Project Deliverable F: Prototype I + Customer Feedback

Faculty of Engineering – Engineering Design - GNG1103

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Abstract

This deliverable focuses on explaining various components of Prototype I and customer feedback of the project given by Mines Action Canada. Feedback given by the client was focused on the game of rock, paper, scissors (RPS) and how we are going to present the game to the players. Peer feedback has generated a couple of ideas that could be incorporated into the next prototype of the RPS game.

The basic code for player targeting and elimination, the Robomaster S1's path, and the RPS have been created separately and been shown to function as intended. Plans to create the game's physical components (player cards, obstacles, arena) have been created and will be built for Prototype II. Moving forward, the team will incorporate the various components for Prototype II and will test said prototype through a series of tests laid out in the Prototype II Test Plan.

This deliverable also includes an updated Bill of Materials (BOM) and PCFME Fishbone Diagram. The updated BOM reflects changes made due to client/peer feedback and the creation of the various components of Prototype I. The PCFME Fishbone Diagram highlights issues that could arise during the game and zones into why these may occur.

Overall, this deliverable's purpose was to create Prototype I, which consisted of various components that could be incorporated to form the next prototype. Feedback from the client/peers will be utilized along with the insight gain from the PCFME Fishbone Diagram to produce Prototype II.

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1.Introduction

In this deliverable, our group conducted the first set of prototyping for the project given by Mines Action Canada. Using the task list and prototyping plan developed in Deliverable E, each member of the group was assigned an element of the project to work on and develop. Using the feedback from Client Meeting 2 and our peer-led design review, we explored different options of how we could implement our ideas into our final project. In this deliverable we will discuss the main pieces of feedback given, the critical elements of our designs, prototyping, our plan for prototype II, and our updated BOM. We will be focusing on prototyping 2 pieces of necessary coding: the target and elimination coding and the Robomaster S1 path coding. We will be prototyping the input and output of the rock, paper, scissors game, as well as the player card, obstacle and arena designs.

2.Client Meeting + Peer Feedback

The biggest piece of feedback from our clients, peers, and TAs was regarding our rock, paper, scissors input and output.

Our original idea was to have players play the game directly with the robomaster. The client has mentioned that the Robomaster cannot interpret the rock, paper, scissors motions that are usually used during the game, and mentioned that we need to find a way to input the player's choice in a way that the Robomaster can interpret.

Since the client meeting, we have been prototyping 2 potential ways that we can input the players choice in rock, paper, scissors. These two methods were presented to our peers and TAs.

One method was that we could make additional player cards that have symbols that are associated with either rock, paper, or scissors. The second method was that we could have the players type directly into the computer python coding. There were a few drawbacks to each method but the largest was with the second method, where the player might see that the won on the screen, but still get eliminated by the LED lights, which could cause confusion

One of our peers mentioned that for the second method we could create a blank screen with a heading of "Choose Rock, Paper, or Scissors:" and then just have a blank input box that would transfer into the code.

Another peer mentioned that the first method seems the most simplistic and that using player cards would be the easiest way for the Robomaster to interpret the player's choice.

Lastly, one peer mentioned that we could combine both methods and have a referee. The referee would be sitting with the laptop, and the players would show the player

card or just tell the referee what their choice is, and the referee would be the one that inputs the choice into the python coding.

3.Critical Elements

The most critical aspects of this design are the 3 codes: the 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 I

4.1. Target and Elimination Coding

The targeting aspect of the Robomaster S1 is essential for our experience to function. By using the DJI environment, we were able to construct a code which when activated, will send visual and audio cues for when a player has been detected or eliminated. Each player is given their player card with a unique, easily identified letter printed upon it. These letters will trigger the elimination code of rock paper scissors whenever they are seen by the Robomaster S1.

