

# **Deliverable D**

## **Conceptual Design**

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October 11, 2024

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# 1. Introduction

Lethal Autonomous Weapons Systems (LAWS) are a kind of autonomous military system that can detect and apply force to targets based on sensor processing, instead of human approval. These systems are often referred to as ‘killer robots’ on account of their lack of human judgement and understanding, lack of accountability, algorithmic biases and more. Many organizations such as United Nations, Red Cross and Mines Action Canada are trying to raise awareness about these systems to stop their production before it’s too late. Our team has been tasked by MAC to create an immersive experience using a RoboMaster S1 to highlight the ethical concerns of LAWS.

## 2. Our Project

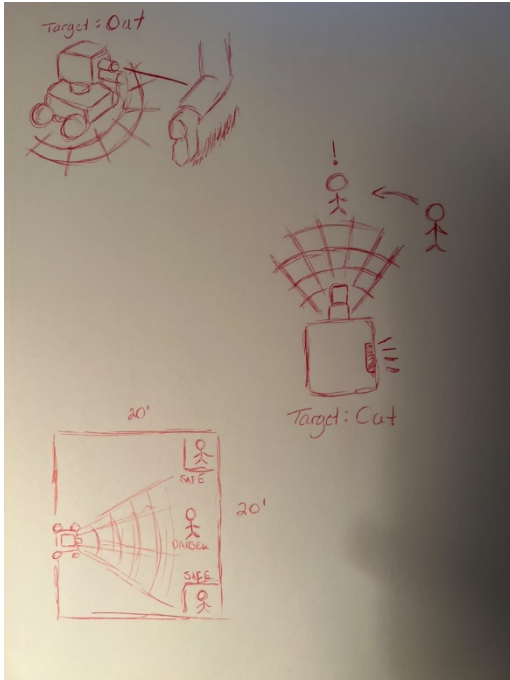
A need exists for Mines Action Canada to demonstrate the ethical concerns regarding LAWS through a simple, portable, and immersive experience with a Robomaster S1, lasting no longer than 10 minutes, where players in groups of 3-5 can grasp the severity of losing human control within a bounded area.

In the experience players interact with the Robomaster within a 20’ by 20’ space where they will be identified by a set of unbiased character cards. Participants in this game try to work together to survive by trying to figure out how and why Robomaster is choosing its targets. However, no matter how hard the players try they will be unavoidably ‘shot’ by the Robomaster.

## 3. Subsystems

### 3.1. Target Recognition Systems

How RoboMaster S1 will recognize players as a target or person to eliminate, e.g., eliminated based on proximity, time spent in a specific zone, gestures, movement, randomized ID, etc.



### 3.1.1. Targeted based on proximity

Based on a camera sensor, the Robomaster will detect the players' distance and distance variation – when players are getting closer. When players are in line of sight of the robot, the camera turns to the player to determine the distance. After the player is already within safe distance of the robot, Robomaster will begin to be warning, change LED light and make sounds. When the player is within the range set by the robot, it will start targeting/eliminating

### 3.1.2. Targeted based on movement

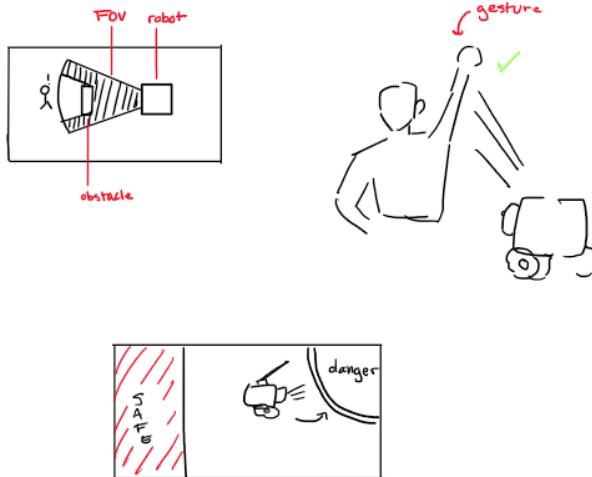
The Robomaster will detect player movements and categorize based on speed, proximity, and the number of players in a certain area and will eliminate based on a first in last out priority stack.

