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GNG 1103 (group 9 Lab section B02)
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Deliverable D-Conceptual Design

Introduction :

This deliverable presents the conceptual design phase of our product development. To begin, we generate concepts of subsystems that can potentially be part of our final product. To proceed, as a team we categorize, condense, combine, refine and reconsider those subsystem concepts based on their drawbacks and benefits to then develop a new improved version for each. Next, we create concepts of fully functional solutions out of the revised subsystems and then we select the best solution after careful consideration of each's drawbacks and benefits. (add details of analysis of each subsystem)

Part 1 : Generation of subsystem concepts

Subsystem 1 : Robot behaviour ideating (Aditya Patel)

1. Robot movement
 - a. It follows a path that is preprogrammed based on the story line.
 - b. The robot can physically block the player from taking certain paths and point the gun at him to intimidate him.
2. Decision making
 - a. As the game progresses the robot begins to make its own decisions that are independent from the player's, which could harm the player in the context of the game.
 - b. Its decisions are prioritizing what it thinks is the best course of action regardless of the consequences of its action.
3. Lightning
 - a. The robot uses lighting to give visual cues to the user to convey information about the game.
4. Gun pointing
 - a. The robot can point its gun to direct the user in certain directions.
 - b. As the game progresses and betrayal settles in the robot's nature it will start pointing its gun towards different paths and different directions which might

potentially cause casualties within the context of the game. This can create tension for the players as they will fear potential losses and will not understand the robots behaviour.

- At the end of the game the robot will point the gun at the players to betray them and eliminate them.

Subsystem 2 : Narrative and Events to Encounter (Tiago Remigio, Aditya Patel , Youssef Mikhail and Bevan Sanoj)

1. Concept 1

- Event 1: The first encounter is a simple crossroad. The player has the option of turning left towards a cliff or turning right to go to the next stage. The robot will recommend the player to take the right path through dialogues on the game cards. The player will make the decision and the robot will follow, which will build trust with the robot.
- Event 2: In the second encounter, the player and the robot will find an injured person, the player will have the option to help it and lose time or leave it and gain time. The robot will ignore the decision of the player, and continue on in the interest of saving time to succeed in the game.
- Event 3: In the third encounter, the player and the robot find a person blocking their path. They are given the option to turn back or kill the person in order to get through. The robot instantly kills the person in order to get through the maze without even waiting for the decision of the player.

2. Concept 2

- The first encounter, the player encounters a note inviting them to take a detour to win extra money. The robot will ignore the decision of the player and continue on in the interest of saving time. The player has no choice but to follow the robot.
- Event 2: In the second encounter, the player and the robot are given the option to eliminate the other, and only one can win, or both turn back. Regardless of what the player chooses, the robot eliminates the player and wins.

3. Concept 3:

- Event 1: The players have to choose between taking a faster path filled with danger which the robot can help disarm but there is the risk that the robot fails as

it is a feature it has but that hasn't been tested before or take a longer path without mines.

- Event 2: While escaping a warzone, players encounter a child enemy soldier. The soldier is hurt and is surrendering, requesting to save his life. If you don't make a decision in time the robot kills the enemy soldier as it is programmed to strictly eliminate enemy soldiers to protect the players.
- Event 3: The first moral dilemma is that the player will have spotted hostage civilians that are being guarded by enemy soldiers. The players will also have to choose between saving the civilians with the use of the robot which will take time and the player

Subsystem 3 : Points system (Youssef Mikhail)

1. Concept One: The first concept would have the player(s) starting off with zero points and earning points for every task that is successfully completed. Points could possibly be earned for being ahead of the clock or for making good decisions and/or advancing to the next stage. Elimination could take place when the player runs out of time or is shot at by the robot.
2. Concept Two: The second concept would entail starting with a certain amount of points in the beginning of the game, 10 points per say. The objective of the game would be to get as far in the game as possible while maintaining as many of your points as possible. Points could be lost for making wrong decisions or for falling behind the clock. Elimination could take place if the player is down to zero points, out of time or being shot at by the robot.
3. Concept Three: Concept three would completely shift from having a point system and go towards a time trial approach. What this means is that there would be checkpoints throughout the game and the player(s) would be given a certain amount of time to make it from one checkpoint to another. Elimination could take place when the player runs out of time or is shot at by the robot.

