Engineering Notebook

Mindcraft Seniors

Leadership through play

FIRST LEGO League 2024-2025

Sponsored By

TANGER MED FONDATION

Written by Salma Hamraoui
Created with LaTeX

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1 MEET THE TEAM

Mortada Taidi Laamiri
Age: 16
Team Leader

Walid Benslimane
Age: 14
Technician

Salma Yaacoubi
Age: 14
Programmer

Omar Lharrak
Age: 14
Technician

Rayan Ghacha
Age: 15
Programmer

Salma Hamraoui
Age: 16
Documentation

Salman Derdeb
Age: 15
Programmer

Ahmad Nayma
Age: 14
Researcher

Mariam Hamraoui
Age: 16
Technician

Mohamed Samadi
Age: 15
Designer

2 OUR COACH

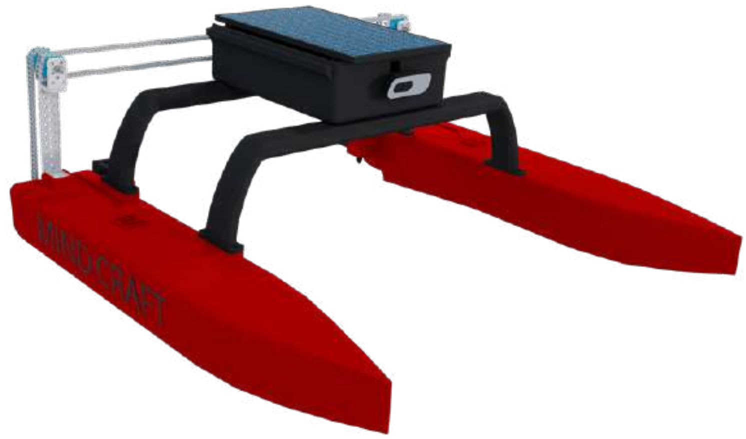
Figure 1: Taha Taidi Laamiri

Our Coach, Taha Taidi Laamiri, is a 19 years old Automated Systems student and an experienced robotics coach. With several years of teaching robotics in FLL, he brings a wealth of knowledge and a hands-on approach to our team. He fosters innovation and teamwork, guiding us to top placements in competitions while encouraging critical thinking and problem-solving.

His passion for robotics and mentorship inspires us to push boundaries and excel in everything we do.

Exploring Ocean Pollution and Its Global Impact

INNOVATION PROJECT



THE PROBLEMATIC OF OCEAN POLLUTION

A closer look at the impacts of plastic debris, marine life, and our global economy.

3 Problematic Overview

Ocean pollution is one of the most significant challenges of our time. With **8–10 million tons of plastic** entering the ocean each year, the consequences for marine ecosystems, biodiversity, and even the global economy are catastrophic. From marine animals choking on plastic to economic losses in fisheries and tourism, the ripple effects are undeniable.

This document will analyze:

- The amount of debris in the ocean.
- How pollution affects marine life and biodiversity.
- The economic consequences.
- Types of pollution present in oceans.
- Barriers pollution creates for ocean exploration.

3.1 Amount of Debris in Oceans

The oceans are inundated with waste, primarily plastic. Research from **NOAA** and **UNEP** shows that:

- **8 million metric tons of plastic waste** are dumped annually.
- By **2050**, there could be more plastic than fish in the ocean (by weight).

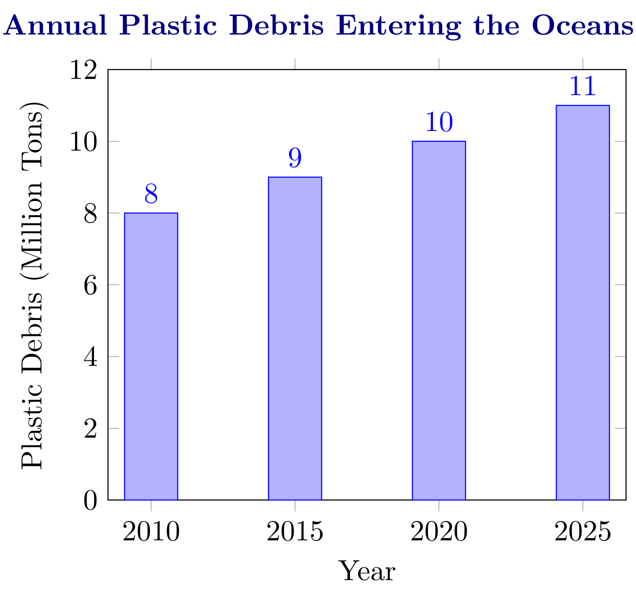


Figure 2: Plastic debris entering the oceans each year.

3.2 Effects on Marine Life

Marine animals are particularly vulnerable to plastic pollution:

- Entanglement: Animals get caught in fishing nets and plastic debris, leading to injuries or death.
- Ingestion: Mistaking plastic for food, animals suffer blockages, malnutrition, and poisoning.

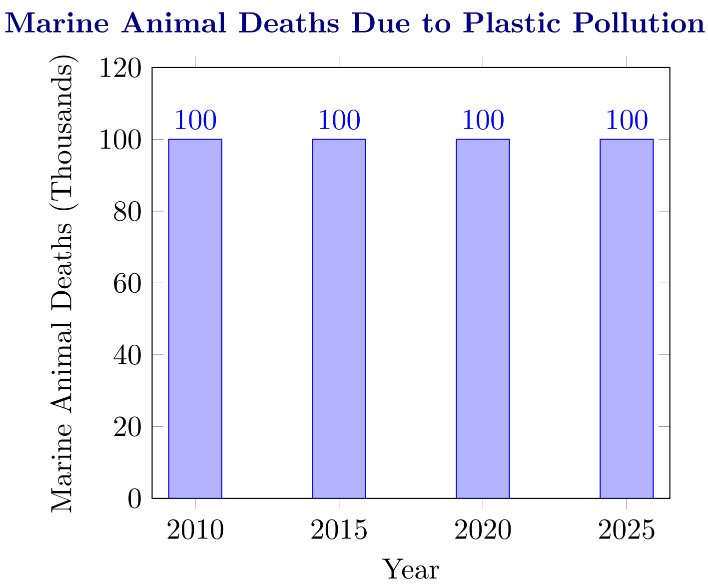
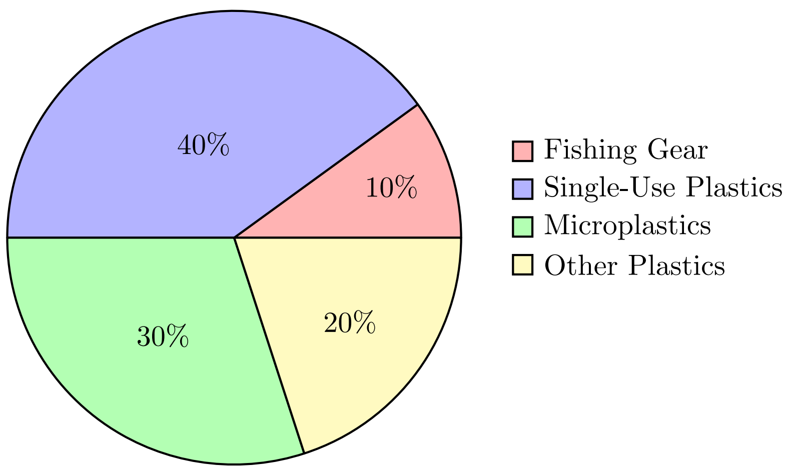


Figure 3: Deaths of marine animals due to plastic entanglement and ingestion.

3.3 Types of Ocean Pollution

- Fishing Gear (10%)
- Single-Use Plastics (40%)
- Microplastics (30%)
- Other Plastics (20%)



3.4 Challenges of Reducing Human Impact on Marine Ecosystems

Ecologists face numerous challenges when it comes to reducing the human impact on marine ecosystems, particularly due to the growing issue of plastic pollution. Despite global efforts to raise awareness and implement strategies to tackle plastic waste, several factors hinder significant progress. Some of these challenges include:

3.5 Economic Impact

Ocean pollution costs the global economy billions annually. Major areas affected include:

- Fisheries: Plastic pollution reduces fish stocks, leading to losses for fisheries.
- Tourism: Polluted beaches and waters deter tourists, impacting coastal economies.
- Healthcare: Increased costs due to health problems linked to marine pollution.

3.6 Barriers to Exploration

Ocean pollution hampers marine exploration. Specialists cannot access key areas due to:

- Pollution Hazards: Risks to equipment and divers.
- Reduced Visibility: Pollution clouds water, limiting exploration.

Pollution impacts ocean discovery efforts, preventing us from uncovering critical information about marine ecosystems.

3.7 Conclusion

Ocean pollution is a multifaceted problem with far-reaching consequences for biodiversity, economies, and the future of marine exploration. Immediate action is required to reduce waste and protect our oceans.

RESEARCH START

4 Research Start

We based our research on credible sources focused on technological advancements and environmental solutions. Each source inspired our project and shaped the vision for our ocean-cleaning robot.

National Geographic provided articles on how technology tackles marine pollution. Their insights guided us in understanding the global challenges of debris in oceans and the role of innovation in resolving them.

Robohub inspired our design with its coverage of cutting-edge robotics for environmental sustainability. It provided examples of autonomous robots used to clean polluted lakes and oceans.

IEEE Xplore provided detailed technical articles on aquatic robotics, helping us refine the mechanical and functional requirements for our robot.

MIT Robotics Lab showcased advanced research in aquatic robotics for environmental use. Their innovative projects inspired the core concepts of our robot.

World Economic Forum highlighted the potential of small, smart robots to clean oceans and reduce pollution.

5 Conclusion

By combining insights from these credible sources, we developed a clear strategy for creating a robot capable of cleaning ocean debris and contributing to environmental sustainability.

TIMELINE

6 Timeline

6.1 First Qualifying Phase

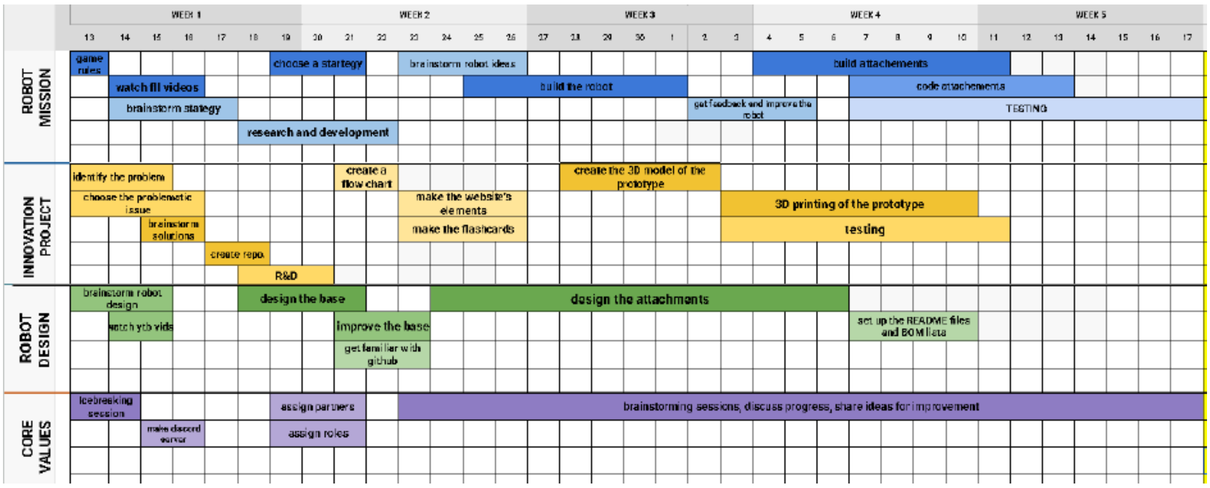


Figure 4: Project Timeline

The preparation for The First Qualifying Phase that was due on January 18th consisted of our initial steps, which included problem identification, brainstorming, and early development of the project. Below is a breakdown of the tasks we completed week by week:

1. **Week 1: Initial Research and Setup**
   - Identify the problem and define the scope of the project.
   - Choose the specific problematic area related to ocean pollution.
   - Brainstorm solutions to address the issue and select the most viable approach.
   - Create a GitHub repository to store and manage the project code and documents.
   - Conduct research to understand the underlying causes of the problem and gather necessary resources.
2. **Week 2: Research and Development**
   - Continue research on the chosen solution and refine the project scope.
   - Create a flowchart to outline the project's workflow and key components.
   - Begin designing and developing website elements, such as the footer and homepage.
   - Design and implement flashcards to assist with project explanation and user interaction.
3. **Week 3: Prototype Design and Initial Testing**
   - Begin work on the 3D model for the prototype.
   - Start 3D printing the prototype components.
4. **Week 4: Prototype Printing and Testing**
   - Continue printing the remaining prototype parts.

- Begin testing the prototype components in parallel with the printing process.

5. **Week 5: Testing and Iteration**
   - Focus on testing the full prototype and gathering feedback.
   - Continuously improve the design based on testing results.
   - Identify any weaknesses in the prototype and iterate on the design to address them.

6.2 Second Qualifying Phase

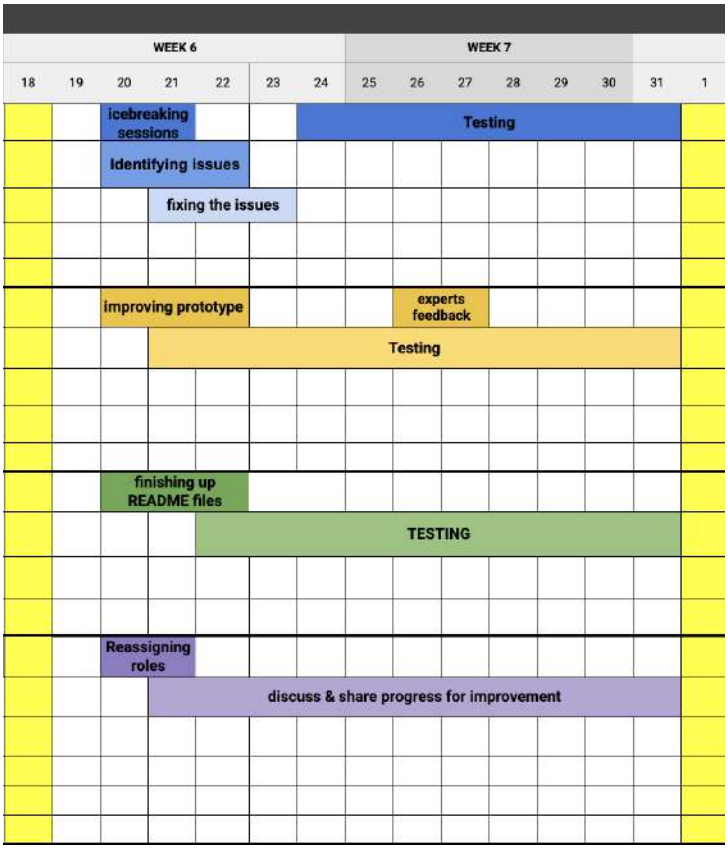


Figure 5: Timeline Q2

In the Second Qualifying Phase, we continued improving the prototype and conducted further testing. This phase also included consulting with an expert to gain feedback and refine the design based on their advice.

1. **Week 6: Prototype Improvement and Testing**
   - Begin improving the prototype based on testing results from the previous phase.
   - Continue testing the prototype to identify any issues or areas for enhancement.
2. **Week 7: Expert Consultation and Final Adjustments**
   - Meet with an expert Naoufal Alouardi in the field to review the prototype and receive feedback.
   - Implement the expert's advice to improve the prototype's functionality and design.
   - Continue testing the prototype in parallel with these adjustments to ensure its performance.

TASK MANAGEMENT

7 Tasks

Title	Tasks	Responsible			Importance	line / sur si	Status	Deadline
Innovation ...	innovation project this year problem	All			Important	Min...	Done	15/12/2024
Innovation ...	choose a problematic				Important	Min...	Done	16/12/2024
Innovation ...	R & D	All			Important	online	In ...	20/12/2024
Innovation ...	find other websites similar to us	All			Less Impor...	online	Done	22/12/2024
Innovation ...	make a list of them				Less Impor...	online	Done	
Innovation ...	make the repo on github	All	Ahmad		Important	online	Done	18/12/2024
Innovation ...	choose the design font and colors	Salman			Less Impor...	online	Done	21/12/2024
Innovation ...	flow chart	Salman	Walid		Important	online	Done	22/12/2024
Innovation ...	flash card	Walid			Less Impor...	Min...	Done	26/12/2024
Innovation ...	problematic and solution and development	Ahmad			Important	Min...	Done	16/12/2024
Innovation ...	google form (survey)	Ahmad			Important	online	Done	
Innovation ...	design 3d model onshape	Mortada	samadi	Walid	Important	online	Done	2/1/2025
Innovation ...	hard documentation	Salma_h	Ahmad		Important	Min...	In ...	1/1/2025
Innovation ...	fabrication	Mortada	Omar_I		Important	Min...	In ...	1/1/2025
Innovation ...	website	Salma_y	Rayan	Salman	Important	online	In ...	1/1/2025
Innovation ...	app development	Salman			Important	online	In ...	1/1/2025
Innovation ...	Hard doc (overleaf)	Salma_h			Important	online	In ...	

Figure 6: Tasks

In this section, we describe how we divided tasks and organized them using a Google Sheet. We created a detailed table with several criteria to ensure that tasks were assigned efficiently, tracked appropriately, and met deadlines.

7.1 Task Assignment Criteria

1. **Task**:

Tasks
innovation project this year problem
choose a problematic
R & D
find other websites similar to us
make a list of them
make the repo on github
choose the design font and colors
flow chart
flash card
problematic and solution and development
google form (survey)
design 3d model onshape
hard documentation
fabrication
website
app development
Hard doc (overleaf)

This column in the Google Sheet lists the name or description of each task that needs to be completed throughout the project. Tasks were broken down into smaller, manageable items to ensure clear focus and allocation of work.

2. **Responsability**:

Responsible		
All		
All		
All		
All	Ahmad	
Salman		
Salman	Walid	
Walid		
Ahmad		
Ahmad		
Mortada	samadi	Walid
Salma_h	Ahmad	
Mortada	Omar_I	
Salma_y	Rayan	Salman
Salman		
Salma_h		

The person responsible for each task was clearly marked in the sheet. This allowed us to ensure accountability and made it easy to track who was working on what.

3. **Importance**:

Importance
Important
Important
Important
Less Impor...
Less Impor...
Important
Less Impor...
Important
Less Impor...
Important
Important
Important
Important
Important
Important
Important
Important

In this column, we identified whether each task was "Important" or "Less Important". Tasks marked as "Important" were prioritized and handled first. This helped to focus on tasks critical for the project's progress.

4. **Online or at Mindcraft**:

line / sur si
Min...
Min...
online
online
online
online
online
online
Min...
Min...
online
online
Min...
Min...
online
online
online

This column indicated whether the task would be completed online or in the club (Mindcraft). For instance, some tasks required in-person collaboration or materials, while others could be done remotely.

5. **Status**:

Status
Done
Done
In …
Done
Done
Done
Done
Done
Done
Done
Done
Done
In …
In …
In …
In …
In …

*T*he status category helps track the progress of each task. It includes labels like "Not Started," "In Progress," and "Done." This makes it easy to see which tasks are completed, which ones are ongoing, and which are yet to begin. Updating the status regularly ensures clarity and keeps everyone aligned

6. **Deadline**:

Deadline
15/12/2024
16/12/2024
20/12/2024
22/12/2024
18/12/2024
21/12/2024
22/12/2024
26/12/2024
16/12/2024
2/1/2025
1/1/2025
1/1/2025
1/1/2025
1/1/2025

*T*he deadline category organizes tasks by their due dates, helping prioritize work efficiently. Tasks with closer deadlines are tackled first, ensuring timely completion and reducing last-minute pressure. This system helps manage time effectively and keeps projects on schedule.

SOLUTION

8 Solution

8.1 Development of the HydroBot Solution

After researching ocean pollution, we developed HydroBot, an autonomous robot designed to efficiently collect waste. With advanced sensors, AI, and eco-friendly materials, it navigates water bodies to identify and remove pollutants, offering a sustainable solution to reduce ocean pollution.

Figure 7: HydroBot

8.2 Inspiration

Our project was inspired by the ocean cleanup efforts led by MrBeast and Mark Robert, whose initiative raised awareness about ocean pollution and engaged millions in large-scale cleanup events.

8.2.1 What is Team Seas?

MrBeast's ocean cleanup project, "Team Seas," focused on raising funds and mobilizing volunteers to remove plastic waste from the ocean. Key points include:

8.2.2 Key Differences Between HydroBot and Team Seas

- **Autonomous**: HydroBot works without humans, unlike Team Seas.
- **Open Source**: HydroBot's design is globally accessible.
- **Sustainable**: HydroBot provides a long-term solution, while Team Seas focuses on one-time events.
- **Tech-driven**: HydroBot uses AI and sensors; Team Seas relies on volunteers.
- **Scalable**: HydroBot can work in multiples; Team Seas is event-based.
- **Eco-friendly**: HydroBot uses sustainable materials.
- **Global**: HydroBot can be deployed worldwide.
- **Continuous**: HydroBot operates 24/7, unlike Team Seas' limited timeframe.

