Project Deliverable F: Prototype I and Customer Feedback

University of Ottawa

GNG1103: Intro to Engineering Design

Group 8 - BOOM

Isaac Chan (300403892)

Spencer Irwin (300415505)

Trevor Lo (300361762)

Adam Nasimi (300351123)

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Abstract

Deliverable F documents the group's production of Prototype I, which is derived from pre-existing user requirements, the group's expected metrics, and user feedback from Client Meeting II. This deliverable also outlines the prototype test plan for the following prototype. Throughout the testing phase, the group validated the project's feasibility based on the group's initial designs and received feedback from the client and peers alike. An additional emphasis on budget constraints, time constraints and resource management are placed in this deliverable and will remain a key emphasis for future deliverables to come.

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Introduction

Group 8 has completed Deliverable B, C, D and E, which focused on interpreting user needs, deriving design requirements from such needs, conceptualizing the requirements into concrete ideas, and planning for prototyping. Taking feedback from the client in Client Meeting II, the group has adjusted the initial global concept into a more suitable idea for the project. Deliverable F will instead outline such changes and document the production of Prototype I. In Prototype I, a low fidelity, digital prototype will be made in each of the three aspects: storyboarding, CAD modelling, and Robomaster coding.

1.1 Related Work

Five deliverables have been completed prior to Deliverable F, with certain deliverables imperative to the current stage in development, these include:

Deliverable B: This deliverable list user requirements we have collected during the Client Meeting. With further interpretation on the requirements, we also included additional ones to ensure the quality of the final product. Additionally, a problem statement is created to summarize the general requirements.

Deliverable C: This deliverable adds on to Deliverable C by assigning expected metrics to design requirements. The requirements are then ordered in a priority list to generate major focus points of the group's design. Benchmarking is also expanded by evaluating existing products with the group's expected metrics. This allows us to better understand whether it is reasonable to set such standards for the group's final product.

Deliverable D: This deliverable focuses on generating conceptual ideas from existing design requirements and criteria. Such ideas revolve around four major subsystems: storyline, interaction between players, players' interaction with the game, and the implementation of Robomaster S1. Three global concepts are then generated by creating amalgams of the group's respective concepts, and one final concept is subsequently chosen.

Deliverable E: This deliverable focuses on the group's plan for the following weeks and method of executing the project with consideration to budget constraints and time limitations. Risks, contingency plans, and expenses are also included in this deliverable.

Appendix I, II, III: Since Deliverable E, the group has received feedback and updates in schedules and budgeting. To keep the most updated information available, such updates are included in appendixes. These appendixes consist of the link to the group Trello board, the updated task schedule, and the bill of materials.

Appendix IV: The fourth appendix consists of a handwritten Fishbone diagram derived from the group's Predictive Failure Modes and Effects (PFME) analysis. This demonstrates the potential aspects of the production that may lead to critical failure, allowing the group to have a more focused baseline for future prototyping.

Client's Feedback

2.1 Written Recordings of Feedback

Following Client Meeting 2, the group have decided to simplify the group's initial concepts and include necessary steps in later stages. These include:

1. **Less characters**: The number of characters of choice will be decreased from 10 to 5, which lowers the number of scenarios in the product and simplifies the flow of the experience such that it caters to a wider audience.
2. **Less event cards**: Like the characters, a lower number of event cards can simplify the flow of the experience such that it caters to a wider audience.
3. **Board design:** The board design will be simplified from an 8x8 board to 5 different freestanding structures that will be used as POI's that can be moved anywhere in the area provided, allowing for more customizability.
4. **Testing with a wide range of testers**: As the client pointed out, the experience itself requires extensive explanation of rules and heavily relies on players' imagination. The group believes testing with all kinds of potential players is required to ensure the explanation is clear and the game's flow is understandable to the project's target audience. The game should be able to be picked up quickly by anyone without much explanation.

Such simplification will be further analysed and explained in the following section.

2.2 Feedback Analysis & Implementation

While the client appreciates the Dungeons & Dragons-esque approach the group had taken for the project originally, they expressed their concern and uncertainty on whether players are able to understand the rules of the game clearly. To alleviate their concerns and ensure the project's target audience can have a quality experience, four major changes outlined above will be implemented in future designs.

2.2.1 Characters

After further discussions, the group has decided to cut down the number of characters and remove the skill set from the design. Despite receiving positive feedback for this aspect in the experience, the group has deemed this feature too complicated for players that are not familiar with Dungeons & Dragons game mechanics. The time constraint is also a major factor that contributed to this decision, as the concern for the game lasting longer than 10 minutes rose in discussion.

To implement this change, the character cards will now only hold the player numbers (Player #1, Player #2, etc...) and the story setting. The importance of a player number will be further discussed in 2.2.2 Storyline and Gameplay.

2.2.2 Storyline and Gameplay

With a major change in characters, the storyline and gameplay will be adjusted to accommodate the simplified design.

Instead of having flexible storyline and a dice-based gameplay, the group has decided to generate a storyline and gameplay with a static and predetermined flow. In each task, the group will read a singular event card that states the situation of the task (You and your team are stuck at the hospital). They will then be given 2 options which are decide based on the situation and their choice will determine their outcome in the task. When a character is eliminated, they will be required to show their elimination card (Flipping their character card over), allowing the Robomaster to recognise them as targets and shoot them while playing a gunshot audio track.

The **bolded** text in the following indicates the ethical concerns as listed in here.