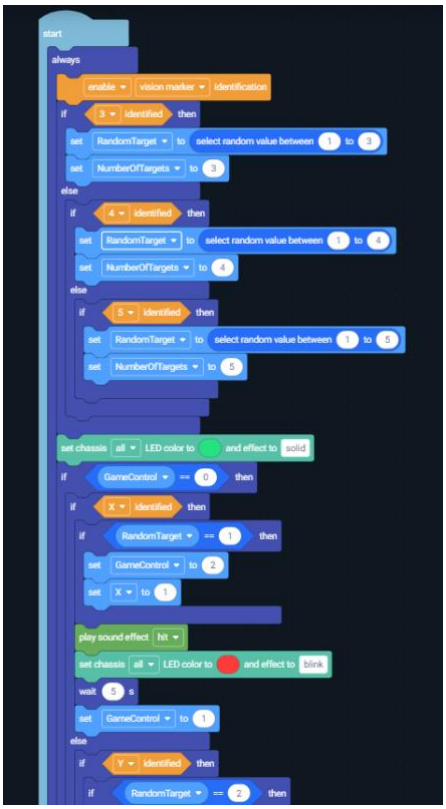

Figure 1: Targeting Code in DJI Environment

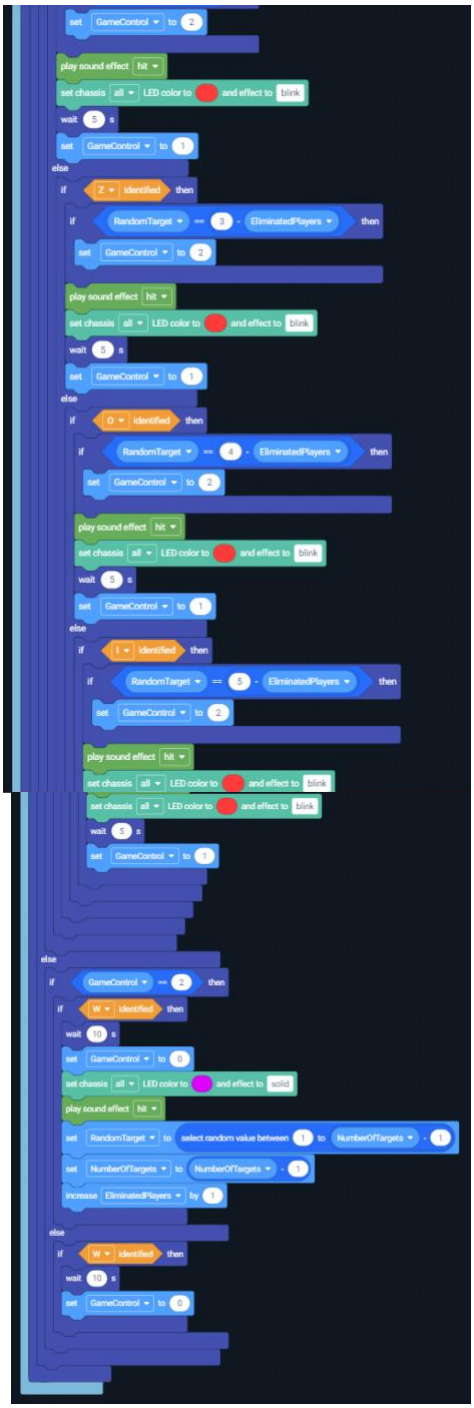

Figure 2: Targeting Code Continuation From DJI Environment

.The game is initiated by showing the Robomaster with the number cards of 3,4 or 5. These cards will inform the code on how many players are participating. The code will produce a random number from 1 to P (P being the number of players) which corresponds to values of the player cards. The randomly selected player will be the target for that round. If any of the players are seen by the Robomaster, its chassis lights will turn red, the hit sound will be played, and the game will be paused for the rock paper scissors match. If it is the target player that is seen by the robot, there is a specialized code segment that will automatically turn the chassis lights purple to indicate the target player, the amount of players will be reduced by one, and a new random number is generated from 1 to P-1. The game repeats this process until only one player is left.

One problem with the code is the inability to change the values for each of the letters, depending on which player is eliminated. For example, with 5 players, if player X whose value is 1 is eliminated, the new random number will be generated from 1 to 4. The problem is that player “I” has a value of 5 and therefore cannot be targeted in any future rounds. There needs to be additional code to rearrange the values of the letters after each elimination. This problem is planned to be fixed for the next prototype along with additions of rock paper scissors cards and its logic.

4.2. Path Coding

The robot's movement throughout the rounds will be relatively simple for the most part. Since the arena is a square, most of the robot's movements are symmetrical, and repetitive, just on different sides of the square. The idea is for the robot to pass through the entire arena while scanning the area for players. This code is subject to change, additions, and removals, once decisions on what exactly the obstacles we will use will be. Movement is not prioritized for now simply because the main purpose of this prototype is to test the visual recognition and camera of the robot, since those two are exponentially much more likely to fail than the movement of the robot.