8.2.3 Benefits of HydroBot

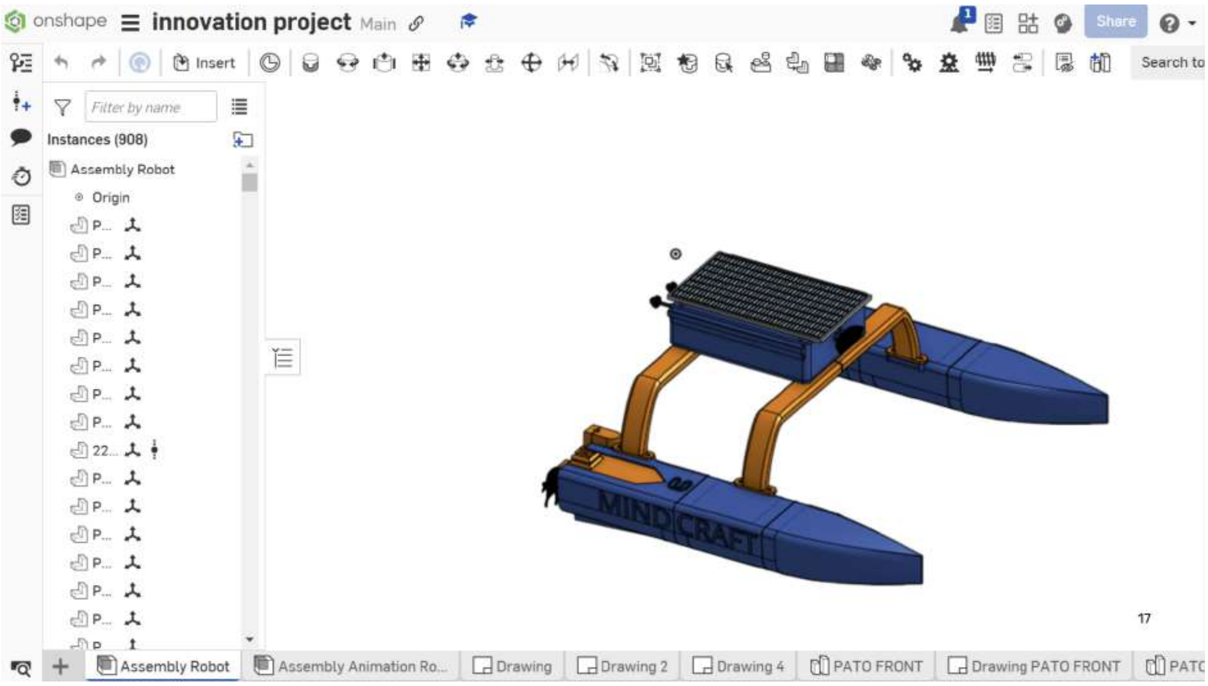
The HydroBot project brings several significant benefits across different domains:

- **Sustainability**: HydroBot offers a long-term solution to ocean pollution, ensuring continuous, efficient waste collection that reduces the burden on ecosystems.
- **Human Health**: By removing harmful pollutants, HydroBot helps reduce waterborne diseases and promotes cleaner, safer environments for local communities.
- **Economic Impact**: The deployment of HydroBot could create new industries around eco-robotics, waste management, and environmental technology, stimulating job growth and economic opportunities.
- **Environmental Preservation**: HydroBot plays a crucial role in preserving marine ecosystems by reducing plastic waste, safeguarding biodiversity, and preventing further environmental degradation.

9 Design of HydroBot

9.0.1 Design Process in OnShape

To bring HydroBot to life, we started by designing the robot's components in OnShape, a cloud-based 3D CAD (Computer-Aided Design) software. This tool allowed our team to collaborate in real-time, ensuring efficiency and precision in our designs.