Storyline	Gameplay
When an enemy state attacks the nation, a group of survivor's bands together to evade the dangerous LAWS. The government has broadcast an extraction message, calling all civilians to contact authorities immediately. The closest location with any communication tools would be the police station.	The group will randomly choose their character cards that states the story setting and the location of Task 1.
Task 1 Prompt: You are trying to contact the extraction squad, do you use... A: a computer. B: the landline.	In this task, the players will be required to decide whether to use a computer or a landline to contact the authorities. *If A is chosen, the LAWS tapped into the web and the player with the lowest number is eliminated during escape.* *If B is chosen, the group successfully evade the LAWS and proceeds to the hospital.* This task focuses on demonstrating the decaying **relationship with technology**. The elimination criteria, where the player with the lowest number is the target for each task, demonstrates **inability to explain why**.
Task 2 Prompt: On the way to the hospital, player with the lowest number got injured, do you... A: stay and help them. B: leave them behind to save yourself.	Like Task 1, the players will be required to decide from two choices. *If A is chosen, as the group has no medical experience, the injured player succumbs to their injuries and is eliminated. You have also stayed too long for the LAWS to detect you. The player with the lowest number is also eliminated. Surviving players proceed to the government building.* *If B is chosen, the injured player succumbs to their injuries and is eliminated. The surviving players then proceed to the government building.* This task focuses on demonstrating that the LAWS has a **lack of human judgement** and understanding and **digitize** their targets regardless of their health, even though terminating injured combatants is a war crime.
Task 3 **Individual** Prompt: You are trying to get to the extraction point, do you... A: try and sneak around the robot. B: wait till the cover of night to make your escape. Make your choices on your own, not as a group.	Task 3 will be an individual prompt, where the group will be separated into two choices. The decisions will only determine the fate of the singular player, and not the group in general. *If you chose A: you have successfully evaded the robot and made it to the extraction point.*

	If you chose B: unfortunately, the LAWS is installed with thermal sensors. You have been eliminated.
Epilogue The surviving player(s) is/are extracted. For the rest of their live(s), they attempt to find the person responsible for the activation of LAWS. Unfortunately, years and years have passed, yet no one is convicted and made responsible in the court of law due to the lack of evidence. You have survived today, but are you always safe from the LAWS?	The final player(s) will flip over the rule book that explains what happens after the experience. The epilogue focuses on demonstrating that there is a **lack of accountability** in making use of the autonomous LAWS.

2.2.3 Board Design

A minor concern from the client is that the preliminary design game board is too crowded and may affect the immersion. To ensure the experience is immersive, we have decided to adjust the gameboard from an 8x8 grid to 5 separate grids. Each grid will contain a 3D-printed building model that indicate a location. Players will then move between such grids to complete tasks. In addition to immersion, the independent grids can also allow a flexible set-up for different scenarios, and not fixed to be set-up within a 20ft x 20ft grid.

2.2.4 User Testing

A major idea that stemmed from the group's discussion is a method to validate the group's redesigned gameplay can be easily understood. The group has decided to create a Google Form survey that gathers opinions from potential players of the project's target age range. The Google Form and its results can be seen here.

Prototype I

3.1 Prototyping Objectives

- Familiarize the group with software that is imperative to the project.
- Create CAD Models (8inx8in12in) of the experience environment.
- Create a storyboard to visualize expected gaming experience.
- Create a Robomaster code that allows the equipment to work as expected in a simulation.
- Create a Laser Cutting document for cards.

3.2 Prototype Images

3.2.1 Storyboard

With the use of Figma, a rough sketch of the storyline of "The Grand Extraction" is made. For simplicity, a group of four is taken, as it is the average of the "3 to 5 players" requirement and can effectively demonstrate the expected environment. The revised storyline can be referred here.

Storyboard	Description

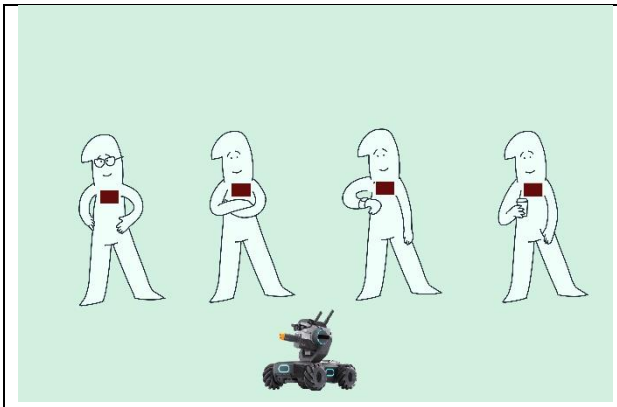


Figure 1: Storyboard for Prologue

Figure 1 demonstrates the prologue of the storyline, where the four players read their character cards, instruction manuals and familiarize themselves with the environment.

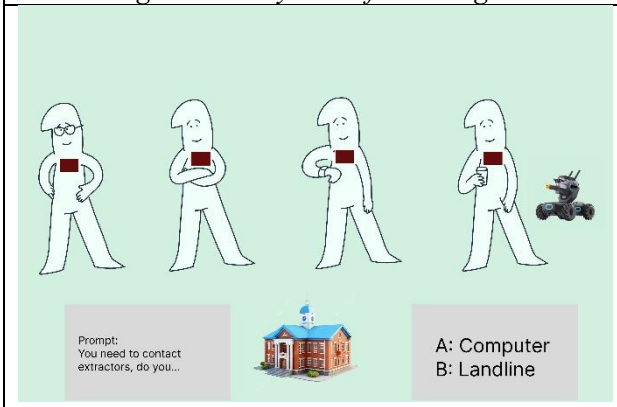


Figure 2: Storyboard for Task 1

Figure 2 demonstrates the decision-making process of Task 1, where the four users will pick an event card with a prompt (left) and given two choices (right). The cards will be held in the prop building.