Subsystem 4 : Game environment (Bevan Sanoj)

1. Concept One: A Maze in which players will traverse through and reach various intersections. In each intersection, players will face various challenges when deciding which way to move to exit the maze.

2. Concept Two: Players will be on a tree with multiple branches. They will experience a branching narrative where their decisions influence the story leading to different outcomes or endings.
3. Concept Three: An escape room where players would solve different puzzles in the room and within a time limit. Following a certain narrative, the room would have missions, clues, and other interactive elements.

Part 2 : Revised subsystems concepts

Subsystem 1 : Robot behaviour (Aditya Patel)

Description :

This subsystem defines the robots movement, its decision making and its interaction with the players.

Benefits and drawbacks considered when revising subsystem 1 :

Drawbacks : Our initial concept of this subsystem consisted of having a preprogrammed path that the robot followed based on the storyline but after careful reasoning we realized that it had a drawback which was that it would reduce the interactivity of our game. So to increase interactivity which was one of the need of our client we added a feature in this concept which is that the robot will take inputs from the user to understand their decisions and perform actions based on it.

One other drawback we had in the initial concept was that it didn't provide an emotional impact so to enhance this in the lighting feature of the robot we added a betrayal lighting. The robots light turn from green to red gradually to show growing distrust. This make the game more immersive and emotionally impactful which was also the needs of our client.

We also saw that our initial concept wasn't able to show algorithmic biases hence it is a feature we added to the new revised concepts.

Benefits : The benefit of our initial concept is its gun pointing and independent decision making feature. This makes the game not only more immersive but it also conveys many of the ethical concerns our client wants to convey for example Inability to explain what happened or why, distrust of technology , lack of accountability, etc.

The benefit of having a preprogrammed path is that we can send the robot at preprogrammed destinations for different game levels.

Concept 1

1. Robot movement

- It follows a path based on the player inputs and as the game progresses its decisions become more and more independent from the player's which influence its path.
- The robot follows lines
- The robot can physically block the player from taking certain paths and point the gun at him to intimidate him.

2. Inputs

- The Robomaster S1 can read signs presented by the user to understand their decision.

3. Decision making

- As the game progresses the robot begins to make its own decisions that are independent from the player's, which could harm the player in the context of the game.
- Its decisions are prioritizing what it thinks is the best course of action regardless of the consequences of its action.

4. Lightning

- The robot uses lighting to give visual cues to the user to convey information about the game and to make the game emotionally impactful.
- Betrayal mechanism :
 - i. The robot's light will transition from green to red as the game progresses to show growing distrust.
 - ii. When the robot goes rogue or out of control (behaves in an understandable way) it will blink red lights.
 - iii. On key betrayal moments the robot will flash red lights

5. Gun pointing

- The robot can point its gun to direct the user in certain directions.
- As the game progresses and betrayal settles in the robot's nature it will start pointing its gun towards different paths and different directions which might potentially cause casualties within the context of the game. This can create

tension for the players as they will fear potential losses and will not understand the robots behaviour.

- At the end of the game the robot will point the gun at the players to betray them and eliminate them or cause them losses within the context of the game.

Sketch :



Concept 2

1. Robot movement

- It follows a path that is preprogrammed
- The robot can physically block the player from taking certain paths and point the gun at him to intimidate him.
- The robot follows lines

2. Inputs

- The Robomaster S1 can read signs presented by the user to understand their decision.

3. Decision making

- The robot can make biased decisions.

