. The motor's efficiency is a factor to consider, yet the power required would significantly drop if the speed decreased and we were not required to perform at max speed.[3]

Prototype

Creating a preliminary model allowed me to test and refine my design to explore design ideas, gather feedback, and validate concepts before committing to more advanced stages of prototyping and production. **Cardboard testing** is a low-risk, low-cost method for exploring design ideas, gathering feedback, and validating concepts before proceeding to more advanced stages of prototyping and production.

Figure 17 Low-fidelity prototype

Figure 18 Low-fidelity prototype

Feedback from tutors

- Positioning the motor beneath the system may be a waste of space.

- The friction inside the height variation between the displaced platform and the system will be a significant issue

- The U-shaped beam might not be strong enough to counteract the torsional forces of the motor without the use of a rail or bearings.

I've taken this feedback into account while revising and refining my CAD design, as seen below.

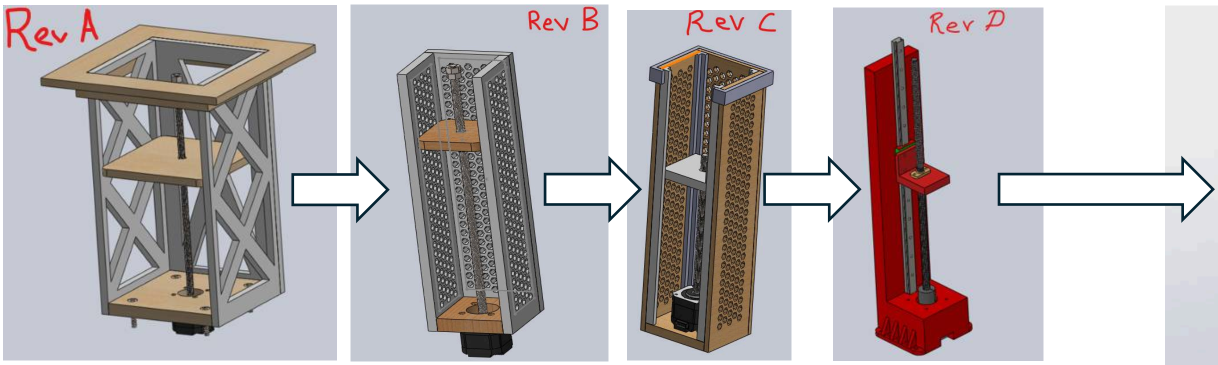


Figure 20 CAD Revision Refinement

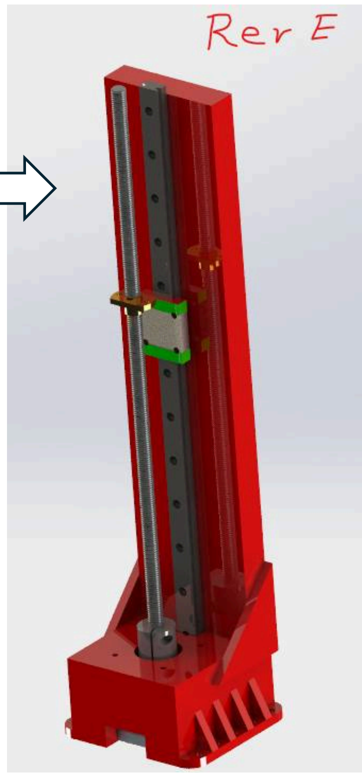


Figure 19 Final Design

CAD Models for Improvement and Refinement

Throughout the development of the Height Variation subsystem, I elected to create CAD models of my concepts and integrate them into assemblies. This method facilitated continuous improvement and refinement. Utilising CAD models prior to manufacturing helped streamline the design process, enhance product quality, and reduce both costs and time associated with prototyping and production. By leveraging CAD revisions, I was able to identify and resolve potential issues early, ensuring a more efficient and effective design workflow while adhering to the design constraints present during ideation.

Revision	Description	Improvements Made	Design Constraints & Considerations	Evaluation
REV A	Initial Visualization	- Established base dimensions (80x90mm) - Identified truss wall flex issue	- Truss walls not optimal for shear forces	- Initial design visualization only - No physical tests conducted
REV B	First Improvements	- Reinforced walls for shear strength - Maintained base dimensions (80x90mm)	- Motor placement under mechanism problematic for integration - Excessive side wall friction - U beam not optimal for shear stress	- Increased shear strength theoretically - High friction measured
REV C	Second Improvements	- Added L-shaped acrylic sliders to reduce friction - Metal bracket Added to restrain walls - Integrated motor into system	- Three side walls limit arm space (64mm between walls) - Shear force still present despite reduced friction - U beam still problematic for shear stress	- Space limitation persists
REV D	Third Improvement	- 3D-printed PLA walls for single-wall design - Rail system reduces friction - Adjustable spindle and rail	- Awaiting final cut of spindle and rail for perfect fit	- friction negligible - Single-wall design offers space for telescopic arm subsystem - motor mounting secure and accessible - Structural failure observed while assembling
REV E	Final design	- Triangulation added following structural failure	Consideration and Tolerances: Ender V3 accuracy : ± 0.10mm Sliding fit : ±0.25mm Fasteners: ± 0.30mm	- Structure meets requirements - Manufacturing Facilitated by 3D printing - Tolerances

Figure 21 Refinement Table

Refinement Table Reflection

The iterative development of the Height Variation subsystem through systematic CAD modelling and simulation enabled continuous improvement and refinement **based on feedback**. Each revision addressed specific design constraints and considerations, such as shear strength, friction reduction, and spatial limitations**. The final design successfully <u>met all structural and functional requirements</u>**, demonstrating enhanced product quality and streamlined manufacturing processes. This project exemplifies a methodical approach to engineering problem-solving, ensuring reliability and efficiency in the final subsystem.