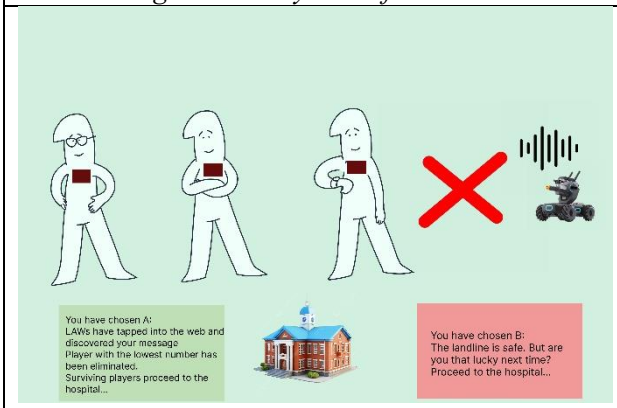


Figure 3: Storyboard for Task 1 Outcome

After picking a certain choice, the players will pick the second event card from the prop building. The second card will state the consequences for the two choices. In this case, the players have picked the choice in **green**, resulting in the elimination of the player with the lowest number.

The eliminated player will be required to turnover the elimination card. The Robomaster S1 (as depicted on the right) will then recognise the card and emit a gunshot audio.

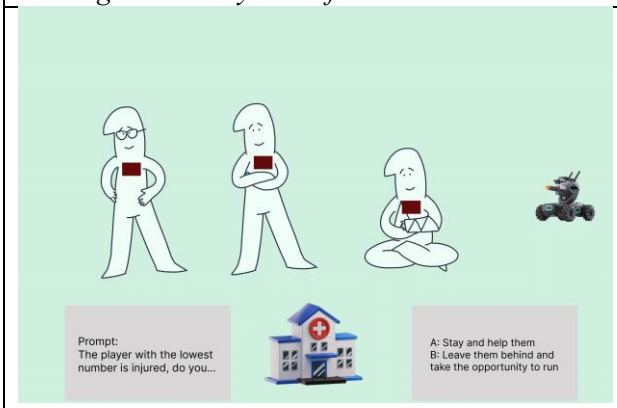


Figure 4: Storyboard for Task 2

Figure 4 demonstrates the decision-making process of Task 2, where the four users will pick an event card with a prompt (left) and given two choices (right). The cards will be held in the prop building.

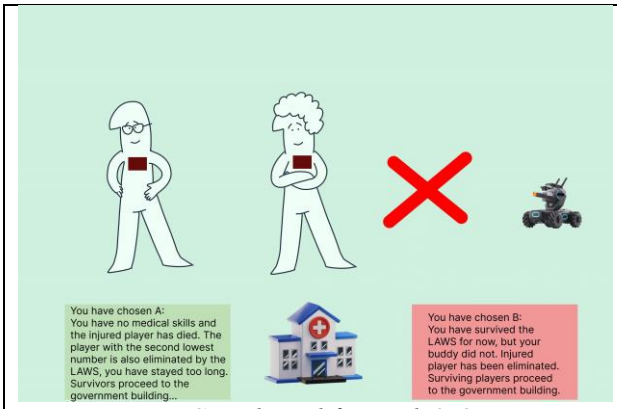


Figure 5: Storyboard for Task 2 Outcome

After picking a certain choice, the players will pick the second event card from the prop building. The second card will state the consequences for the two choices. In this case, the players have picked the choice in **red**, resulting in the elimination of the injured player.

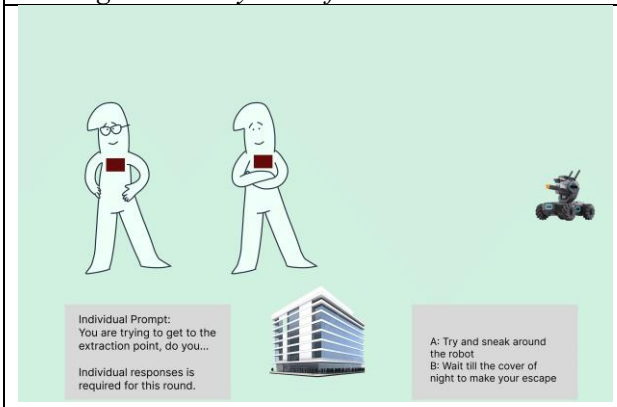


Figure 6: Storyboard for Task 3

Figure 6 demonstrates the decision-making process of Task 3, where the four users will pick an event card with an individual prompt (left) and given two choices (right). The cards will be held in the prop building.

In this round, instead of deciding as a group, each player will decide on their own.

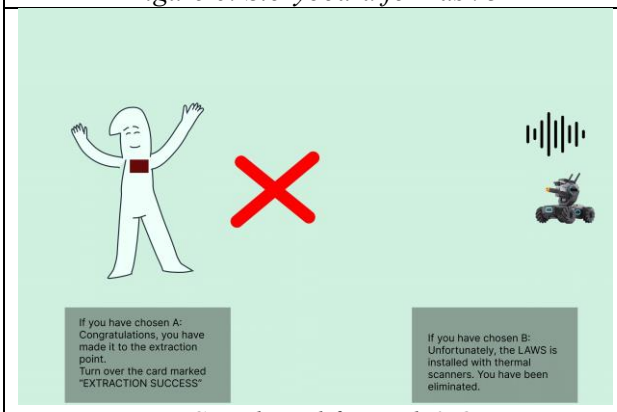
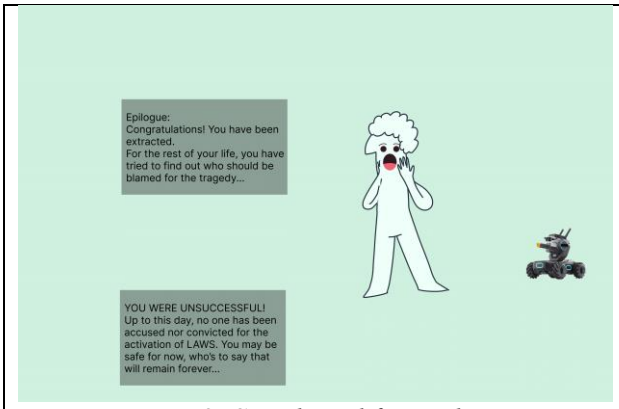