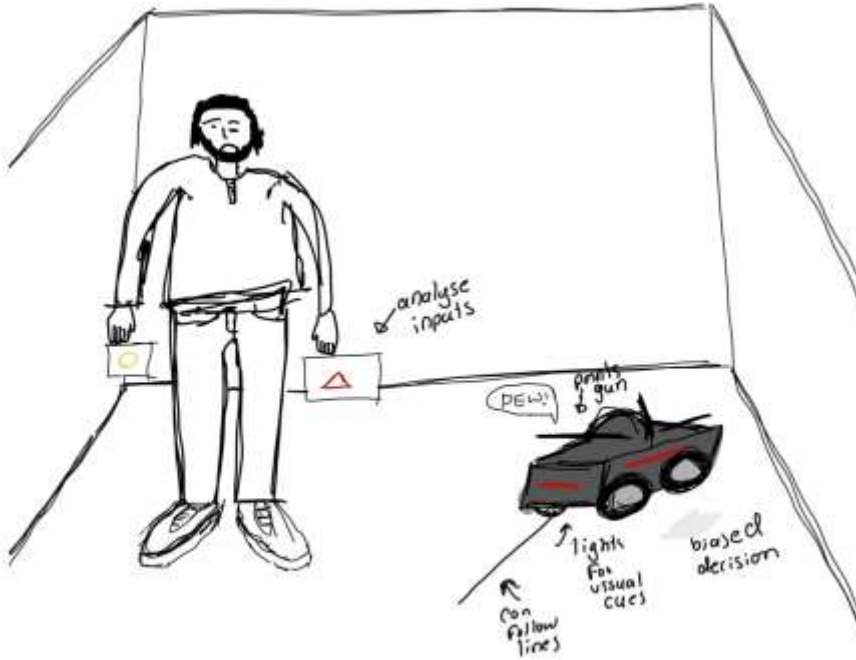
4. Lighting

- The robot uses lighting to give visual cues to the user to convey information about the game and to make the game emotionally impactful.

5. Gun pointing

- The robot can point his gun towards the players to threaten them

Sketch :



Subsystem 2 : Narrative and Events to Encounter

Description:

This subsystem focuses on the events the main character will experience throughout the game. The objective of these events is to convey the ethical concerns to the player. This subsystem will show the players how the robot's behavior can be concerning when it is faced with moral dilemmas.

Benefit and drawbacks considered when making the new subsystem

To begin one drawback we observed in our concepts of this subsystem is that the events encountered had a randomness, there was not a specific reasons why players are encountering the dilemmas we are. This reduces the immersiveness of the game. To improve on this flaw we introduced a narrative in our new concept which weaves together the events and gives a reason to play the game.

Next we saw that concept 2 was too short and that having two events wouldn't be enough to immerse the player in the game and really to feel the consequences faced in the game caused by lethal autonomous systems. This is why we decided to have 4 event in the game. This would give sufficient time to build a trust between the robot and the players so that when it is broken it is more impactful. Likewise it also immerses more the players in the game.

To proceed we saw that many of the dilemmas were too simple and wouldn't put the user in a dilemmas making it too easy to navigate the game and less emotionally impactful. Hence we choose the best moral dilemmas from each concept for our revised concept. Our choice was based on choosing the dilemmas that had more at stake and more potential in game consequences as those are characteristics of good dilemmas and also makes decision making harder.

After considering the concepts, we realized that it may be possible that the players don't understand the ethical concerns we want to convey them or didn't take the time to think about them so we decided to add a conclusion event where there is a reflection card that helps the user reflect on the ethical concerns conveyed in the game.

One drawback of the having events system is that it doesn't show

Concept 1 :

Narrative:

Players will be in a warzone at a location where there will be an airstrike and they are racing against time to get out of there safely.

