Project Deliverable G: Prototype II + Customer Feedback

Faculty of Engineering – Engineering Design - GNG1103

November 10, 2024

Meg South (300368211)

Thomas Linkruus (300403123)

Samuel Orimolade (300430809)

Nithini Amarakoon (300349713)

Ahmad Imad Ali (300404898)

Abstract

This project deliverable is aimed at the development and testing of a second prototype, representing an iterative design of a targeted engineering solution. The goal will be to refine a critical subsystem that was informed through the testing of an initial prototype, with the intent to confirm feasibility while bettering subsystem integration and lessening uncertainties. This Deliverable focuses on the design thinking stages of Testing, Prototyping, and Failure and Iteration.

Other important activities include developing a target-focused prototype with quantifiable deliverables, developing an analytical or experimental model to supplement this, and obtaining specific and detailed feedback from users based on this. Teams are expected to finalize the target specification, update the detailed design, and modify the Bill of Materials, as needed, based on testing. A formal prototyping test plan was also developed for the third prototype, including pre-defined stopping criteria and standards of fidelity. This deliverable therefore encapsulates practical project management activities, including updating of task plans and addressing team dynamics to maintain workflow that assures progress toward the final comprehensive prototype demonstration.

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1.Introduction

In this deliverable, our group aimed to make adjustments and upgrades based off the previous prototype and information changes. The main aspects that have been changed are the targeting and elimination code, game arena, the robot movement code, identification cards, and our obstacles. Each aspect is explained in further detail in its respective section of this document. The document also features the feedback given from the most recent client meeting, target specifications and detailed design, testing plan, and our most recent bill of materials.

2.Client Meeting 3 + Peer Feedback

During the third client meeting, our team received new feedback regarding our arena design. Our project manager raised the question, “How are we designing our arena gameplay in a way to prevent players from stepping on and destroying the Robomaster S1”. Our original design had the players and Robomaster S1 interweaving around the arena and obstacles, with no separation between them, meaning that there is a possibility of a player accidentally damaging the Robomaster. In this deliverable, we propose a new arena design which will take this feedback into account.

Our group is also continuing to work on the client and peer feedback from Deliverable F. This feedback was regarding our rock, paper, scissors code input and output, which we have also proposed solutions to within this deliverable.

3.Critical Elements

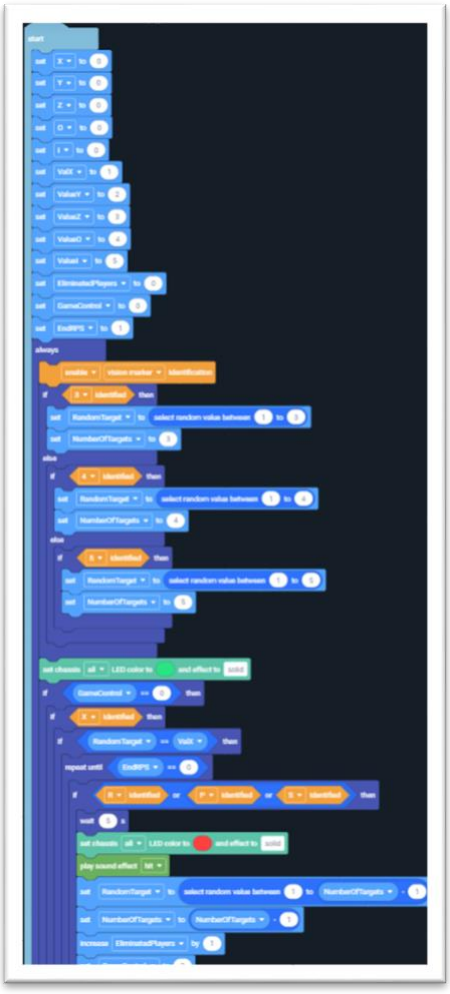
In Prototype II, we will continue to focus on our most important subsystems: the 3 codes (target and elimination code, path coding, and Rock, Paper, Scissors code), the player card designs, and the obstacles and arena designs.