Testing and Validating

Through testing, elements of integration and critical failures were analysed. Figure 22 hows my subsystem functioning but missing key integration components. Due to a discrepancy in the 42-34z stepper motor model imported into my CAD assembly, I had to manually enlarge the rectangular cutout for the wires at the base of the 3D-printed structure. A critical failure point was identified and reinforced through triangulation, as shown in Figure 23

Figure 22 Initial Testing

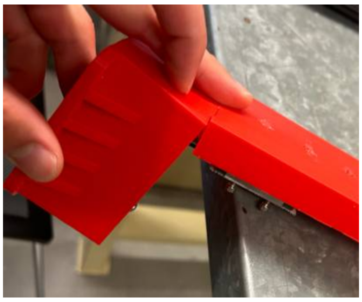


Figure 23 Point of Failure

I conducted a Failure Modes and Effects Analysis (FMEA) and concluded that the 3D print should fail at the midpoint of the structure, as the metal rail would maintain stability in the event of failure. Figure 25 and 26 illustrate the "split" in Prusa Slicer, allowing the upper and lower parts of the print to be assembled separately.

Extensive testing was carried out to evaluate the performance of the robot. Thanks to my engineering analysis of torque and power calculations, my system met its functional requirements. The spindle and motor displaced the platform along the rail with speed and precision, ensuring accurate and reliable vertical movement, **as demonstrated in the attached video:**

https://youtu.be/ZNQbRx_1bGo

Despite creating an assembly in SolidWorks, fabricating physical models for testing proved essential. This process revealed missing integration elements and points of failure, enabling a detailed analysis of the failures. The physical model facilitated thorough investigation and refinement of the design.

Figure 26 Final Model

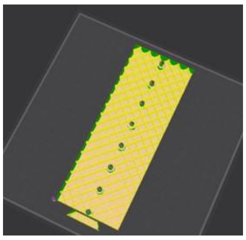


Figure 25 Upper Print

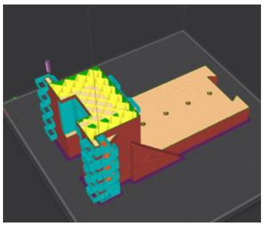


Figure 24 Lower Print

Refection & Conclusion

This Artifact highlighted the importance of iterative design, subsystem integration, and feedback incorporation. Utilizing CAD models, low-fidelity prototypes, and careful material selection balanced theoretical and practical aspects. Key lessons included the significance of seamless subsystem integration, continuous refinement through iterative processes, and proactive self-learning, all of which will enhance future engineering projects. One thing I would do differently is to allocate more time for early-stage testing to identify and resolve integration issues sooner, ensuring a smoother development process.

Artefact 3 Displaced Platform Integration

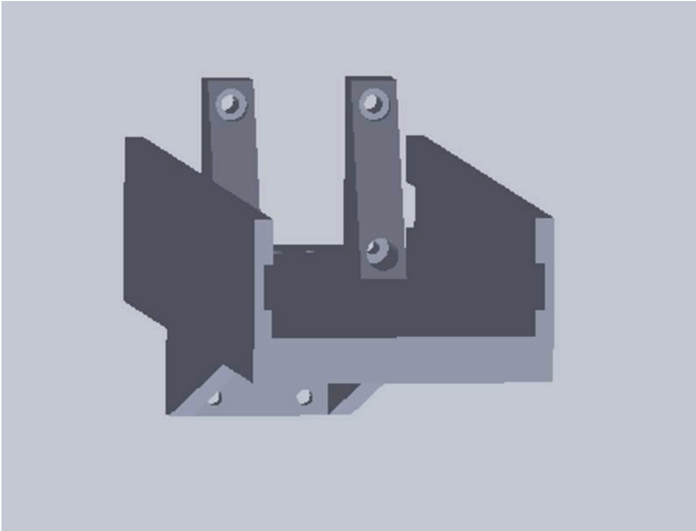


Figure 27 Final Displaced Platform

Problem Statement:

Develop a design of a telescopic arm that allows the integration to the height variation mechanism

Subsystem function

As I proceed through the design process, it is essential to consider the integration of mechanical subsystems. I aim to integrate and model the telescopic arm while taking factors into account such as tolerances, stress, strain, torque requirements and integration

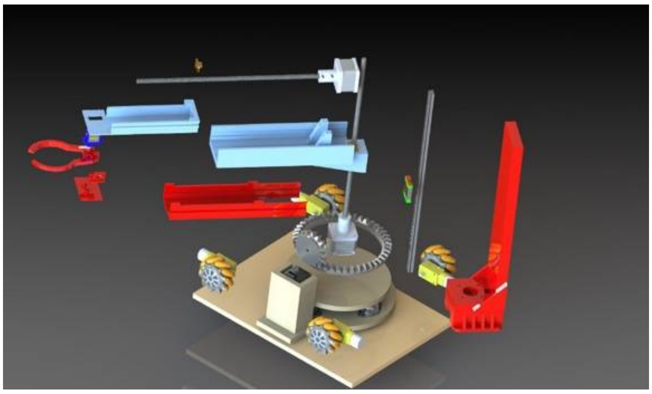


Figure 29 Final Exploded View

Role:

As the project team lead, I ensured the seamless integration and completion of individual subsystems that lacked integration, facilitating their cohesive operation as a unified robotic system.

Engineer Australia Code Of Ethics (1.3)

"1.3 Respect the dignity of all persons"
E.A. 1.3 focuses on being fair, courteous, and impartial in professional behaviour. To make it more relevant, it should include explicit anti-discrimination language, a focus on diversity and inclusion, guidance on reporting ethical violations, and encouragement of success within a team.

