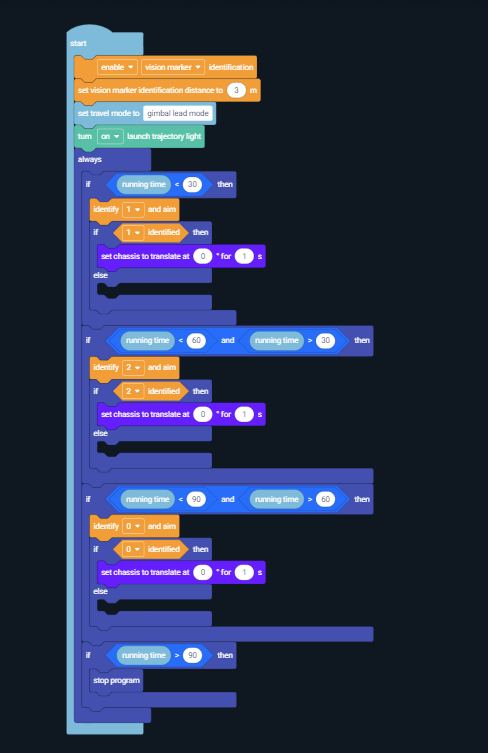
**Introduction:**

The goal for this deliverable is to develop our second prototype, and make a test plan for our third prototype. The goal for the second prototype is to ensure the robot has functioning code, as well as a meaningful story to go along with our experience. The code made in our second prototype will engage the robomaster with the participants which will allow them to understand the ethical concerns associated with AWS. This document also covers an analysis of our prototype, and reflects on feedback that we have received from potential clients, and potential participants of the game.

**Sample Code**

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The current code is an improved version of our first prototype, we incorporated a timer into the program that can be easily adjusted to make sure the game ends on time. Every 30 seconds the robomaster will swap targets for patrolling. The running time will also be used to control the music but this isn’t possible to show in the dji platform as clips must be recorded on the physical robot.

**Objectives for prototype one:**

Why:

The main reason for the second prototype is to ensure that the robot has most of its code functioning in order to bring our experience closer to the final product and to start making our game feel immersive. Unlike in the first prototype, our main goal was only to focus on the sensing part of the experience, this prototype we are focusing our attention on making our robot respond more intensely to participant actions. By making the robomaster make decisions based on people's actions, it will make our experience much more immersive as the participants will get to actually interact with the robomaster. Another thing that we are doing for this prototype is creating the story behind our game. In order to ensure that the participants in our game get the full experience to understand why automated weapons systems need to be banned, we need to have an engaging story to go along with our code. The code for this prototype will be designed to make the robomaster more aware of its surroundings, and to react in a way that will make the participants understand the ethical concerns behind AWS.

**What:**

The first thing that we are doing for this prototype is to make sure that the robomaster is able to move around in all directions. We will code the robot to move its turret to search for player cards, and also to utilize the omni wheels which allow it to rotate the whole body of the robot 360 degrees while maintaining the same XYZ position. The next thing that we will be doing for this prototype is to code the robomaster to read the tape we will have laid on the ground so that it is able to recognize the different quadrants we have. After we’ve made sure the robomaster can recognize the quadrants we will code the algorithm for eliminating players. This algorithm for the first two rounds will eliminate the players in quadrant one, once people think they have figured out the code, it will switch up the algorithm and eliminate the person in quadrant 2. This same process repeats until everyone is eliminated. Next we will code the time intervals for the eliminating periods, also adding when the music starts/stops, as well as when the lights are green, and red. Moreover, something else we will be coding will be when the robomaster is in the eliminating stage and the participants are supposed to stop moving, if it detects movement it will ignore its previous algorithm and eliminate the person that moved.

**When:**

This code and storyboard need to be done by November 10, 2024 at the absolute latest. If everything goes to plan however, the code will be completed by Wednesday November 6, 2024 as to leave sufficient time to test our prototype both, in the simulation and in the MakerLab with the actual robomaster. The storyboard is to be completed by November 8th, 2024, leaving us enough time to get feedback from potential clients and participants of the game to see if they feel as though our background story is effective enough for them to understand the ethical concerns behind the AWS.

**How:**

To do this we will all make an attempt to code the sensing on the robot, then we will meet together and discuss the things we did that were successful, and also discuss the things we were struggling with. We will then combine the best aspects of everyone's code, in order to create the best possible final code for this prototype.