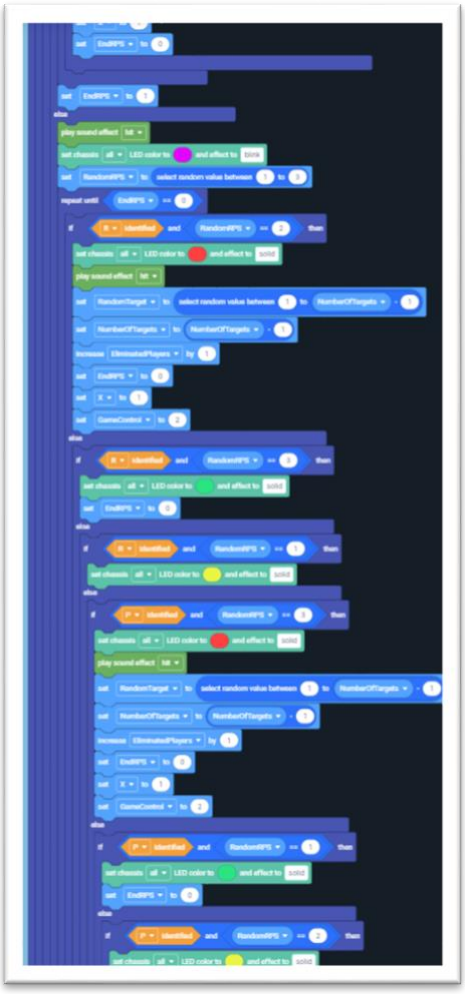
The player card designs are one of the most important cards aspects as the game does both the targeting and elimination based of a player’s identification card. All the aspects of coding are important for the Robomaster S1’s function, as our code influences the way the game will be conducted. The most critical codes at the moment are the Rock, Paper, Scissors Coding and the Targeting and Elimination Coding as that is where our ethical issues are seen within the game. The obstacles are important in making our game more complex for the layers and the arena is important for the basic design of our game.

4. Prototype II

4.1. Target and Elimination Coding

In this prototype, the code from prototype I which could only select a random target and identify letters or numbers has been upgraded. The new additions feature adaptive logic which adjusts the numeric value of each symbol depending on which symbols have previously been eliminated. Previously, a new random number from 1-(number of players remaining) would be generated but the letter values would not fit within this range. For example, the letter “I” (Value 5) could not be targeted after the first elimination because the new random number would be from 1-4. This problem has been solved by adding logic which takes note of which letter has been eliminated and adjusting the others accordingly. The next feature added was the logic for the rock paper scissors game which eliminates players if they lose against the code.





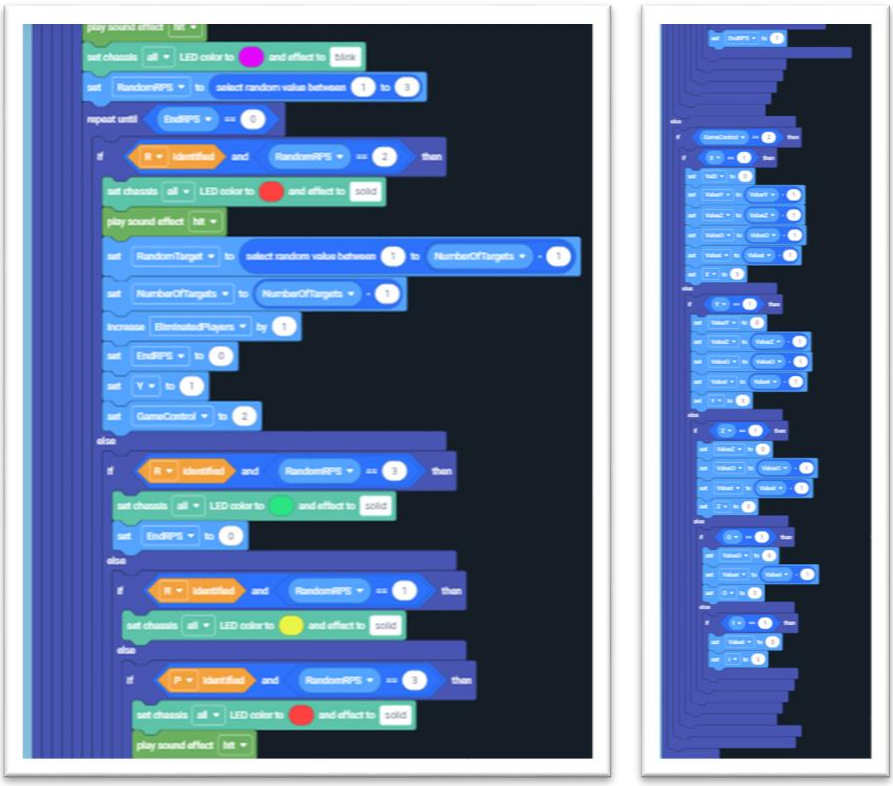


Figure 1: Targeting and Elimination Code

The end portion of the first image along with the second and third images show the targeting code for player X. All 5 letters that act as potential players have the same code but with the sole difference of their respective variables. These differing variables are the identified target, letter order and letter value. The identified target is simply which letter the robot is designed to identify while the other two are more complex. The letter order is crucial since it will adjust depending on which letters have been previously eliminated which keeps those letters as potential random targets while the random number generated decreases. The letter value is simply the value that is being adjusted depending on the previously mentioned letter order.