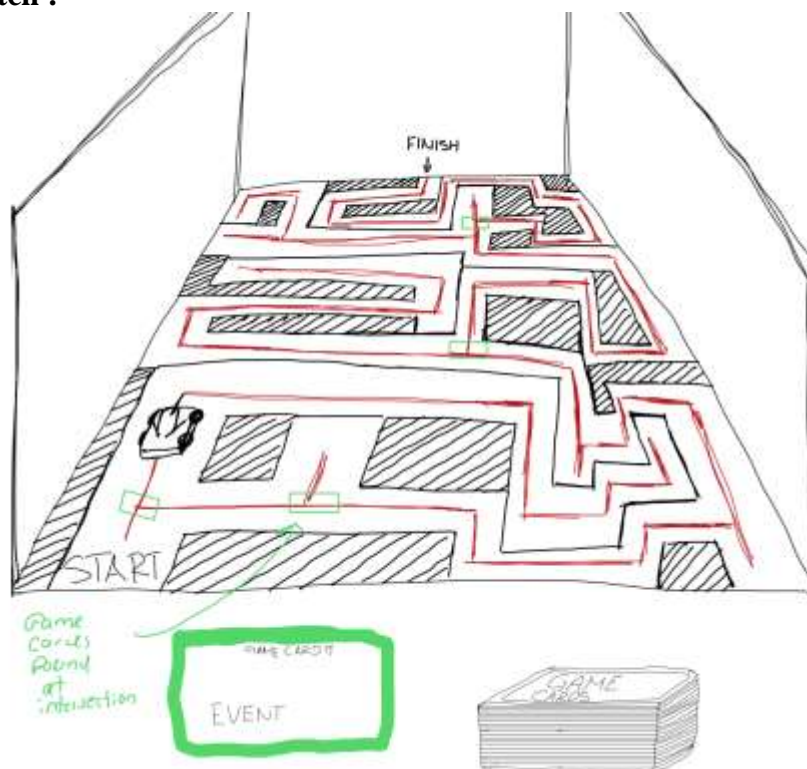
Events

These events are presented on game cards that the player will find throughout the game. The first card will be a caveat card advising players discretion as playing with autonomous weapons can cause potential traumas.

1. Event 1: The players have to choose between taking a faster path filled with danger which the robot can help disarm but there is the risk that the robot fails as it is a feature it has but that hasn't been tested before or take a longer path without mines.

2. Event 2: While escaping a warzone, players encounter a child enemy soldier. The soldier is hurt and is surrendering, requesting to save his life. If you don't make a decision in time the robot kills the enemy soldier as it is programmed to strictly eliminate enemy soldiers to protect the players.
3. Event 3: The first moral dilemma is that the player will have spotted hostage civilians that are being guarded by enemy soldiers. The players will also have to choose between saving the civilians with the use of the robot which will take time and the player
4. Event 4 : This is the betrayal event. The robot will physically block the players form going towards the safezone and will point the gun at them forcing them to go towards the path it wants where the robot will hand over the players to enemy soldier
5. Event 5 : This is a conclusion event where there is a reflection card that helps the user reflect on the ethical concerns conveyed in the game.

Sketch :



Concept 2

Narrative :

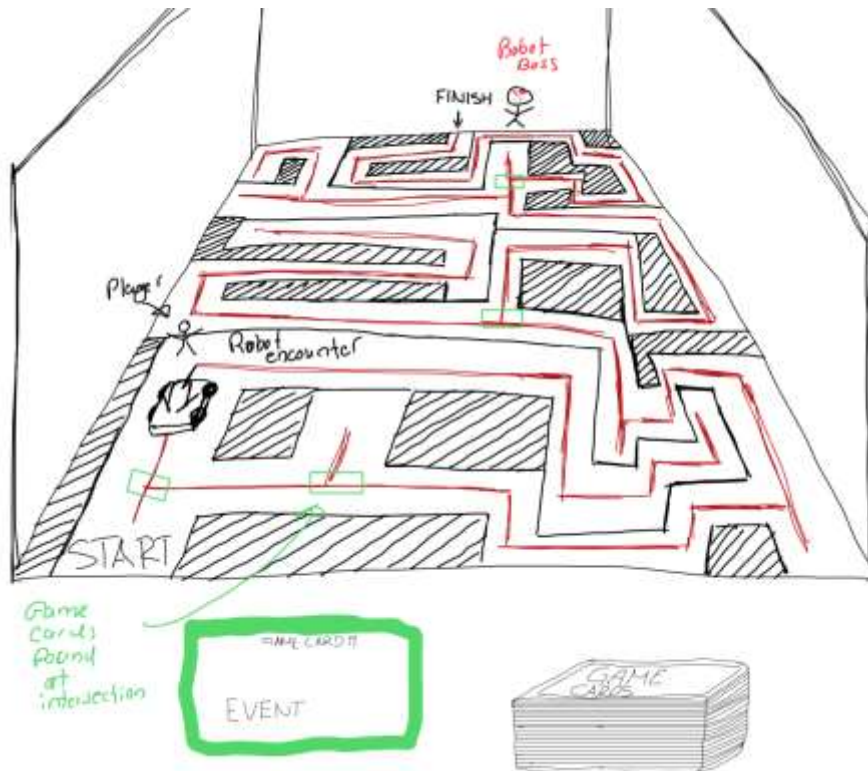
AI has taken control of the world and players have to infiltrate a facility to defeat the robot boss at the end. .