Pros: it can be confusing in an engaging way for players, very fun, can add to unpredictability, and can contribute to the frustrating element of the game

Cons; might be difficult to program

## 3.2. Player Interaction and Response

How the participants interact with the RoboMaster S1 and how the RoboMaster S1 responds/gives feedback, e.g., players must dodge, avoid or gesture to RoboMaster, RoboMaster provides audio, visual - LEDs or pictures from computers, etc.



### 3.2.1. Players Avoiding Detection

The Robomaster will be able to detect player movements and target them if they are moving.

Pros:

1. Highly engaging and forces players to be constantly alert
2. The robot can be made to move unpredictably or be highly sensitive to movement, creating frustration

Cons:

1. In a 20 by 20 ft area, players trying to avoid detection may feel too constrained

### 3.2.2. Using Gestures

Players can make specific gestures such as raising a hand or wave to the Robomaster, which then responds by not targeting them

Pros:

1. Can make players feel like they are directly interacting with the robot, making the experience more personal and thus immersive

Cons:

1. The Robomaster may have problems accurately identifying some gestures

### 3.2.3. Visual and Audio Feedback

The Robomaster can interact with the players to indicate danger zones or elimination through sounds or LED lights.

Pros:

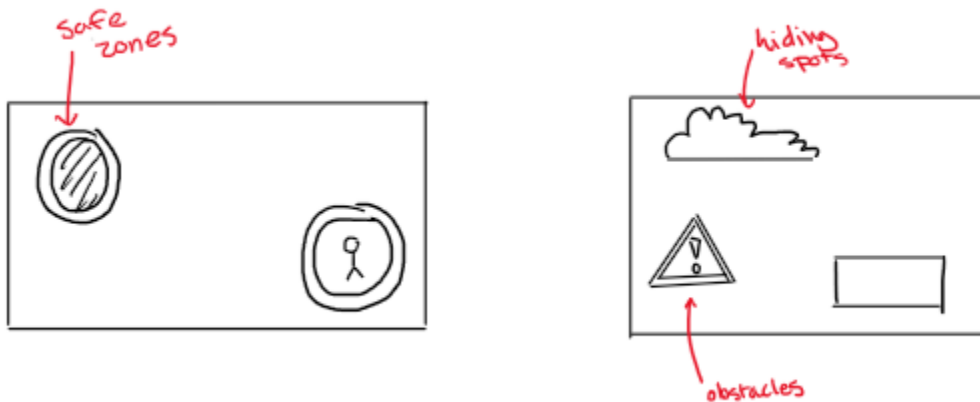
1. Provides clear and instant feedback to players
2. Customizable because sounds and lights can increase in intensity based on how close players are to being eliminated

Cons

1. Speakers are required for audio feedback

### 3.3. Environmental Awareness

How the game is going to work within space and how participants will have to move, e.g., players will have to stay in specific zones, players will have to move through a maze, players navigate through different symbols, etc.



#### 3.3.1. Zone Based Movement

Players are required to move between color coded zones. Robomaster alternates between which ones are safe or dangerous.

Pros:

1. Makes a clear structure so that players can easily understand objectives and rules
2. Allows for the game to flow because players must keep moving zones, preventing stagnation

3. The time constraint before players in an unsafe zone are eliminated creates pressure and can make players feel like they are being hunted by a killer robot

Cons:

1. The minimal variation can make the game feel repetitive

### 3.3.2. Triggers

There are certain symbols or objects within the bounded play area that players must navigate through to survive

- a. Pros; Some strategy, movement, confusing
- b. Cons; may be hard to program or easy to figure out

## 4. Game Ideas

### 4.1. Capture the Flag Style

The robot has a flag either mounted to it or set to guard, with the players having to acquire it and bring it back to their safe zone without being targeted.