4.2. Path Coding

With this prototype, we have completely changed the movement system. Initially, the robot was to move around in between the obstacles and around the whole ring. We later discovered the infeasibility of that idea, as it risks the robot being stepped on and damaged. The robot now moves in its own arena within the actual experience arena, and the players move in the outer part of the actual whole arena. So, the robot now just moves in a square, and only stops when it detects a visual identifier, after which it will engage with the player.

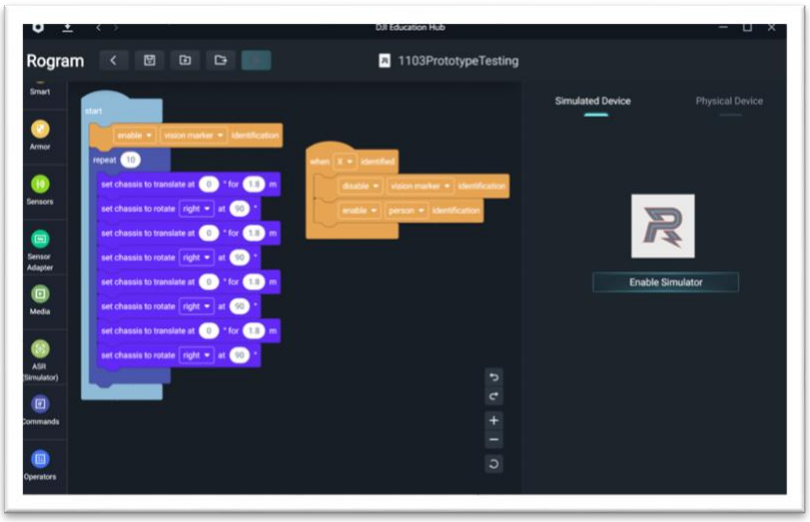


Figure 2: Path Code

4.3. Rock, Paper, Scissors (RPS) Game

```
import random

user_action = input("Enter a choice (rock, paper, scissors):")
possible_actions = ["rock","paper", "scissors"]
computer_action = random.choice(possible_actions)

print(f"\nYou chose {user_action}, computer chose {computer_action}.\n")

if user_action == computer_action:
    print(f"Both players selected {user_action}. It's a tie!")
elif user_action == "rock":
    if computer_action == "scissors":
        print("Rock smashes scissors! You win!")
    else:
        print("Paper covers rock! You lose.")
elif user_action == "paper":
    if computer_action == "rock":
        print("Paper covers rock! You win!")
    else:
        print("Scissors cuts paper! You lose.")
elif user_action == "scissors":
    if computer_action == "paper":
        print("Scissors cuts paper! You win!")
    else:
        print("Rock smashes scissors! You lose.")
```

Figure 3: RPS Code

Prototype II of the RPS code is the same as Prototype I. Moving forward, the RPS code is going to be incorporated with the other code to allow for integration with the Robomaster's targeting and elimination functions. Cards have been added to the game which will allow for the player to make their selection of rock, paper, or scissors. This card will be shown to the robomaster which will then result in the robomaster to inform the player if they have been eliminated or not. The RPS aspect of the game still has a lot to be figured out and will require testing of the Robomaster's recognition of the card, the

integration of the code, presentation of the game, as well the timing of the elimination notification.