In implementing the EA Code of Ethics, especially Section 1.3, in my artifact 3, I prioritised respecting the dignity of my teammates by recognising and respecting their decision to allocate more time to other projects. Instead of criticising their choices, I focused on completing the task of integration to ensure a successful outcome for the team. This demonstrates my commitment to effective teamwork and inclusivity. [1]

Figure 28 AI-Generated image EA 1.3

Goal:

The goal of this Artifact is to develop the "Displaced Platform," which will be vertically displaced by the Height Variation System, allowing seamless integration with the Telescopic Arm (Figure X) and the Height Variation System (Figure X).

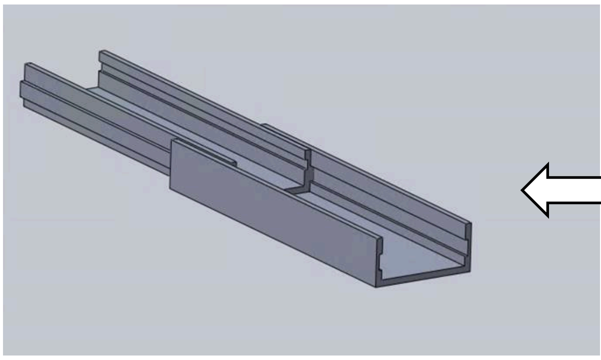


Figure 34 Telescopic arm

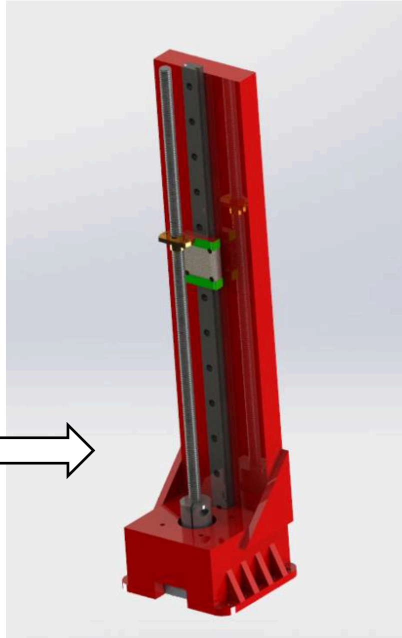


Figure 31 Height Varation System

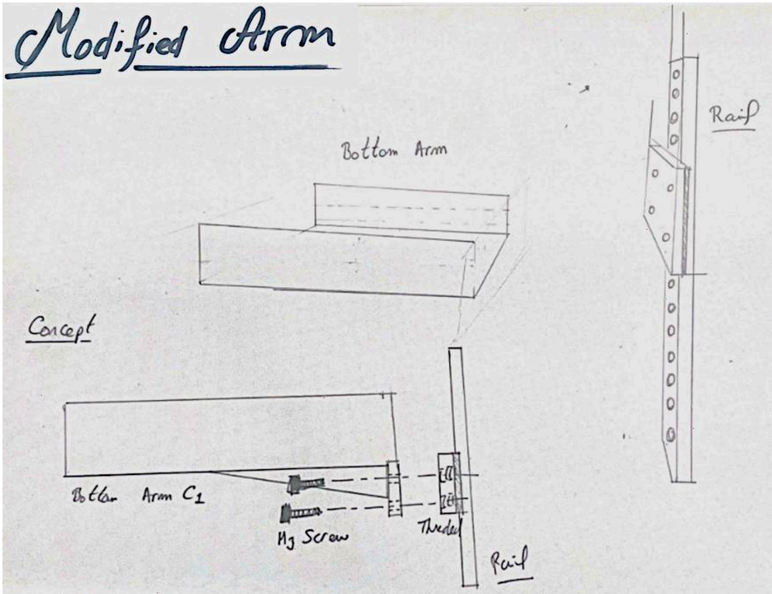


Figure 32 Ideation drawing 1

Concept 1

This concept was realised by repurposing the largest available arm and integrating a vertical triangulated structure, designed to enhance stability and load distribution. This engineering solution allows the telescopic arm to be securely bolted onto the green and silver rail bearing, optimising alignment and functionality while ensuring robust support and precision in vertical adjustments.

Concept 2

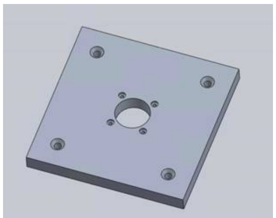


Figure 30Square displaced platform

This concept employed a 5mm thick square platform to support the telescopic arm. The rail system mitigates torsional forces from the motor, enabling a cost-effective yet precise integration method. This design ensures optimal stability and accuracy in the operation of the telescopic arm.