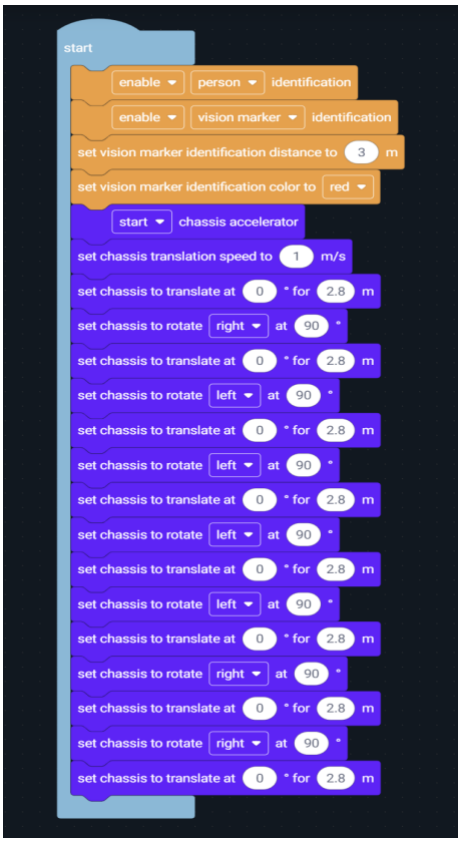

Figure 3: Path Code in DJI Environment

```python
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 4: RPS Python Code

4.3. Rock, Paper, Scissors (RPS) Game

Prototype I of RPS consists of the python code used to play against a computer. Prototype I has shown to be successful as the code runs and a user can input their response and receive output whether they won or lost the game. Prototype II will have to address the issue of how to present the game to the players if they must play RPS. Through peer feedback, there are a couple of ideas that could be incorporated into Prototype II to solve this issue.

4.4. Player Cards

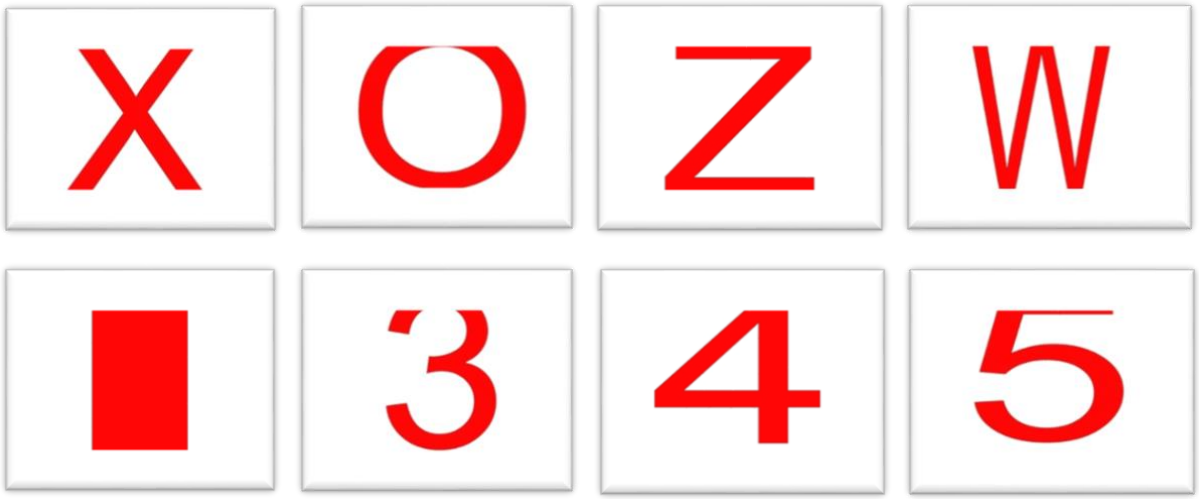

Figure 5: Player Card Symbol Set

These are the symbols that the player card symbols will be on each board and be distributed to each player in the game. We will make a more formal design based on these symbols and then print the symbols onto player cards in the Prototype 2 testing phase. These are going to be used both to implement the hidden elimination rule for investigation in the game and ensure players get unique identifiers which will affect the outcomes of gameplay in a very subtle manner.

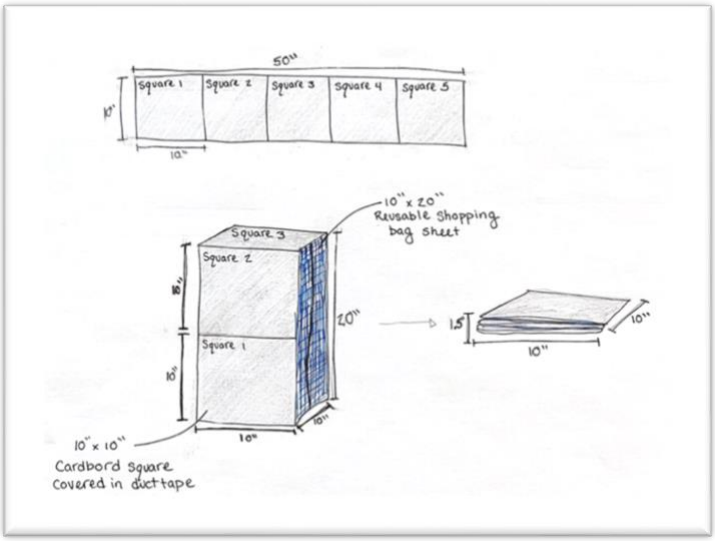

Figure 6: Sketch of Foldable Obstacle

4.5 Obstacles

The collapsible obstacle prototype will be 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 will be taped together to form a long rectangle. The 10” side of the shopping bag strip will be taped to the 10” side of the third square of the long rectangle of 5 squares.

The 20” side of the shopping bag strip will be taped to two of the squares next to the center square of the long rectangle. This will be repeated with the other 20” side of sheet and the other two squares of the rectangle. This will be repeated with the other sheet of reusable shopping bag to form another side of the obstacle. The