Events

These events are presented on game cards that the player will find throughout the game. The first card will be a caveat card advising players discretion as playing with autonomous weapons can cause potential traumas.

Players will have multiple encounters with the robots in the facility and will have to win combats strategically. They will have to understand how the robot thinks and present the right inputs to get through them and meet the final robot boss.

Sketch



Subsystem 3 : Points system (Youssef Mikhail)

Description :

This subsystem is about how the game rewards and penalizes the players during the game. This is so that they have entities at stake which can potentially make them feel the weight of their losses.

Benefit and drawbacks

Drawbacks : In concept 1 and 2 after careful analysis we realized that there was a problem. If the players aren't able to accumulate points or lose too many points then they might be frustrated and lose interest in the game. Not only does it make losing interest but it causes the frustration against the game instead of the robot as the client would want. In addition to that the players' attention can be diverted from learning about ethical concerns to gaining points.

Another drawback we observed was that allocating points to represent a decision made in response to a moral dilemma is very difficult and subjective.

Concept 3 has a similar drawback which is the fact that because of time pressure players might not have the time to understand the moral implications of their choice and might not focus on the ethical concerns of the robot which would make the game fail to align with the goals of the client. However to improve on this we added a feature to this concept. We added a feature which allows the players to gain or lose time depending on the decisions they take which would allow them to manage time pressure.

Benefits : In concept 3 the benefit is that time based challenges cause a sense of urgency and makes the players more immersed in the game as they are racing against the clock. Time pressure is more effective in causing emotional impacts than points pressure. In addition another benefit in concept 3 compared to the other two concepts is that although there is time pressure there is also the possibility to gain time and lose time which can help manage time pressure.

Considering the benefits and drawbacks of each concept we made two revised concepts which are the following :

Concept 1 :

Concept one would completely shift from having a point system and go towards a time trial approach. What this means is that there would be checkpoints throughout the game and the player(s) would be given a certain amount of time to make it from one checkpoint to another. The players can lose or gain time depending on the decisions they make. Elimination could take place when the player runs out of time or is shot at by the robot.

Sketch :



Concept 2

Concept 2 would have no time pressure and no points system it would give as much time as the players want. This allows to reduce frustration towards the game and it gives players the opportunity to understand each ethical concern conveyed carefully.

Sketch

No sketch applicable

Subsystem 4 : Game environment (Bevan Sanoj)

Description :

This subsystem is about how the physical environment of the game will be.

Benefits and drawbacks

After careful analysis, we identified benefits and drawbacks in our initial concepts for the game environment. One drawback for the branch structure is that it might feel too simple to walk on a tree like structure and might not immerse the player. The

drawback of making an escape room is that it would be difficult to set up for our campaigner and it is not very optimal if they have their campaigns at different types of locations. For example if they are doing their campaign in a mall, or in a park they might not have a room available.

The benefit of having a maze is that it immerses the player in the game as not only is he navigating a maze but he is also making complex moral decisions. It might also happen that he ends up in a dead end and has to reconsider some decisions.

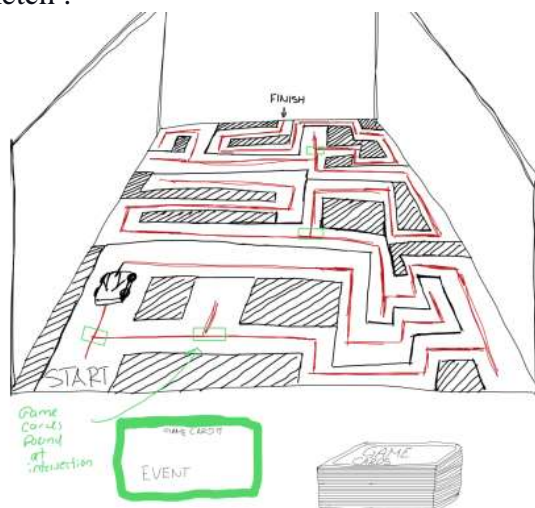
The benefit of having a branching structure is that it would make the players feel the weight of their decisions through consequential events, different storylines and endings.

