Deliverable E
Project Schedule and Cost

Team: Five Alive

Zoe Saunders, Aurora Bedggood, Yunfei Qiu, Nada Abdelkader, Matthew Godreau

October 24th, 2024

Table of Contents

1.0 Introduction

Lethal Autonomous Weapons Systems (LAWS) are a kind of autonomous 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 the United Nations, Red Cross and Mines Action Canada (MAC) 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 robot to highlight the ethical concerns of LAWS raised by their organization.

2.0 Chosen Concept

For our chosen concept we combined a safe-zone style game with a hot potato aspect to form one final experience that touches on several different ethical concerns over various rounds. The players are tasked with avoiding being eliminated by the RoboMaster S1, which has been programmed to scan their sector for enemies every minute and thirty seconds. Players will have to blindly navigate through the play area which has been divided into refuge zones and enemy zones with no indication of which is which. Once the play area has been scanned, players who have been identified in enemy zones will be eliminated and the timer will reset. For the consecutive rounds, the difficulty is amped up by incorporating the possibility of a "live grenade" and/or intruding enemy forces. When a "live grenade" has been thrown, players are given the objective to keep it off the ground and away from themselves to survive. If dropped there will be a mass elimination of all remaining players. In rounds where intruding enemies are present during the scans, the RoboMaster S1 will eliminate any players it randomly identifies as enemies. This will continue until all players are eliminated.

2.1 Design Drawing

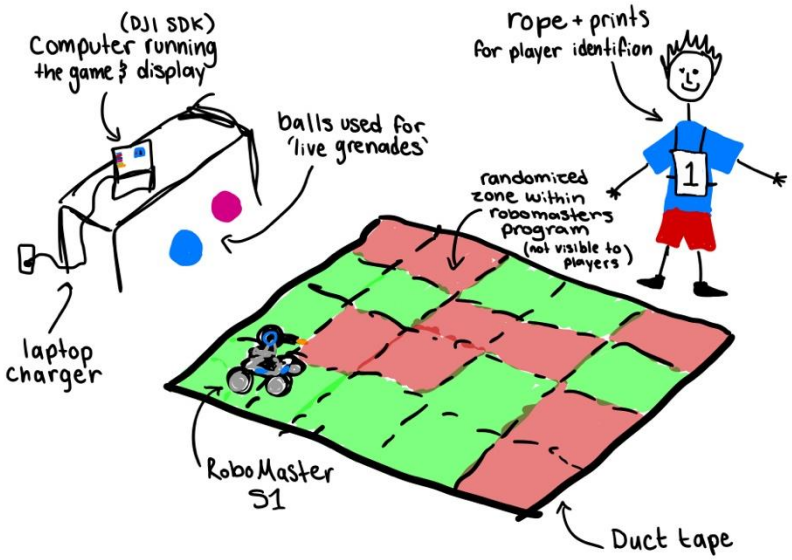

Figure 1. Final game design sketch

3.0 Schedule for Prototyping and Testing

Table 1. Comprehensive schedule with project risks and contingency plans

Task	Deadline	Group Member Assigned	Project Risks	Contingency Plan
Develop storyboard ideas/concept	November 3rd, 2024	Five Alive	Project members could have differing ideas of how the game runs	Host group meeting to fully discuss and flesh out details
Develop storyboard drawings for initial prototype	November 3rd, 2024	Aurora, Matt	Drawings could be unable to clearly communicate the prototype's functionality	Include annotations in drawings & detailed labelling
Write initial instructions for set up and execution of game	November 3rd, 2024	Five Alive	If instructions are not clear, may cause issues for future set up/execution of the game	This information will be verified and tested multiple times over the course of the month

Design target IDs and share with member programming target identification	Nov 3, 2024	Nada	Potential to not be bright and visible enough to be identified by the robot	Test the identification accuracy of different colours under lighting conditions
Finish practicing elevator pitch presentation	Nov 4th, 2024	Five Alive	Time overruns or unclear messaging during the pitch	Refine the presentation to focus only on key points and practice within the time limit
Program human target identification (vision marker tracking)	Nov 5, 2024	Yunfei Qiu	May not be able to accurately pinpoint or recognize the targets we developed	Separate ID designs will be created to minimize inaccuracy
Program grid & safe zone randomization	Nov 5, 2024	Aurora	May be hard to randomize safe zones or have an accurate grid	Adjust and test for grid accuracy
Print & assemble prototype IDs	Nov 9, 2024 2:30pm	Nada	Paper tearing, rope slipping off shoulders	Flexible plastic sheets (laminated) can be used instead, and add back strap to help stability
Program robot movement (including chase effect)	Nov 9, 2024 2:30pm	Nada	May be complicated to program randomized movement	Can be programmed to move in a pattern if random movement not possible
Program “bomb” marker tracking & identification	Nov 9, 2024 2:30pm	Zoe	Marker tracking may be inaccurate or processing may be too slow	Many minor adjustments can be made to test, otherwise we can program identification to occur only when the round is over and no throwing is occurring
Program LEDs/sound effects (including arbitrary sound	Nov 9, 2024 2:30pm	Aurora	LEDs/sound effects may not trigger at the correct times or don’t fit the gameplay.	Test the sound effects multiple times in real gameplay scenarios