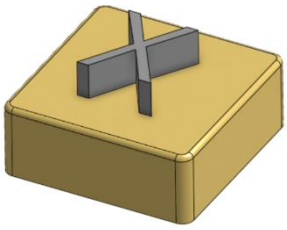
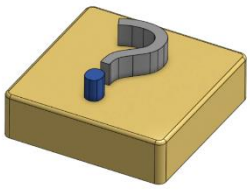
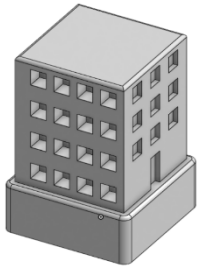
Figure 7: Storyboard for Task 3 Outcome

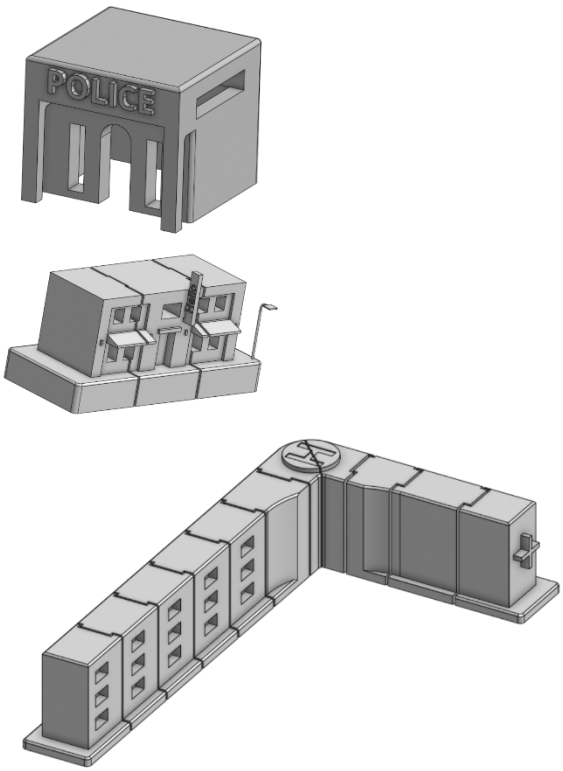
After picking a certain choice, the players will pick the second event card from the prop building. The second card will state the consequences for the two choices.
For the players that have chosen the card on the left, they survive the experience and move on to the epilogue.
For the players that have chosen the card on the right, they are eliminated from the experience. The eliminated player(s) will be required to turnover the elimination card. The Robomaster S1 (as depicted on the right) will then recognise the card and emit a gunshot audio.

 *Figure 8: Storyboard for Epilogue*	*Figure 8* demonstrates the epilogue of the experience, where the surviving player will be told of that there was no accountability for the activation of LAWS.

3.2.2 CAD Model of Props

After Client Meeting 2, the group has realised that the dimensions of the parts must be within the capabilities of the 3d printers that are available. In which has the maximum dimensions of 13”x14”x15”. The group has split parts into multiple pieces, each with a mechanical fitting into other pieces. This allows the parts to be able to be printed, while maintaining the structure and its stability.

Model Parts	Description
 *Figure 9: Extraction point*	The goal, or other known as the “finish line” of the game. It is the target where the players will be heading. In which, when the player arrives to the extraction point, they will be given the final choices that determines the final fate of the players in the end.
 *Figure 10: Event space*	A location placed on the player’s path, where tasks, events are held. When players arrive, one must take an event card.
 *Figure 11: Building 1*	A building placed throughout the game board. These act as blockages where the players need to move around the blockage.

 *Figure 12-13: Building 2 (store), Building 3 (police station), and 4 (hospital)*	Buildings placed throughout the game board. These act as blockages where the players need to move around the blockage. In addition, these buildings will be used within the storyline. Engaging the players with an immersive experience within the scenes during events and tasks. Since these buildings are too large to be 3D printed, they have been split into multiple pieces that are within the ability of the 3D printers on *Makerspace*. Pieces have mechanisms that lock movement on the x and y axis. Allowing stability on the buildings. Vertical movement is not considered as the game pieces are meant to be placed on the ground. That no vertical movement is required.

3.2.3 Robomaster Code

The following figure is the code that the prototype robot will run during tests.