9.0.2 our Robot drawings

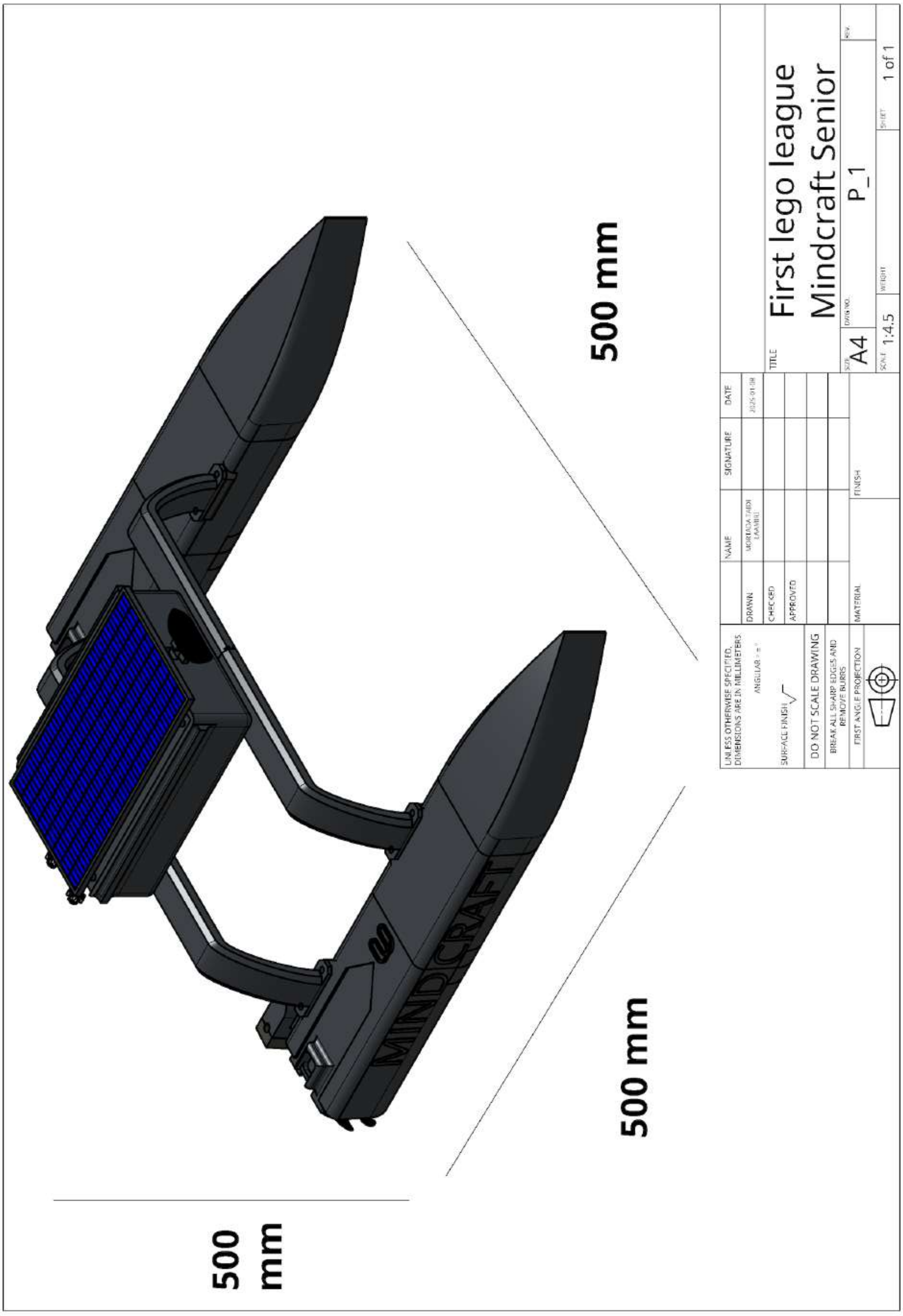


Figure 8: drawing dimensions

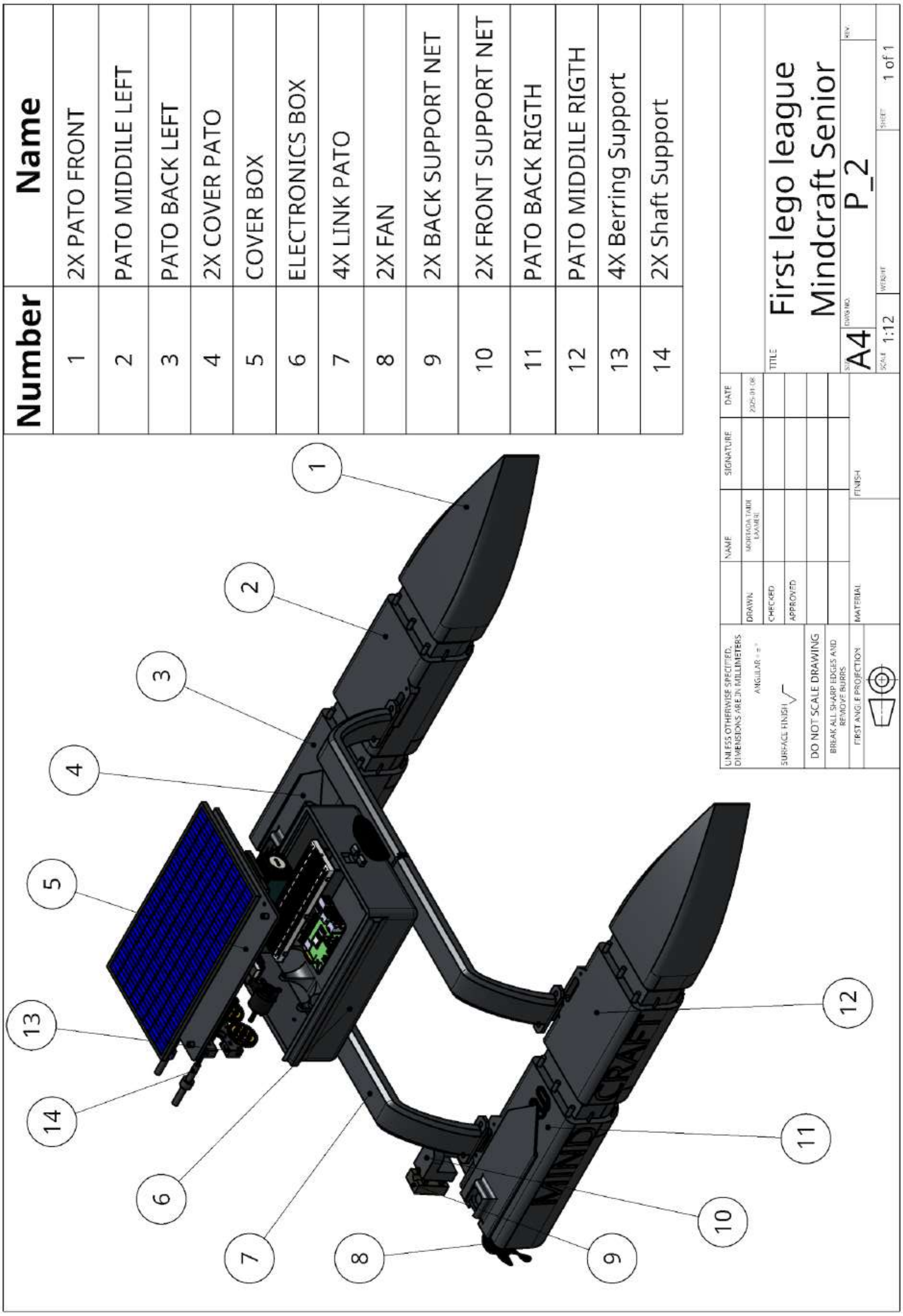


Figure 9: drawing parts

Figure 10: drawing views

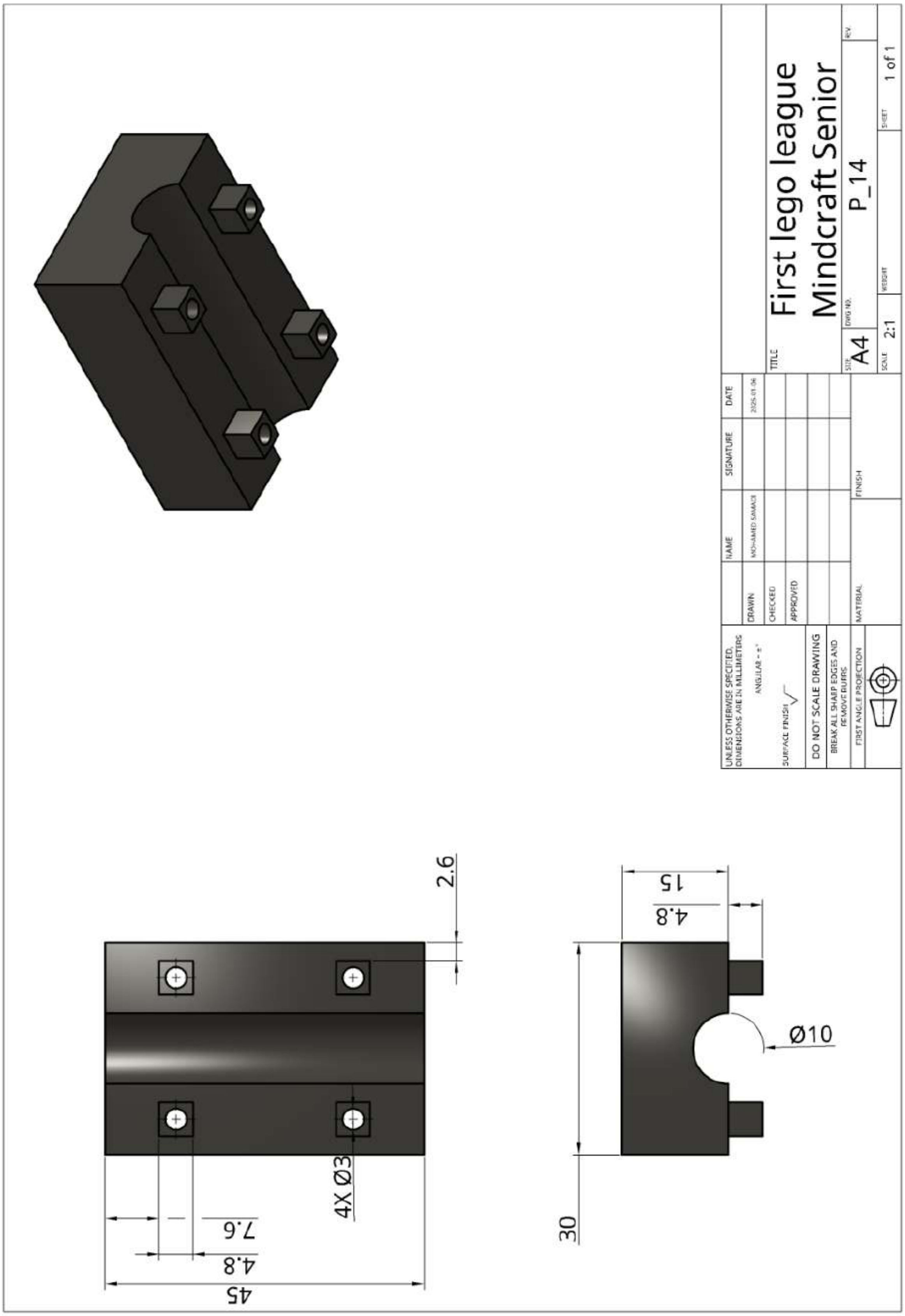


Figure 11: back supports net

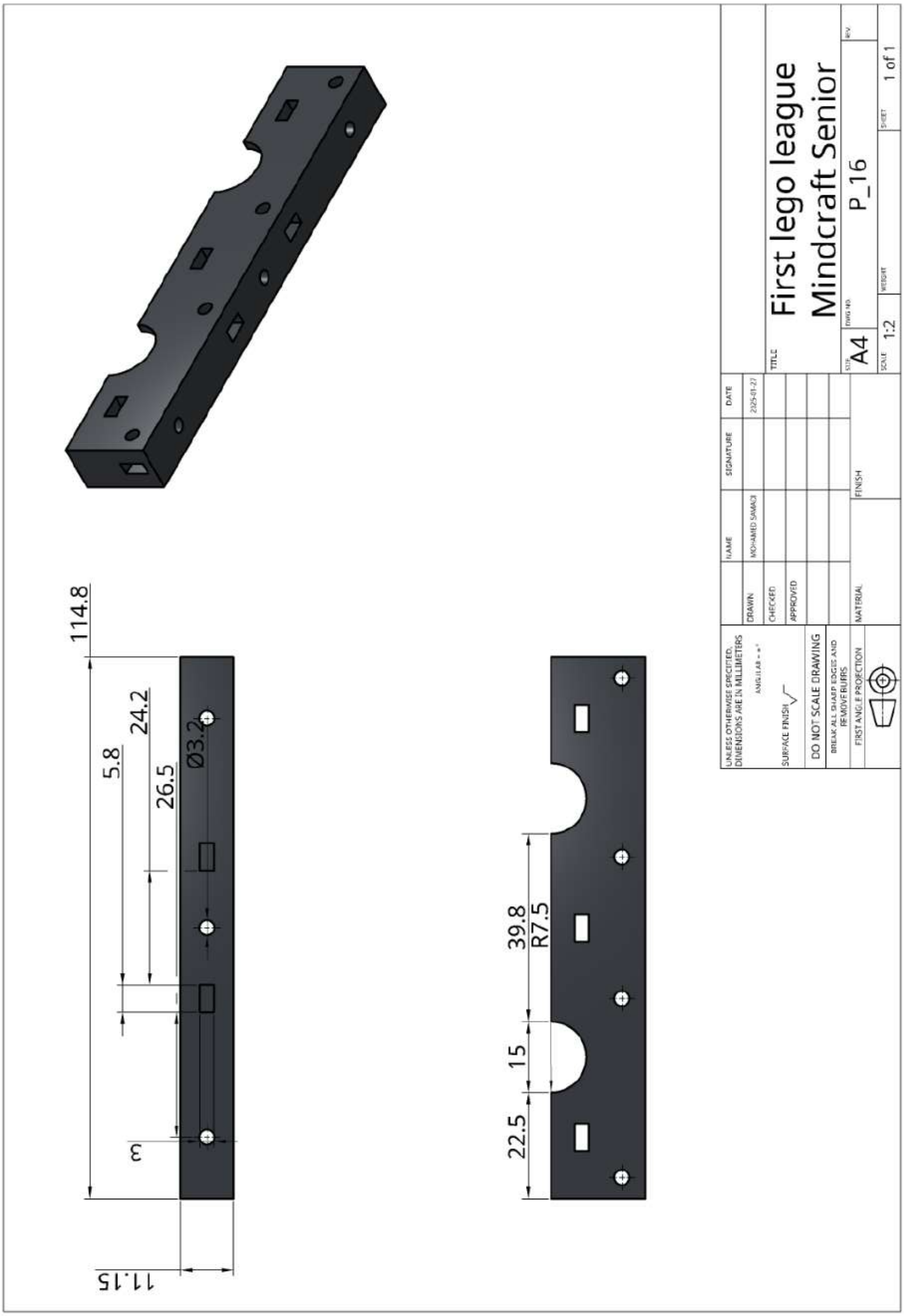


Figure 12: BERRING SUPPORT

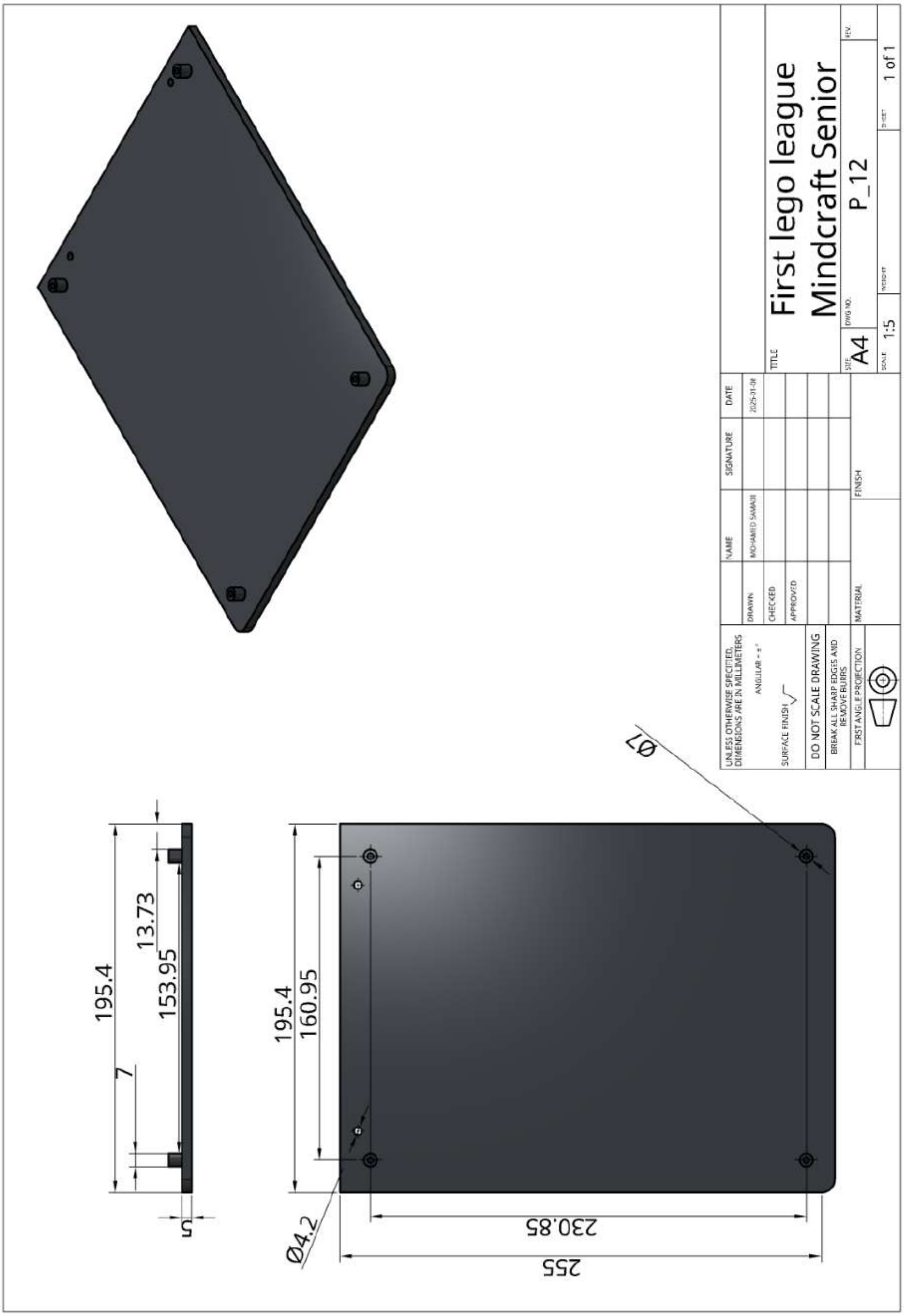


Figure 13: cover box

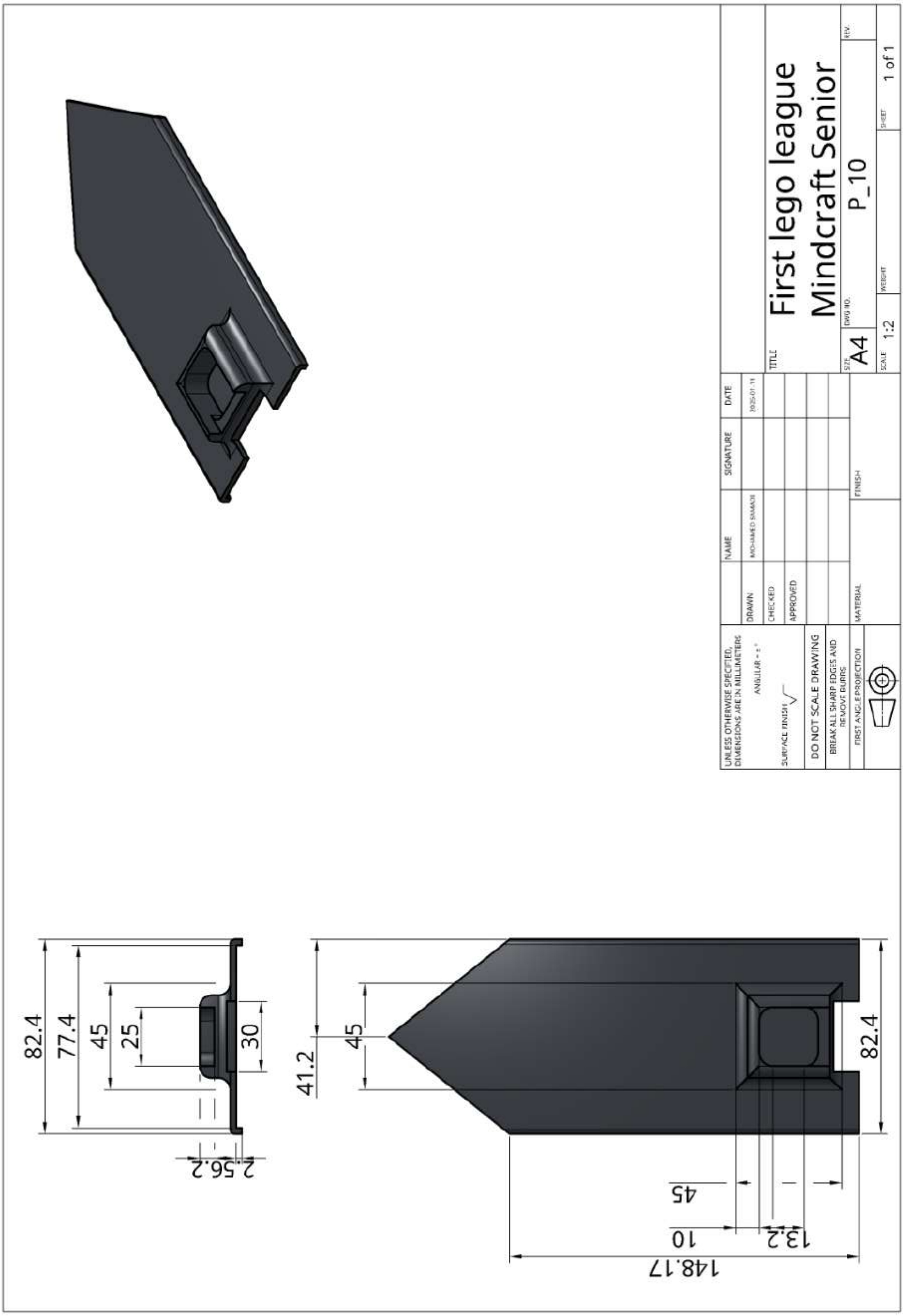


Figure 14: cover pato

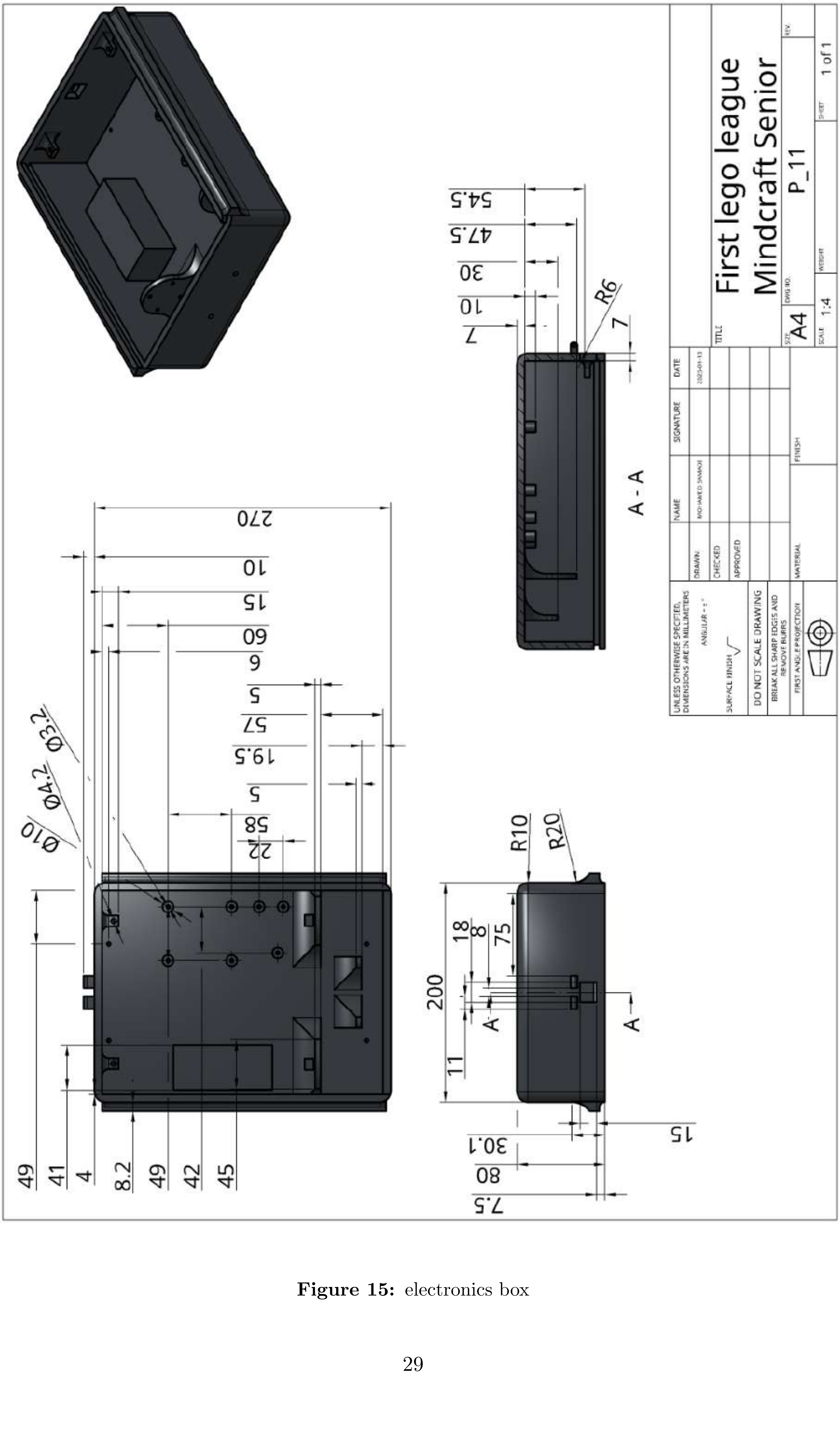


Figure 15: electronics box

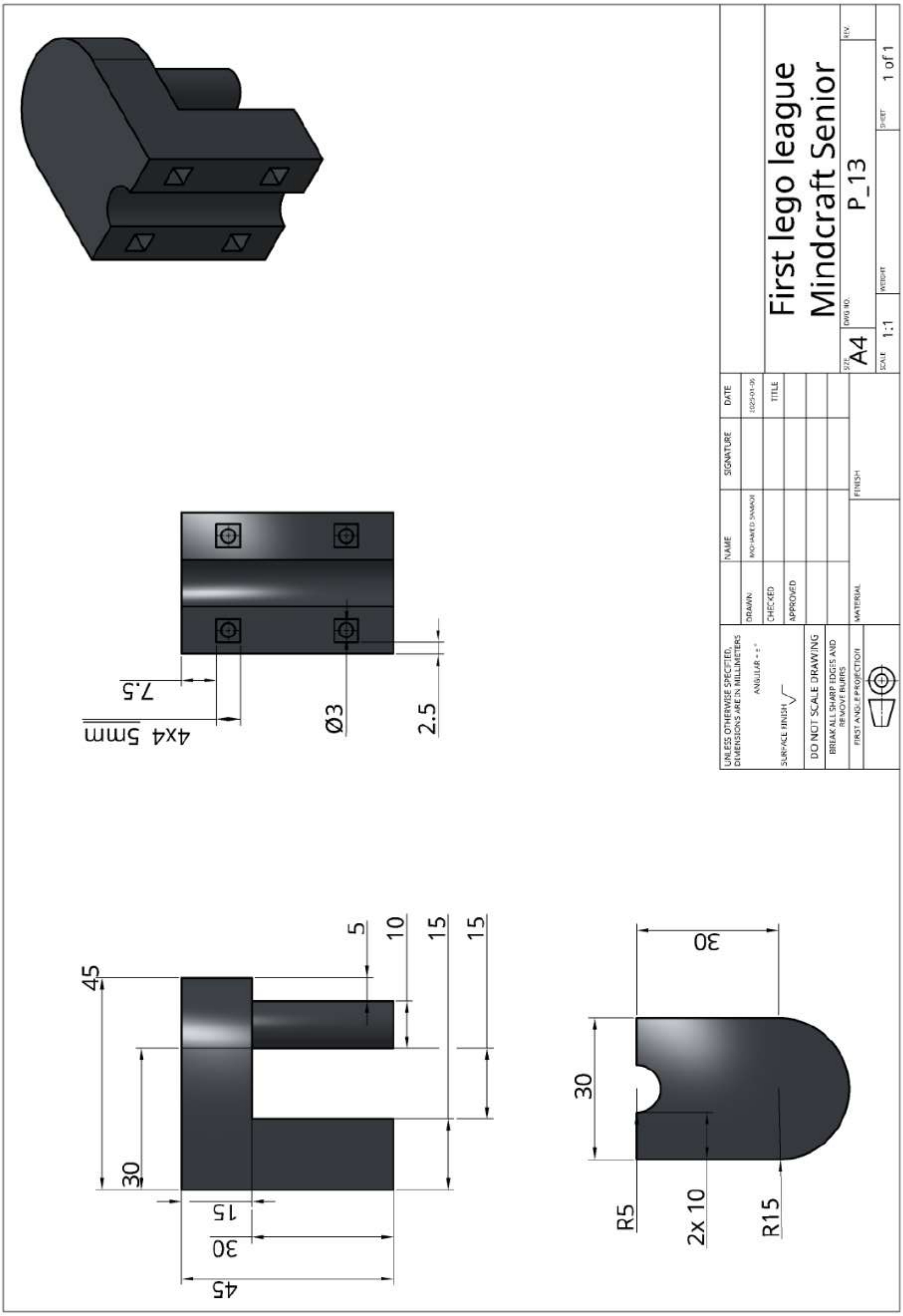


Figure 16: front supports net

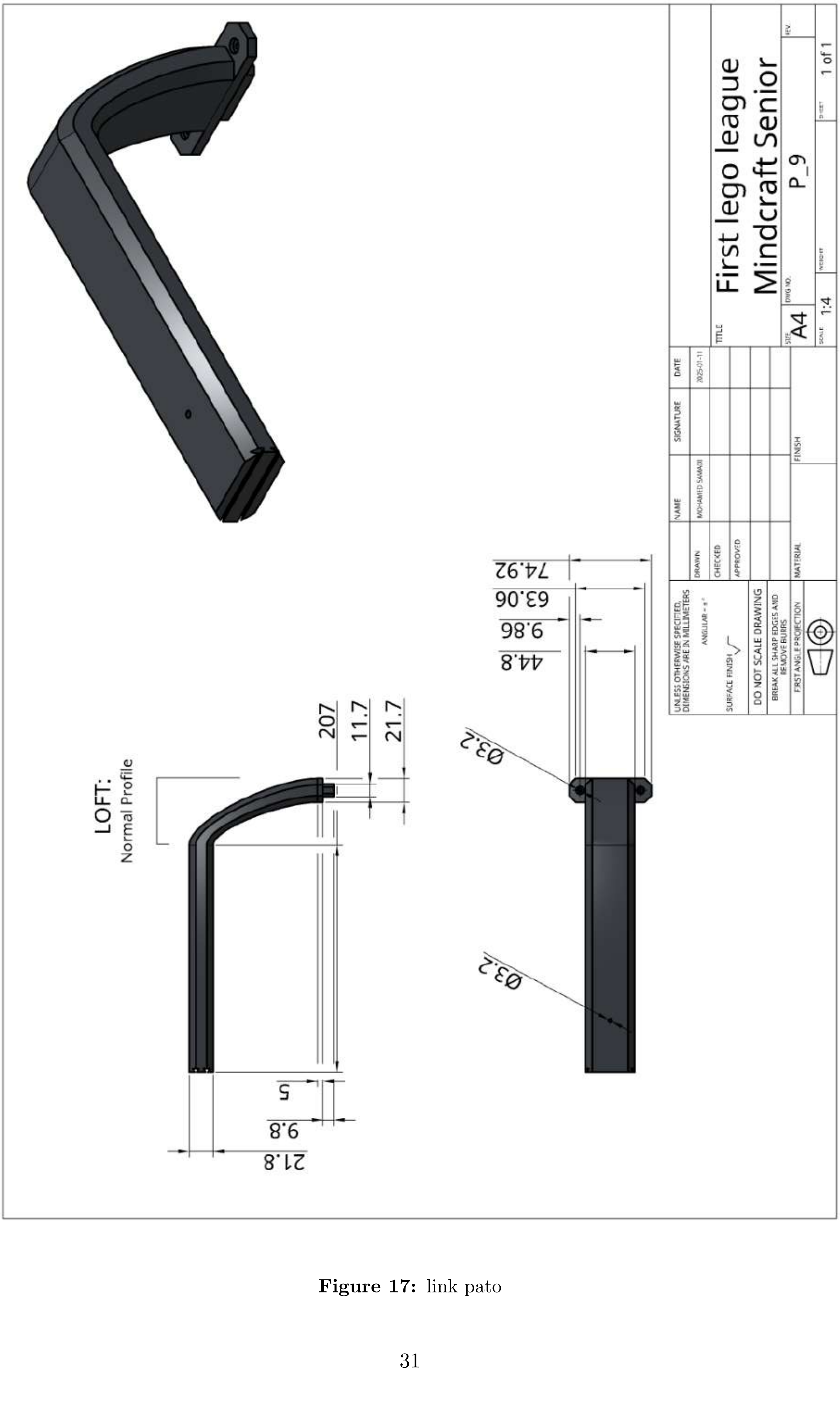


Figure 17: link pato

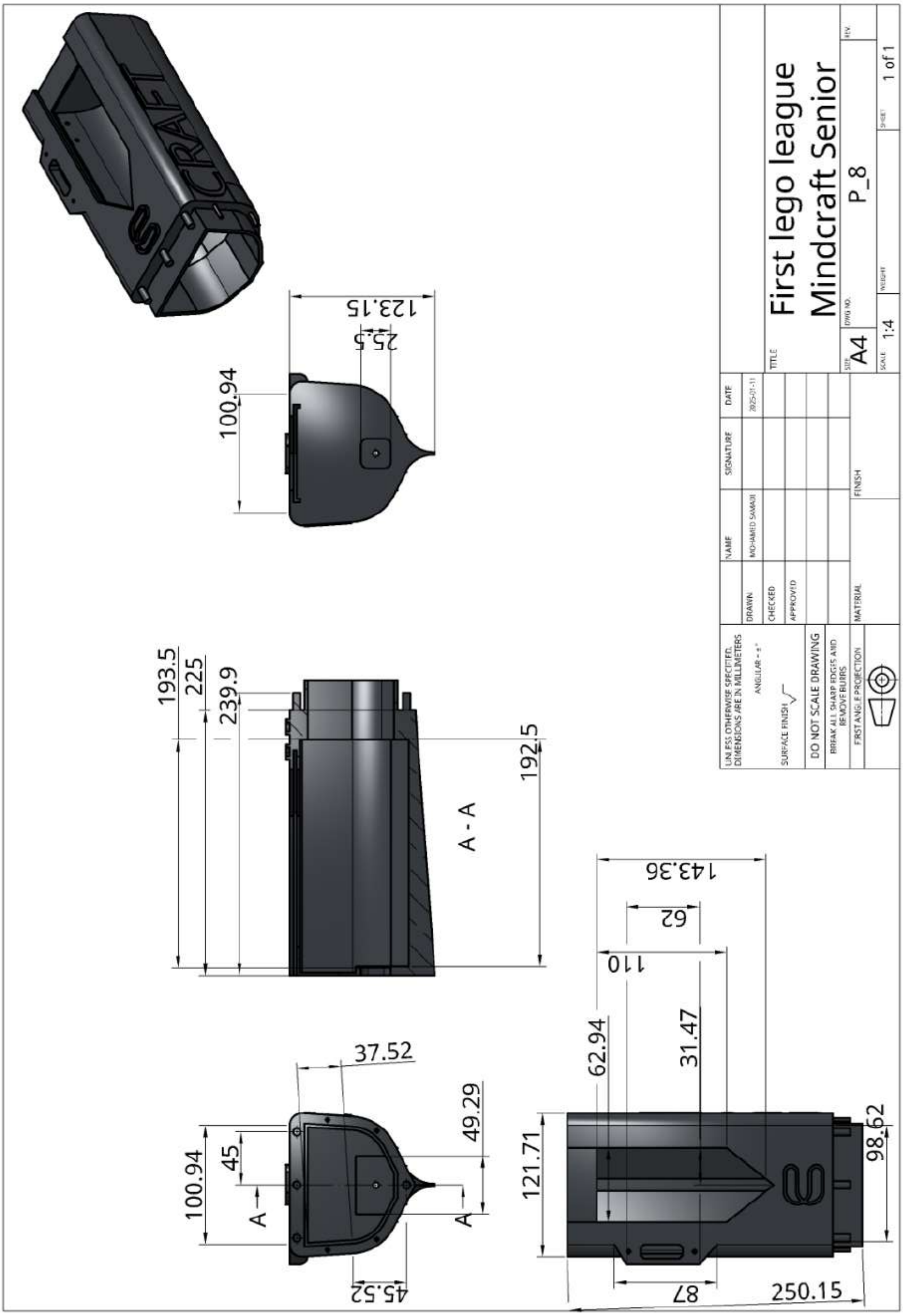


Figure 18: pato back left

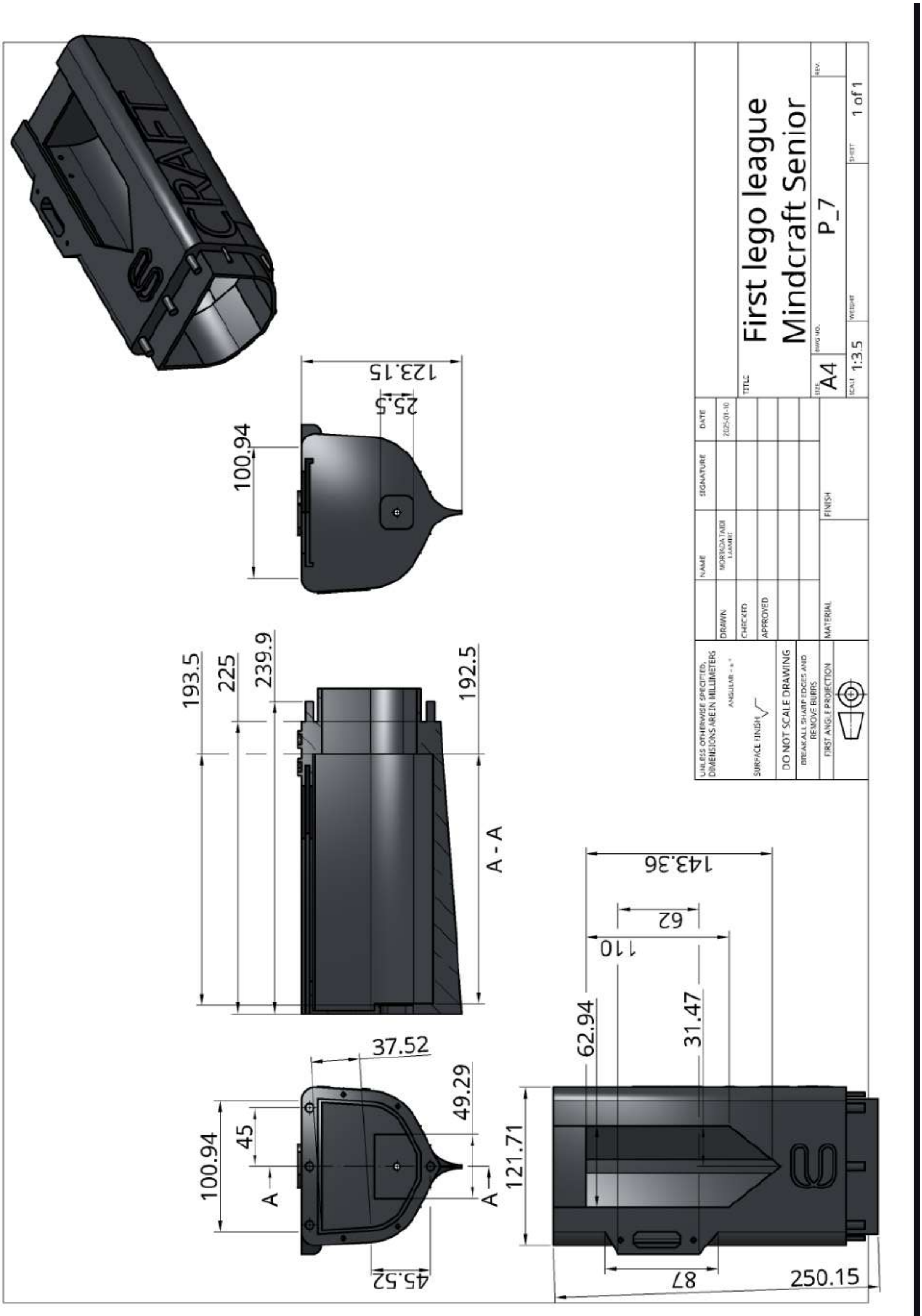


Figure 19: pato back right

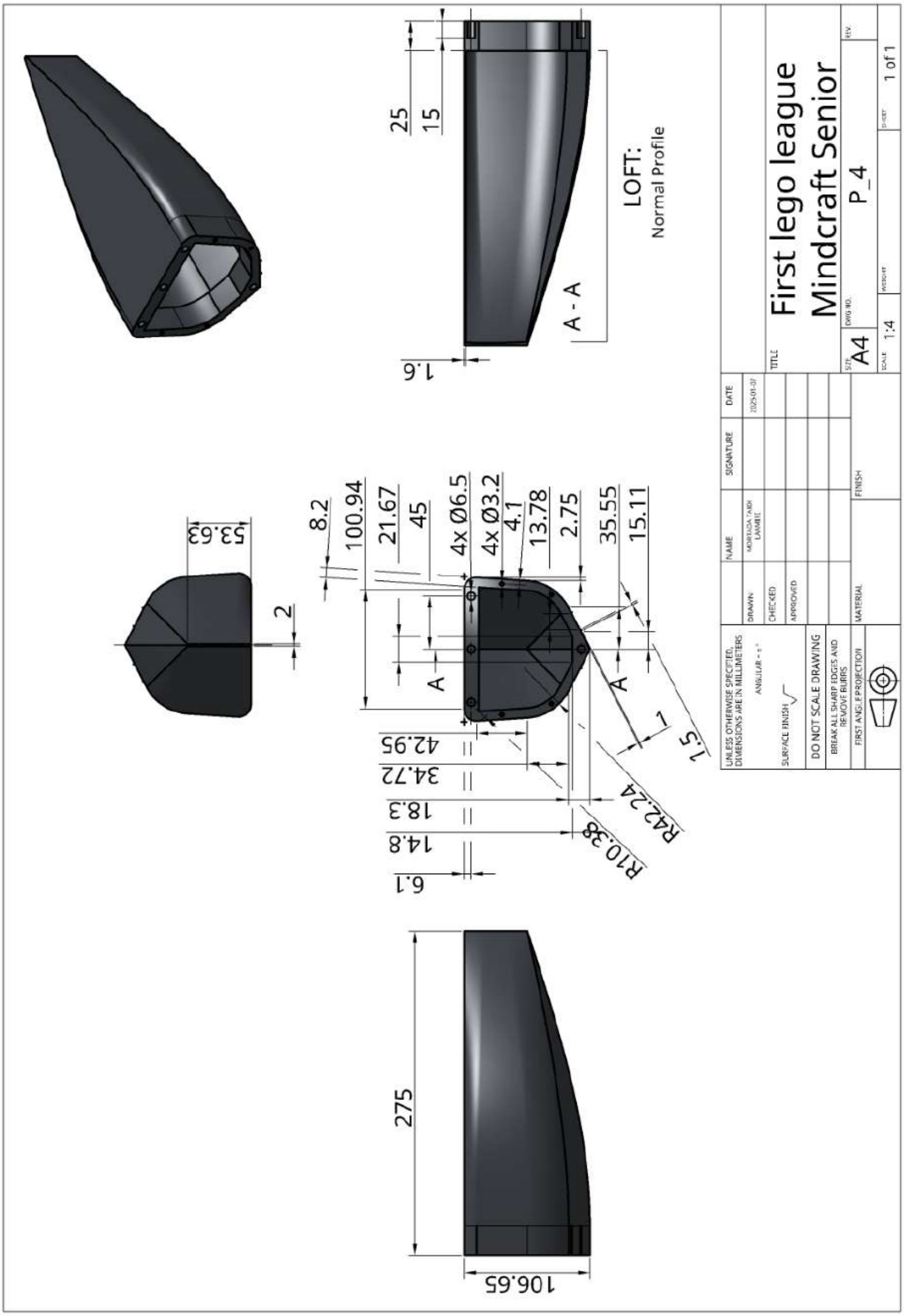


Figure 20: pato front

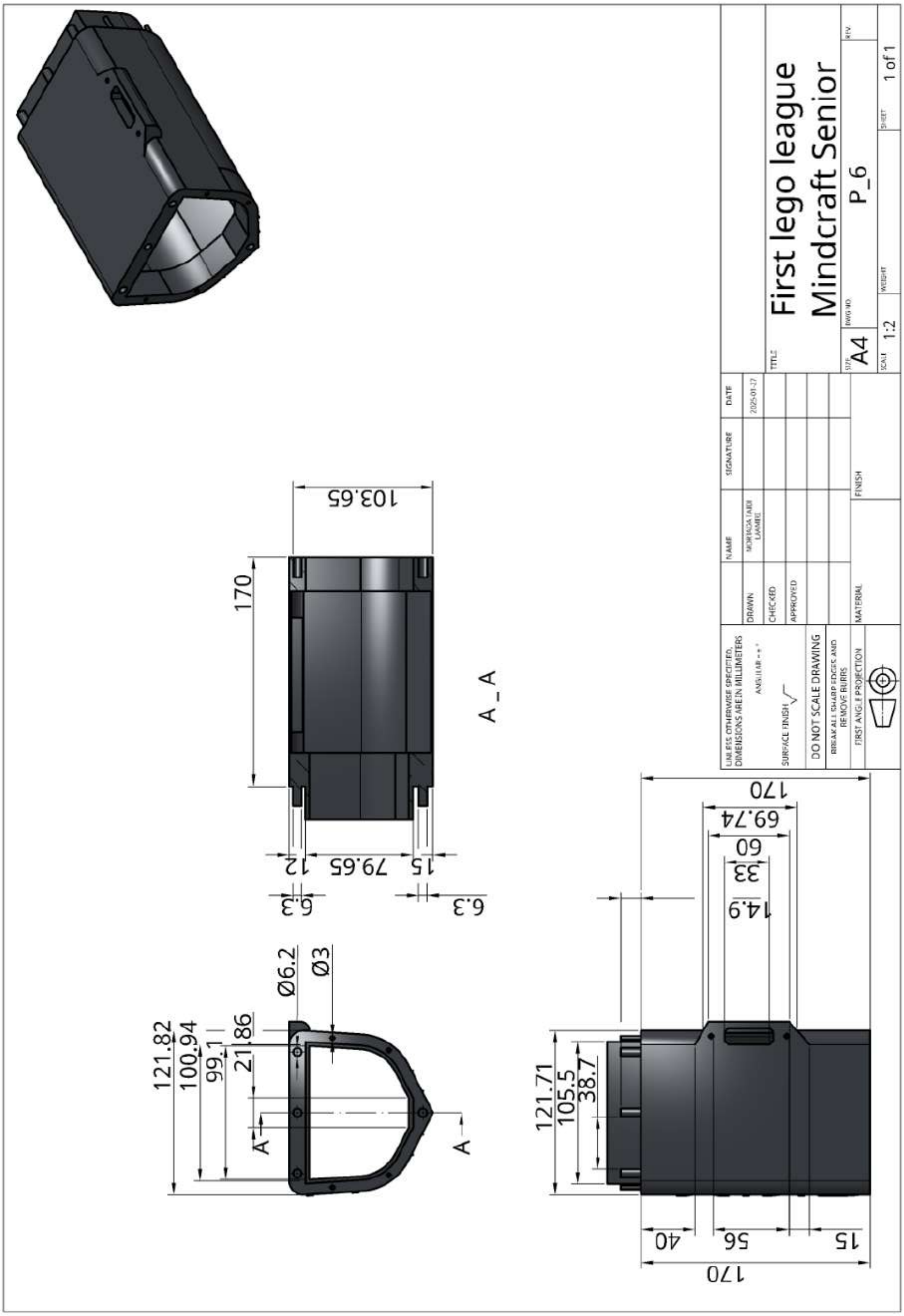


Figure 21: pato middle left

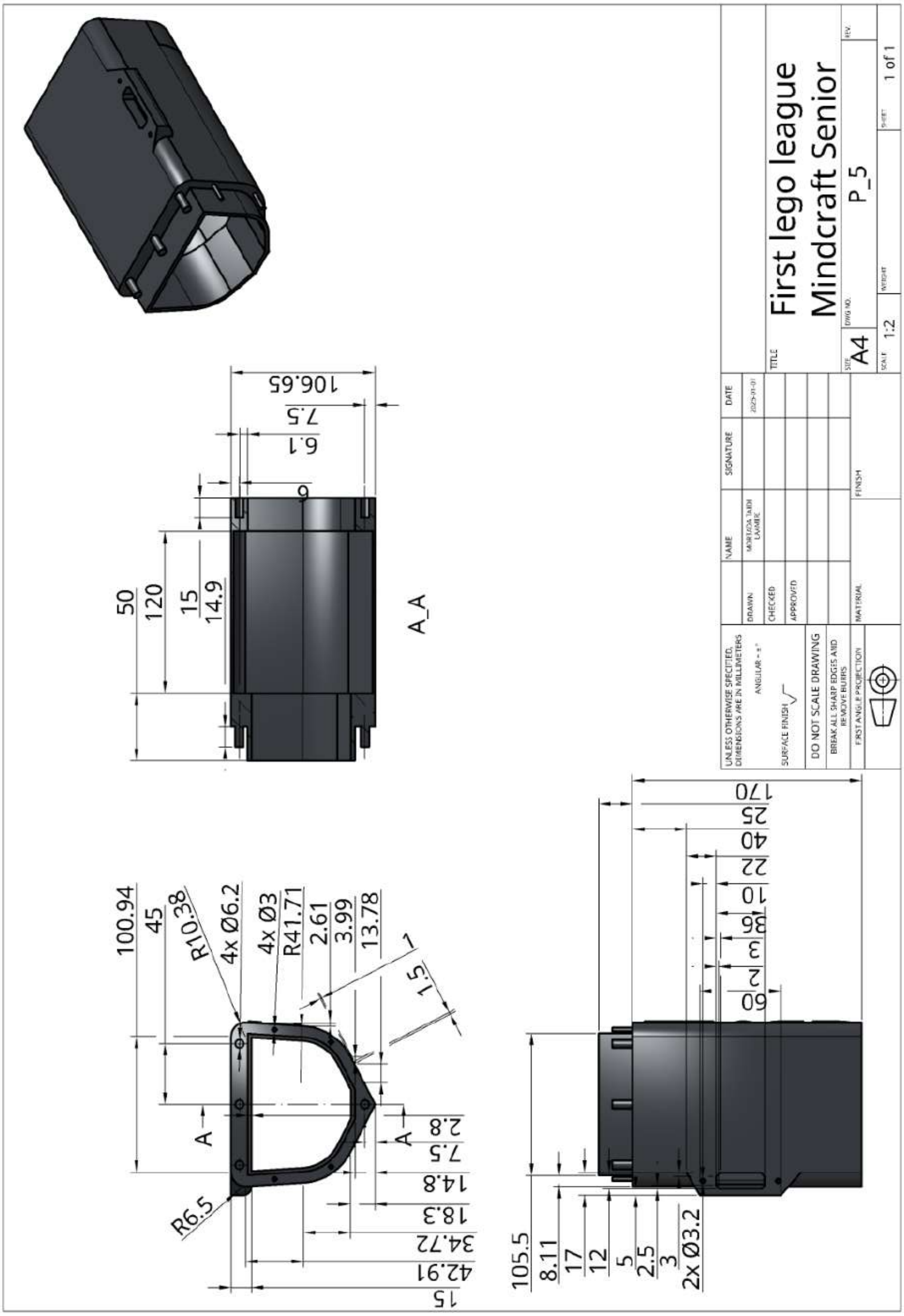


Figure 22: pato middle right

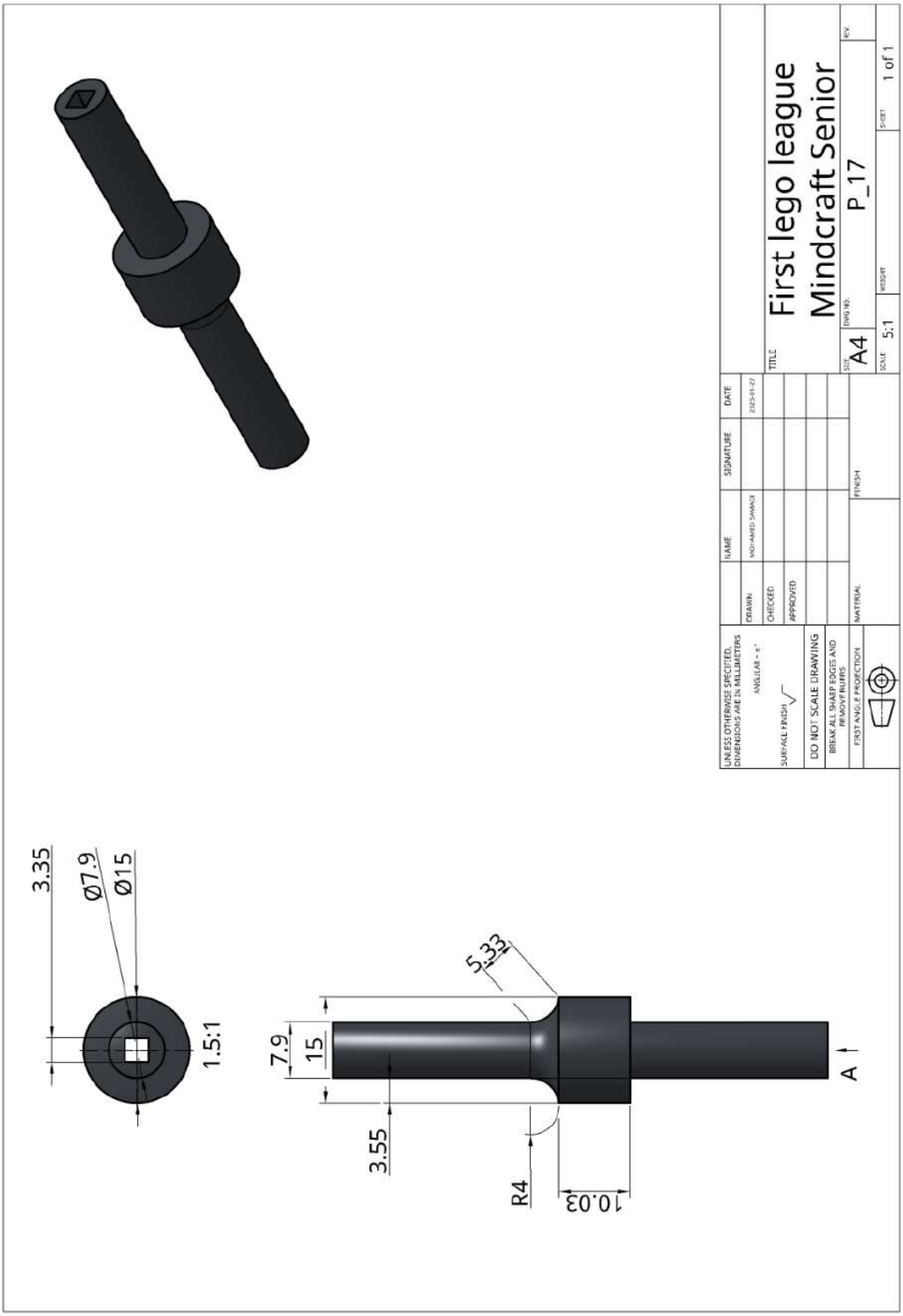


Figure 23: SHAFT SUPPORT

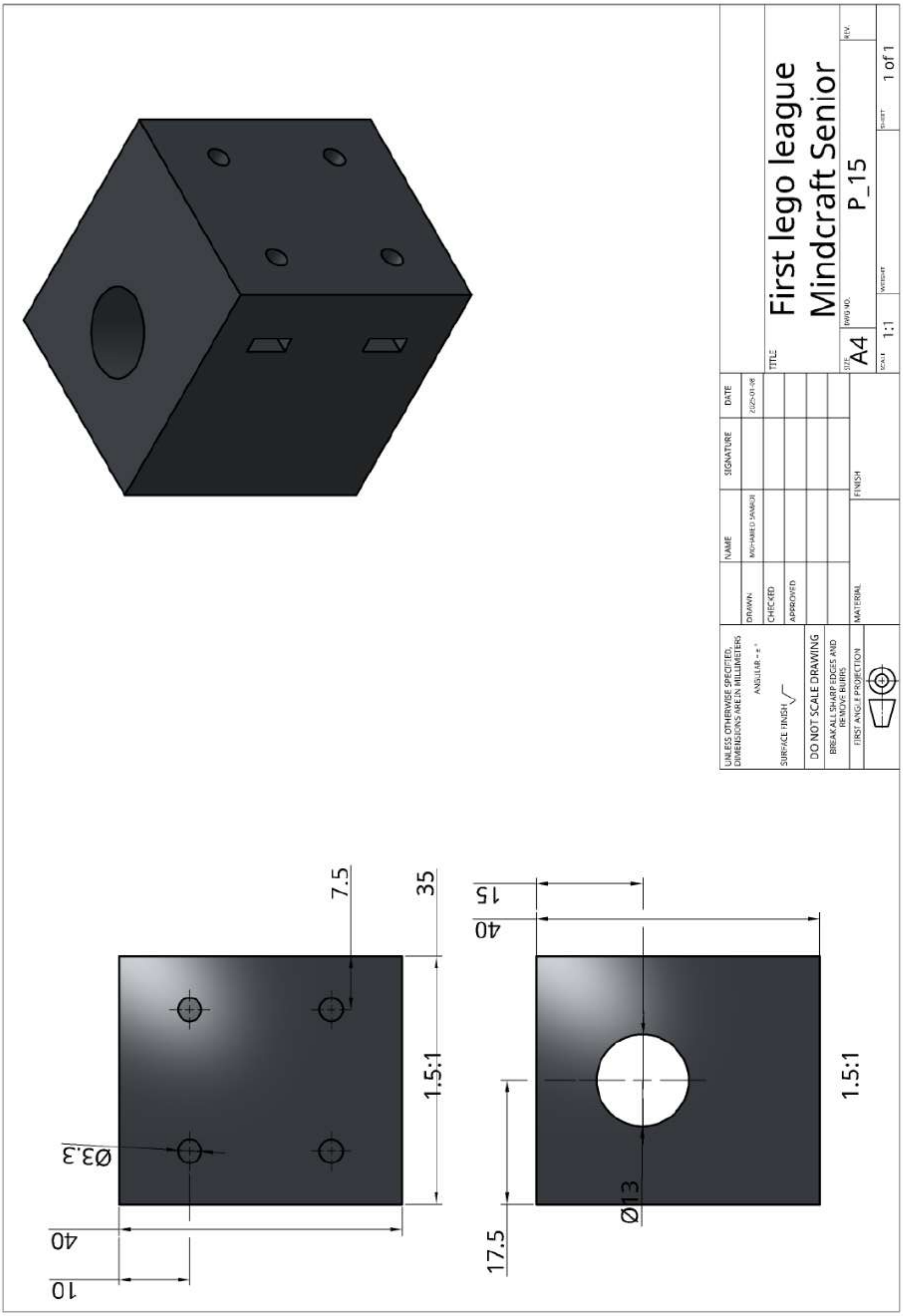


Figure 24: supports of support net

9.0.3 3D Printing with Creality

After finalizing the designs in OnShape, we moved on to the physical creation of HydroBot's components using Creality 3D Printers. 3D printing was chosen due to its precision, cost-effectiveness, and the flexibility it offers in prototyping. Here's how we used the technology:

- **Printer Model**: We used the Creality Ender 3 printer, known for its high accuracy and reliable performance.