effects during rounds)				
Program player identification to a zone (if they are in a safe zone or not)	Nov 9, 2024 2:30pm	Matt	Errors in player zone detection (e.g., false positives/negatives) or integration issues	Fine-tune to avoid misclassification; develop in parallel with systems it is dependent on
Program display	Nov 9, 2024 2:30pm	Zoe	Has the potential to make the project visually unappealing if not executed correctly	Can be scrapped if not beneficial to the plan
Program real-time sensor data to relay from robot to display	Nov 9, 2024 2:30pm	Zoe	Sensor data may not be able to translate effectively	Tests for accuracy will be run, and display can be potentially scrapped if sensor data does not effectively align
Program internal timer for robot	Nov 9, 2024 2:30pm	Yunfei Qiu	Round length may not always be accurate if internal timer fails	Tests for accuracy will be run
First attempt to translate code from block to python (for the display)	Nov 10th, 2024	Zoe	Translation may be more complex than anticipated, which means the display which relies on using python will have to be scrapped	Instead of using the display to show the participants when they are eliminated, we will use sound cues and LEDs that represent the player's colour
Adjust instructions based on initial testing & programming	Nov 10th, 2024	Five Alive	Instructions might be unclear or too complex for users	Test the instructions with a small group for feedback, revise them for clarity and simplicity.
Test for player detection in safe zone	Nov 11th, 2024	Matt	If the code made in previous parts doesn't work for player detection, then this step would be inherently flawed from the beginning.	If the system is imperfect for player detection, it can aid in highlighting possible flaws of LAWs.

Test playzone calibration for accuracy	Nov 11th, 2024	Five Alive	If the robot is not able to accurately stay within the playzone, it could affect multiple features of the game and most of the general game	Continue testing as much as possible to ensure accuracy. Otherwise, tape the border of the playzone and add in line tracking.
Test robot movement for accuracy	Nov 11th, 2024	Nada	If the robot does not accurately follow the movement in the simulation, it could cause issues with collisions and inaccurate target response	Continue testing for as much accuracy as possible
Test for potential collision consequences	Nov 11th, 2024	Five Alive	Could potentially cause harm to participants or to the robot itself	Continue testing, program a certain distance to a player that the robot cannot enter
Test LEDs (delay, contrast)	Nov 11th, 2024	Aurora	Could not be bright enough or obvious enough for the players to recognize elimination	Use alternate method (display) to signify who is out
Test sound loudness	Nov 11th, 2024	Nada	Sound may not be loud enough for players to hear	Bluetooth speakers can be used (may need to add to budget)
Test real-time sensor data relay for time accuracy	Nov 11th, 2024	Yunfei Qiu	If sensor data is not relayed with accuracy, players may not know when they are eliminated or who	Use LED feedback to more accurately synchronize the sensor data relay
Test internal timer for accuracy	Nov 11th, 2024	Yunfei Qiu	If the internal timer is inaccurate, we may be over or under the set limit which could throw off the game.	Start to Record time when running program and stop recording when program time is up. Compared it with what time we set.

Test both display timer and internal timer for alignment	Nov 11th, 2024	Zoe	If one timer is not aligned correctly by a substantial amount, then the game could be thrown off and the robot's reactions could either be early or delayed	Possible delays could be attributed to robot unpredictability
2nd attempt to translate code from block to python	Nov 12th, 2024	Zoe	If the first attempt is unsuccessful, this is redundant.	(this is the contingency plan)
Compile individual parts, test for any conflicts	Nov 12th, 2024	Five Alive	Some parts may interfere or not work together	Collaboratively fix code of conflicting parts (github)
Finalize instructions for the game	Nov 12th, 2024	Five Alive	Instructions might be unclear or too complex for users	Test the instructions with a small group for feedback, revise them for clarity and simplicity.
Potentially present final product & prototype	Nov 12th, 2024	Five Alive	Prototype malfunctions or doesn't perform as expected. Lack of preparation or coordination during the presentation.	Conduct multiple test runs. Schedule presentation rehearsals for team members.
Finish designing design day graphic	Nov 23rd, 2024	Five Alive	Graphic may be visually unappealing or creatively lacking	Hold design check-ins to ensure all members are satisfied
Print graphic (may take some time to process)	Nov 24th, 2024	Five Alive	Printing delays or errors. The printing service may also not live up to expectations	Have deadline for printing submission far in advance of the presentation
Design day presentation	Nov 28th, 2024	Five Alive	Technical issues during presentation	Practice in advance; set up early

4.0 Product Cost Spreadsheet

Table 2. Comprehensive project materials and costs

Item	**Quantity**	**Type (software/tangible)**	**Cost**	**Link**
DJI Edu	1	software	$0	https://edu.dji.com/hub/login?t=708
DJI Python SDK	1	software	$0	https://github.com/dji-sdk/RoboMaster-SDK
Duct tape	1	tangible	$13	duct tape
Rope/string	1	tangible	$10	rope
Figma	1	software	$0	https://www.figma.com/downloads/
Vscode	1	software	$0	https://code.visualstudio.com/download
Printing costs	10	tangible	~$3	Uoprint.uottawa.ca
Ball	2	tangible	$30	LED ball
Robomaster App	1	software	$0	https://www.dji.com/ca/robomaster-s1/downloads
Total Cost: $56				

5.0 Conclusion

Our chosen concept is a simplified version of our previous concepts and combines safe zone style game with hot potato to form an immersive experience for all players to reflect on the ethical issues of LAWS. We have divided the process of creating the game into various testing plans and tasks whether completed individually or as a team. We have projected most of the games coding to be complete by November 9th and our final project game by November 12th. Our projects budget is also well within standards so we should see no issues moving forward. Next steps for our team included creating a story board as our first prototype and beginning the work on our second.

6.0 References

RoboMaster S1 - DJI. (n.d.). DJI Official. https://www.dji.com/ca/robomaster-s1