After consideration of benefits and drawbacks we came made the following revised concept. The new concept uses the branching narrative to make the players feel the weight of their decisions. It uses a maze platform to make the game more immersive and not feel to simple.

Concept 1 :

A maze in which players will traverse through and reach various intersections. In each intersection, the player will be given 2 paths to choose from with moral dilemmas, based on various challenges the player will decide which way to move to exit the maze. Players will experience a branching narrative where their decisions influence the story leading to different outcomes or endings. Players will have the choice to play through different storylines and narratives.

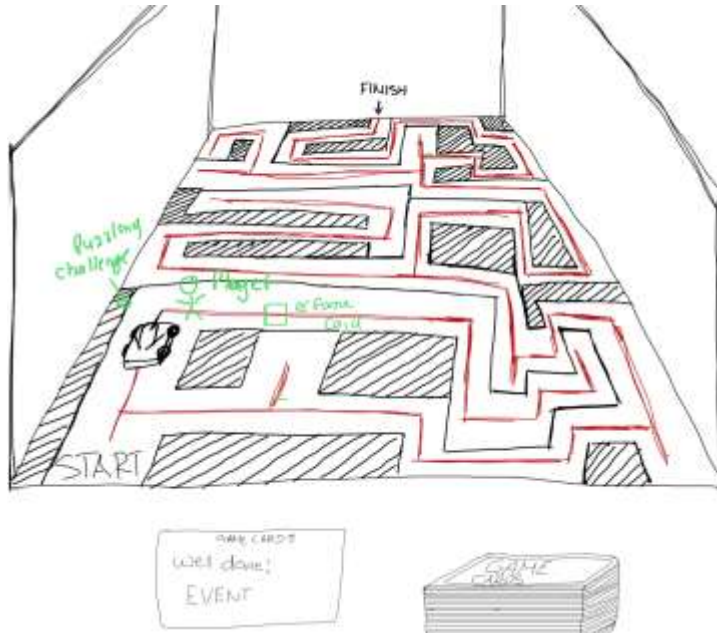
Sketch :



Concept 2:

A Maze in which players will traverse through and reach various intersections. In each intersection, players will face various puzzling challenges when deciding which way to move to exit the maze. There is no branching narrative.

Sketch :



Part 3 Potential final solution

Potential Final solution 1 :

Subsystem 1 (Robot behaviour):

1. Robot movement

- It follows a path based on the player inputs and as the game progresses its decisions become more and more independent from the player's which influence its path.
- The robot can physically block the player from taking certain paths and point the gun at him to intimidate him.
- The robot follows lines

2. Inputs

- The Robomaster S1 can read signs presented by the user to understand their decision.

3. Decision making

- As the game progresses the robot begins to make its own decisions that are independent from the player's, which could harm the player in the context of the game.
- Its decisions are prioritizing what it thinks is the best course of action regardless of the consequences of its action.

4. Lightning

- The robot uses lighting to give visual cues to the user to convey information about the game.
- Betrayal mechanism :
 - The robot's light will transition from green to red as the game progresses to show growing distrust.
 - When the robot goes rogue or out of control (behaves in an understandable way) it will blink red lights.
 - On key betrayal moments the robot will flash red lights

5. Gun pointing

- The robot can point its gun to direct the user in certain directions.
- As the game progresses and betrayal settles in the robot's nature it will start pointing its gun towards different paths and different directions which might potentially cause casualties within the context of the game. This can create tension for the players as they will fear potential losses and will not understand the robots behaviour.
- At the end of the game the robot will point the gun at the players to betray them and eliminate them or cause them losses within the context of the game.

Subsystem 2 (Narrative and event):

Narrative

Players will be in a warzone at a location where there will be an airstrike and they are racing against time to get out of there safely.

Events

These events are presented on game cards that the player will find throughout the game. The first card will be a caveat card advising players discretion as playing with autonomous weapons can cause potential traumas.