sheets of reusable shopping bag along with the joints where the squares were connected should allow for the obstacle to collapse and take up 10’x10”x1.5’ of space. The main priority during prototype II testing will be to see how does the obstacle collapse and how much space will it take up. The compatibility of the obstacle will determine how many obstacles can be included in the game environment due to the portability constraints of game materials must fit into a standard 22”x14”x9” carry-on luggage bag.

4.6 Arena

The maximum area size that we are allowed to use for this project is 20ft x 20ft. As our game requires much movement and needs to be able to shrink, while still allowing the players and Robomaster space to move, we have decided to utilize the whole 20x20 area space for the arena.

For the arena corners there were three elements that we are focusing on. The main elements that we are focusing on is the visibility of the arena boundaries to the player. The secondary element that we are focusing on is the ability to shrink the arena with the corners, and the last element is whether the arena corners can be easily compacted into carry on for travel.

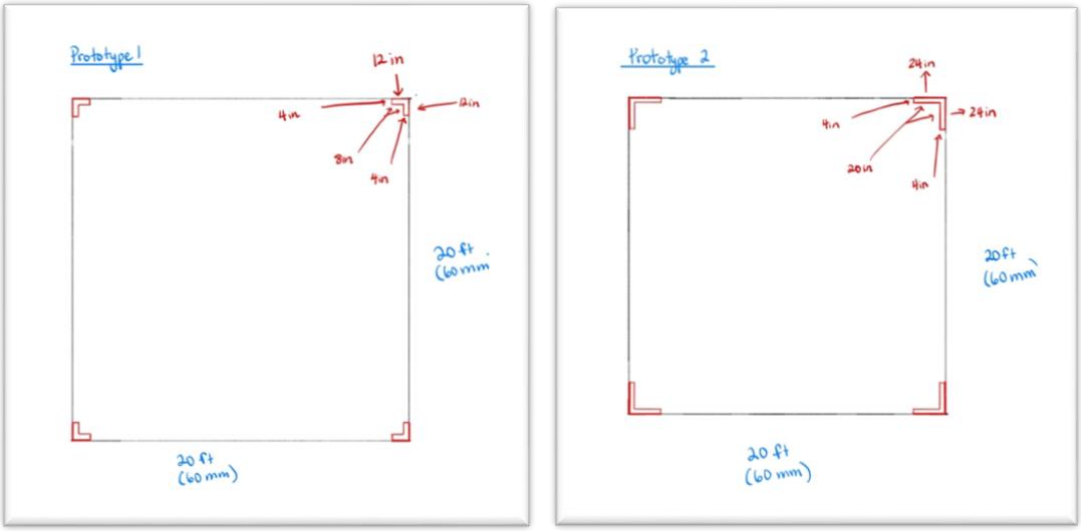

Figure 7: Sketches of Prototype 1 and Prototype 2 of Arena Corner Sizes

The pictures were drawn to a scale of 1mm = 4inch.

The first two pictures are 2 prototypes regarding the arena corner sizes. Prototype 1 is a 12-inch by 12-inch design while the other is a 24-inch by 24-inch design. While the 24-inch design seems to have a better visibility than the 12-inch, it is also very large and therefore might not be very compact.

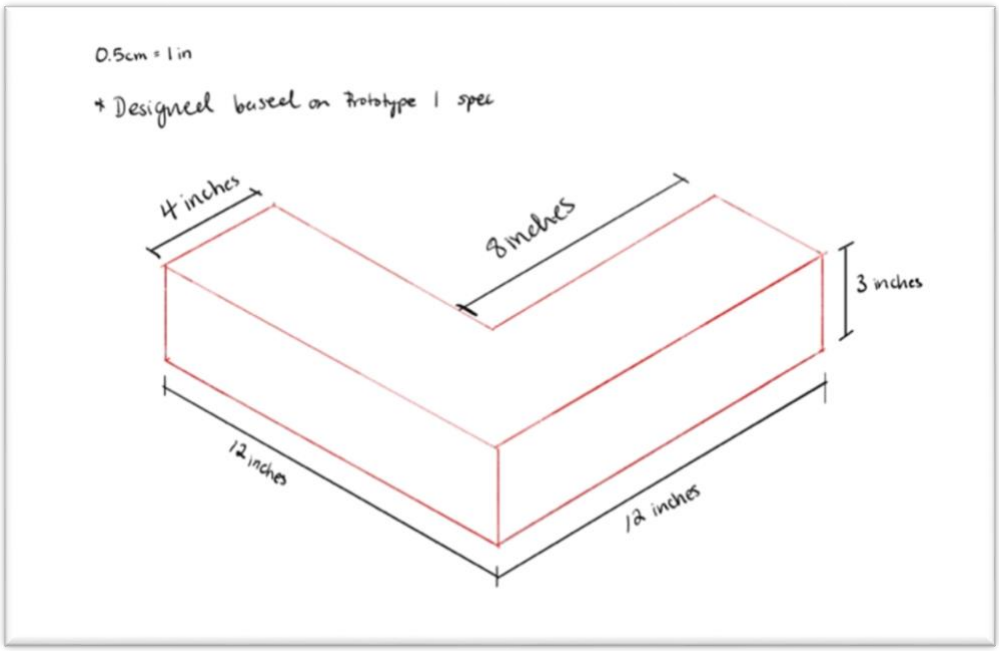

Figure 8: Isometric Sketch of Arena Corner Prototype 1 and Design 1

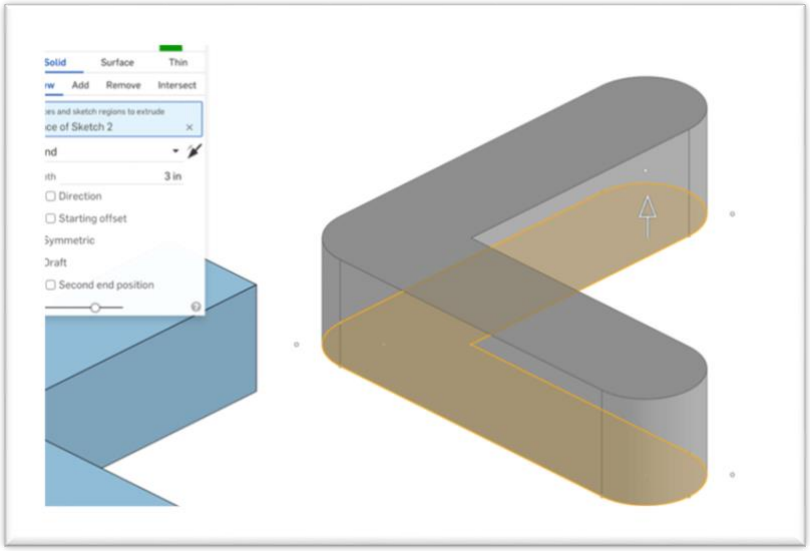

Figure 9: Isometric Sketch of Design 2

The second and third drawing are isometric sketches of two potential arena corners designs, one done by hand one done on Onshape.