4.4. Player Cards

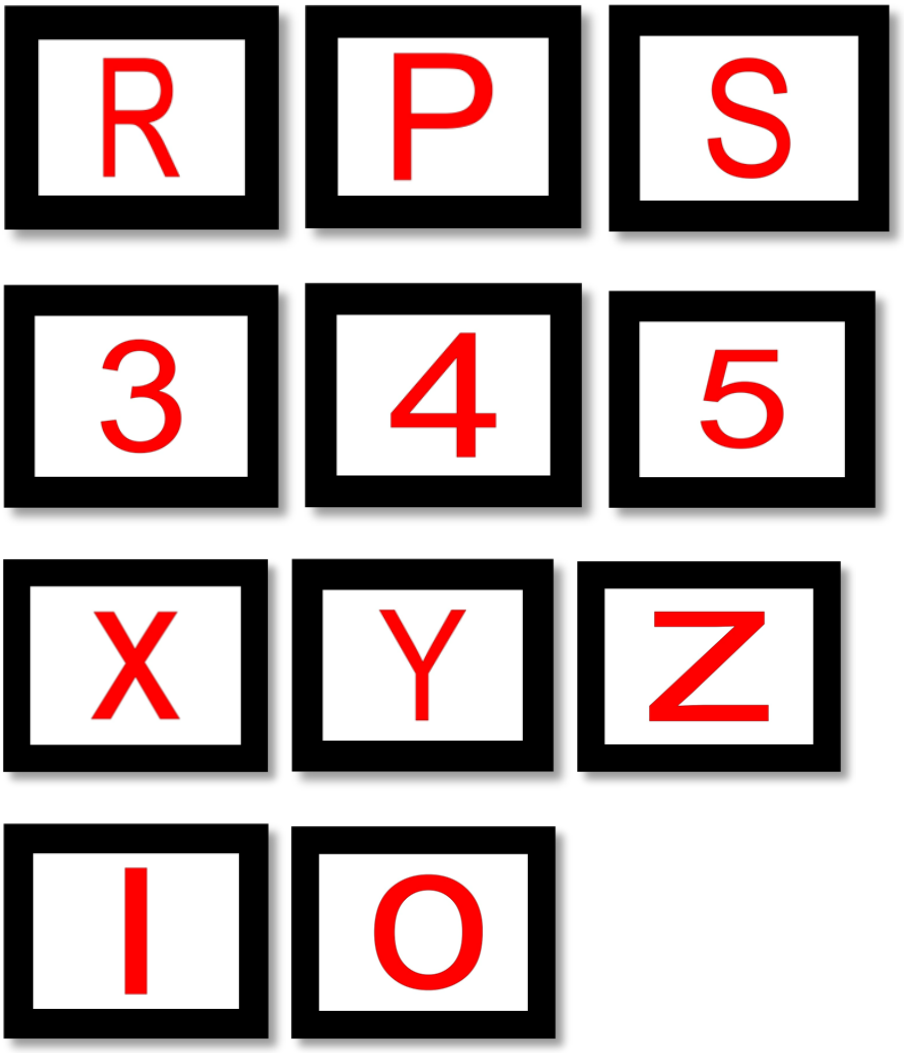


Figure 4: RPS Cards Designs, Calibration Card Designs, and Player Card Designs

Our final player cards designs have been created as seen in Figure 4. The Player card designs include the R, P, S cards, which will be used for indicating to the Robomaster whether the player has chosen Rock, Paper or Scissors in the game. The player cards 3, 4, and 5 will be used to calibrate the Robomaster in how many players are within the game and will not be used to symbolize any of the players. Finally, as there will be 3-5 players within the game, the symbols used to associate the players will be the symbols X, Y, Z, I and O.

4.5. Obstacles

In the previous deliverable, the sketch of the collapsible obstacle was created. The original design of the obstacle was made from five 10”x10” cardboard squares that have been covered with duct tape and two 10”x20” sheets cut from reusable shopping bags. The squares were going to be taped together to form a long rectangle. The 10” side of the shopping bag strip was going to be taped to the 10” side of the third square of the long rectangle of 5 squares.

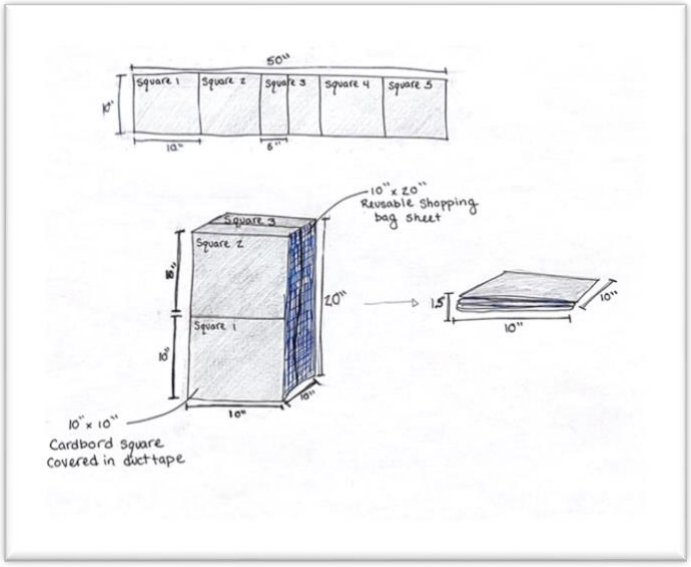


Figure 5: New Obstacle Design Sketch

One difference was made from Prototype I to Prototype II. The top of the obstacle, square 3, which was made from one 10” x 10” square in Prototype I was instead made to be two 5-inch x 10-inch rectangles. This was in order to make the design more easily collapsible. The improved sketch design can be seen in Figure 5.