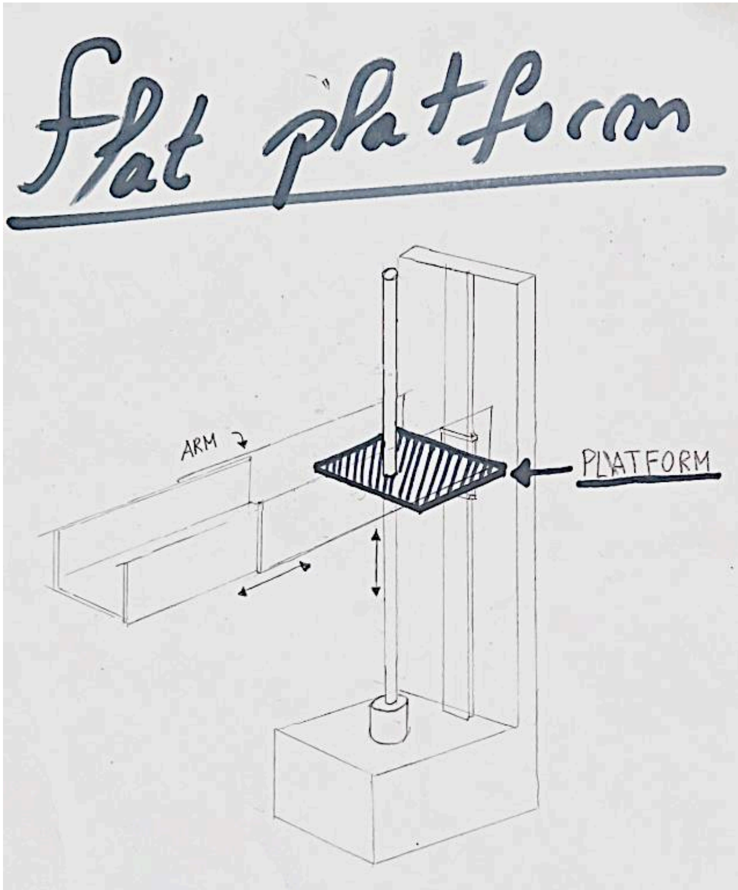
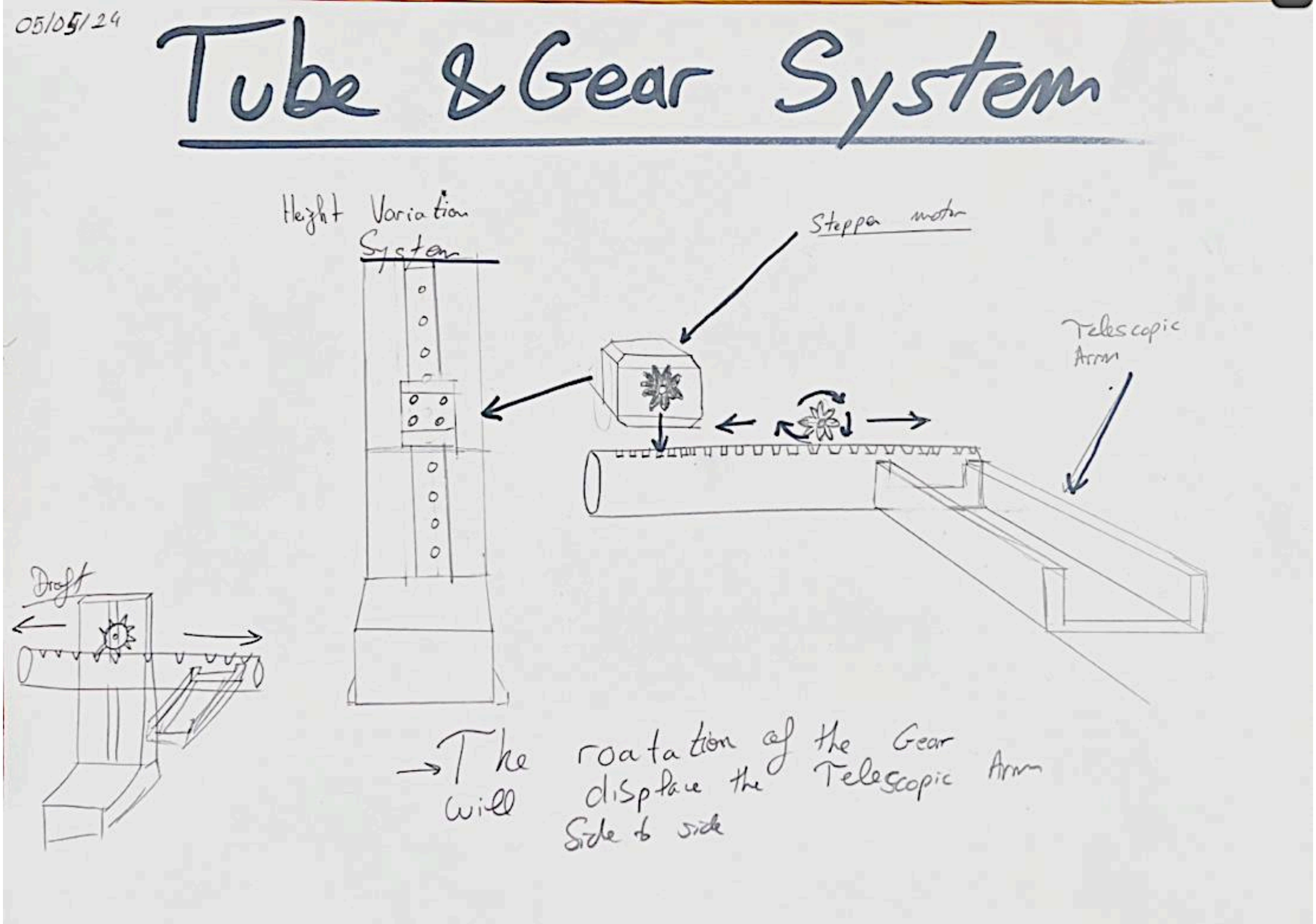


Figure 33Ideation drawing 2



Concept 3

Figure 36 Ideation drawing 3

This tube gear system introduces an additional axis of operation for our robot. The stepper motor is directly connected to the rail bearing, with the tube secured beneath the motor. As the gear rotates, it actuates the tube horizontally, providing a stable attachment point for the telescopic arm.