- **Material Choice**: We used PLA (Polylactic Acid), an eco-friendly filament, ensuring that the robot's components are both durable and sustainable.
- **Layer by layer Printing**: The robot parts were printed layer by layer, allowing us to maintain high resolution and minimize waste during production.
- **Post-Processing**: After printing, the components were smoothed and assembled with precision to ensure the parts fit together perfectly.

LIST OF TOOLS

10 list of tools

Image	Name	Quantity	Price (USD)
	**Filament PLA+**	4	100 USD
	**Raspberry Pi**	1	70 USD
	**Webcam Logitech C270**	1	30 USD
	**Brushless DC Motor**	2	40 USD
	**Lipo Batterie 3s 2200mAh**	3	60 USD
	**Battery Voltage Indicator**	1	3 USD
	**Electrical Speed Control**	2	6 USD
	**Small Solar Panel**	1	12 USD
	**Net**	1	15 USD
Others		-	34 USD

TOTAL: 370 USD

10.1 Affordability and Accessibility

Our project is affordable and accessible, with budget-friendly components available from local stores and online marketplaces, making it easy for anyone to replicate without high costs or supply issues.

Functional Analysis

11 Functional Analysis of the Hydrobot

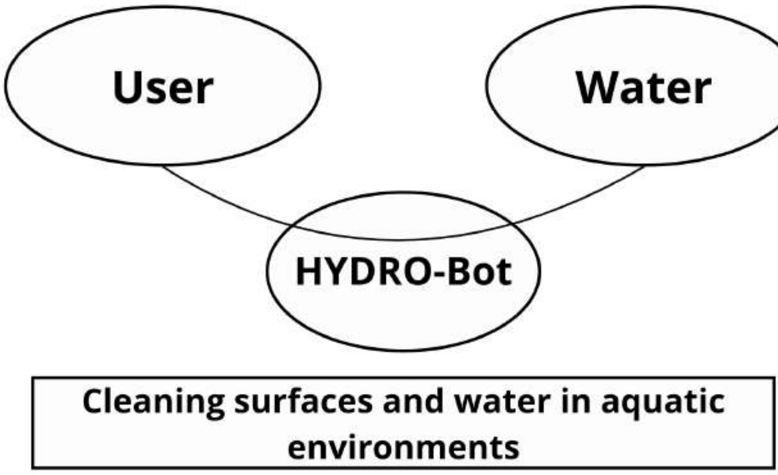


Figure 25: horned beast diagram

The Hydrobot is designed to clean oceans by removing plastic waste. The system involves three main components: the user, the water environment, and the Hydrobot itself.

11.1 User

The user controls and monitors the Hydrobot's operation through a simple interface. They can:

- Set cleaning schedules.
- Monitor progress.
- Empty the waste collected.

11.2 Water Environment

The Hydrobot:

- Detects and collects plastic waste.
- Navigates through water using sensors.