Figure 6: Cardboard Obstacle Prototype

The prototype of the obstacle has been created; this can be seen in Figure 6. In the sketch of the cardboard prototype, the top of the obstacle was Square 3, we have decided to make the square 3 the bottom of the obstacle. For Prototype III, we will try to figure out a way to prevent the top of the obstacle from collapsing inwards and find a way to close the top of obstacle. Our idea for this at the moment is to have a removable piece of cardboard that will fit into the top portion and will not fall to the bottom. This will allow the top sides to remain in tension and not collapse inwards and also allow the top of the obstacle to be covered so that the inside of the obstacle is not seen.

4.6. Arena

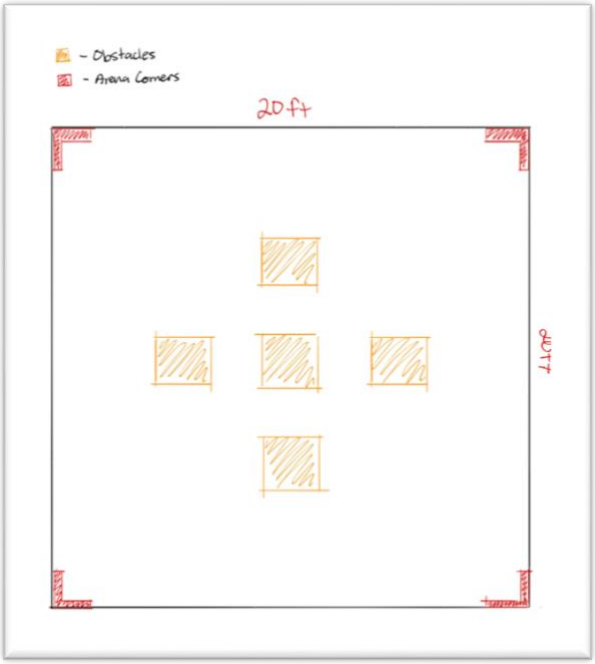


Figure 7: Arena Design from Prototype I

4.6.1. Arena Layout

During our last prototype, we had an arena layout which had been a 20ft x 20ft space, with five obstacles within it, which can be seen in Figure 7. Initially, the Player would be allowed to move freely within the arena and the Robomaster would move in a specified pattern around the arena and obstacles, and there was no separation between the Robomaster and the players.

During the last client meeting, a piece of feedback was given to us regarding our initial arena layout. Our project manager advised that we should figure out an arena layout that separates the players from the Robomaster, so that we can prevent the Robomaster from getting damaged. From this, we started brainstorming alternate ideas to how we could create the arena layout ultimately landing on the design seen in Figure 8.

Figure 8 displays our new design which has a small 6 ft x 6 ft arena that will solely be for the Robomaster to move within. The rest of the arena, which will give the players 7 ft to move in Size 1, 6 ft to move in for Size 2 and 5 ft to move in for Size 3, will be solely for the players, which will fix the problem we previously had with our arena, which was that the players could damage the Robomaster. The new design allows the Robomaster to still move in the square design and makes sure that the Robomaster