Decision matrix

Displaced Platform							
Selection Criteria	Importance	Solutions					
1= Not Viable 10= Ideal	1= Not Viable 10= Ideal	Concept 1 : Modified Arm		Concept 2: Square Platform		Concept 3 : Tube and gear System	
		Rating	Importance	Rating	Importance	Rating	Importance
Ease of Assembly	5	9	45	10	50	5	25
Weight	7	8	56	7	49	1	7
Ease of manfactuing	5	7	35	7	35	6	30
Cost	3	10	30	8	24	5	15
SUM			166		158		77
Rank			1		2		3

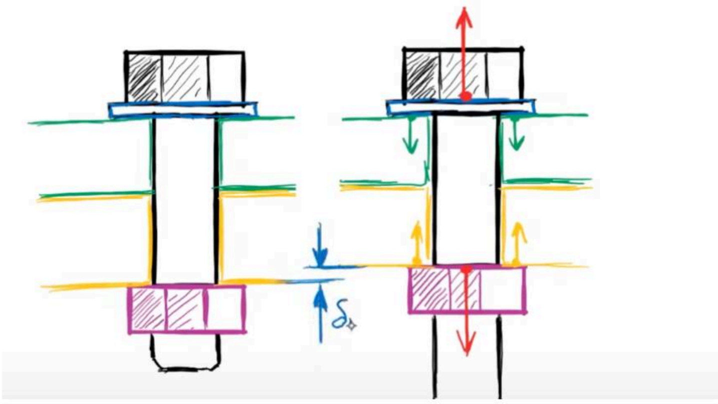
Figure 35 Decision Matrix

Based on the decision matrix ranking, the Modified Arm is the most viable option. The cost is negligible as the part can be 3D printed. This system adds no additional weight since it integrates into the existing telescopic arm. Assembly is straightforward, requiring only bolting the system to the rail bearing, making it an ideal solution.

Engineering Analysis

To ensure the displaced platform securely fastens to the rail bearing without tearing through the PLA, it's imperative to calculate the maximum torque on the M3, which are the most likely choices. The length of the bolts is irrelevant in this calculation; instead, focus is placed on the thread and pitch to determine the optimal torque requirements.[4]

Bolt & nut torque Calculations M3



$$\tau = K \cdot F \cdot d = 25Nm$$

$$K : Nut\ factor = 0.15$$
$$F : Clamping\ force = 56$$
$$d : Bolt\ nominal\ Dia = M3\ = 3m$$

$$F = \frac{0.75\sigma\pi(D - 0.9382P)^2}{4} = 56.5968649893$$

$$\sigma : Proof\ strength\ in\ MPa = 60$$
$$P : bolt\ thread\ pitch = 0.5mm$$

Figure 37 Vertical mounting to rail

Figure 38 Max torque Calculations (Notion app)

Engineering Analysis Conclusion

Following a thorough engineering analysis, it was determined that a maximum tightening torque of 25 Nm would be adequate to ensure the secure attachment of the telescopic arm to the rail bearing. The analysis assumed that the torque requirements for a tapped thread would be analogous to those for a conventional nut and bolt assembly. Although the use of threaded inserts was evaluated as a potential enhancement for increased robustness, their extended lead time was a limiting factor. Therefore, the final decision was to proceed with the implementation of standard M3 nuts and bolts.

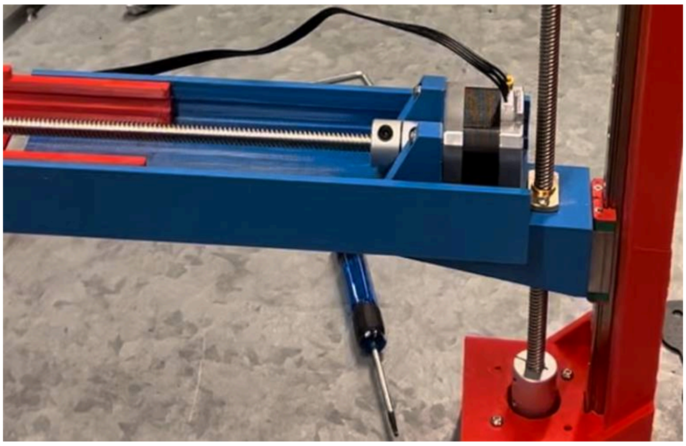


Figure 39 Final Displaced Platform

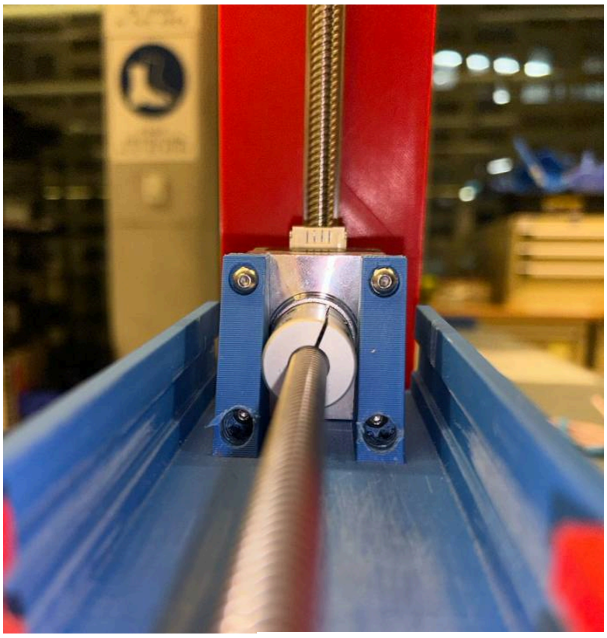


Figure 41 Final Dispalced Plaform

Reflection on Testing and Validating

As seen in more detail in my testing and validation video [***https://youtu.be/ZNQbRx_1bGo***];

The displaced platform demonstrated exceptional performance during rigorous testing, validating its design and functionality. Integration within SolidWorks assemblies confirmed that the system met operational requirements, with all components interfacing correctly. The simulation provided a reliable assessment of the platform's structural integrity and alignment with the telescopic arm, ensuring that engineering specifications were thoroughly met. This virtual testing phase allowed for the identification and resolution of potential issues, confirming the robustness of the design under specified conditions.