In the next prototyping stage, we will decide which sized arena corners to use and create a design mockup out of cardboard to test the chosen sizing. A design will be created for the chosen sizing on Onshape to 3D print for in Prototype 3.

5.Prototype II Testing Plan

Test	Objective	Procedure	Observation	Metric

Game Mechanics	Making sure the Robomaster S1 successfully detects players that gets in its field of vision	Players randomly enter and exit the Robomaster's field of vision,	Record if players are detected consistently and if the game works smoothly.	Pass or fail
Deceiving the Players	Test the hidden elimination rule tied to the player card.	Play a round where players are unaware that elimination is determined by their player card.	Analyze if players believe rock-paper-scissors results is the cause of their elimination and if the hidden rule remains undetected.	Pass or fail
Game Arena Corner Visibility	Check a user's ability to identify where the arena boundaries are	Move 3-D corners into the arena size	Get user feedback on the visibility of the arena boundaries	Pass or fail
Final Game Rounds & Last Player Standing	Play a complete game to see how the game plays out when few players are left.	Keep playing until one player remains.	Monitor player movements, how the robot's path affects gameplay, and what happens at the end.	Pass or fail
Robomaster Obstacle Navigation	Making sure the robomaster gets around the arena easily.	Place obstacles around the arena.	Check if the Robomaster easily avoids obstacles without affecting its abilities to identify players	Pass or fail
Player Obstacle Navigation	Evaluate players' ability to move around obstacles and avoid detection.	Arrange obstacles in different places each round.	Observe if players can easily dodge obstacles and change their movement patterns so they stay undetected.	Pass or fail