### 4.2. Night at the Museum Style

The players will need to traverse space from one area to another without having their movement detected by the robot.

### 4.3. Cops and Robbers Style

The robot has a specific targeted player based on proximity, and if another player comes within that certain proximity, they are the next target. When the robot sees its target's specified notation, they would be considered out.

### 4.4. Hot Potato Style

A target object is being passed between players, with the robot tracking it. Within the time limit, the item is passed around between players, but once the time limit has ended, the robot tracks who has the target item and eliminates them. The time per round is shortened with each player eliminated.



## 5. Final Game Ideas

### 5.1. Four Corners Style and Night at the Museum

Four zones are marked by colors, and the robot can indicate them as safe zones or danger zones. Players have to move to that zone, but the robot will move towards them as they do. The players will have to stop moving entirely to avoid detection by the robot, and if the robot comes within a certain range of them before they freeze or before they reach the safe zone, they are considered out.

#### 5.1.1.Subsystem 1: Target Recognition System

The Robomaster uses target recognition to detect players based on movement and proximity. Players that have not stopped moving or are within a certain proximity of the robot while moving between zones are eliminated.

Pros:

1. The game can be tuned to the desired difficulty by adjusting proximity and movement detection sensitivity. These can be randomly changed during the game to increase unpredictability or made intentionally strict, so players feel eliminated without a clear reason and feel frustrated

Cons:

1. Designing a target recognition system that is sensitive enough to detect subtle movements but not enough where there are too many false positives can be challenging

#### 5.1.2.Subsystem 2: Player Interaction and Response

Players interact with the Robomaster by trying to stay out of its detection range while moving zones, and the Robomaster responds with feedback that can be visual (LEDs or use a computer screen to signal elimination) or through sound.

Pros

1. Adds immersion through visual or sound cues
2. Simple actions like standing still don't require complex instructions, making the game easy to understand and intuitive

Cons:

1. Since the player interaction is just freeze, move, or avoid detection, the game may feel slow or not physically engaging enough for a survival game

### 5.1.3.Subsystem 3: Environmental Awareness

The Robomaster is aware of the defined zones and determines and changes their status as a safe or a danger zone, forcing players to move to get to a safe zone while also trying not to get detected.

Pros

1. Creating a dynamic and unpredictable game by switching the safe and danger zones
2. The constant movement of the robot within the game creates immersion by putting pressure on players and forcing them to act quickly
3. The game can be played in various environments and terrains without needing large equipment as the zones can be set up quickly anywhere

Cons:

1. If the game doesn't introduce new variations other than zones, players might lose interest and excitement over the course of the game
2. If there are established patterns for the robot's movement or the zones, players may start predicting them

## 5.2. Safe Zone Style

Several zones are indicated as safe zones, with the Robomaster patrolling around the zones. The players are given a time limit to move from one zone to another, and if they come within a certain proximity or don't make it to the zone in time, the robot considers them out. After the first outs, the robot introduces a rule. If it applies to any living players, they are out, and it repeats until the time limit has come to an end.

### 5.2.1.Subsystem 1: Target Recognition System

The Robomaster will target players and determine if the player is in a designated safe area. If players are not in a safe zone, it will eliminate them. This can be done using visual sensors.

Pros:

1. Player can have fun while avoiding attacks from Robomaster. When shooting, players also can feel the crucial aspects of Robomaster

2. It can extend play time by avoiding quick player eliminations

Cons:

1. If the integration of the attacks is not clever, players may lose interest. Moreover, this may not convey all the aspects we want if the Robomaster is beaten by players too easily; showing that it is not harmful.

2. Delay of detection, some players get stuck in the last seconds to enter the safe zone. If the delay exists, a player, who enter safe area one second before times out, is also judged to have failed.