11.3 Hydrobot

The Hydrobot collects plastic waste from the water through:

- A net for collection.
- Autonomous navigation

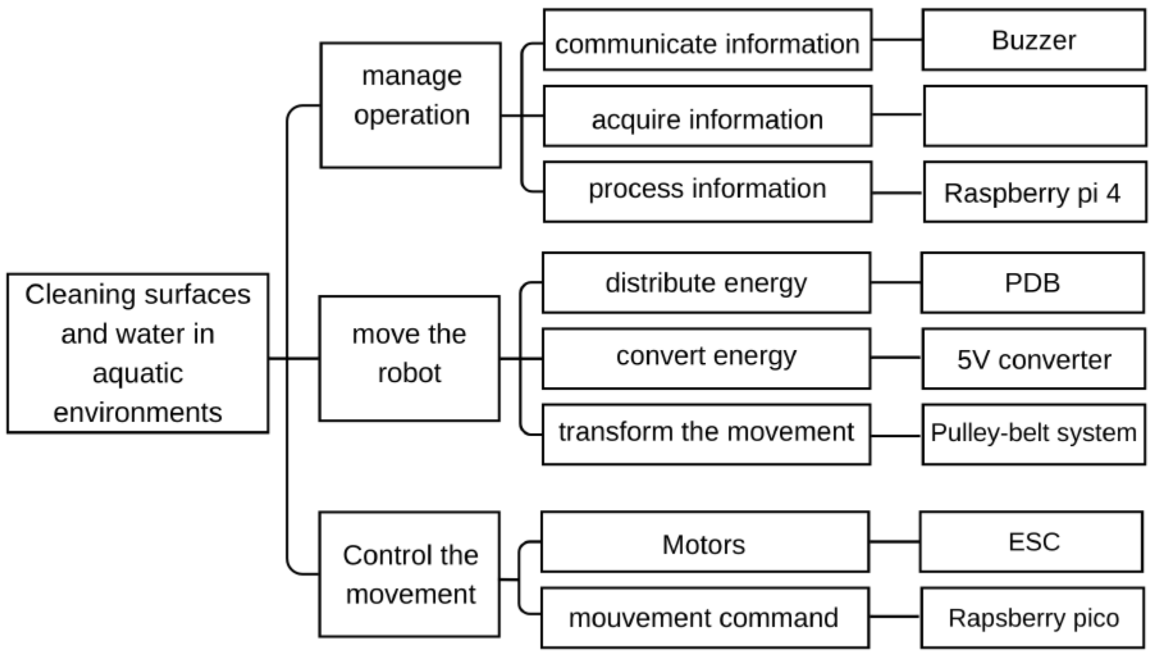


Figure 26: need expression diagram

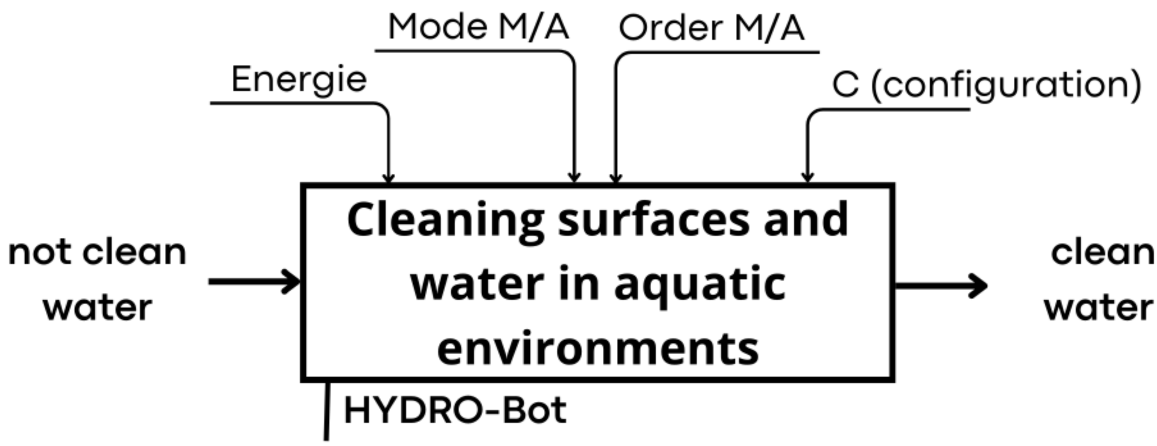


Figure 27

11.4 Managing Operations (Processing Communication)

- **Communicate Information:** A buzzer is used to provide alerts or notifications, such as low battery warnings or obstacle detection.
- **Acquire Information:** Bluetooth Low Energy (BLE) is implemented for wireless communication, allowing data exchange for remote monitoring and control.
- **Process Information:** A Raspberry Pi 4 serves as the central processing unit, handling sensor data and making decisions.

11.5 Moving the Robot (Power Motion Systems)

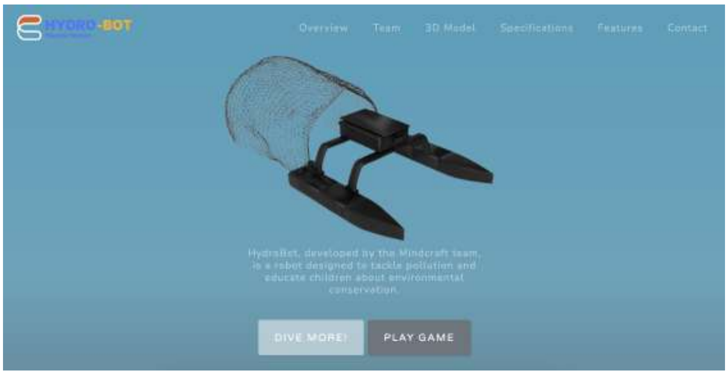
- **Distribute Energy:** A Power Distribution Board (PDB) ensures efficient power supply to various components.
- **Convert Energy:** A 5V converter regulates voltage to ensure proper power delivery to different electronic parts.
- **Transform Movement:** A pulley-belt system is employed to transfer mechanical motion from motors to other components.

11.6 Controlling Movement (Motor System)

- **Motors:** Electronic Speed Controllers (ESC) manage motor speed and direction, ensuring smooth propulsion and maneuverability.
- **Movement Command:** A Raspberry Pi Pico microcontroller is responsible for precise motor control based on instructions from the Raspberry Pi 4.

HydroBot Website Overview

12 Dive Into Discovery



Scan to Visit Our Website!

Our HydroBot project is presented on an interactive website, built with HTML, CSS, and JavaScript for a seamless user experience. Key features include:

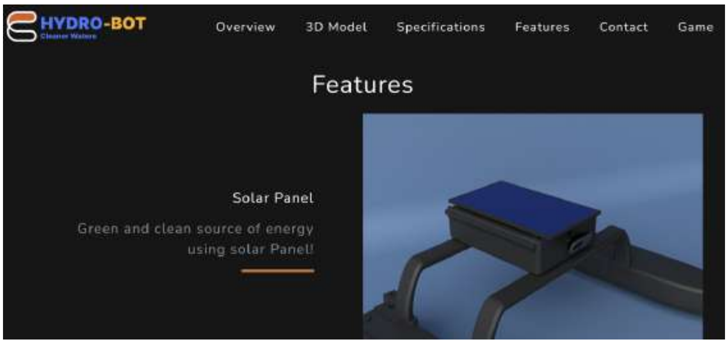
- **Responsive Design**: The website adjusts to various devices, ensuring an optimal viewing experience on desktops, tablets, and smartphones.

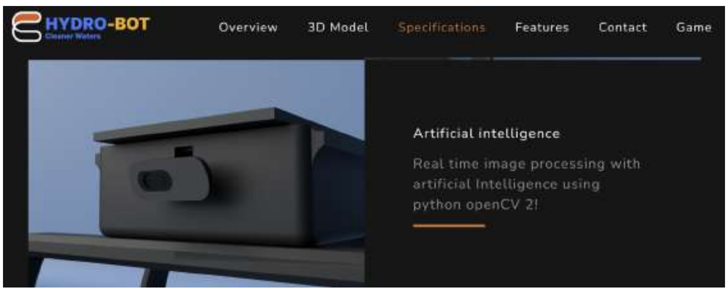
- **Interactive Interface**: Users can explore HydroBot through interactive buttons, sliders, and animations for an engaging experience.

- **Detailed Sections**: The site is divided into clear, informative sections that explain the project in-depth, including its overview, components, and specialized areas, allowing users to navigate and understand the information with ease.

- **Smooth Navigation**: Menus and navigation bars make it easy to find info on HydroBot's design, functionality, and technology.

This user-centric website makes it easy for visitors to learn everything about HydroBot through an accessible, well-structured, and interactive design.





OPEN SOURCE

13 The Open-Source Nature of HydroBot

13.1 What is Open Source?

Open source refers to software, designs, or technologies that are made available to the public for free, allowing anyone to view, modify, and distribute it.

13.2 Why Open Source?

Choosing to make HydroBot open-source is a strategic decision that aligns with our mission to create a global and sustainable solution to ocean pollution. Here's why we believe open-source is the best path forward:

- **Collaboration**: The open-source community works together to improve the project and share ideas.
- **Transparency**: Open-source projects are transparent in terms of development, licensing, and usage.
- **Community-driven**: it's powered by a global network of contributors who collaborate, discuss, and innovate together.
- **Free and Open Access**: Open-source software is freely available for anyone to use, modify, and distribute.
- **Sustainability**: Open-source projects rely on community support for adaptability and longevity.
- **Inclusivity**: Open-source fosters inclusivity by allowing anyone,to contribute to the project.

HydroBot App

14 HydroBot App

The HydroBot mobile app offers full control and monitoring of the robot, providing users with a seamless way to interact with its features. Designed for convenience, the app allows users to track system performance, manually control movements, or enable AI-driven automation.

- **Connect via IP Address**: Users can connect to HydroBot by entering the Raspberry Pi's IP address, ensuring secure and direct communication.
- **Robot Control**: The app provides manual controls for guiding and driving the robot remotely.
- **Garbage Auto-Detect**: Using AI, the app can automatically detect and respond to garbage in its path.
- **AI-Driven Mode**: Users can switch to AI mode, allowing the robot to navigate and operate autonomously based on real-time data.

Additionally, the app tracks essential metrics such as battery level and CPU temperature, ensuring users stay informed about the robot's status at all times.

14.1 Autonomous Mode: Image Processing and GPS Navigation

14.1.1 Overview

The autonomous mode of the FLL Submerged 2025 robot enables it to clean a predefined square area using a combination of image processing and GPS-based navigation. Inspired by robotic vacuum cleaners, the system ensures efficient coverage of the area while avoiding obstacles.

14.1.2 Hardware Components

To achieve autonomous navigation, the following components are utilized:

- **Raspberry Pi:** The central processing unit for decision-making and image processing.
- **Camera Module:** Captures real-time images to detect floating debris.
- **GPS Module:** Provides location data for path planning and boundary enforcement.
- **Motors and Actuators:** Control movement and maneuverability.

14.1.3 Software and Algorithm

The navigation system is based on a combination of image processing and GPS waypoints to ensure optimal coverage.

14.1.4 Image Processing for Debris Detection

The camera module continuously captures frames, which are processed using OpenCV to detect floating trash. The processing steps include:

1. **Image Preprocessing:** Convert images to HSV format and apply color thresholding to detect debris.
2. **Contour Detection:** Identify the shape and size of detected objects.
3. **Movement Adjustment:** Adjust path based on debris location to optimize cleaning.

14.1.5 GPS-Based Navigation

The robot follows a structured cleaning pattern based on predefined GPS waypoints:

1. **Boundary Definition:** The user inputs a square area defined by four GPS coordinates.
2. **Path Planning:** A back-and-forth sweeping motion is implemented to ensure complete coverage.
3. **Waypoint Tracking:** The robot moves sequentially through waypoints, adjusting its course based on drift and detected obstacles.

14.1.6 Mathematical Model for Path Planning

The robot follows a lawnmower pattern (zigzag) to maximize coverage. The total number of passes, N, is determined by:

$$N = \frac{L}{d} \tag{1}$$

where:

- L is the length of the square area.
- d is the width covered in one pass.

The turning points are determined by:

$$(x_{i+1}, y_{i+1}) = (x_i + (-1)^i \times d, y_i + s) \tag{2}$$

where s is the step size.

14.1.7 Obstacle Avoidance

If an obstacle is detected via image processing or sudden GPS inconsistencies, the robot performs an avoidance maneuver:

1. Stop and scan surroundings using the camera.
2. Calculate an alternative path around the obstacle.
3. Resume the cleaning path once the obstruction is cleared.

14.2 Field Fullness Detection Algorithm

To determine if the robot's collection area is full, the following methods are considered:

1. **Gyroscope-Based Detection:** If the robot's movement slows significantly despite normal motor operation, it suggests increased resistance due to collected debris, indicating that the storage area may be full.
2. **Camera-Based Debris Measurement:** The size and accumulation of detected debris are monitored. If the detected debris does not decrease significantly over time, it implies that the storage is reaching capacity.

A combined approach is used where:

- If the gyroscope detects slowed movement and the camera detects excessive debris, an alert is triggered.
- The robot stops and signals the user for manual intervention or automatic unloading if applicable.

The autonomous mode integrates GPS navigation and image processing to ensure efficient and effective trash collection within a predefined area. The combination of structured movement, real-time debris detection, and obstacle avoidance maximizes the robot's performance in cleaning water surfaces.

FEEDBACK

15 FeedBack

In order to gather meaningful feedback for our project, we created a Google Form that was distributed to a diverse group of people. To ensure that everyone could understand and participate, we designed the questions in Moroccan dialect, which made the form more accessible.

15.1 Google Form

The form contained several questions related to the ocean, its pollution, and marine life. Some of the key questions included:

- How do you perceive ocean pollution?
- Who do you think is responsible for ocean pollution?
- Do you believe robots can actually clean the oceans and remove debris?

These questions were designed to engage the participants and gather their opinions on ocean pollution, as well as their thoughts on the potential role of technology in addressing the issue.

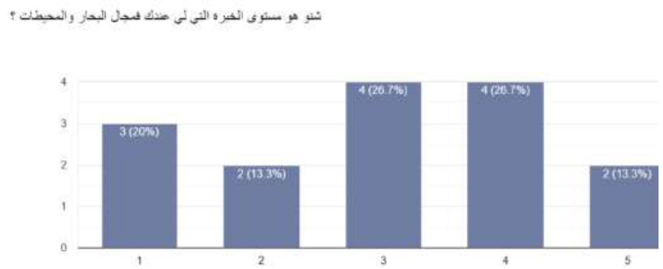


Figure 28: What is your level of expertise in the field of ocean studies?

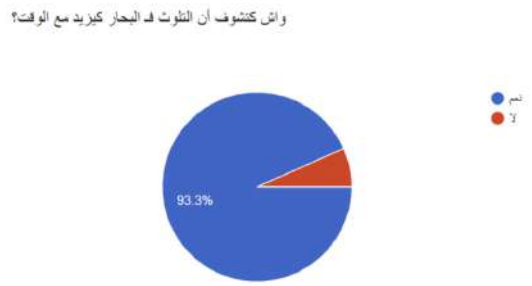


Figure 29: Do you think ocean pollution is increasing over time?

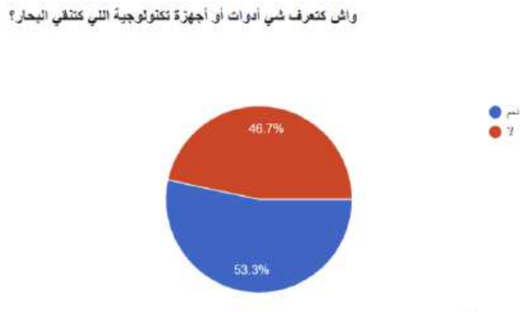


Figure 30: Do you know of any devices or technologies that clean oceans?

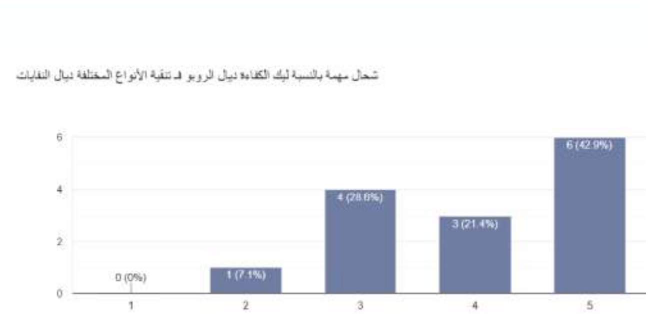


Figure 31: How important do you think a robot's ocean-cleaning capability is?

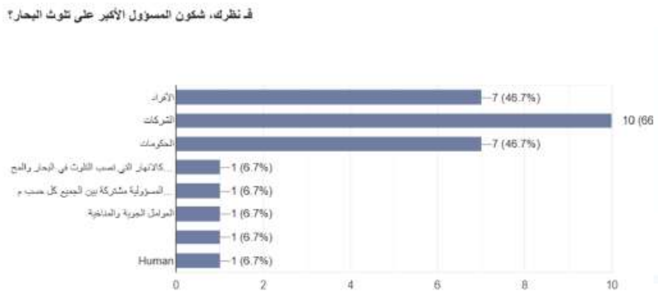


Figure 32: In your opinion, what is the main cause of ocean pollution?

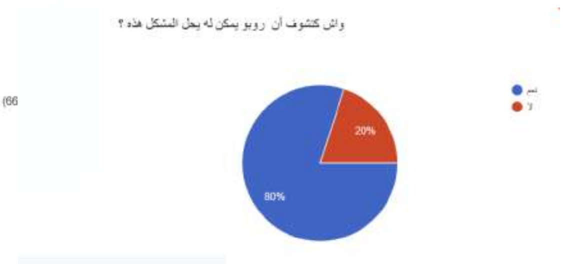


Figure 33: Do you think robots can actually solve the ocean pollution problem?

This Google Form helped improve our robot by gathering feedback on ocean pollution and robot capabilities. The responses guided us in refining the robot's design and focusing on features that are most important for cleaning the ocean effectively.

15.2 Talking with an Expert about Ocean Pollution

During our discussion with an oceanography expert,**Naoufal Elouardi**, we explored the critical issue of ocean pollution and its consequences. The expert highlighted how pollution affects marine ecosystems and human endeavors alike.

15.2.1 Challenges for Ocean Cleanup Efforts

The expert highlighted that pollution poses numerous obstacles to cleaning efforts, including:

- **Water Contamination:** Plastics, chemicals, and oil spills degrade water quality, making cleanup operations more difficult.
- **Microplastic Detection:** Tiny plastic particles are challenging to detect and remove efficiently.
- **Artificial Light Disruption:** Excessive human-generated light affects marine organisms and interferes with underwater monitoring.
- **Equipment Durability:** Corrosive pollutants can damage cleanup devices, reducing their operational lifespan.

MEET THE EXPERTS

15.2.2 Naoufal Ouardi

Naoufal Ouardi is a Marine Architect with 15 years of experience in port construction and the development of marine systems. Throughout his career, he has been involved in numerous projects, contributing to the advancement of maritime infrastructure and innovative marine technologies.

Key Insights from Our Meeting:

- Explained the classification of marine waste based on depth: surface, mid-water, and seabed.
- Provided detailed information about ocean structure and environmental impact.
- Recommended focusing on surface-level waste, particularly floating plastics.

His expertise have significantly contributed to the improvement of our project, making it more efficient and sustainable.

Figure 34: Evidence of our meeting with the expert.

15.2.3 Mohamed Taha El Ouriachi

Mohamed Taha el Ouriachi has 12 years of experience in Marine and Port Engineering, working on projects across Morocco and Africa. In 2014, he helped launch a Physical Asset Management division at Tanger Med Engineering.

In 2019, he co-developed WAVE BEAT, a patented wave energy solution in 70+ countries. Since 2020, he has been the co-founder and Managing Director of ATAREC, a startup recognized in 15+ global competitions, including Morocco's Startup of the Year (2022) and the UN's Top 5 Climate Initiatives.

Mohamed Taha El Ouriachi visited our center, where we had the opportunity to present our innovation project to him. We explained our idea in detail, showcased our prototype, and walked him through its key features and functionality. He carefully analyzed our work and provided us with valuable feedback to help improve our project.

He suggested several improvements, such as:

- Including a **GPS** system to enhance navigation and tracking.
- Improving the **AI** capabilities of our robot for better efficiency.
- Conducting thorough **testing** to ensure it functions properly.
- Making sure the robot is **waterproof** and does not drown.

15.2.4 Abdessamad Ghacha

Abdessamad Ghacha is a Moroccan engineer and sanitation expert at ONEE, with a Ph.D. in Civil and Environmental Engineering. A certified PMP, he leads sustainable sewage sludge management projects and contributes to environmental initiatives and climate risk assessments, with recognized research in waste treatment.

Abdessamad Ghacha gave us a training on project management, introducing us to key **PMP methodologies**. He emphasized the importance of planning, organizing tasks, managing time and risks, and fostering effective team communication.

Based on expert feedback, we implemented these strategies to enhance our innovation project:

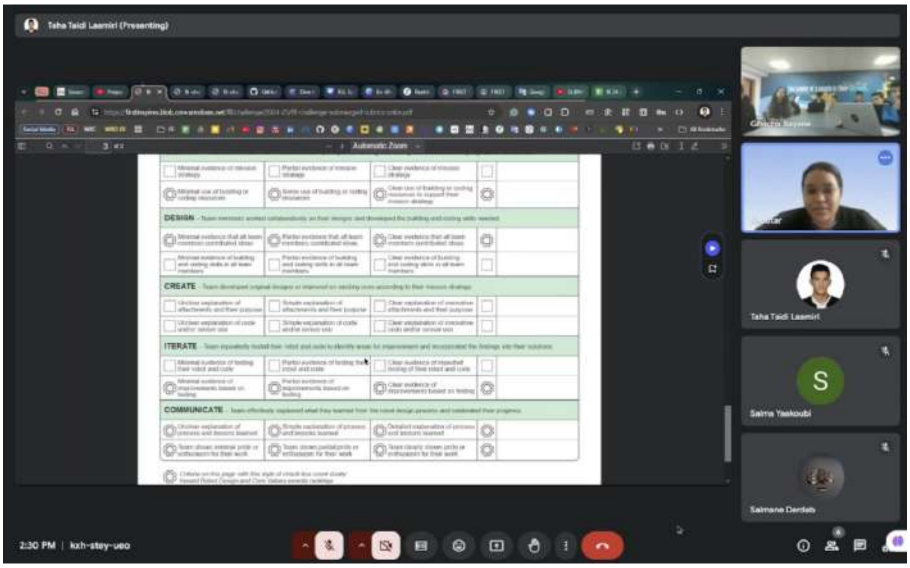
- Kanban → Visualize workflows and track progress
  Waterfall → Define stages and move step by step
- Regular Updates → Daily updates to keep the team aligned
  Project Constraints → Manage time, budget, and resources

15.2.5 Kaoutar Abbahaddou

Kaoutar Abbahaddou is a full stack software engineer who graduated from the prestigious Mohammedia School of Engineers.
In addition to her work in software engineering, she is one of the lead judges for the FIRST LEGO League in Morocco, where she uses her technical knowledge and experience to mentor and inspire young innovators.