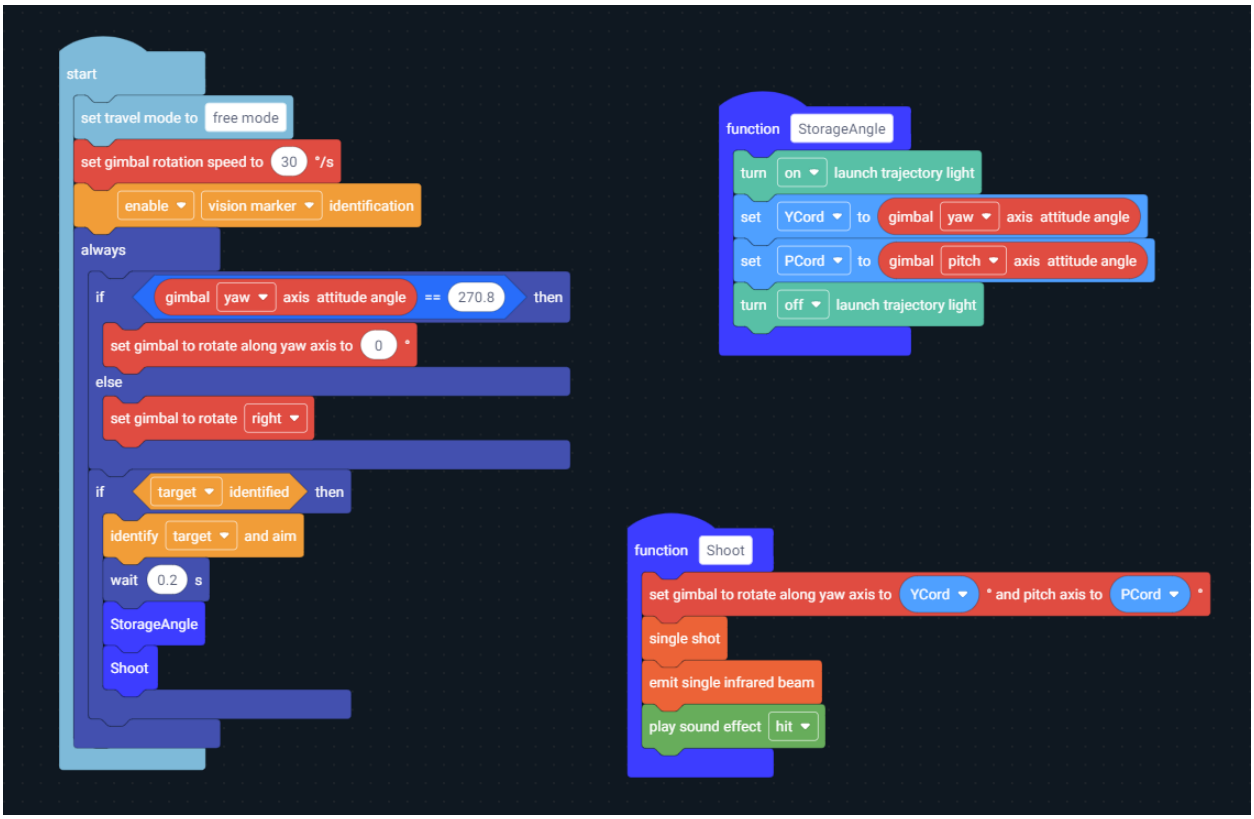


Figure 14: Code used for robomaster S1Figure 14: Code used for robomaster S1

The main block of the program will unlock the gimbal and set it to rotate right. If the "target" symbol is identified, then it will run the "StorageAngle" function which saves the coordinates then the Shoot function. However, if the gimbal reaches its rotation limit of 270.8 degrees, then it will start rotating back to its starting position while scanning.

3.2.4 Laser Cutting

The following figures demonstrate the event cards and character cards that will be created through laser cutting and laser engraving. These figures are created with the use of Inkscape.

Figure 15: Inkscape document for Event Cards

For each event, there will be two event cards. Each card will be laser cut and engraved, subsequently glued together to form one card.

For the first card in each task, the front would state the prompt/individual prompt, and the back would state the given choices.

For the second card in each task, each side would state the consequence of two choices.

Figure 16: Inkscape document for Character Cards

Five Player Cards will be produced for the experience. This allows for a group from 3 to 5 to take part in the experience properly.

In each Player Card, the front would state the player number.

The back would include a Vision Marker for the Robomaster S1 to recognise as a target. When a player is eliminated, they will be required to flip over their cards to show the symbol, allowing the Robomaster to execute its elimination commands.

3.3 Evaluating Prototyping Objectives

Familiarize the group with software that is imperative to the project.	Successful ☑
Create CAD Models of the experience environment.	Successful ☑
Create a storyboard to visualize expected gaming experience.	Successful ☑
Create a Robomaster code that allows the equipment to work as expected in a simulation.	Successful ☑
Create a Laser Cutting document for cards.	Successful ☑

3.3.1 Skills Acquired/Improved in Prototyping

3.3.1.1 Storyboard

- **Making use of Figma assets**: Prior to Prototype I, group members have limited experience with Figma. In lab sessions, the group had only done so with simple storytelling and application design. For prototyping, group members in charge of the task is required to properly make use of assets provided by Figma and gather assets from online resources.

3.3.1.2 CAD Modelling

- **3D modelling:** As the group acknowledges a considerable number of objects required to be used. The group has dedicated itself to designing 3D models using CAD software named **"**Onshape".
- **Predicting outcome**: The Onshape software can provide the necessary tools to create a 3D model. However, it does not support load and stress simulations on the 3D models. As a result, the physical testing of the models will be done after being printed.

3.3.1.3 Robomaster Coding

- **Predicting outcome**: While the DJI Edu Hub includes a simulation feature, allowing the code to be run through a simulated environment of the Robomaster S1, the functionality of the code remains uncertain. As a result, the group is needed to trace the code manually after the simulation to ensure the execution meets the expected outcome.
- **Debugging**: During the coding process, the group encountered several logical obstacles. However, with repeated testing, the group soon became more familiar with the coding environment of the DJI Edu Hub. This allows following coding to be much smoother.