**Progression of Storyboard:**

The details behind our game have been designed to give this game more of a purpose than just some game to play for fun. (Easily changeable) The scenario will be that the robot is approaching a village and in its programming it wants to eliminate this village as it sees the innocent villagers as “targets”. The players are the last soldiers and line of defense for this village and the robot will not proceed to the village if the soldiers are in its way. Therefore the robot needs to complete its mission and eliminate its targets and will try to eliminate the soldiers (players) that are trying to get in the way of that objective. The goal for the soldiers is to survive while the robotis hunting them. If they survive, the robot cannot proceed to the village, but if they are eliminated, the robot will proceed to the village and hurt innocent people.

Prototyping test plan for Prototype 2 (with results)

<https://docs.google.com/spreadsheets/d/1w66JQsP3n7EAuIhhXrmzx0aBd1nQGbUe/edit?gid=330383338#gid=330383338>

Finalized BOM:

[Final Budget Group 14 - Google Sheets](https://docs.google.com/spreadsheets/d/13gcfOTl1KLVePR-R6UaD4ufRZbPTR_-iS_s4KLsGZiM/edit?gid=0#gid=0)

**Analysis for prototype two:**

The laser system that we plan to use on the Robomaster S1 has the main goal of making the experience more scary. The laser will be paired with the camera and sensing system and as the robot is able to identify certain symbols or colors that we put in the code, it will track these symbols. This is where the red dot laser will be on and have the laser following with the camera tracking system and pointing at the symbol or color which will be on a player. This creates the illusion that the robot is tracking them with a red laser. We will assume that the laser will be able to be seen in the lighting of design day, and that the players will understand that when the laser is on them, they are being targeted by the robot. This system is more tricky for us to proceed with now though as we realized going through the testing that this laser is not available to test on DJI software so we will need to make use of the maker space and physically test it with the real robomaster.

Another major system to analyze is how we will tell players when to move and stop throughout our game. We will either use sounds/music and the players can move around and choose their corner while the robomaster is playing music and then have to stop when the music stops. Or we will use lights in the same way where green will be for moving and red will tell them to stop moving. Either way, this will control the flow and pace of our game and allow us to have the players move in a way that we can make most effective. We have made progress with this system after testing and talking to the clients and professor where we now know that colors work better with the robots scanning and so when the players are moving or stopped, we will give them colors cards to be identified.

**Feedback:**

After doing tests with our prototype 2 in the engineering design lab, we got feedback regarding our code and how the robot ran with our code. We found that the robot was very specific about things that it does well and other actions it does not do well. We got feedback that when using the camera, the robot senses but with colors rather than using symbols and numbers. We also found that the laser concept we have is very risky because the TA’s confirmed that there is no laser in the simulation testing.

We also made a survey to gather information of the different emotions that people might have when playing our game. We had random people answer these questions. We tested what different people would feel like in each of the different scenarios that the participants might be put into during the experience. For example, in the survey one of the questions was about the emotions you would be feeling if a robot had a red dot laser pointed on you. We discovered that most people would feel scared, or vulnerable. Continuing on this, we did a demonstration of the code for our second prototype with the physical robomaster, and discovered that people felt vulnerable as the robomaster was tracking them, and had the light on them. Another thing that we found was successful with our code, was when the robomaster identified the player card it quickly accelerated in the participants direction which caused the participants to feel scared, and unaware of why it was doing that, which demonstrates the ethical concerns with the AWS.

**Prototype 3 and Testing plan:**

[**Prototype 3 and Test Plan .xlsx - Google Sheets**](https://docs.google.com/spreadsheets/d/1BiWrpSVqpuMqzc6pdZezFb7rHEIagy-P/edit?gid=564856675#gid=564856675)

**Conclusion:**

Prototype 2 has significantly advanced both the functionality of the Robomaster and the overall immersive experience of the game. Through iterative development and testing, we've successfully made progress for integrated movement, target identification, and a dynamic elimination algorithm. Additionally, the introduction of the storyline has enhanced the participants' understanding of the ethical implications of Autonomous Weapon Systems. Feedback from clients and participants has been instrumental in refining our design, and while challenges remain—such as limitations in the laser system and camera sensing—we are well-positioned to move forward with Prototype 3, incorporating these lessons for further improvements.