Kaoutar Abbahaddou, one of the top judges in FIRST LEGO League Morocco, provided valuable advice and feedback to improve our presentation. Her key points were:

- **Presentation Improvement**: Emphasized clear communication and confident role explanations from all team members.
- **Judging Criteria**: Explained the importance of innovation, teamwork, and problem-solving in the judging process.
- **Team Collaboration**: Stressed the need for strong teamwork and collaboration throughout the project.
- **Attention to Detail**: Advised us to focus on the finer details of our design and explanations.
- **Confidence and Presentation Style**: Encouraged us to deliver ideas with confidence and engage the audience.



15.3 Incorporation of Feedback

Thanks to the feedback collected through the Google Form, and the meetings with the experts we were able to make significant improvements to the robot. Key updates include:

Focus on Surface Plastics

Based on Naoufal El Ouardi's advice, we chose to target floating plastic before it becomes microplastic and sinks.

Solar Panel Integration

We added solar panels to power the robot sustainably and increase its autonomy.

Camera System

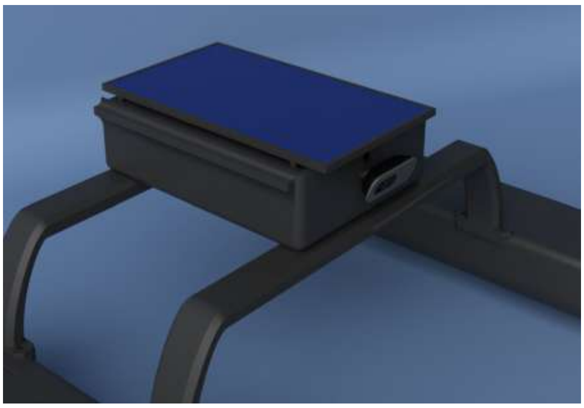
A front-facing camera was added for detecting trash and monitoring the environment in real-time.

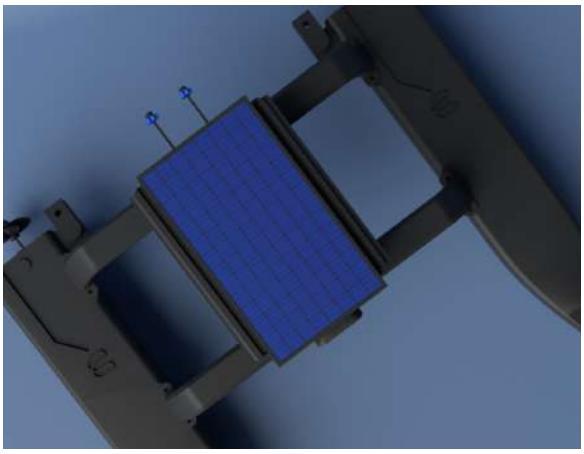
GPS AI Features

Following Taha Ouriachi's feedback, we implemented GPS and AI to allow autonomous movement and smarter decisions.

Improved Visibility

We painted the robot red (instead of black) to make it easier to spot on water surfaces.





IMPACT

16 Impact

Our Hydrobot presents a sustainable and innovative approach to tackling ocean pollution.The potential impact of our solution extends beyond environmental benefits; it also contributes to cleaner resources for marine biodiversity, safer waters for human activities, and technological advancements in environmental conservation.

16.1 Alignment with Sustainable Development Goals

Our project aligns with several United Nations Sustainable Development Goals (SDGs). Below is a breakdown of each goal, its relevance, and how our Hydrobot contributes to it.

Goal	Impact of the Hydrobot
	**Goal 6: Clean Water and Sanitation** The HydroBot helps improve water quality and support the sustainable management of water resources through the removal of pollutants like microplastics and debris.
	**Goal 7: Affordable and Clean Energy** HydroBot uses solar panels, a renewable energy source, to power its operations. This reduces reliance on non-renewable energy and promotes sustainable energy solutions.
	**Goal 9: Industry, Innovation, and Infrastructure** The project promotes innovative engineering solutions, demonstrating how technology can be used to address global environmental challenges.
	**Goal 11: Sustainable Cities and Communities** HydroBot reduces ocean pollution, improves environmental quality, and helps create cleaner, more resilient coastal urban areas.

	**Goal 13: Climate Action** Ocean pollution directly affects climate change; our Hydrobot helps mitigate this by reducing marine contaminants and preserving ecosystems.
	**Goal 14: Life Below Water** Protecting and restoring marine ecosystems is the core mission of our project, directly addressing ocean pollution and ensuring healthier waters for marine life.

PROGRAMMING TECHNIQUES AND 3D DESIGN TOOLS

17 Programming techniques and 3D design tools

17.1 Design and programming

Canva

Used for creating visually appealing graphics and designs.

VSCode

Main programming environment for coding.

Thonny

Main programming environment used for coding.

Premier Pro

Used for video editing.

PowerPoint

Mainly used for presentations and slide creation.

We used several powerful tools for both programming and design purposes. **Canva** was utilized for creating visually appealing graphics and designs. **VSCode** and **Thonny** were the main programming environments used for coding, while **Premier Pro** was used for video editing. **PowerPoint** was mainly used for presentations and slide creation.

17.2 3D Design Tools Used

OnShape

Used for designing 3D models with collaboration features.

Studio.io

Used for designing 3D models with collaboration features.

Creality

Used for 3D printing.

Blender

Used for advanced 3D modeling and animation.

For 3D design, we employed various tools. **OnShape** and **Studio.io** helped in designing 3D models with collaboration features. **Creality** was used for 3D printing, and **Blender** was employed for advanced 3D modeling and animation.

17.3 Tools Used

GitHub

Used for version control of our code.

ChatGPT

Assisted in debugging and improving our programming tasks.

Discord

Used for team discussions.

Reverso

A useful translation tool.

Google Drive

Used for cloud storage and document sharing.

For collaboration, version control, and communication, we made use of **GitHub**, **ChatGPT**, and **Discord**. **GitHub** provided version control for our code, while **ChatGPT** assisted in debugging and improving our programming tasks. **Discord** was used for team discussions. **Reverso** was a useful translation tool, and **Google Drive** served for cloud storage and document sharing.


ROBOT
DESIGN

18 Our Robot

In preparation for the FLL Submerged 2025 competition, our team began by thoroughly reviewing the competition rules to understand the key objectives and challenges. We then watched the season teaser to gain insight into the theme and challenges, which inspired our approach to designing and building the robot. To equip ourselves with the necessary skills and knowledge, we explored several online resources, including the Prime Lessons website, which provided us with valuable guidance on both building and coding the robot. Additionally, we watched multiple YouTube tutorials to further enhance our understanding of the technical aspects of the competition. This combination of rule analysis, inspirational content, and resourceful learning helped us lay the foundation for our project, leading to the development of a functional robot that meets the competition's requirements.

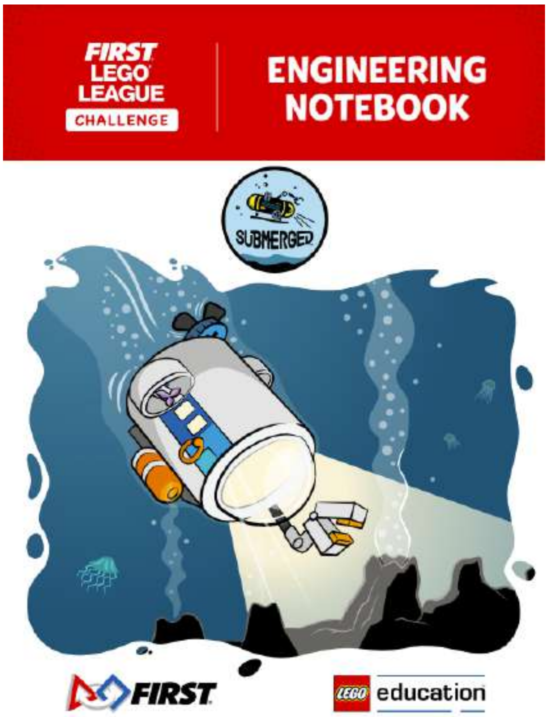


Figure 35: FLL season teaser.

The Robot Game

Here's a general overview of how the *FIRST*® LEGO® League robot game is played:

1. Your team works together to design and build a LEGO® robot. The robot operates autonomously, meaning that it will will follow pre-programmed instructions that your team writes to complete missions on the robot game field. The goal is to earn as many points as possible within a 2.5-minute match.
2. During a match, your team earns points as your robot completes missions, or tasks. Missions are represented by LEGO® models, referred to as mission models, that are positioned around the field. Missions can challenge the robot to manipulate objects, activate mechanisms, or move items to designated areas.
3. Your team launches your robot from one of the launch areas, contained in home. The robot should be programmed and prepared with the necessary attachments to accomplish the mission(s) your team is attempting.
4. It's your job to strategize and determine the order and approach your team will use to complete missions and maximize your score. You may choose to focus on specific high-scoring missions or aim for a combination of missions to accumulate points.
5. Mission requirements must be visible at the end of the match to score, unless otherwise stated in the mission.
6. In competitions, you will have three matches to show what your robot can do. Each round offers an opportunity to improve your score and your strategies. Only your team's best score of the three official matches counts toward awards and advancement. Ties are broken using second and third best scores.
7. *FIRST* LEGO League cares about not only the robot's performance but also how you express Core Values through *Gracious Professionalism*®. Referees at the event will evaluate your *Gracious Professionalism* at every official match.

For a full understanding of the robot game, please review the robot game rules found at the end of this guide.

Home | Left Launch Area | Right Launch Area | Home

6 Robot Game Rulebook | Introduction

Figure 36: Prime Lessons Website

link	name	Responsible
https://firstinspires.blob.core.windows.net/fll/challenge/2024-25/fll-challenge-submerged-rgr-eng.pdf	rule-book	All
https://firstinspires.blob.core.windows.net/fll/challenge/2024-25/fll-challenge-submerged-en-eng.pdf	Engineering-Notebook	All
https://youtu.be/dQ6qKkLI7MQ?si=m8oqmOhxWMUS_v4g	mission 14	Walid
https://youtu.be/NHHws7X7UBk?si=M0N9DCo-OWz0Hjfy	mission 14	Ahmad
https://www.youtube.com/watch?v=cpJqknUAbdY&t=13s	mission 7	Rayan
https://www.youtube.com/watch?v=FXL3_GJVM5I	mission8	Rayan
https://www.youtube.com/watch?v=aPVtw9h-xsI	mission 1	Mortada
https://www.youtube.com/watch?v=UaP27WAg3HA	mission 8	Salma_h
https://www.youtube.com/watch?v=Wx_8SWVIbwY&t=66s	full run	All
https://www.youtube.com/watch?v=9KNSUKzYGio	full run	All
https://www.youtube.com/watch?v=5mdZ78bceZs	full run	All
https://www.youtube.com/watch?v=42Zjfiep6gA	mission 4	Rayan
https://www.youtube.com/watch?v=n_35LP9AVWU	mission 8-15	Omar_a
https://www.youtube.com/watch?v=2HVHh_HjQco	mission 15	Walid
https://www.youtube.com/watch?v=-z88MWqk7Bw	mission 12	mariam
https://www.youtube.com/watch?v=rhr4CaOxZNU	mission 2-3	Mortada
https://www.youtube.com/watch?v=o33yKCrhKSI	mission 3-8-15	Ahmad

Figure 37: Ressources

18.1 Hardware

For our robot design, we had the option to choose from three platforms: LEGO EV3, LEGO Spike Prime, and LEGO Robot Inventor. After careful consideration of the competition's requirements and the capabilities of each platform, we decided to use the LEGO Robot Inventor set. One of the key reasons for this decision was the wide range of Technic pieces available in the Robot Inventor set, which provided us with more flexibility and precision in designing a robot that could meet the competition's challenges. The additional Technic components allowed us to create a more robust and versatile robot, capable of handling the tasks efficiently and effectively. This choice enabled us to leverage the strengths of the Robot Inventor system, ensuring that our robot would perform optimally throughout the competition.

Figure 38: EV3 robot

Figure 39: Spike prime

Figure 40: Inventor

18.2 Software

When selecting the programming environment for our robot, we had the option of using either the default block-based coding or the Pybricks firmware, which allows for Python-based programming. After evaluating both options, we chose Pybricks because it offers greater flexibility, efficiency, and control over the robot's behavior. Unlike block coding, which can be limiting for complex tasks, Pybricks enables us to write more advanced and optimized code, making our robot faster and more responsive. Additionally, Pybricks allows for direct control of motors and sensors with more precise commands, giving us an advantage in completing missions with higher accuracy. This choice also helped us improve our programming skills and better understand real-world coding applications, making our robot more competitive in the FLL Submerged 2025 competition.

Figure 41: Spike code-blocks

Figure 42: Prime Lessons Website

19 Robot Game strategy

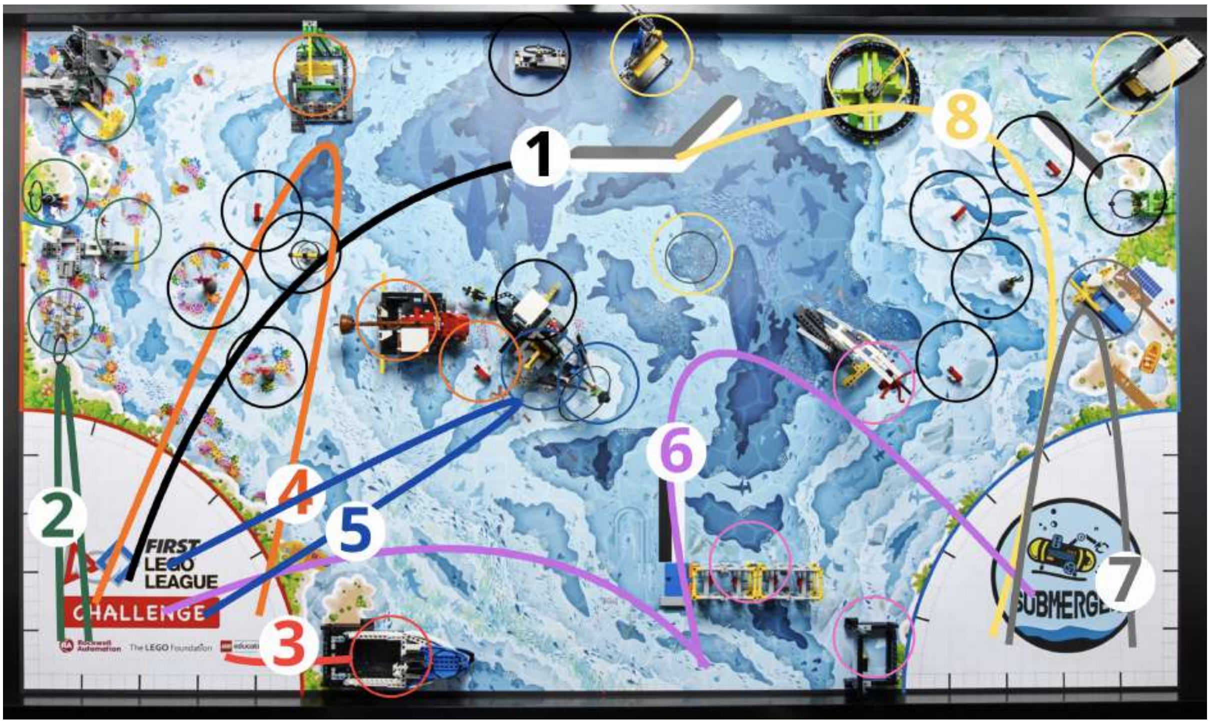


Figure 43: our strategy in the robot game

Our strategy was built around achieving consistent and high scores across all missions. To ensure efficiency and precision, we implemented the following key techniques:

Mission Grouping

We grouped nearby missions together to minimize travel time and maximize points in each run.

Robot Attachment Alignment

We carefully aligned the robot and its attachments to the mission models to reduce the margin of error and improve accuracy.

Dual Mechanism Approach

Our attachments were built using both passive and active mechanisms, depending on the specific needs of each mission.

Testing Consistency

We conducted over 50 trials to ensure mission consistency. The final evaluation was based on the results of the last 5 runs to confirm stability.

Performance Tracking

A dedicated table was used to track scores and completion times, helping us identify areas for improvement and stay organized during matches.

19.1 Run 1

Figure 44: Robot path from the Blue area, scoring 20 points, and returning.

19.1.1 Robot Path Overview

The robot starts from the Blue launch area and follows a predefined path. It takes approximately 10 seconds to reach the scoring zone, where it scores 20 points. After scoring, the robot returns to the Red launch area, completing its task.

19.1.2 code

```
def RUN1():
    move(745)
    turn(-85)
    move(-70)
    motor2.run_angle(800,180)
    move(870)
    turn(40)
    motor1.run_angle(800,330)
    move(105)
    motor1.run_angle(-200,340)
    turn(-58)
    move(430)
    turn(-56)
    move(700)
    gyro(False)
```

19.2 Run 2

Figure 45: Robot path from the Red area, scoring 55 points, and returning.

19.2.1 Robot Path Overview

The robot starts from the Red launch area and follows a predefined path. It takes approximately 15 seconds to reach the scoring zone, where it scores 55 points. After scoring, the robot returns to the Red launch area, completing its task.

19.2.2 code

```
def RUN2_1():
    move(540, 800, 700)
    motor1.run_angle(-800, 1000)
    motor1.run_angle(800, 1100)
    motor2.run_angle(800, 535)
    move(-420,state=False)
    gyro(False)
```

19.3 Run 3

Figure 46: Robot path from the red area, scoring 90 points, returns to the blue launch area.

19.3.1 Robot Path Overview

The robot starts from the Red launch area and follows a predefined path. It takes approximately 7 seconds to reach the scoring zone, where it scores 90 points. After scoring, the robot returns to the Red launch area, completing its task.

19.3.2 code

```
def RUN3_1():
    move(150)
    move(-500, 500, 400, state=False)
    gyro(False)
```

```
def RUN3_2():
    move(150)
    move(-500, 500, 400, state=False)
    gyro(False)
```

19.4 Run 4

Figure 47: Robot path from the Red area, scoring 15 points, and returns to the Red launch area.

19.4.1 Robot Path Overview

The robot starts from the Red launch area and follows a predefined path. It takes approximately 8 seconds to reach the scoring zone, where it scores 15 points. After scoring, the robot returns to the Red launch area, completing its task.

19.4.2 code

```
def RUN4():
    move(545)
    turn(79.5)
    move(345, 600, 400)
    motor2.run_angle(-500, 340)
    move(-188)
    turn(81)
    move(-450)
    motor1.run_angle(800, 200)
    motor1.run_angle(-800, 100)
    move(100,400,200)
    move(450,800,700)
    run_task(multitask2())
    turn(-94)
    move(-210)
    gyro(False)
```

19.5 Run 5

Figure 48: Robot path from the Red area, scoring 90 points, and returns to the Red launch area.

19.5.1 Robot Path Overview

The robot starts from the Red launch area and follows a predefined path. It takes approximately 30 seconds to reach the scoring zone, where it scores 90 points. After scoring, the robot returns to the Red launch area, completing its task.

19.5.2 code

```
def RUN5():
    move(485)
    turn(-45)
    move(280)
    motor2.run_angle(800, 200)
    motor2.run_angle(-800, 1350)
    motor2.run_angle(800, 1400)
    motor1.run_angle(-800, 300)
    move(-230)
    turn(42)
    move(-530)
    gyro(False)
```

19.6 Run 6

Figure 49: Robot path from the Red area, scoring 40 points, and returns to the blue launch area.

19.6.1 Robot Path Overview

The robot starts from the Red launch area and follows a predefined path. It takes approximately 25 seconds to reach the scoring zone, where it scores 40 points. After scoring, the robot returns to the blue launch area, completing its task.

19.6.2 code

```
def RUN6():
    move(600)
    turn(50)
    move(650, state=False)
    motor1.run_angle(800, 500)
    motor1.run_angle(-800, 500)
    motor2.run_angle(-800, 300)
    move(-440, speed=800, acceleration=750)
    turn(-93)
    move(-95, state=False)
    move(192)
    turn(65)
    motor2.run_angle(800, 300)
    move(330)
    turn(25)
    move(585)
    turn(37)
    move(-300)
    move(460)
    turn(-118)
    gyro(False)
```

19.7 Run 7

Figure 50: Robot path from the blue area, scoring 40 points, and returns to the blue launch area.

19.7.1 Robot Path Overview

The robot starts from the blue launch area and follows a predefined path. It takes approximately 25 seconds to reach the scoring zone, where it scores 40 points. After scoring, the robot returns to the blue launch area, completing its task.

19.7.2 code

```
def RUN7_1():
    move(50)
    turn(-51)
    move(950)
    turn(-40)
    move(50)
    move(-80)
    turn(37)
    move(-1000)
    gyro(False)
```

```
def RUN7_2():
    move(270)
    run_task(multitask1())
    move(215)
    motor1.run_angle(800, 750)
    move(-165)
    turn(-47)
    move(-270)
    gyro(False)
```

19.8 Run 8

Figure 51: Robot path from the blue area, scoring 130 points, and returns to the blue launch area.

19.8.1 Robot Path Overview

The robot starts from the blue launch area and follows a predefined path. It takes approximately 26 seconds to reach the scoring zone, where it scores 130 points. After scoring, the robot returns to the blue launch area, completing its task.