3.3.1.4 Laser Cutting

- **Mass produce**: As the number of Character Cards and Event Cards is of a considerable amount, the group designed a format for each card that can be repeatedly replicated for future designs.
- **Predicting outcome**: The Inkscape software is only capable of showing black and white lines and cannot display the appearance of the final product. As a result, the group must use knowledge from previous lab sessions to assume whether the design would be feasible. This will be further discussed in Prototype II, with physical prototypes made to prove whether such designs are feasible.

3.3.2 Physical Components

Through storyboarding and CAD modelling, the physical environment of the experience is conveyed digitally. The following lists the physical props that will be included in the final product and their relative importance to conveying an immersive experience for players.

Component	Description	Importance (1-3)	Justification
Game board and props	A scaled-down physical model of buildings that will indicate the task location.	3	While full scale buildings are unfeasible, a scaled-down physical model can still maintain a certain level of immersion and influence players' choices.
Character Cards	Cards that state the players' numbers, identity, and setting.	2	The cards provide the background narration for the players and include a

			player number to ensure a proper flow of the game.
Elimination Cards	Cards that contain a symbol that indicate the players have been eliminated.	3	The cards are the only method for the Robomaster to theoretically detect whom to eliminate.
Event Cards	Cards that describe each task and the players' given choices.	3	The cards ensure a proper, static flow of the game.
Instruction Manual	Manual that describes the gameplay.	3	Different audience groups may take part in the game, instruction manual is required to ensure players understand the gameplay properly.

Table 1: List of Physical Components

User Feedback

To gather feedback for Prototype I, the group had conducted an online google survey, gathering responses from peers within the age range of potential users.

Link to Google Survey: https://forms.gle/ru8CPfnMw2Weqfvc7

Figure 17: QR Code for Google Survey

4.1 Results from Survey

Questions				
Do you believe that our design is too complicated? (If "Yes" Please Give a Reason Why)	It is not too complicated. On the other hand, it is too simple. There could be more than two choices and more levels with varying difficulty.	I think the design if anything is rather simple if there is enough time added some more details could be useful	The design itself is definitely simple and easy to understand	
Will we be able to explain our design effectively within the available time?	It will be challenging to explain effectively in 2 min, but it is possible.	The instructions need to be shortened but they convey all necessary info	Your design should have a problem being conveyed, but with only 2 minutes the explanation needs to be very minimal yet concise.	The explanation will need to be shortened to be fit in the 2 minutes explanation period
Were the dangers of LAWS	The words death and kill could be used more to convey	The dangers of laws are communicated	Yes, all the dangers of LAWS were	Yes, the dangers were clearly shown

communicated effectively?	more emotions through the instructions	effectively and does well to show that if you pick wrong, there is no escape from the machine.	communicated in your design	
Where the Ethical Concerns listed actively met in the design?	Yes, the concerns were met in the design especially the lack of accountability and the lack of meaningful human control.	Of the 3 listed they could definitely be seen in the design.	The ethical concerns were clearly showed	
Is the implementation of the Robomaster effective in our design? (If "No" Please give a better way to implement it)	It is quite effective and its portrayal as an inhuman killing machine is seen well.	The robot does not sound like it is doing much like maybe it runs around and stuff	I think that the implementation is very minimal	The implementation is simple yet effective I believe as if you try to over complicate it, it will not work.

Table 2: User comments from survey

4.2 Analysis of Results

1. **Design Complexity**

While the simplicity is beneficial for ease of understanding, a slight increase in complexity (if there's time) could make the design more engaging. Added a few more decisions per level could enhance the experience without complicating the flow.

2. **Time Constraints for Explanation**

A more focused, and minimal explanation approach is necessary. The explanation should be refined to ensure clarity and understanding within the limited time. Having a made-out script explaining the simulation could help to maintain consistency and clarity.

3. **Communication of LAWS Dangers**

The dangers of LAWS seemed to have been well-communicated, but to add to the emotional impact, a subtle addition of the emphasis of gravity of your decision could be added, this will make the risks feel more immediate and help to make them potentially resonate more with the users.

4. **Ethical Concerns**

No major changes seem necessary for the ethical concerns, as the design conveys these ethical issues effectively. Making sure that these elements remain obvious in the explanation will help keep their importance to the users.

5. **Effectiveness of Robomaster Implementation**

The current implementation of the Robomaster was considered effective for its purpose, but it was said how we could consider adding subtle movements to make it more dynamic and interactive. This might add to the perceived threat of the robomaster without overcomplicating the design.

Overall Recommendations

The design is simple and communicates its ethical and safety concerns well. However, to make it more engaging the group could:

- **Consider adding minor elements of complexity** (additional choices) if time allows.
- **Prepare a concise explanation** that highlights the core of the game and practice delivering it within the time limit.
- **Use impactful language** in the narrative to convey the high stakes involved.
- **Enhance the Robomaster's role** with minor actions or animations to make it feel more threatening.

These adjustments would maintain the design's clarity while also potentially making it more immersive.