3. Players may have an advantage staying only in the safe zones

### 5.2.2.Subsystem 2: Player Interaction and Response

In unsafe areas, the Robomaster will make a warning sound upon detecting a player, and the LED light will turn red to show its hostility. Then, the player must follow the robot's instructions to avoid elimination.

Pros:

1. Robot warnings will build player engagement

2. player can know what Robomaster thinks and plan what to do next to prevent to be one of its targets.

Cons:

1. If the Robomaster cannot recognize what player express exactly, it may make wrong decision, and player will feel grievance (potential to be buggy)

### 5.2.3.Subsystem 3: Environmental Awareness

Dynamically altering the safe zone area and rules of the environment. The player should move or change gesture once the requirement of Robomaster is changed.

Pros:

1. It revert to a situation in which the environment is changeable and unpredictability in reality.
2. player may feel boring if Robomaster doesn't shoot or stay in one area for a long time. Change situations will let them have to think next solution to win the game.

Cons:

1. Players may not understand where safe zone is exactly. Change quickly or frequently will let players go around instead of looking for safe zone.

### 5.3. Round Based, Multi-Style Game

Combining Night at the Museum Style, Hot Potato Style, and a gesture recognition round of some form into one final game that combines several different elements over various rounds. The players are tasked with simply avoiding being eliminated by Robomaster S1, which detects and eliminates players based on movement within a certain view. For the consecutive rounds, difficulty is amped by incorporating a "hot potato" that players must keep off the ground and out of the robot's view. If dropped or detected by robot, there will be mass elimination of all players. The final round incorporates gestures that the players must perform to avoid being eliminated while performing the previously assigned tasks.

#### 5.3.1.Subsystem 1: Target Recognition System

The robot's detection system is based on movement. It will consider two targets: the player and the "hot potato". Within a certain range, the robot will be able to view the target and will eliminate based on whether it is moving or not. The "hot potato", if within the viewing area, will always be targeted regardless of movement, but will have a slight delay for relief and to manage player frustration. The "hot potato" will also be prioritized for elimination above player elimination.

Pros:

- The players will have a certain relief zone outside of the robot's field of view, where they can move around and strategize. This will manage player frustration.
- Difficulty can be amped by altering the field of view throughout the game, which will also increase unpredictability of the robot.

Cons:

- If the players stay out of the field of view too consistently/effectively, there will be no challenge

### 5.3.2.Subsystem 2: Player Interaction and Response

Player interaction will vary throughout the rounds, but will initially have players staying out of the robot's field of view or stopping their movement within the field of view. Robot response to movement within the field of view will consist of sound effects and LED lights flashing. This response will be similar (with different sound effects) for when the "hot potato" is detected and mass elimination occurs.

Pros:

- This method of using sound and LED lights is good for providing players with immediate feedback. Players will know whether they are detected or eliminated and be able to learn from their mistakes
- Allows for flexibility in the way that each type of elimination is shown (single player elimination, mass elimination, etc.)

Cons:

- There is no tactile feedback, so if a player is not directly looking at the robot and the environment is loud, there is a chance they will not know they are eliminated.
- There may be some ambiguity if two players are eliminated at the same time or in the position to both be eliminated as to who the robot was targeting.
- Can be repetitive over multiple rounds

### 5.3.3.Subsystem 3: Environmental Awareness

For this game, environmental awareness is not as crucial to design. The emphasized aspects are player collaboration and strategy to avoid instant elimination, so this subsystem is very flexible in terms of what it can contribute to the game. Some environmental elements can be set up to act as obstacles to break the robot's line of sight.

Pros:

- The simple design will allow for more player collaboration and strategizing without confounding variables or confusion
- The obstacles will give the players some respite from the robot and places to hide from its FOV.

Cons:

- The design will be less flexible to incorporation of environmental storytelling to communicate the core intention of the experience
- The robot will have to differentiate between targets and obstacles, and physically avoid the obstacle area
- The robot will have to consistently patrol around the obstacles to avoid players camping or hiding the hot potato