Arena Shrinking	Observe the effect of the shrinking arena	Keep reducing arena size with	Monitor changes in player movement	Pass or fail

	and how it affects player movement and overall strategy.	3D-printed corners.	strategies as the arena becomes smaller.	
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	Record results of rock-paper-scissors interactions while the game progresses.	Observe if players think the rock-paper-scissors result is the cause of elimination or if they think there might be a hidden rule tied to their player cards.	Pass or fail
Game Referee	Evaluate if rock, paper, scissors elimination would benefit from a game referee	Compare different ways of inputting the rock, paper, scissors answers, both without and with a referee	Observe whether game runs smoother with a referee, observe whether ethical issues are still valid if a human is inserted in the gameplay	Analysis

6.Bill of Materials (BOM) (Samuel)

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

Item #	Description	Quantity	Source	Cost
1	Printing services for player cards	8	Staples	$5.06
2	Tape for Obstacles	1	Michaels	$6.77
TOTAL				$11.81

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

Item #	Description	Quantity	Source	Cost
1	Paper for printing	8	N/A (have at home)	$0
2	Cardboard for obstacle	5	N/A (have at home)	$0
3	3-D printing filament for arena corners	1	Makerspace	$0
4	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

7. PCFME Fishbone Diagram

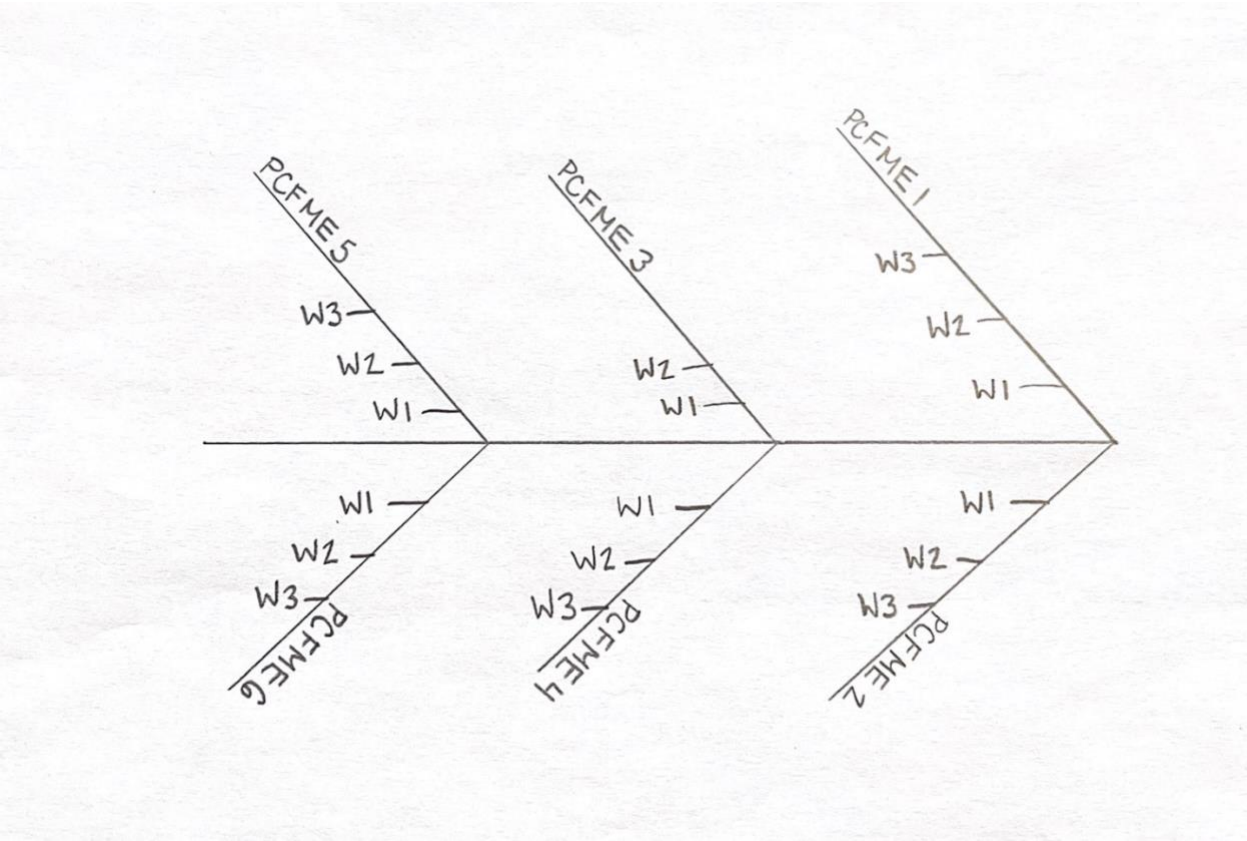

Figure 10: PCFME Fishbone Diagram

PCFME 1: Camera does not see symbols

- Why 1: Camera angle is too low or angle at which the camera sees the player
- Why 2: Relative heights of player and robot are not optimal
- Why 3: Positioning within the game space

PCFME 2: Robot gets stuck on obstacles

- Why 1: Robot has a set path and does not react to any obstacles in its way