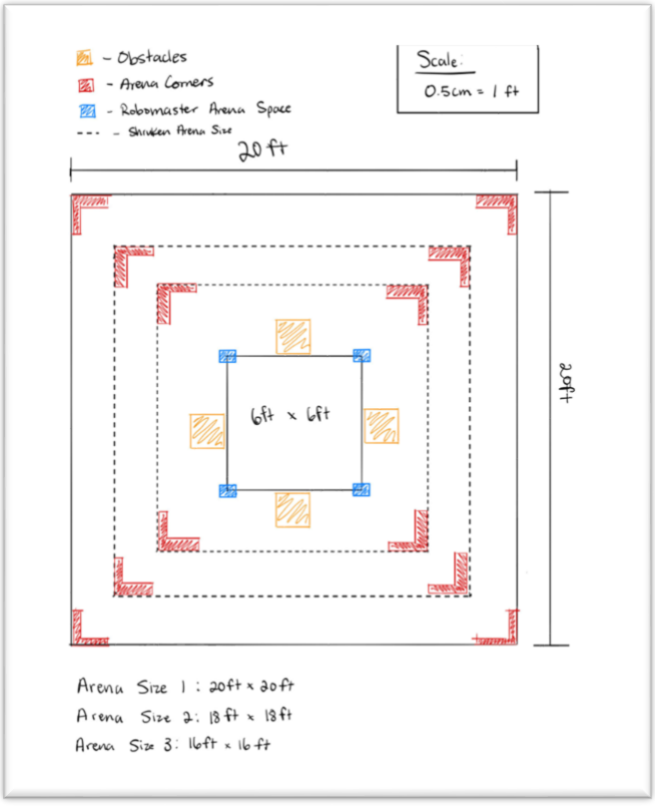


Figure 8: New Arena Design

will sweep the whole arena area with its vision, but also makes sure that the path of the Robomaster and the players don't cross. Due to the nature of this design, we went from having 5 obstacles to 4 on the outskirts of the Robomaster's arena space. This makes sure that the obstacles are included even when the arena layout shrinks.

4.6.2. Arena Corners

In Prototype I, the plan was to 3D print the arena corners, which had initially been designed in the dimensions seen in Figure 8. When doing testing in Onshape and figuring out the logistics for the 3D printing, we came across a problem with our design. It was too large to print on the 3D printer, and would take upwards of 15 hours to print, which was not feasible for us. With this information, we decided to adjust our design to a smaller size.

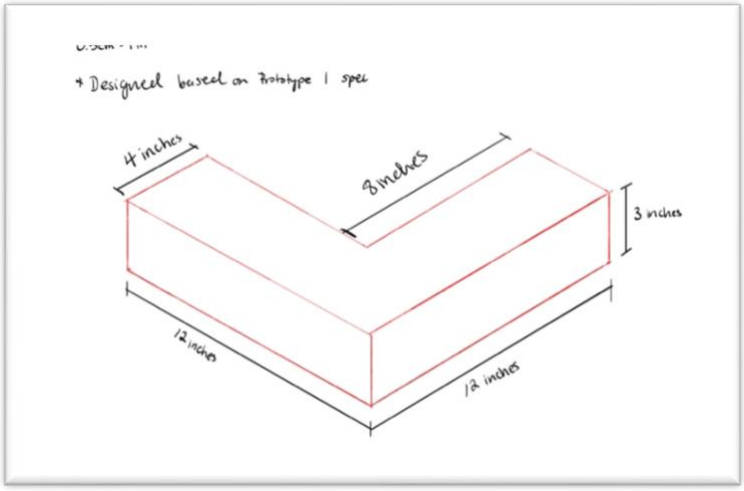
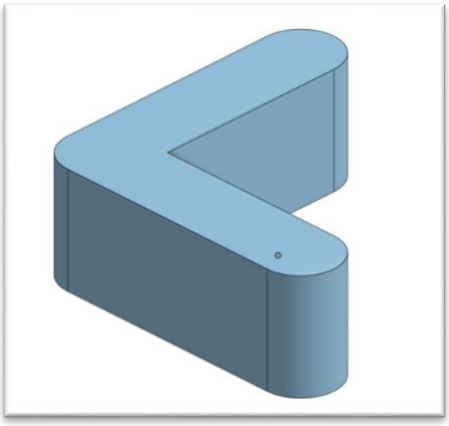


Figure 8: 12-inch x 12-inch Design from Prototype I



We ended up redesigning our corners from a 12x12 inches corner design to an 8x8 inch corner design. Our piece also went from the height of 4 inches to a height of 3 inches. We modeled the new shape in Onshape and decided to also give the corners a rounded look, both for aesthetic reasons as well as to make the corners less sharp and potentially dangerous.

Figure 9: New Arena Corner Design

After we changed the dimensions of our corner piece, there was still an issue regarding the time it would take to print the piece. Due to this we decided to print each corner piece in two pieces, seen in Figure 9.