Prototype II Test Plan

Test ID	Test objective (Why)	What is being figured out (what)	Testing Method (How)	Attributes to Observe / Record	Duration (When/How Long)
1	Test if the robot shoots the symbol once then continues to rotate.	Does the Robomaster S1 fire once and move on when it sees the target symbol?	Use the physical robot when we get the chance.	Observe if the after the target is fired on and the symbol "disappears" does the turret move to the starting position	Test in the final prototypes to make sure it does not fail. It should take at most 20 minutes for enough testing barring any errors
2	Test if the robot stays locked on to the coordinates of the first target it sees.	Does the Robomaster stay locked on to the coordinates of the first target it sees and ignore any other.	Use the physical robot when we get the chance.	Observe if the after the target is fired on and a new one appears in a different location does the robot stay locked on to the original spot.	Test in the final prototypes to make sure it does not fail. It should take at most 20 minutes for enough testing barring any errors

3	Test that the story is simple, engaging and makes sense.	Does the plot of the game effectively convey the intended messages?	Give the story to other users and record what they say.	Ask users about their thoughts on killer robots before the experience. After the experience, ask the same question as well as their thoughts on the story as a whole	Test each prototype story with users until 80% or more deem the plot good. If it is not reached the story will have to be updated
4	Test that the instructions can be followed easily without confusion.	Are the instructions simple and easy to follow?	Give the instructions to other users and record what they say.	Ask users what they think about the manual, if it was easy to follow, how to improve it.	Test each prototype manual with users until 80% or more deem the instructions simple. If it is not reached the manual will have to be updated.
5	Test how fragile the pieces are to avoid breaking them.	How sensitive are the game pieces are to stress?	Run a stress simulation of the material to see how much force it can withstand.	Record the maximum force the material can take.	Test in all the first prototype to record the force. It should take at most 10 minutes for the test.
6	Test how stable the game pieces are.	What outside factors such as vibrations affect the pieces of the board?	Physical test to see what can knock over the pieces.	Record what can interfere with the game.	Test in prototype 2 and 3 with any issues being addressed between the prototypes.

Table 3: Prototype II Test Plan

Project Plan

The following includes the detailed tasks and work distribution between team members. The following tasks are expected to be completed on or before Design Day. For future deliverables, further tasks

regarding Prototype II and Prototype III will be included. The following list is tentative and may subject to change in personnel.

Task	Description	Duration	Group Member(s)	Status
Prototype I				
Storyboarding	Storyboard on the existing storyline in Prototype I	2 hours	I. Chan	Completed
Robomaster Coding	Draft a prototype code for the Robomaster and test through DJI Edu Hub simulations	2 hours	A. Nasimi	Completed
CAD Model Sketch	Sketch the CAD for the props that will be produced in future prototypes	2 hours	T. Lo	Completed
Laser Cutting	Design character, elimination, and event cards on Inkscape	1 hour	I. Chan	Completed
User Feedback	Create a Google Form to collect feedback from potential users and analyse the result	2 hours	S. Irwin	Completed
Prototype II Test Plan	Create a test plan that outlines the following prototype	0.5 hours	A. Nasimi	Completed
Update Project Plan	Update task schedules to accurately demonstrate the week of Prototype I	0.5 hours	I. Chan	Completed
Future Prototypes				
Purchase materials on Bill of Materials	Consult TA and purchase materials	2 hours	S. Irwin	Incomplete
Find suitable audio files	Find suitable audio files (gunshots, explosions, robot moving) in the public domain	0.5 hour	S. Irwin	Incomplete
Robomaster Testing	Test whether the program works properly on the physical Robomaster	1 hour	A. Nasimi	Incomplete
3D Printing	3D Print CAD Models and test its durability	3 hours	S. Irwin	Incomplete
Write Instruction Manual	Create instruction manual that explains the actual operation of the game	2 hours	-	Incomplete

Table 4: Task List

Conclusion

In conclusion, Deliverable F allows Group 8 to understand the physical limitations and room for development for the project. Nonetheless, Group 8 has been able to adhere to the budget constraint of $25without deviating much from the group's conceptual design, with only suitable changes done to reflect user and client feedback.

During the production of Prototype I, three major aspects of the product is further discussed: storyline, 3D printing, Robomaster implementation and laser cutting. The production of the prototype allowed each member of Group 8 to have an opportunity to practice their skills using certain software, as well as understanding the limitations of such software. It is believed that these opportunities will contribute to a smoother production phase for Group 8.

Deliverable F also focuses on gathering as much feedback from clients and potential users as possible. From Client Meeting II, the group received praise and concerns from the client, with this deliverable adjusting certain aspects of the project to further meet the expectations of the client. From potential users, the group received first-person feedback and have a more thorough understanding of what effect the experience will have on its players. In addition, the priority of the project has now been adjusted from focusing only on client expectations, to client and user expectations alike.

Deliverable F serves as a pivotal step in the production of "The Grand Extraction." Not only did it assist Group 8 in having a more thorough understanding of how the conceptual ideas can be converted into physical ones, but also guided the group to have a stronger baseline to proceed with further prototypes.

Appendix I – Trello Link

Click here for the link to the Group 8 Trello board.

Appendix II – Updated Task Schedule

The following table lists the upcoming tasks that Group 8 in the following weeks. The list begins in the week of October 20 – 26, and includes deliverables, client feedback, and prototyping steps. Aside from the order of tasks, their dependencies, due date, duration, and the group member-in-charge (only for certain tasks) are also included. For simplicity, the order of tasks listed below are in order of the due date.