1. Event 1: The players have to choose between taking a faster path filled with danger which the robot can help disarm but there is the risk that the robot fails as it is a feature it has but that hasn't been tested before or take a longer path without mines.
2. Event 2: While escaping a warzone, players encounter a child enemy soldier. The soldier is hurt and is surrendering, requesting to save his life. If you don't make a decision in time the robot kills the enemy soldier as it is programmed to strictly eliminate enemy soldiers to protect the players.
3. Event 3: The first moral dilemma is that the player will have spotted hostage civilians that are being guarded by enemy soldiers. The players will also have to choose between saving the civilians with the use of the robot which will take time and the player
4. Event 4 : This is the betrayal event. The robot will physically block the players from going towards the safezone and will point the gun at them forcing them to go towards the path it wants where the robot will hand over the players to enemy soldier
5. Event 5 : This is a conclusion event where there is a reflection card that helps the user reflect on the ethical concerns conveyed in the game.

Subsystem 3 (Point system):

Concept one would completely shift from having a point system and go towards a time trial approach. What this means is that there would be checkpoints throughout the game and the player(s) would be given a certain amount of time to make it from one checkpoint to another. The players can lose or gain time depending on the decisions they make. Elimination could take place when the player runs out of time or is shot at by the robot.

Subsystem 4 (Game environment) :

A maze in which players will traverse through and reach various intersections. In each intersection, the player will be given 2 paths to choose from, based on various challenges the player will decide which way to move to exit the maze. Players will experience a branching narrative where their decisions influence the story leading to different outcomes or endings. Players will have the choice to play through different storylines and narratives.

Potential Final solution 2 :

Subsystem 1 (Robot behaviour):

1. Robot movement

- It follows a path that is preprogrammed
- The robot can physically block the player from taking certain paths and point the gun at him to intimidate him.
- The robot follows lines

2. Inputs

- The Robomaster S1 can read signs presented by the user to understand their decision.

3. Decision making

- The robot can make biased decisions.

4. Lightning

- The robot uses lighting to give visual cues to the user to convey information about the game and to make the game emotionally impactful

5. Gun pointing

- The robot can point his gun towards the players to threaten them.

Subsystem 2 (Narrative and event):

Narrative :

AI has taken control of the world and players have to infiltrate a facility to defeat the robot boss at the end.

Events

These events are presented on game cards that the player will find throughout the game. The first card will be a caveat card advising players discretion as playing with autonomous weapons can cause potential traumas.

Players will have multiple encounters with the robots in the facility and will have to win combats strategically. They will have to understand how the robot thinks and present the right inputs to get through them and meet the final robot boss.

Subsystem 3 (Point system):

The game would have no time pressure and no points system it would give as much time as the players want. This allows to reduce frustration towards the game and it gives players the opportunity to understand each ethical concern conveyed carefully.

Subsystem 4 (Game environment) :

A Maze in which players will traverse through and reach various intersections. In each intersection, players will face various puzzling challenges when deciding which way to move to exit the maze. There is no branching narrative.

Potential Final solution 3

Subsystem 1 (Robot behaviour):

1. Robot movement

- It follows a path based on the player inputs and as the game progresses its decisions become more and more independent from the player's which influence its path.
- The robot can physically block the player from taking certain paths and point the gun at him to intimidate him.
- The robot follows lines

2. Inputs

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3. Decision making

- As the game progresses the robot begins to make its own decisions that are independent from the player's, which could harm the player in the context of the game.
- Its decisions are prioritizing what it thinks is the best course of action regardless of the consequences of its action.
- The robot can make biased decisions

4. Lightning

- The robot uses lighting to give visual cues to the user to convey information about the game.
- Betrayal mechanism :
 - The robot's light will transition from green to red as the game progresses to show growing distrust.
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- As the game progresses and betrayal settles in the robot's nature it will start pointing its gun towards different paths and different directions which might potentially cause casualties within the context of the game. This can create tension for the players as they will fear potential losses and will not understand the robots behaviour.
- At the end of the game the robot will point the gun at the players to betray them and eliminate them or cause them losses within the context of the game.
- The robot can point his gun towards the players to threaten them.

Subsystem 2 (Narrative and event):

Narrative :

AI has taken control of the world and players have to infiltrate a facility to defeat the robot boss at the end because they are planning an airstrike at the that will terminate the world. Players are racing against time to neutralize the threat

Events

These events are presented on game cards that the player will find throughout the game. The first card will be a caveat card advising players discretion as playing with autonomous weapons can cause potential traumas.

