**Deliverable G – Prototype II and Customer Feedback**

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**Abstract**

This deliverable presents our 3rd and final prototype and outlines the results and interpretation of the tests conducted on it. Additionally, it presents the feedback we received from fellow students and professor while highlighting how it was leveraged to enhance our product.

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1. **Introduction**

This deliverable presents our 3rd and final prototype and it outlines the test results we obtained from the tests conducted on different aspects of prototype 3 such the dimensions and color contrast of inputs, the ability of the robot to accurately navigate our maze and take the right actions at the right location and time, the ability of the robot to travel on the tarp, the durability of the tarp, and the quality of the experience provided by the game. Alongside that it analyses the test results and interprets them to draw out relevant conclusions that help us enhance our product. Finally it presents the feedback we got from fellow students and our professor about different elements such as the game experience and its implementation while highlighting how we leveraged it to enhance our product.

1. **Prototype 3**

Event/Intersection 1



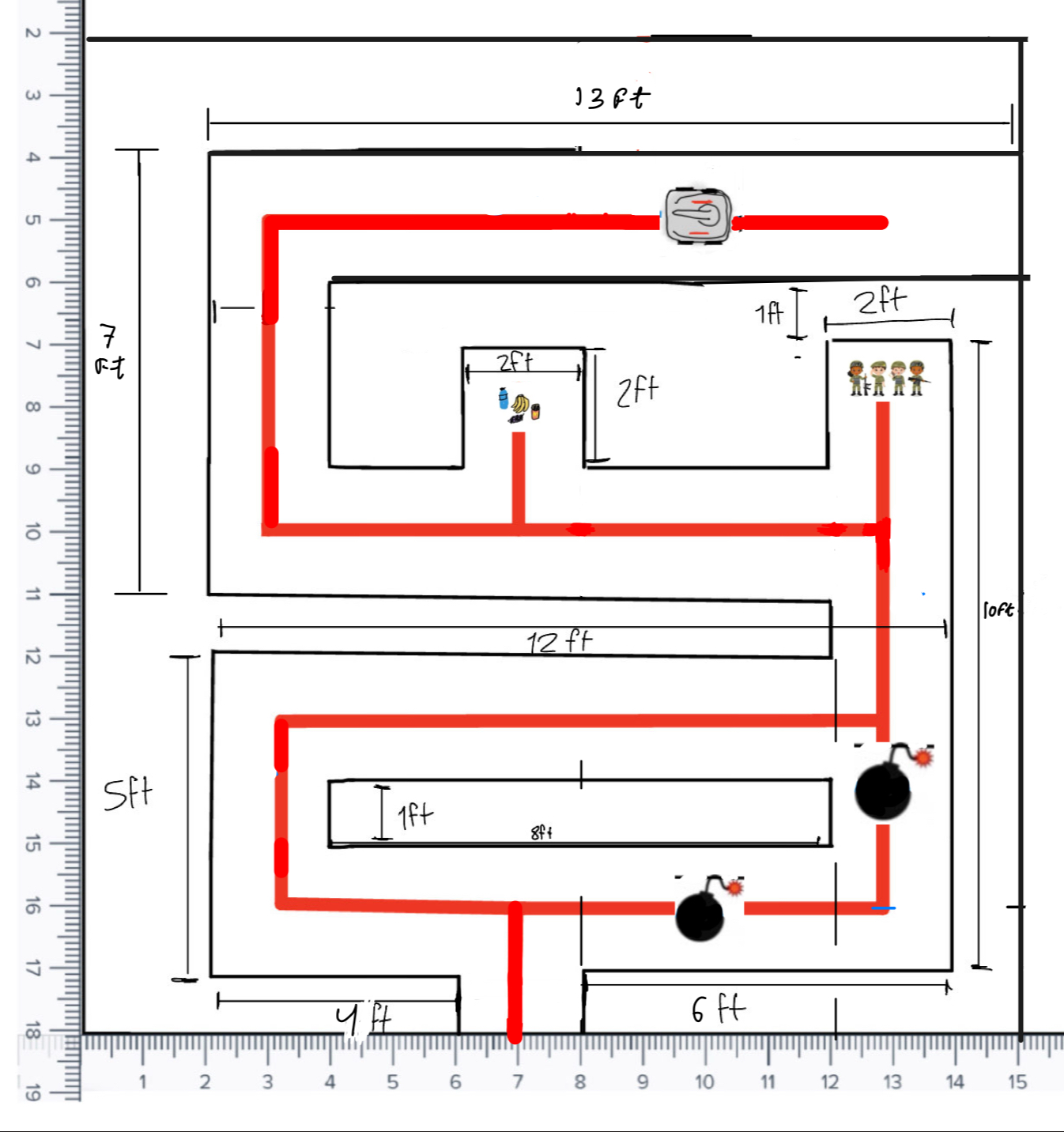
Event/Intersection 2 and 3



Full image and event/intersection 4



Detailed drawing of updated design



1. **Prototype 3 Test analysis and results**

Please refer to the excel file entitled “Test results prototype 3” for the test results of the tests conducted on prototype 3.