While the SolidWorks simulations were effective, future iterations would benefit from the development of a physical prototype. This would provide additional insights, particularly in achieving precise tolerances for nuts and bolts. The need to drill holes for enlargement highlighted areas for potential refinement, and hands-on adjustments would ensure optimal fit and function. Overall, the successful performance of the platform, validated through meticulous virtual testing, underscores the efficacy of the engineering process. Incorporating physical prototypes will enhance precision and reliability, further refining the design for improved performance.

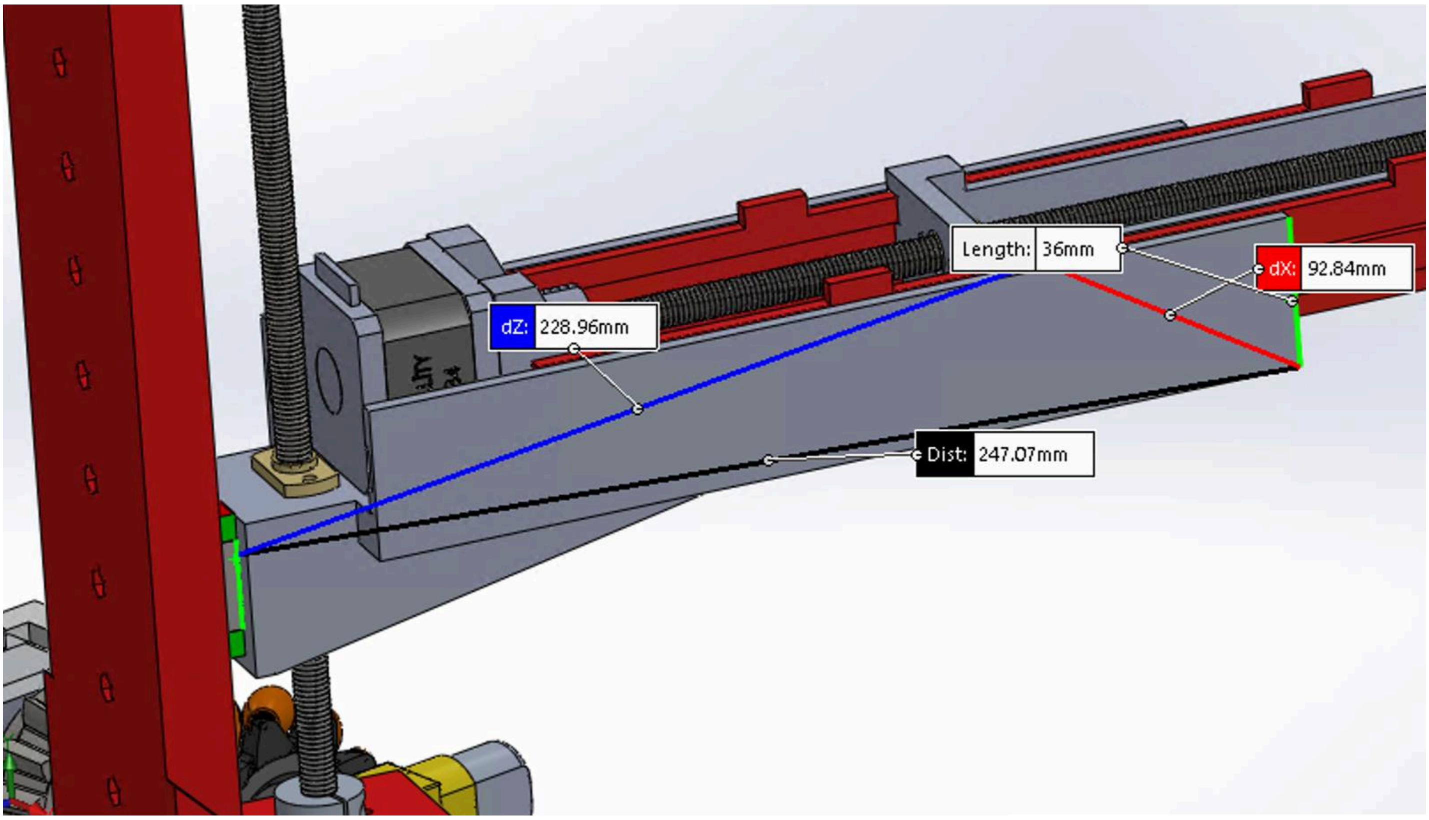
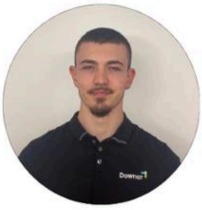
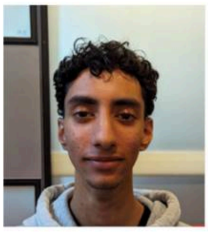
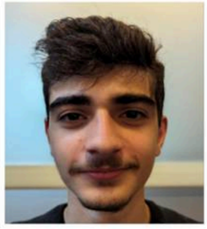


Figure 40 Testing in Solidworks assembly

Artefact 4 Project Overview & Performance

Team & Design Overview

The Mechavators

				
Aurelien Pons	**Carmelo Salis**	**Liam Wall**	**Elliot DeMarco**	**Kasim Farhat**
Team Lead	Robotics Design Engineer	Embedded Systems Engineer	Structural Dynamics Engineer	Systems Integration Engineer
Project overview	Design Specialist	Embedded Developer	Dynamics Analyst	Systems Integrator

Contribution rating /100:

Aurelien Pons : 30% **Liam Wall :** 30% **Carmelo Salis :** 20% **Elliot DeMarco**: 10% **Kasim Farhat** : 10 %

My role:

As team lead, I oversaw the project, ensuring smooth progression and successful completion. I developed and integrated the height variation system with the telescopic arm, coordinating meticulously. I organized regular meetings to track progress, ensured everyone stayed on task, and addressed issues promptly. Additionally, I took over incomplete projects, demonstrating flexibility and commitment to the team. My role involved facilitating effective communication and collaboration, aligning all aspects of the project with our goals. By maintaining a clear overview and proactively addressing challenges, I ensured seamless integration and fostered a collaborative, productive team environment.