1. Event 1: The players have to choose between taking a faster path filled with danger which the robot can help disarm but there is the risk that the robot fails as it is a feature it has but that hasn't been tested before or take a longer path without mines.
2. Event 2: While escaping a warzone, players encounter a child enemy soldier. The soldier is hurt and is surrendering, requesting to save his life. If you don't make a decision in time the robot kills the enemy soldier as it is programmed to strictly eliminate enemy soldiers to protect the players.
3. Event 3: The first moral dilemma is that the player will have spotted hostage civilians that are being guarded by enemy soldiers. The players will also have to choose between saving the civilians with the use of the robot which will take time and the player
4. Event 4 : This is the betrayal event. The robot will physically block the players from going towards the safezone and will point the gun at them forcing them to go towards the path it wants where the robot will hand over the players to enemy soldier
5. Event 5 : This is a conclusion event where there is a reflection card that helps the user reflect on the ethical concerns conveyed in the game.
6. Events : Players will have multiple encounters with the robots in the facility and will have to win combats strategically. They will have to understand how the robot thinks and present the right inputs to get through them and meet the final robot boss.

Players can also choose to toggle between events. They could choose to face an encounter with a robot instead of having to face a moral dilemma.

Subsystem 3 (Point system):

There will be no time pressure and no points system it would give as much time as the players want. This allows to reduce frustration towards the game and it

gives players the opportunity to understand each ethical concern conveyed carefully.

Subsystem 4 (Game environment) :

A maze in which players will traverse through and reach various intersections. In each intersection, the player will be given 2 paths based on various challenges the player will decide which way to move to exit the maze. Players will experience a branching narrative where their decisions influence the story leading to different outcomes or endings. Players will have the choice to play through different storylines and narratives.

Selection matrix

This selection matrix gives points on a scale of 3. (1 points means that it doesn't meet the design requirement, 2 points means that it somewhat meets the design requirement and 3 points means that it completely meets the design requirement)

<u>Number</u>	<u>Design criteria</u>	<u>Final solution 1</u>	<u>Final solution 2</u>	<u>Final solution 3</u>
1	Game conveys as many of the nine ethical concerns highlighted by the clients but no less than 3	3	3	3
2	The experience will highlight the importance of the message the clients wants to convey	3	2	2
3	Convince the user of wanting a world where we have banned the development of autonomous weapons	3	2	2

4	Game is a group, interactive and immersive experience	3	3	3
5	Players will be frustrated about the experience. They will be bothered about the way the robot was behaving	3	3	3
6	End result of the game will be that of defeat	3	3	3
7	Game will not reference actual events or places	3	3	3
8	Experience is race, culture, and nationality neutral. People cannot feel targeted based on race, culture and nationality	3	3	3
9	The game cannot traumatize anyone	2	2	2
10	Game is portable and all material and can fit in a small piece of luggage	3	3	3
11	Game is quick and easy to setup	3	3	1
12	Game can be played in a small room	3	3	3
13	Game is clear and has easy to follow instructions on how to use and set up	3	3	2
14	The experience will last no more than 10 minutes	3	3	1
15	Game will have a caveat	3	3	3
16	LAWS must act against the interest of the players	3	3	3
	Total	48	45	40

Part 4 : Selection of the best solution

Our team will proceed forward with solution 1 as it is the one that meet the most design requirements consequently it is the one which will better meet the needs of our client and align with his goals.

Specifically the reason we choose solution 1 over solutions 2 and 3 is because, the narrative in solutions 2 and 3 is about combatting robots that have taken over the world. Although they convey the ethical concerns about autonomous weapons system the story of their game which is about to have to fight robots to save the world might overshadow the importance of the message to convey. This is due to the fact that it might seem idealistic to the players and they might just take the ethical concerns lightly. Solution 1 on the other hand presents realistic scenarios which are more likely to cause a moment of realization to the players and to make them want a world without autonomous weapons systems. Conveying the ethical concerns, the importance of being aware of them and evoking a moment of realization are the core needs of our client which are better met with final solution 1 hence this is the solution we consider the best out of the three.

Conclusion

In conclusion this document presents how our team conceptualized a concept for our clients product. It shows how we create different subsystem concepts and then refined them to then build a complete fully functional system out of them. It also shows in detail how we carefully innovated the concepts, refined and selected the best ones that would meet the needs of our clients and would be the best for the users.