19.8.2 code

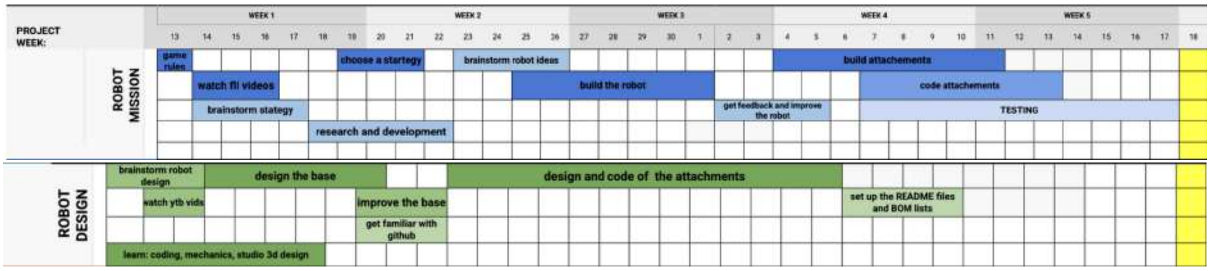
```
def RUN8():
    move(725)
    turn(38)
    move(120, state=False, speed=400, acceleration=200)
    move(-150)
    turn(37)
    move(-240)
    motor1.run_angle(800, 700)
    move(-210)
    turn(38)
    move(-220)
    motor2.run_angle(-800, 650)
    wait(700)
    move(110)
    gyro    (False)
```

```python
from RUNS import *

COLOR1 = sensor1.color()     # First sensor detected color
COLOR2 = sensor2.color()     # Second sensor detected color

hub.display.icon(Icon.HEART)
pressed = []

while True:
    COLOR1 = sensor1.color()     # First sensor detected color
    COLOR2 = sensor2.color()     # Second sensor detected color

    if COLOR1 == RED and COLOR2 == WHITE:
        pressed = hub.buttons.pressed()
        hub.display.char("1")
        if Button.LEFT in pressed:
            wait(100)
            RUN1()
    elif COLOR1 == WHITE and COLOR2 == RED:
        pressed = hub.buttons.pressed()
        hub.display.char("2")
        if Button.LEFT in pressed:
            wait(100)
            RUN2_1()
        if Button.RIGHT in pressed:
            wait(100)
            RUN2_2()
    elif COLOR1 == RED and COLOR2 == RED:
        pressed = hub.buttons.pressed()
        hub.display.char("3")
        if Button.LEFT in pressed:
            wait(100)
            RUN3()
    elif COLOR1 == WHITE and COLOR2 == WHITE:
        pressed = hub.buttons.pressed()
        hub.display.char("4")
        if Button.LEFT in pressed:
            wait(100)
            RUN4()
    elif COLOR1 ==BLUE and COLOR2 == BLUE:
        pressed = hub.buttons.pressed()
        hub.display.char("5")
        if Button.LEFT in pressed:
            wait(100)
            RUN5()
    elif COLOR1 == RED and COLOR2 == BLUE:
        pressed = hub.buttons.pressed()
        hub.display.char("6")
        if Button.LEFT in pressed:
            wait(100)
            RUN6()
    elif COLOR1 == WHITE and COLOR2 == BLUE:
        pressed = hub.buttons.pressed()
        hub.display.char("7")
        if Button.LEFT in pressed:
            wait(100)
            RUN7()
```

TIMELINE

20 Timeline

20.1 First Qualifying Phase



The preparation for the First Qualifying Phase in robot game and robot design consisted of our initial steps, including learning about the game rules, watching FLL videos, brainstorming strategy, and designing our robot. Below is a breakdown of the tasks we completed week by week:

1. **Week 1: Initial Research and Setup**
   - Learn about the game rules and objectives.
   - Watch FLL videos to gain insights into robot design and strategies.
   - Brainstorm possible strategies for the competition.
   - Begin brainstorming robot design ideas, focusing on the base design.
   - Set up a GitHub repository to manage our project files and code.
2. **Week 2: Strategy and Base Design**
   - Choose a strategy to focus on and refine the robot's design.
   - Continue building the robot's base while incorporating improvements.
   - Start parallel research and development on the robot's functionality.
   - Familiarize the team with GitHub for version control.
3. **Week 3: Prototype Building and Attachment Design**
   - Continue building and refining the robot's base structure.
   - Gather feedback from teammates to improve robot design.
   - Begin designing and coding attachments for the robot.
   - Test attachments with the base to ensure compatibility and functionality.
4. **Week 4: Attachment Development and Testing**
   - Finalize the design and coding for attachments.
   - Perform parallel testing of attachments and base structure.
   - Set up a "readme" file and a Bill of Materials (BOM) list for the project.

- Continue refining attachments based on test results.

5. **Week 5: Final Testing and Adjustments**
    - Finalize all attachments and their code.
    - Perform extensive testing, identify issues, and fix them.
    - Iteratively improve the robot based on test results.

20.2 National Phase

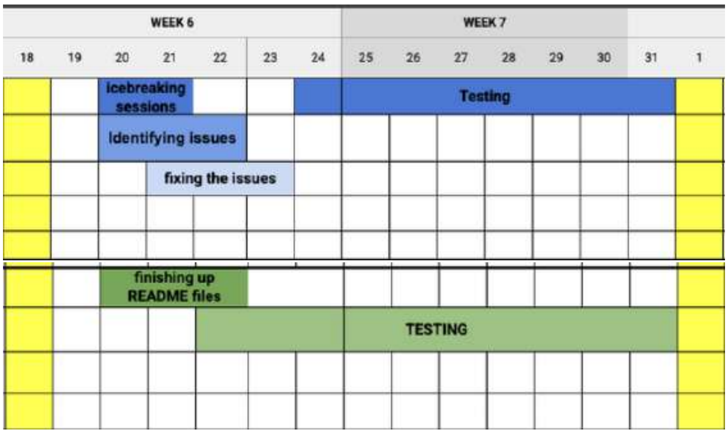


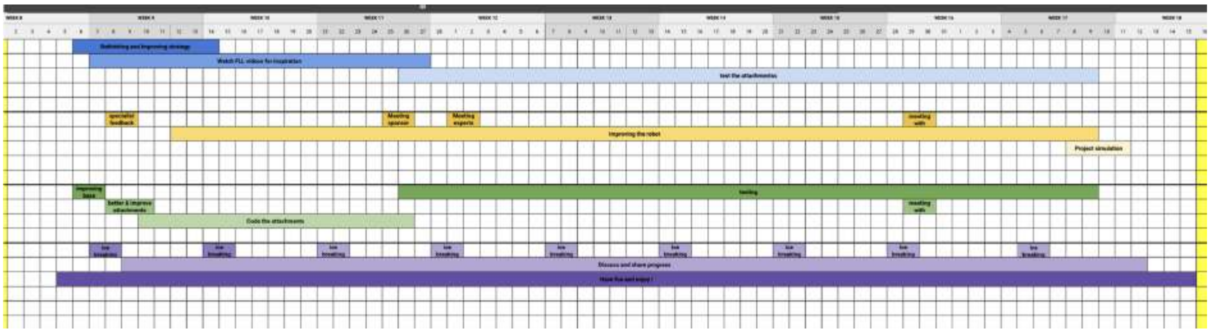
Figure 52: Timeline nationals

For the preparation for the national phase, we focused on refining the robot, testing attachments, and addressing any issues identified during previous tests. We also continued to improve our project files, including the GitHub repository.

1. **Week 6: Icebreaker and Testing**
    - Conduct an icebreaker session to strengthen team collaboration.
    - Identify issues with the robot's performance and fix them.
    - Complete the "readme" file on GitHub with updated documentation.
    - Begin systematic testing to identify weaknesses and areas for improvement.

2. **Week 7: Finalizing Robot and Testing**
    - Continue testing robot performance and iterating on designs.
    - Make final adjustments based on test results.
    - Prepare and complete all necessary documentation on GitHub.

20.3 International Phase



For the international phase, we focused on refining our strategy and improving our robot. Key activities included:

- **Rethinking and Improving the Strategy:** We revisited our approach to the Robot Game, analyzing past competition videos for inspiration and refining our mission strategy.
- **Innovation Project Meeting:** We held a meeting with a specialist expert, whose insights we implemented into our project, improving our solution.
- **Sponsorship and Expert Feedback:** In Week 11, we met with sponsors, discussed our progress, and had a meeting with additional experts to gain valuable feedback.
- **Robot Improvement:** Based on the feedback from sponsors and experts, we made several improvements to our robot, enhancing its performance and capabilities.

TASK MANAGEMENT

21 Tasks

The division of tasks was carefully planned to ensure efficiency and clarity throughout the project. We utilized several criteria to manage and assign tasks, including deadlines, importance, the availability of team members (whether tasks were done online or in-person), and status updates. Each task was broken down into manageable pieces, allowing for smoother execution and parallel progress.

We used a collaborative approach, ensuring that each member contributed to both the design and development phases of the robot, as well as the testing and iteration stages. This enabled us to leverage the strengths of every team member and efficiently work on different components of the robot.

	A	B	C	D	E	F	G	H	I
1	Title	Tasks	Responsible			Importance	line / sur si	Status	Deadline
2	Robot Design	Watch fll videos	All			Less Impor...	online	Done	6 /11 / 2024
6	Robot Design	brainstorn robot design	All			Important	Mind...	Done	15/12/2024
18	Robot Design	design base	Mortada	Walid	Omar_l	Very Urgent	Mind...	Done	21/12/2024
30	Robot Design	build attachement 1& 2	Salman	Mortada		Very Urgent	Mind...	Done	28/12/2024
31	Robot Design	build attachement 3	samadi	Rayan		Very Urgent	Mind...	Done	28/12/2024
32	Robot Design	build attachement 4	Salma_h	mariam		Very Urgent	Mind...	Done	28/12/2024
33	Robot Design	build attachement 5	Salma_y	Omar_l		Very Urgent	Mind...	Done	28/12/2024
34	Robot Design	build attachement 6	Walid	Ahmad		Very Urgent	Mind...	Done	28/12/2024
35	Robot Design	code attachement 1& 2	Mortada	Salman		Very Urgent	Mind...	Done	6/1/2025
36	Robot Design	code attachement 3	Rayan	samadi		Very Urgent	Mind...	Done	6/1/2025
37	Robot Design	code attachement 4	mariam	Salma_h		Very Urgent	Mind...	Done	6/1/2025
38	Robot Design	code attachement 5	Salma_y	Omar_l		Very Urgent	Mind...	Done	6/1/2025
39	Robot Design	code attachement 6	Ahmad	Walid		Very Urgent	Mind...	Done	6/1/2025
40	Robot Design	scoring system	Salman			Less Impor...	Mind...	Done	13/12/2024

Figure 53: Task Assignment for Robot Design

In this section, we describe how tasks were distributed among team members for the robot design process.

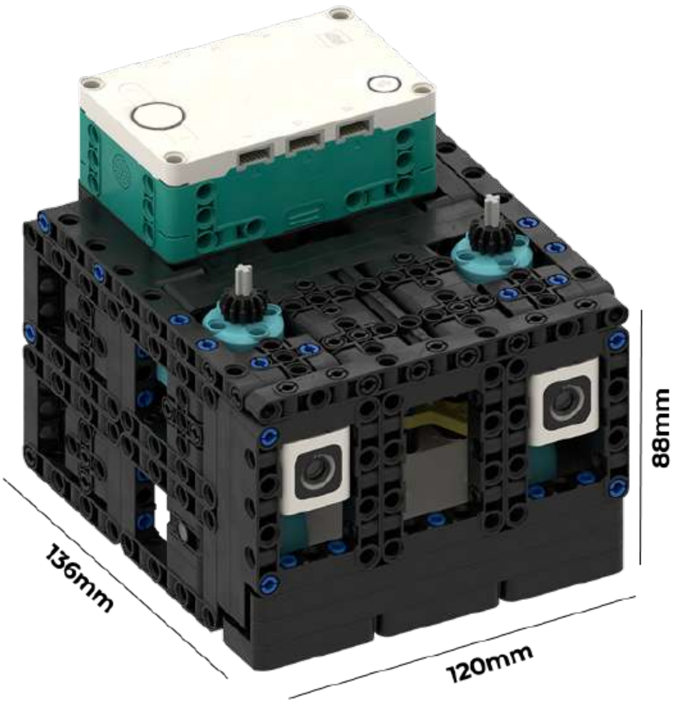
21.1 Task Assignment

The tasks were divided among the team based on both design and coding responsibilities, with each pair of team members focusing on specific attachments. Here's an overview of how the tasks were assigned:

- **Mortada and Salman:** Worked on Attachment 1 and Attachment 2
- **Walid and Ahmed:** Worked on Attachment 6
- **Omar and Salma Yacoubi:** Worked on Attachment 5
- **Rayan and Mohammed:** Worked on Attachment 3
- **Mariam and Salma:** Worked on Attachment 4

Features Of The Robot

22 Features of the robot



Our robot was designed with performance, efficiency, and ease-of-use in mind. Below are the main features that contributed to its success during the missions:

- ☐ **Auto Attachment Detection:** Enables the robot to recognize and adapt to different attachments seamlessly.
- ☐ **Compact Design:** Small and efficient structure allowing smoother navigation and better movement in tight spaces.
- ☐ **Cable Management System:** Organized and secured wiring to avoid tangling and improve reliability.
- ☐ **Easy Hub Access:** Hub can be easily swapped or accessed, making it more convenient for adjustments or programming.
- ☐ **High-Traction Wheels:** Small wheels chosen to increase grip and stability on the mission map.
- ☐ **Medium Motors:** Powered by medium motors for a balance between speed and precision.

Attachment Base

23 Attachment Base

The attachment base is designed to be both practical and versatile, making it a core part of our robot's efficiency and adaptability. Here's why:

- **Strong and Stable Foundation:** The base provides a solid and secure foundation for all the attachments, ensuring everything stays in place during operation, even in challenging situations.
- **Quick Attachment and Detachment:** We made sure that swapping attachments is fast and easy, so the robot can be reconfigured quickly based on the mission's needs. No time wasted – just efficient adjustments.
- **Multiple Shaft Outputs:** Whether it's vertical or horizontal, the base comes with multiple shaft outputs with different ratios. This flexibility means we can optimize the robot's performance for a wide range of tasks.
- **Color-Coded System for Easy Identification:** To make things even simpler, we've added a color identification system. It helps us instantly recognize which attachment is being used, saving time during setup and making everything run smoothly.

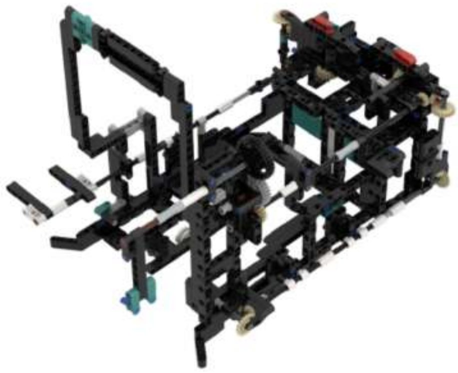
Attachments

24 Attachments

Attachment	Mission(s)	Points Earned	Image
Attachment 1	Mission 5, Helps in Mission 12, 3, and 14	55 points	
Attachment 2	Mission 1, 2, 4, Helps in Mission 15	90 points	
Attachment 3	Mission 3, Helps in Mission 15	15 points	
Attachment 4	Mission 3, 4, 6, 7, Helps in Mission 12	90 points	
Attachment 5	Mission 2, 14	40 points	
Attachment 6	Mission 8, 9, 15	110 points	
Attachment 7	Mission 13	20 points	
Attachment 8	Mission 9, 10, 11, 12	130 points	

Total Points Earned: 550 points

Mechanisms



25 Mechanisms

In our project, we used two types of mechanisms: **active systems** and **passive systems**. Both of these systems contribute to the robot's functionality, enabling it to perform a variety of tasks with precision and efficiency.

25.1 Active Systems

Active systems are powered by the robot's **motors**. These mechanisms allow for **precise control** of complex tasks, which require detailed movements and adjustments. Active systems are essential for tasks where the robot needs to exert specific force or perform intricate operations.

Key features of **active systems**:

- Powered by the robot's **motors**.
- Enables **precise control** for complex tasks.

25.2 Passive Systems

On the other hand, **passive systems** are powered by the robot's **movement** and the motion of its body. These systems do not require motors and instead rely on the robot's own actions to perform simple tasks.

Key features of **passive systems**:

- Powered by the robot's **movement**.
- **Simple** and easy to implement.

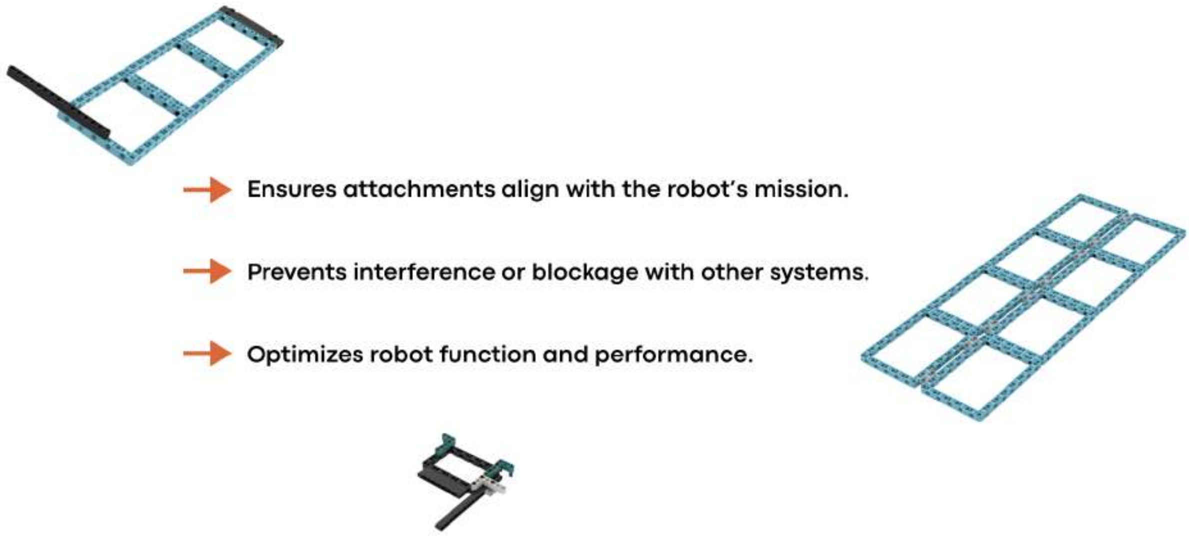
Functions Served by Both Systems

Both **active** and **passive systems** enable the robot to perform six main functions: **Push, Pull, Move, Lift, Rotate, Grip**

Alignement

26 Alignments

The alignment of the attachments is crucial to the robot's overall performance and functionality. Proper alignment ensures that the attachments are in the correct position to perform their designated tasks without interference from other systems.



26.1 Attachment Alignment and Mission Performance

Ensuring the proper alignment of each attachment is essential for the robot to effectively carry out its mission objectives. Misalignment can result in a failure to perform tasks correctly or hinder the robot's ability to function efficiently.

26.2 Prevention of Interference or Blockage

Accurate alignment prevents the attachments from obstructing or interfering with other systems, ensuring smooth operation throughout the robot's movement. This minimizes the risk of mechanical issues or failures that may arise from improperly aligned parts.

26.3 Optimization of Function and Performance

When attachments are aligned correctly, the robot's performance is optimized. Tasks are executed with greater precision and efficiency, and the robot is better equipped to handle the complexities of the mission without unnecessary delays or errors.

CODING

27 Coding

27.1 Introduction to the Coding Process

For our robot, we used **MicroPython** as the programming language, along with the **Pybricks** framework. Pybricks is specifically designed for programming LEGO robots and provides an efficient way to control motors, sensors, and other hardware components.
To manage our code and collaborate effectively, we utilized **GitHub**, where we stored our files, tracked changes, and worked on different versions of our program.

27.2 File Structure

Our project was structured into three main Python files:

- **main.py**: This is the central file that calls functions from other files and controls the robot's overall execution.
- **attachments.py**: This file defines the various attachments and mechanisms used in the robot.
- **runs.py**: This file contains predefined sequences of movements and operations for different competition tasks.

```
├── ATTACHMENT.py
├── RUNS.py
└── MAIN.py
```

Each file plays a crucial role in maintaining a well-organized and modular code structure.

27.3 Libraries Used

We imported essential libraries from Pybricks, including:

- `pybricks.hubs`: For controlling the hub.
- `pybricks.pupdevices`: For handling motors and sensors.
- `pybricks.parameters`: For defining ports, directions, and other configurations.
- `pybricks.robotics`: For drivebase control.
- `pybricks.tools`: For using wait times, tasks, and multitasking features.

```
from pybricks.hubs import InventorHub
from pybricks.pupdevices import Motor, ColorSensor, UltrasonicSensor
from pybricks.parameters import Button, Color, Direction, Port, Side, Stop, Axis
from pybricks.robotics import DriveBase
from pybricks.tools import wait, StopWatch, hub_menu, run_task, multitask
```

27.4 Defining Ports and Devices

To ensure proper hardware configuration, we defined all the motors and sensors with their respective ports:

- Motors: Left, right, front, and back motors assigned to specific ports.
- Sensors: Color sensors assigned to different ports.
- Drivebase: A combination of motors for overall movement control.

```python
# Initialize the hub
hub = InventorHub()

# Defining hub devices and ports
left_motor= Motor(Port.C, Direction.COUNTERCLOCKWISE)
right_motor= Motor(Port.D)
front_motor = Motor(Port.A)
back_motor = Motor(Port.F)

# Defining Color Sensors
sensor1 = ColorSensor(Port.B)
sensor2 = ColorSensor(Port.E)

# Define the drivebase (robot)
robot = DriveBase(left_motor, right_motor, 56, 140)
```

27.5 Essential Functions

We created functions for fundamental robot actions:

- **move(distance, speed, acceleration)**: Moves the robot forward or backward at a specified speed and acceleration.
- **turn(rotation)**: Rotates the robot by a certain angle.

These functions ensure smooth and precise control of the robot's movement.

```python
def move(distance, speed=700, acceleration=600):
    """
    Moves the robot in a straight line with specified speed, acceleration, and optional gyro stabilization.

    Args:
        distance (int): The distance to move in millimeters. Positive for forward, negative for backward.
        speed (int, optional): The target speed in mm/s. Defaults to 700.
        acceleration (int, optional): The acceleration in mm/s². Defaults to 600.
        gyro (bool, optional): Whether to use gyro stabilization. Defaults to True.

    Returns:
        None
    """
    robot.settings(speed, acceleration)
    robot.straight(distance)

def turn(rotation):
    robot.settings(turn_rate=400, turn_acceleration=300)
    robot.turn(rotation)


def gyro(self):
    robot.use_gyro(self)
```

27.6 Each Attachment Function

For each attachment, we defined specific functions in the `attachments.py` file:

- **m1_open(angle)**: Controls the back motor to run at a specified angle.
- **diver_open(angle)**: Moves the front motor to a specific angle.