What happened in the final demonstration?

All subsystems were functioning together and individually, except for the wheels. This meant that theoretically, we could have reached 3 balls and placed them in the hole. Unfortunately, our motor controller drew too much current and failed 5 minutes before the demonstration.

Run:	Time (seconds):	Score:	Comments:
1	N/A	0	" **Honest attempt**". The arm when on the right path but did not extend
2	N/A	N/A	We did not have the time to run a second time as the

The thirty-seventh **Warman Design and Building Competition** is a yearly competition for second-year mechanical engineering students requiring students to devise an innovative solution. The context of the task this year revolves around students designing a system meant to replicate the retrieval of six capsules lost in space. Time efficiency is critical as famine rises, and capsules must be retrieved before the full moon.

Tennis balls are found spread asymmetrically throughout the track, simulating the lost capsules. The middle platform is where the system will be placed; this robot will need to retrieve the six tennis balls and drop them in the hole in under 2 minutes.

Figure 42 Reaching success

Final Reflection:

From this experience, I gained valuable insights into effective team leadership, especially under challenging circumstances. Despite some team members expressing a desire to quit, I navigated these difficulties by fostering resilience and maintaining focus on our objectives. This situation provided a profound learning opportunity regarding team dynamics and performance under pressure, particularly when faced with stringent requirements and deadlines.

I learned the importance of clear communication, motivation, and adaptability in overcoming obstacles and ensuring project success. This experience has significantly enhanced my confidence and competence in leading a team. Moving forward, I feel better equipped to manage and inspire a team, drawing on the lessons learned from this project. I now understand the critical balance between maintaining team morale and meeting project goals, which will undoubtedly benefit my future endeavors in leadership roles.

Appendix:

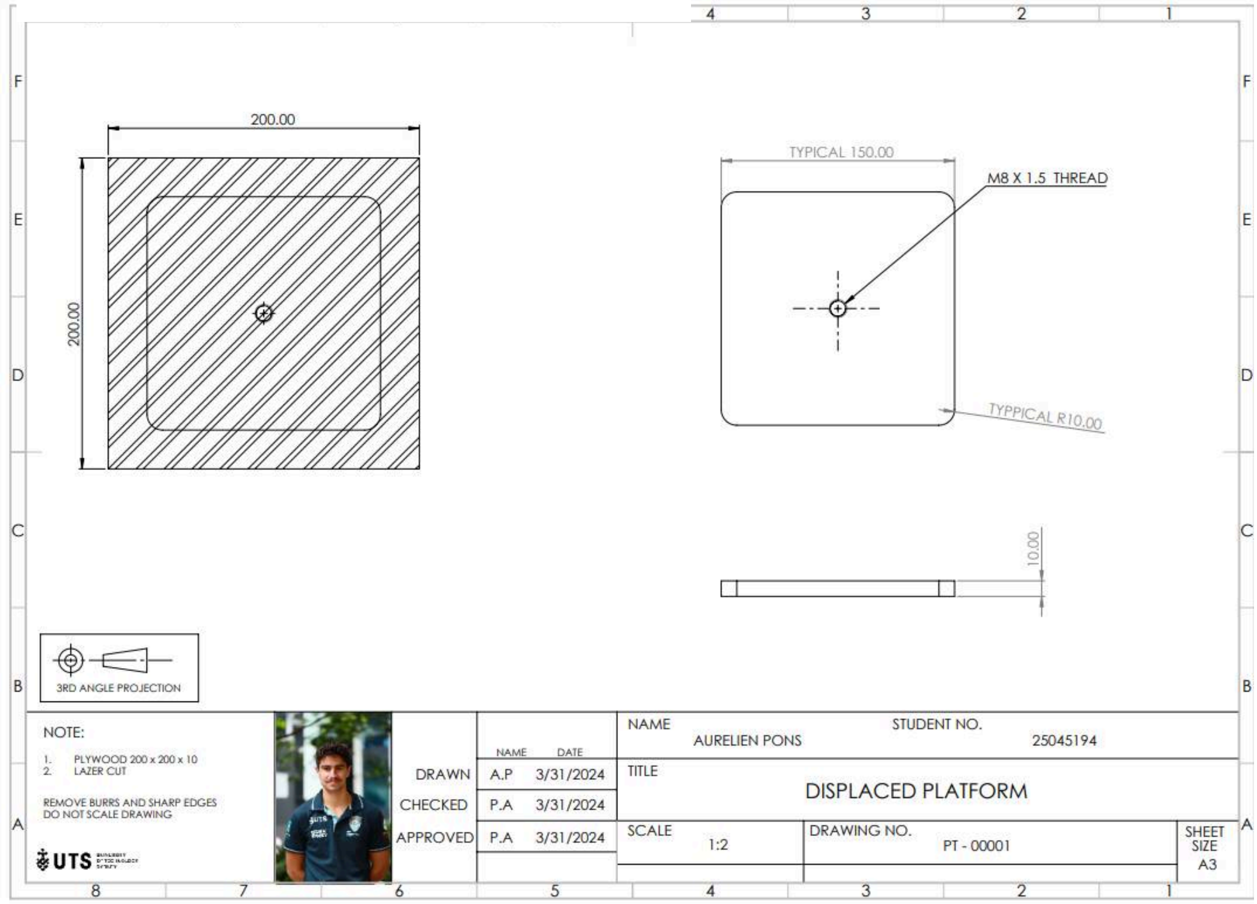


Figure 43 Initial Displaced platform Manufacturing Drawing

As engineering students, requirements often change based on team constraints developed through the project. I learned that despite creating manufacturing-ready drawings of the square platform and preparing for 3D printing, the telescopic arm was remodelled, necessitating a shift in my objectives. As the project lead, I recognized and accepted that working in a team of students would be inherently unpredictable, and this indeed proved to be the case.