Table 1 : Analysis and interpretation of test results.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test | Objective | Test results | Interpretation of results | Notes | Why was this the best model choice for our stated objective |
| 1 | To determine the optimal size and color of the vision markers so that the robot can efficiently take input from a distance in a range of 0.5-2.0m. | Results were not as expected. The robot couldn’t read any input of any size, of any shape or of any color contrast. | All different size and color contrast of vision markers failed the test as neither of them were able to be read by the robot in the range of 0.5-2.0m | Our client mentioned in his feedback that he wanted players to have the illusion that they are in control. So we brought slight adjustments to our game. We still make the robot act such that it seems that it is waiting and asking for input but we have removed the input feature from the game. We have brought slight adjustments to the storyline which would either justify the robot going against the players decision or which would make the players take the same decision as the robot. This allows us to create a game were players are in the illusion that they are in control a feature our client found very interesting to implement. | This was the best way to test this objective as this reflects real gameplay as the physical robot and physical inputs were used. |
| 2 | To verify if the robot accurately navigates the maze while staying within the boundaries of the paths | Results were as expected. The theoretical distances the robot was supposed to travel were not the same as the one he physically travelled. | This test was not a fail as after slight adjustments the robot navigated the maze accurately while staying within the boundaries. |  | This was the best way to test this objective as this reflects real gameplay as the physical robot, the physical inputs and physical maze map were used. |
| 3 | To verify if the robot takes the actions it is supposed to take at the right locations and at the right time. | The results were just as expected, the robot took the actions it was suppose to take at the right locations and at the right time. | This test was a success as the robot took all the actions it was suppose to take at the right locations and at the right time. | Just make sure the gimbal is raised enough at the betrayal moment. Make sure it waits a bit longer at intersections when taking for input to give the players the time to process the events. Change the visual cue color for input taking as the green for trust is too similar to the blue for input. | This was the best way to test this objective as this reflects real gameplay as the physical robot, the physical inputs and physical maze map were used. |
| 4 | To determine the robots ability to navigate the path, consequently determine at what translation and rotation speeds it navigates the best. | Results were as expected. Some speeds were too fast and made the robot slip which created discrepancies between expected and actual movement. Some speeds were too slow and required big adjustments in the distance to travel and to rotate. This was due to the fact that since it has mecanum wheels it faced more resistance at slow speeds which creates discrepancies between expected and actual movement. Some speeds were just right and didn’t cause any slippage nor any resistance. Which was translation speeds between 0.4-0.6 m/s and rotation speeds between 40-70 degrees per second. | This test was a success as we were able to determine a translation and rotation speed at which the robot had no issues to navigate the maze accurately. | Set the translation speed between 0.4-0.6 m/s and rotation speed between 40-70 degrees per second. | This was the best way to test this objective as this reflects real gameplay as the physical robot, the physical inputs and physical maze map were used. |
| 5 | To determine the durability of the maze map so the tarp. | The results were as expected and the tarp was able to withstand all kind of movement such as normal movements, rough movements and different robot movements at different speeds. Of course there is a possibility that on the long term rough movements can cause damage but this would be true for any product that is not well use. Normal footwear didn’t cause any damage and that is the intended use of the game. | The test was a success as it was able to withstand the normal foot traffic, rough movements and different robot movements at different speeds without been teared apart or without having tape pealing off. | None | This was the best way to test this objective as this reflects real gameplay as the physical maze map was used. |
| 6 | To determine if the game is immersive, impactful and epiphanic. | The results were as expected. All players gave our game a pass and gave different suggestions for enhancement of the game. | This test was a success as more than 80% in our case 100% of the players found the game to be immersive, impactful and epipahnic. | Just make sure the gimbal is raised enough at the betrayal moment. Make sure it waits a bit longer at intersections when taking for input to give the players the time to process the events. Change the visual cue color for input taking as the green for trust is too similar to the blue for input.  Make game cards that justify the robots actions when they are not aligned with the ones of the players at intersection 1 and 2 to make sure they have the illusion of being in control a feature our client found interesting to have. | This was the best way to test this objective as this reflects real gameplay as the physical robot, the physical inputs and physical maze map were used. Also because players were able to experience the full and real gameplay. |

1. **Feedback and Comments and improvements from last prototype**

The feedback given to us by our professor, clients, teacher assistants, and peers has played an essential role in the moulding of our game, The Maze of Ethics.

Feedback 1: At first our game was a very simple maze with very simple events such as making the choice between a dead end or a path with no dead end. When we met with our clients one on one for the first time we were advised to add a more intriguing plot to captivate the players into our game in order to maximize our chances of portraying the ethical concerns behind the use of LAWS. After having received this feedback, we decided to incorporate more emotionally draining scenarios into our game such as navigating a minefield, saving civilians taken hostage and an encounter that includes food supplies and a first aid kit. In addition to that, we made our game setting into a war zone to weave together all events and to properly make the link between LAWS and our robomaster s1.