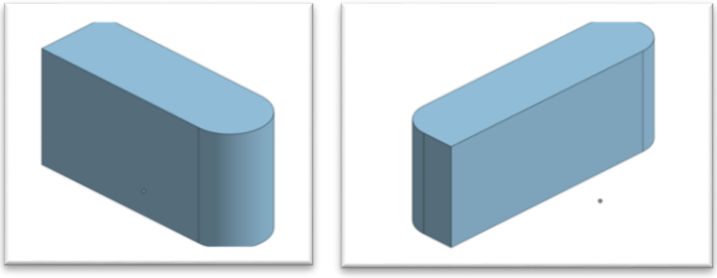
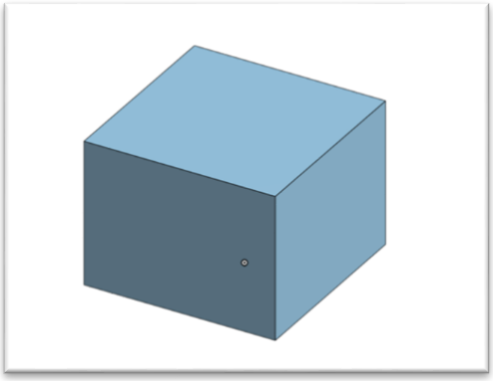
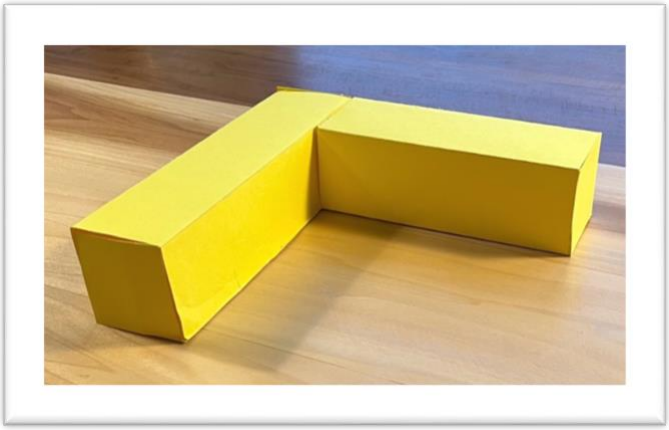


Figure 9: Part 1 and Part 2 for 3D Printing



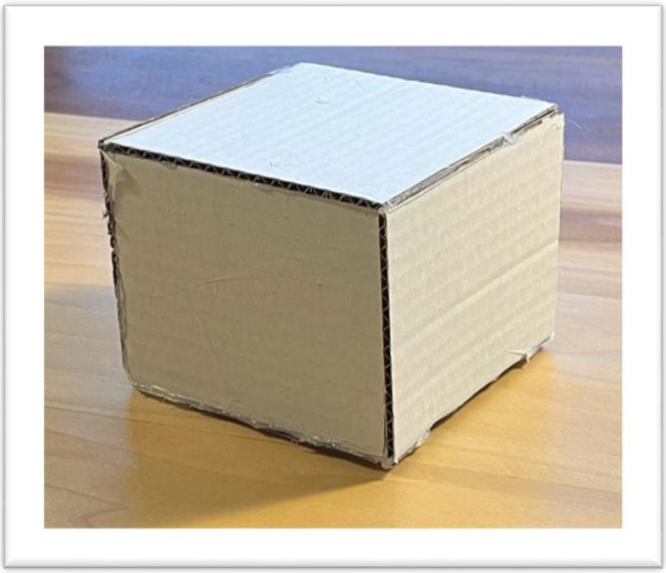
Due to our change in arena design, the Robomaster's arena space also needed a way to be defined. To define this arena, cubes of 4" x 4" x 3" will be made and place at each corner of the Robomaster's arena space. The Onshape modeling can be seen in Figure 10.

Figure 10: Robomaster Arena Corner Design



For Prototype 2, we decided that we would create a cardboard model of our arena corners, both the main arena corners and the Robomaster arena corners. We made them to the accurate sizes and made them yellow, which is the color that we plan to print them in, for the greatest visibility. Our plan for Prototype 3 is to test these arena corners in the real-life game dimensions and determine

Figure 11: Main Arena Design Cardboard Prototype



their visibility, so that we can be sure of our design prior to creating the final product. This will ensure that we do not waste the 3D printing filament if we are not happy with the sizes of the corners. Once we determine whether the arena corner size and color are suitable or not, we will 3D print our final arena corners. If the color and size are unsuitable for the game, we will redesign the dimensions and create an alternate prototype and test it again. The cardboard prototype for the main arena corner can be seen in Figure 11 and the cardboard prototype for the Robomaster's arena corners in Figure 12.

Figure 12: Robomaster Arena Design Cardboard Prototype

5.Prototype III Testing Plan

Most of our subsystems are almost complete. We also now have access to a Robomaster to do testing with as well. During Prototype 3, we will start completing our Prototyping list and get our results for each test.