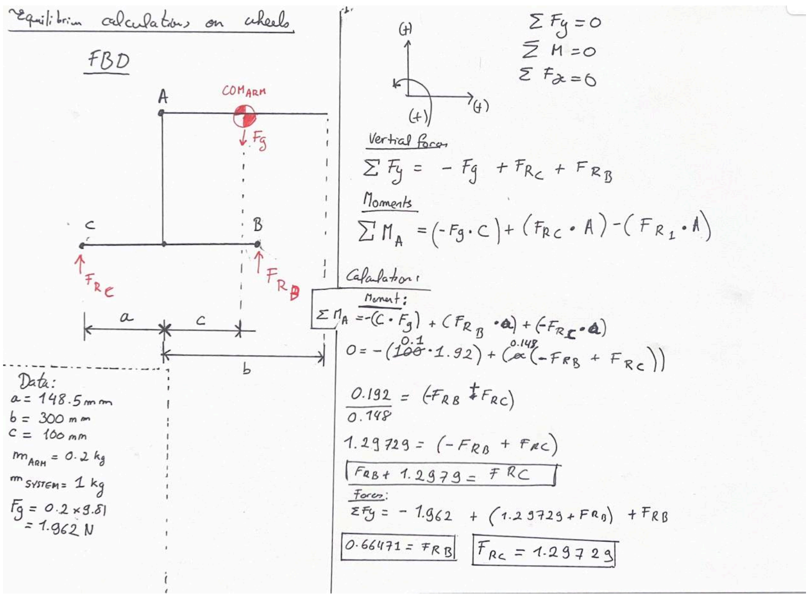


Figure 45 FBD force on wheels

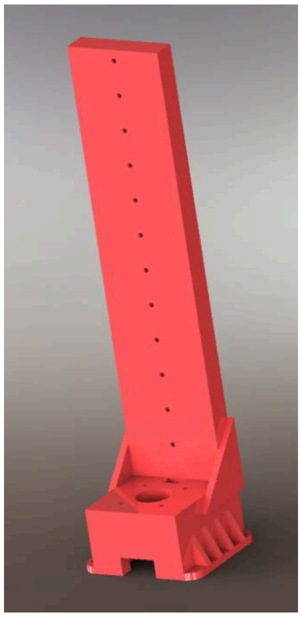


Figure 44 Solidworks render

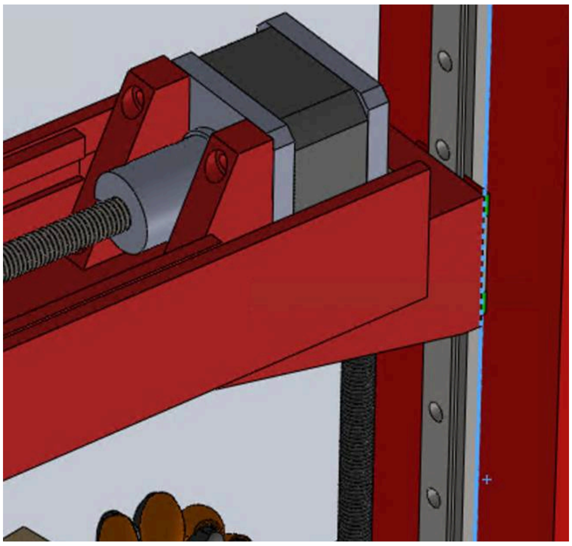


Figure 47 Integration

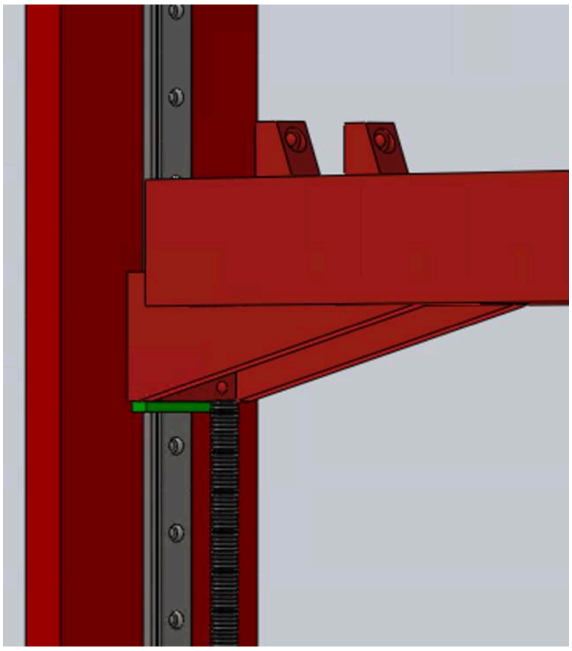


Figure 46Integration

Acknowledgment

I wants to thank my mentors in class Mx 7 for providing invaluable feedback on my projects and portfolio. I also want to acknowledge the use of AI, which helped me structure my ideas and provided feedback on the layout of my artifacts. Furthermore, Chat GPT assisted my team in identifying errors in our code and extracting important information, such as material density and structure my thoughts.

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