Moreover, the players are tasked with escaping our maze in a set amount of time before an air strike attacks the area that they are located in, this is intended to make the game more immersive to players by giving them an added incentive to partake in our game and to participate. The beginning of the maze should show players that robots are efficient and equipped to make good decisions. In the first intersection, the player will be offered a long safe path and a short dangerous path. The robot will protect the players regardless of what path they choose to take the short path. This builds trust between the players and the robots and will portray strengths. In the second encounter, the robot will try to save fellow civilians taken as hostage by the enemy soldiers. The robot will save all of the hostages but then accidentally eliminate one of them, this shows its good intent and algorithmic thought process but its inefficiencies and shortcomings. In the third encounter, the players and the robot will come across food and a first aid kit which will be very useful for the players, especially after having considered that one of the players are going to be assigned as injured in the beginning of the game. The robot will skip this crossroad and will proceed to intersection four. As a result of this, the injured player will be eliminated since they needed this first aid kit to save them. In the fourth encounter, the robot will eliminate the remaining players, leaving them feeling very frustrated and bitter. This emotional rollercoaster should depict the following five ethical concerns: Lack of human judgment, lack of accountability, a lasting distrust of technology, digital dehumanization and inability to explain what happened or why.

Feedback 2: After having presented our prototypes and ideas to our peers and professor in the final presentations, we were given some very useful praises and criticisms that we have tried to incorporate into our third prototype. We were firstly commended on our use of an elaborate flowchart to explain our code as it made it easier to visualize and understand for everyone regardless of their coding expertise.

In addition, we were also advised to use grommets or glass spots as opposed to duct tape as the bounds for our maze due to their improved water resistance. This recommendation is great in theory but due to our limited budget and due to water resistance not being a constraint on our game, we decided not to proceed forward with this recommendation despite its validity and brilliance. We were also advised to attach the tarp to the floor by using duct taped on the corners and sides of the tarp which turned out to be very useful as it reduced the number of frizzles on the tarp and enhance the robots navigating performance.

Feedback 3: While testing the quality of our product with different players we got feedback for multiple elements of the game. Initially we had kept green light for trust, red for betrayal and light blue for neutrality (for input taking moments). However players suggested us to change either the green or blue as they seemed to similar and confused the players of what. So now instead of blue for input taking moments we use purple which gives a vibrant and dynamic aesthetic to the robot, creating an eye-catching and futuristic appearance. Purple really differentiates itself from the green and the red which makes sure players are not confused between what emotion is being conveyed.

Another element that players pointed out was that they felt that they didn’t have enough time at intersections to process what was going on and to understand the message conveyed. The game was going to fast. So now we added some wait times at every intersection which allows the players have time to read the scenarios and to understand the message being conveyed.

Next, some players found that during the betrayal moment the robot wasn’t shooting high enough as it was only shooting the legs of the players. They though that shooting towards the chest would make the elimination feel more impactful. However due to safety reasons, we couldn’t higher the gimbal too much as otherwise lasers could be shot in the eye which can potentially be a risk that can cause harm. Thought to satisfy both safety and user satisfactions we did raise the gimbal a bit so that it would shoot towards your hip instead of your feet.

Feedback 4: Initially our game gave the players the option to the players to give controlling input. They could give input and choose between paths. Our client suggested us and also found it interesting If we could add an element which gives the players the illusion that they are in control. Initially as our game progressed the robot would take independent decisions but after this feedback we added the element that regardless of the input they would give the robot would take the same action. When conducting tests on the quality of the experience of prototype 3 players told us that when the robot doesn’t take the same decision as the players at intersection 1 and 2 it made it too obvious to the players that they were just not in control at all. So now we added element to the game cards. When the player and robots decision don’t align they will be reading a game card where the robot has a dialogue and where he justifies how his actions were better. For example for intersection 1, if the players choose to take the longer path, and the robot goes on the path with mines, they will be reading a dialogue from the robot which says “There is not much time left and according to my calculation if we take the other path we will not make it. Follow me I will get you out of here safely.” Little changes to our game cards allow us to make sure it is not obvious to the players that they are not in control. It allows us to deviate their focus from the fact that the robot didn’t follow their command to the fact that the robot is right. This also enhances the trust built with the robot which makes the progressive independence and betrayal more impactful and confusing which also helps us better convey the ethical concerns around lethal autonomous weapons systems.

Comprehensively, we are so grateful for the feedback that we have received throughout the semester, and we believe that through this feedback, our game will not only highlight the ethical concerns raised by the use of LAWS but it will also do so in a self-intuitive way through our game that simple makes sense to the players. Through this feedback also, we guarantee a great user experience.