#	Task	Dependencies	Due Date	Duration	Group Members
0	*Deliverable D*	*Deliverable D is done prior to the range of this table*			
1	Client Meeting #2	Task 0	2024-10-24	1 session	Everyone
2	Adjust Global Concept	Task 0, 1	2024-10-26	2 days	Lo
3	Deliverable E: Project Plan & Cost	Tasks 0, 1, 2	2024-10-27	7 days	Everyone
4	Build Prototype I	Task 3	2024-10-31	4 days	Everyone
5	Customer Feedback (Prototype I)	Task 4, 5	2024-11-02	1 day	Chan
6	Deliverable F: Prototype I and Customer Feedback	Tasks 4, 5	2024-11-03	7 days	Everyone
7	Client Meeting #3	Task 0	2024-11-05	1 session	Everyone
8	Build Prototype II	Task 7	2024-11-08	5 days	Everyone
9	Customer Feedback (Prototype II)	Task 8	2024-11-09	1 day	Nasimi

10	Deliverable G: Prototype II & Customer Feedback	Tasks 7, 8, 9	2024-11-10	7 days	Everyone
11	Deliverable J: Project Presentations	*TBA*[1]	*TBA*	*TBA*	Everyone
12	Build Prototype III	Task 10	2024-11-22	12 days	Everyone
13	Customer Feedback (Prototype III)	Task 12	2024-11-23	1 day	Irwin
14	Deliverable H: Prototype III & Customer Feedback	Tasks 12, 13	2024-11-24	14 days	Everyone
15	Deliverable I: Design Day Presentation Material	Task 14	2024-11-27	3 days	Everyone
16	Design Day	Task 15	2024-11-28	1 session	Everyone
17	Deliverable K: User & Product Manuals	Task 16	2024-12-03	*TBA*	Everyone

Table A: Plan for Upcoming Tasks from October 20 to December 7, 2024

Appendix III – Bill of Materials

The following table outlines the required materials for the final product, how such materials will be incorporated in the product, the source for the purchase, and the price of the material. The total budget is updated from a total of $50 to $25.

Material	Description	Quantity	Source	Price (CAD)
3D Print Material	Task location indicators, cards	1	Makerspace	Free
Card Material (MDF)	Character and Event Cards	2	Makerspace	Free
Rope	Used for Cards	1	Home Depot	$10.00
Super Glue	Used for glueing 3D prints and player cards	2	Home Depot	$12 (6$ each)
Scissors	Used for cutting rope and other materials	1	Provided by group	Free
Markers (Black Sharpie)	Used for outlining and defining shapes	1	Home Depot	$3

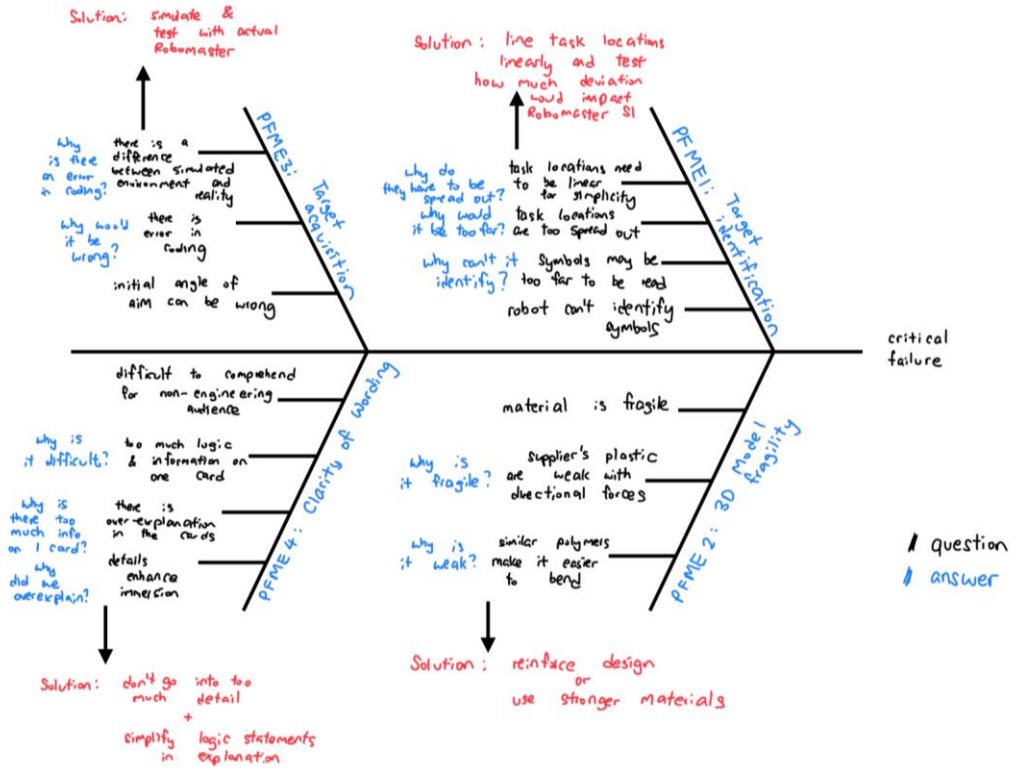
Table B: Bill of Materials required for final product

[1] Deliverable J is due in the week of November 12, 2024.

Appendix IV – PFME Analysis

The following consists of a Fishbone diagram derived from the group's Predictive Failure Modes and Effects (PFME) analysis. The Fishbone diagram narrows the potential risks down to four major PFMEs: target identification, 3D model fragility, target acquisition and clarity of wording. Each aspect is then further discussed to pinpoint the root problem.

With a clear idea of potential risks, each of the PFME is then given a score from 1 to 4 in terms of effect and mode. A table is then drawn to demonstrate which PFME, and its aspects are of utmost importance and should be a priority in prototyping.



PFME	Effect	Mode
①	4	3
②	3	2
③	2	4
④	4	4

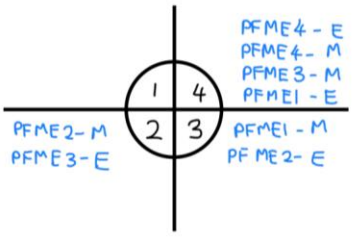


Figure A: Fishbone Diagram derived from PFME analysis