These functions allow modular control of different robot mechanisms.

```
class A2:
    def m1_open(angle):
        back_motor.run_angle(800, angle)


    def diver_open(angle):
        front_motor.run_angle(500, angle)


    async def multitask1():
        await multitask(back_motor.run_angle(800, 2250), front_motor.run_angle(800, 650))

```

27.7 Auto Detection

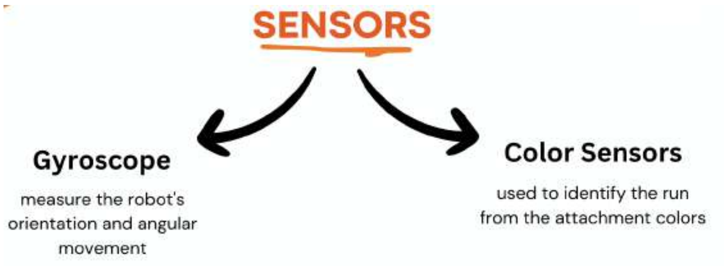
Our robot is equipped with an automatic detection system using a color sensor to identify different attachments. This feature allows the robot to recognize which attachment is currently in use and execute the corresponding code accordingly.

- **Color Sensor for Attachment Recognition:** The color sensor scans the color of the attachment placed on the robot.
- **Automatic Code Selection:** Based on the detected color, the robot automatically selects and runs the pre-programmed code specific to that attachment.
- **Efficiency and Precision:** This system eliminates the need for manual selection, reducing errors and improving efficiency during operation.

Figure 54: Auto-Detection logic

27.8 Sensors Used

Our robot utilizes two primary sensors to enhance functionality and precision:



27.9 Gyroscope Sensor

The gyroscope sensor is used for orientation and balance control. It helps in:

- **Maintaining Stability:** Ensuring the robot moves in a straight line without deviation.
- **Accurate Turns:** Assisting in precise angle measurements for smooth and controlled turns.
- **Reducing Drift:** Minimizing errors caused by external factors like friction or minor obstacles.

27.10 Color Sensor

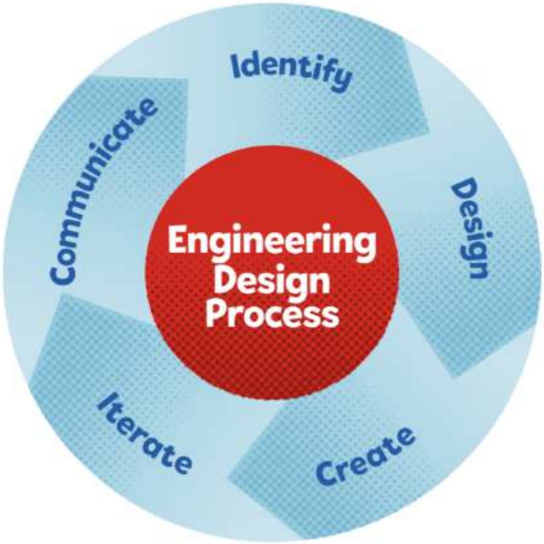
The color sensor is a crucial component for multiple functions in the robot:

- **Attachment Detection:** Recognizing the color of the attachment to trigger the corresponding code.
- **Line Following:** Assisting in navigation by detecting different colors on the surface.
- **Object Identification:** Differentiating between objects based on color variations.

ENGINEERING DESIGN PROCESS

28 Engineering Design Process

The engineering design process helped us build and refine our robot to succeed in the robot game.



28.1 1. Define the Problem

We identified the goal: to build a robot capable of navigating the game environment and completing tasks with precision and efficiency.

28.2 2. Research and Brainstorming

We researched robot designs, mechanisms, and strategies, then brainstormed solutions that fit the game requirements and constraints.

28.3 3. Develop Solutions

We chose a design, selected the necessary components (motors, sensors, controllers), and sketched the initial plan.

28.4 4. Build and Test

We built the prototype, tested its performance, and identified areas for improvement (speed, maneuverability, and precision).

28.5 5. Iterate and Improve

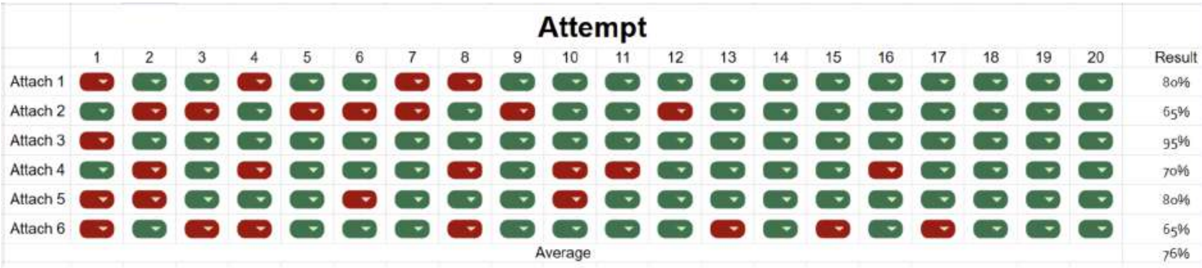
Based on test results, we made adjustments to the robot's design and programming for better performance.

28.6 6. Finalize the Design

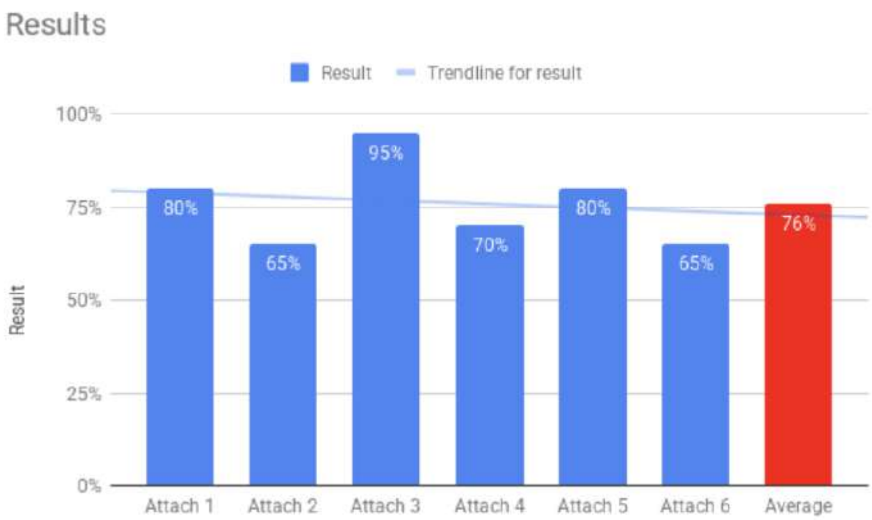
After refining the robot, we ensured it could effectively complete the tasks in the game.

ATTEMPTS AND TESTING

29 attempts and testing



To ensure the reliability and efficiency of our robot, we conducted a series of tests using a structured approach. We created a Google Sheet table to document the performance of each attachment, across 20 attempts.



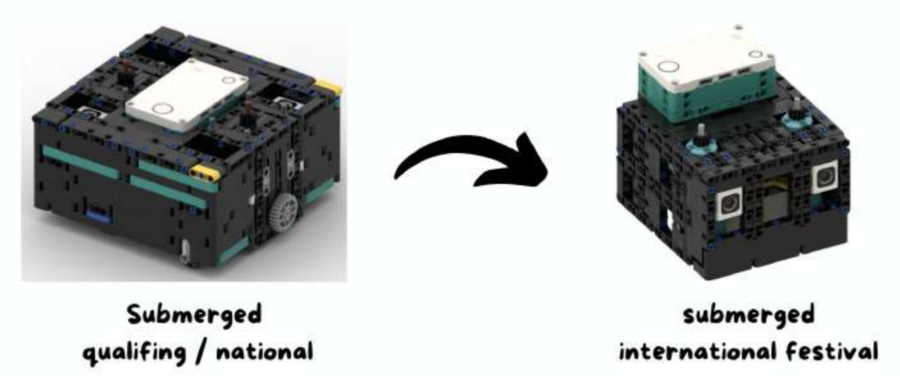
By recording the **Sucess rate** of each attempt, we were able to analyze patterns, identify weaknesses, and refine our design. Our final results showed an average success rate of **76%**, which provided valuable insights into our robot's consistency and areas for improvement

This technique allowed us to:

- Quantify our robot's performance with real data.
- Identify inconsistencies and failures.
- Improve our design based on measurable results rather than assumptions.

ROBOT IMPROVEMENT

30 robot improvements



Our 2025 robot design features several key improvements over last year's model, making it more efficient and better suited for the competition.

30.1 Increased Height

Last year's robot was too low, causing it to scratch the ground during movement. This year, we **raised the robot's height** to prevent friction and improve navigation.

30.2 Optimized Motor Placement

Last year, both motors were placed in the front, limiting the robot's efficiency. For this current robot, we repositioned one motor to the opposite side, allowing the robot to complete **two missions simultaneously** instead of one.

30.3 Reduced Weight

The previous design was heavier, making movements slower and less precise. This year, we **reduced the weight**, increasing the robot's speed and maneuverability.

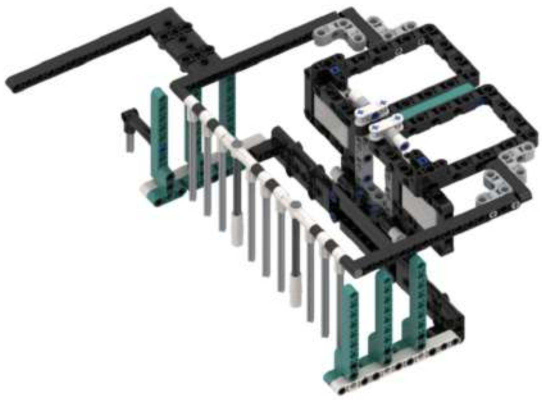
These improvements helped us create a more stable and efficient robot for this year's challenges.

DEVELOPING STEPS

31 Developing steps

the development of our robot and attachements has been an ongoing process of refinement. Initially, we started with a basic design and gradually improved it over time through testing. Each iteration was based on the lessons learned from previous tests. Below are the key stages of improvement we made in one of our attachements

31.1 Initial Design: Passive Mode



In the first phase of the development, we designed Attachment 1 to function in passive mode. This version of the attachment did not require any external power and was designed to operate solely based on the robot's movements and interactions. While this design was simple and required minimal energy, it proved to be ineffective during testing. The attachment lacked the necessary force and precision, which made it unsuitable for tasks that required more control and impact. Despite its simplicity, the passive design was inadequate for the robot's goals.

31.2 Second Iteration: Active and Passive Modes (Dual-Piece Design)

After the initial tests, we decided to redesign Attachment 1 to include both active and passive modes. The new design featured two components: one piece was powered (active mode) to provide the necessary force, and the other was passive, assisting with stabilization and fine adjustments. This dual-piece design seemed promising, as it combined the benefits of both modes. However, after further testing, we found that the two components did not work as effectively as we had hoped. The interaction between the active and passive pieces still lacked the desired impact, and the performance was still not optimal. The dual design did not provide the seamless integration we needed.

31.3 Final Iteration: Active Mode with a Single Piece

After identifying the flaws in the previous designs, we reverted to a simpler, more focused approach by returning to a single-piece attachment. In this iteration, we decided to go with active mode only, where the attachment would rely entirely on powered components to generate force. This approach allowed for more control, precision, and impact. Following extensive testing, this version of Attachment 1 delivered significantly better performance compared to the earlier iterations. The single-piece active mode proved to be more efficient, providing the required impact and stability for the robot's tasks.

PROUDEST PART OF OUR ROBOT DESIGN

32 Proudest Part of Our Robot Design

32.1 Robot Base

Our robot base is one of the key elements of the project that we're most proud of. Here's why:

- **Small Wheels**: Designed for better grip and traction on the map.
- **Medium Motors**: Balanced power for smooth, efficient movement.
- **Auto Attachment Detection**: Automatically detects attachments for increased versatility.
- **Compact Design**: Small and lightweight, ensuring agility and energy efficiency.
- **Cable Management**: Neatly organized wiring to prevent tangling and ensure longevity.
- **Easy Hub Access**: Quick and easy access to the central hub for maintenance and adjustments.

32.2 Attachment Base

We're incredibly proud of our attachment base because it is the key to our robot's efficiency and versatility. Here's why it stands out:

- **Strong and Stable Foundation**: It provides a rock-solid foundation for all attachments, ensuring that everything stays secure, even in tough situations.
- **Quick Attachment/Detachment**: We designed it for seamless, rapid swapping of attachments, making sure the robot can be quickly reconfigured without wasting a second.
- **Multiple Shaft Outputs**: The base offers multiple shaft outputs, giving us the flexibility to choose between vertical or horizontal shafts with different ratios, optimizing performance for any task.
- **Color-Coded System**: The color-coded system makes attachment identification super easy, ensuring smooth and quick setups, saving us valuable time.

Core Values

CORE VALUES

*W*e are stronger when we work together. Our team has weekly brainstorming sessions where everyone's ideas matter.

*O*ur project is designed to make a difference, and we're proud to contribute to solving real-world problems.

*W*e respect and embrace everyone's differences. Our team includes members with different strengths, and that's our superpower!

*B*y sharing tasks and supporting each other, we've achieved so much more as a team.

*O*ur team is built on inclusivity, where everyone feels welcome and valued, and we're driven to make a positive impact through our collective efforts.

*E*very day is a chance to discover something new, whether it's a coding solution or a new robot design.

*W*e are stronger when we work together. Our team has weekly brainstorming sessions where everyone's ideas matter.

*W*e celebrate our progress and have fun while learning. Whether we're testing our robot or working on the project, we always enjoy ourselves.

*W*e love exploring new skills and ideas. This year, we learned about Pybricks, 3D design, and a lot of other useful tools!

*E*ach one of us contributes unique ideas, and that's what makes our team dynamic and inclusive.

OUR STORY


FIRST
LEGO
LEAGUE
CHALLENGE
SUBMERGED
CHAMPION'S AWARD
2ND PLACE

The start of our journey

33 The start of our journey

Our journey began when we formed our team and decided to compete in the First LEGO League. We started late, which meant we had to catch up quickly. With limited time, we focused on developing our robot and completing the innovation project.

Despite the setbacks, we stayed determined and excited. We saw the FLL competition as a chance to grow, learn, and collaborate as a team. With hard work and dedication, we overcame our initial doubts, and the real journey began.

34 Making our way through qualifying

- **The Road to Qualifying:**
  - With the competition approaching, we focused on refining the robot, perfecting the code, and preparing the presentation.
  - Despite the pressure, we were determined to give our best effort.
- **A Family-Like Bond:**
  - Our team quickly bonded, meeting almost every day to build, program, and rehearse together.
  - We supported each other through challenges and celebrated small victories.
- **Learning from Each Other:**
  - With diverse experience levels, we shared knowledge—more experienced members taught new skills, while fresh ideas sparked creative solutions.
- **Facing Challenges Head-On:**
  - During the competition, we encountered technical issues, but worked together to adapt and solve problems under pressure.
- **The Thrill of Progress:**
  - Despite setbacks, we made progress with each round, gaining confidence as we approached our goal. The qualifying competition was a major achievement that motivated us for the next stage.

35 First LEGO League Qualifying Competition Success

Our team had an incredible experience at the First LEGO League (FLL) Qualifying Competition! We secured **Third Place in Robot Design**, showcasing our creative robot and unique design.

This achievement qualified us for the **National Competition**, motivating us to refine our strategies and aim higher. We were excited to embrace new challenges at the national level.

Our National Competition experience

36 First Lego League National Competition

The competition on February 1st, 2025, was held at the prestigious Polytechnic University of Bengrir (UM6P) in Morocco.

UM6P
University
Mohammed VI
Polytechnic

The Preparation Phase

After qualifying, we had a two-week preparation period to sharpen our skills for the nationals.

- **Focus Areas:**
  - Teamwork: Strengthening collaboration and communication within our team.
  - Problem Solving: Practicing a variety of scenarios to enhance our ability to respond quickly.
  - Technical Improvements: Improving our technical execution and tools used during the event.
- **Efforts Made:**
  - Conducted extra practice sessions.
  - Addressed areas that were identified as weaknesses during the qualifying phase.
  - Ensured a well-rounded team effort, with each member improving their individual contribution.

37 Our Performance in the National Competition

When the day of the national competition arrived, we were ready to give our best performance. Despite the challenges we faced, we were able to secure **SECOND PLACE** in the **Champion's Award**, which was a huge accomplishment for our team!

All our hard work, hours of preparation, late night grinds, and countless discussions had led us to this moment,and we're incredibly proud of what we've achieved.

Although we were on track to win, we ended up in 8th place in the robot game, while the team that took first place had been in 7th, with only a 5-point difference between us. Despite this setback, we finished second in the champions' winners!

Throughout the competition, we faced some technical challenges during the robot game, but we remained focused and pushed through. Our ability to troubleshoot and problem-solve in real-time showcased the skills we had developed during our preparation.

In the end, securing second place was a proud moment, reflecting our dedication, resilience, and teamwork.

NEXT STOP: Houston, Texas

Our Journey from National Champions to International Competitors!

38 The Exciting Path to Houston

We're beyond thrilled to announce that after securing an impressive second place in the Champion's Award at the national level of the FIRST LEGO League, we've earned the opportunity to compete at the prestigious FIRST Championship in Houston, Texas. This is a dream come true, and we're ready to take on the challenge!

This is our chance to showcase months of hard work, creativity, and innovation on the global stage, representing our country and our team. We are determined to make the most of this incredible experience and bring home memories that will last a lifetime.

- **Date:** April 16–19, 2025
- **Location:** George R. Brown Convention Center, Houston, Texas, USA

38.1 Why We Can't Wait to Compete in Houston

This isn't just a competition to us. It's a chance to push the limits, create unforgettable memories, and represent our country with pride. Here's why we're beyond excited:

- **Proud Representation:** We are incredibly proud to represent our country on the global stage. This is our moment to show what we've worked so hard for!
- **Winning Mindset:** Our team is fueled by a competitive drive, and we are aiming for nothing less than the top spot. We're bringing our best to Houston!
- **Showcasing Our Work:** After countless hours of building, coding, and testing, it's time to shine! Our project reflects our dedication and passion for innovation.
- **Deserving Opportunity:** We've earned this opportunity through hard work, determination, and a commitment to excellence. It's time to prove we belong among the world's best!
- **Learning and Growth:** Competing with teams from across the globe means learning new skills, gaining fresh perspectives, and continuing to grow as innovators.

- **Cultural Exchange:** Beyond the competition, we're excited to immerse ourselves in the diverse culture of Houston and the United States, forging lasting memories and friendships.
- **Team Bonding:** This experience will strengthen our team like never before. We're in it together, and this journey will bring us closer than ever.

38.2 We're Ready for Houston!

The excitement is real. This is the opportunity we've been working towards, and we're not holding back. We'll be surrounded by the brightest young minds from around the world, and we can't wait to share our project, ideas, and passion for STEM with everyone.

We are going to give it everything we've got. Let's make it happen!

OUR IMPACT

39 Our Impact

39.1 Supporting the Hajr Nhal School Robotics Team

Our team provided comprehensive support to a group of students from the Hajr Nhal region who were preparing for the first LEGO league competition.

- **Translated Competition Materials:** We translated all relevant documents, including **competition rules** and **guidelines**, into **Arabic** to ensure that the students could fully understand the requirements.
- **Visiting Schools for Hands-On Support:** Our team visited a school in Fahs Lanjra, where we directly assisted the students in understanding the competition details. We explained the tasks, provided guidance, and addressed any questions they had in person.
- **Hosting Students for Preparation:** The students from Hajr Nhal also visited us at Mindcraft, where we organized preparation sessions. During these visits, we helped them with hands-on practice in **robot design**, **programming**, and **problem-solving**, ensuring they were well-prepared for the competition.



39.2 Outreach to Other Regions Across Morocco

In addition to our work with schools in Hajr Nhal, we have been actively reaching out to other regions across Morocco. Our team conducted multiple meetings with schools in various localities, where we explained the details of the competition and answered any questions they had.

Collaborative Meetings with Other Teams: We set up meetings with teams from other regions to promote knowledge exchange and help clarify any doubts the students had about the competition.

Explained Competition Structure: During these meetings, we took the time to explain the **competition structure** in detail, making sure that all teams, understood the expectations and scoring criteria.

OUR MOTIVATION

40 Our Motivation

41 Why We Do It

Our passion for robotics drives us to give our best each day. We don't just go to the center because it's a requirement, but because we genuinely love what we do. Every day, we strive to learn more, push ourselves beyond our limits, and constantly aim for success. Our journey isn't just about building robots;**it's about learning, growing, and improving as individuals and as a team.**

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42 Dedication to Success

We never give up. Even with busy schedules and daily challenges, each of us is determined to make time for this team because we believe in its potential. We are motivated by our goal to be the best in robotics, and we know that requires hard work, discipline, and an unwavering commitment. We take each task seriously, but we also know that the road to success is not only paved with effort but with **fun and enthusiasm.**

43 Teamwork and Family

We are more than just a team, we are a family. Every one of us brings something unique to the table, and together we create something amazing. Our bond allows us to support and motivate each other to reach new heights. We help each other out, celebrate victories, and learn from our failures. We're in this together, and that's what makes us **unstoppable**.

44 Why We Love Robotics

Robotics isn't just a passion for us; it's a way of life. We thrive on the challenge, the problem-solving, and the creativity involved in building robots. It's a field that pushes us to think outside the box, collaborate effectively, and always strive for innovation. Winning isn't just about the competition; it's about the satisfaction of knowing **we gave everything we had.**.

45 Conclusion

As we prepare for the international competition in Houston, Texas, we're excited and determined to showcase everything we've worked for. We've proven our resilience and commitment at local levels, and now we're ready for the global stage. Next year, we'll be participating in FTC, so we're especially focused on giving our best to succeed.

For some of us, this is our last chance to participate in the FIRST LEGO League, making this opportunity even more meaningful.

Built on passion, innovation, and collaboration, we are ready to push boundaries and rise to any challenge. This competition is our chance to shine and prove we are among the best. We're not just participating—we're aiming to make our mark and give our all.

AND WE ARE... MINDCRAFT!