Test	Objective	Description of Prototype used and of Basic Test Method (What)	Description of Results to be Recorded and how these results will be used (How)	Metric	Estimated Test duration and planned start date (When)
1. Game Mechanics	Making sure the Robomaster S1 successfully detects players that gets in its field of vision	Prototype II: Testing targeting and elimination code with player cards by having Robomaster try to identify player card	Either the Robomaster can or cannot identify the player cards. Determines if the player card design must be changed	Pass or fail	By Nov 17th
2. Deceiving the Players	Test the hidden elimination rule tied to the player card.	Prototype II: test elimination part of the code and timing to inform player they have been eliminated	Either the Robomaster can or cannot notify the play at an appropriate time. Determines if the timing needs to be changed in the code.	Pass or fail	By Nov 24th
3. Game Arena	Check a user's ability to identify where	Prototype II: corners will be placed	Either the corners will be seen or not. Dimensions will	Pass or fail	Nov 12

Corner Visibility	the arena boundaries are	within the game environment that is in scale and will be checked for visibility	have to be modify if cannot be seen.		
4. Final Game Rounds & Last Player Standing	Play a complete game to see how the game plays out when few players are left.	Prototype III: full concept will be tested to make sure each component works together	Either the game will run smoothly or not. Components will be adapted depending on what is not working.	Pass or fail	By Nov 24th
5.Robomaster Obstacle Navigation	Making sure the robomaster gets around the arena easily.	Prototype II: test path code by having the Robomaster stay in the designated area and see the optimized Robomaster speed for the game	Either the Robomaster will stay in within the area or not. Either the Robomaster will travel at the right speed or not. Code will be changed depending on outcome.	Pass or fail	By Nov 17th
6. Player Obstacle Navigation	Evaluate players' ability to move around obstacles and avoid detection.	Prototype III: Have team member act as a player and move around game environment	Either the team member can or cannot move within the game environment. Changes to the environment will be made depending on	Pass or fail	By Nov 24th

			how the test goes.		
7. Arena Shrinking	Observe the effect of the shrinking arena and how it affects player movement and overall strategy.	Prototype II: set up game environment and have team members move within. Change size of the arena and repeat.	Either team members can navigate game environment or not. Changes to game environment will be made depending on test.	Pass or fail	Nov 12
8. Rock-Paper-Scissors Input and Output	Record how players interact with the rock-paper-scissors function and see how effective it is in the hidden elimination rule	Prototype III: Test how the RPS game is played and if elimination notification works	O Either the RPS game works smoothly and elimination notification works or not. Changes to the code would have to be made if not.	Pass or fail	By Nov 24th
9. Game Referee	Evaluate if rock, paper, scissors elimination would benefit from a game referee	Prototype III: Test game concept with a referee to moderate game	Either the game will run more smoothly or not. Depending on the outcome, we will choose whether to incorporate a referee into the game.	Analysis	By Nov 24th

6.Updated Bill of Materials (BOM)

6.1. BILL OF MATERIALS FOR ITEMS THAT NEED TO BE BOUGHT

Item #	Description	Quantity	Source	Cost
1	Colour printing services for player cards	16	UOttawa Printing	$4
2	Tape for Obstacles	1	Michaels	$6.77
TOTAL				$10.77

6.2. BILL OF MATERIALS FOR ITEMS WE HAVE/ DO NOT NEED TO PAY FOR

Item #	Description	Quantity	Source	Cost
1	Cardboard for obstacle	5	N/A (have at home)	$0
2	Yellow Cardstock for arena corner prototype	2	N/A (have at home)	$0
3	Hot glue sticks	2	N/A (have at home)	$0
4	3-D printing filament for arena corners	1	Makerspace	$0
5	3D printer for printing the boarders	1	Makerspace	$0
TOTAL				$0

6.3. BILL OF MATERIALS FOR THE ROBOTS

Item #	Description	Quantity	Source	Cost

1	**Computer/USB drive** will be used to put the implement the code into the Robomaster S1	3	We would bring our own	$0
2	**Robomaster S1** is needed to play the game against the players	1	The clients are providing this	$0
TOTAL				$0

8.Conclusion

The main goal of this prototype is to test it this week, mainly to ensure it stays on path, and can detect and target player cards. Prototype II focused on streamlining the actual gameplay experience of the project and ensuring that users did not run into any bugs or glitches while playing the game. In addition, we took the feedback from the presentation we had this week and implemented it into this prototype. The movement system was completely revamped. Instead of having the robot move around the entire arena, the robot is now moving in a constant square pattern in its own isolated part of the arena to ensure that it is not being stepped on by any of the players. The targeting and elimination code has been refined greatly for this prototype, and this code will undergo testing this week in the STEM building with the physical example of the Robomaster S1 that we have been given access to. The code helps the robot with switching targets randomly with each progressing round, increasing the complexity of the experience. Also, the code for phase II of our experience, which is the RPS game, has been refined greatly and will be put to the test this week, as mentioned with other parts of our prototype, and will be refined further after that.