- Why 2: Obstacles get moved slightly or any unexpected factor changes its course
- Why 3: Obstacles are not fixed in place or floor is not clear

PCFME 3: Rock, Paper, Scissors game fails

- Why 1: User input fails (showing robot rock, paper, scissors cards)
- Why 2: Camera does not see symbols

PCFME 4: Robot goes off course/out of arena

- Why 1: Starting position of robot is off
- Why 2: Error from game operator
- Why 3: Game instructions are unclear

PCFME 5: Obstacles collapsing

- Why 1: Failure of components of the obstacles
- Why 2: Cheap materials used
- Why 3: Low budget

PCFME 6: Elimination not happening fast enough

- Why 1: RPS game does not eliminate the players
- Why 2: Robot does not find the target player
- Why 3: Camera does not see symbol or non-target players too good at RPS

8.Conclusion

This prototype helped in the insight of the core elements of our project, which concern player targeting and the mechanics involved in the removal of a player and RPS integration. Based on feedback from the client, Mines Action Canada, and from our peers, we compiled a list of refinements that needed attention: such as RPS input methods and improved symbol recognition. These insights have helped shape our approach to Prototype II, focusing on improvements that streamline gameplay and improve user experience.

These trials have pointed out a series of issues that we need to refine, moving forward. Namely, a dynamic code would have to be written for target selection-that is, one which changes and adjusts itself as players get eliminated; and secondly, the physical obstacles within an arena can take a lot of wear and tear. We will integrate these refinements into Prototype II to ensure the environment we create is more engaging and interactive, which is what our client has in mind. With this adjustment, we are certain that we would have a game and educational balanced prototype that is polished and functional.