**Project Deliverable D: Design Conceptual Design**

GNG 1103C – Engineering Design

Faculty of Engineering – University of Ottawa

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# Introduction

Mines Action Canada has asked our class to come up with a VR simulation to support the ban against killer robots. They are looking for a project that is simple but must make the user feel for the cause. In this deliverable, the idea for the project was chosen through brainstorming many ideas and narrowed down to our single best concept. The deliverable follows the problem statement, benchmarking and design criteria previously discussed.

# Problem Statement

Killer robots are a readily available technology that could be deployed in warfare any day, but raise ethical, moral, and humanitarian concerns. A concise, catered, and potent VR experience can demonstrate to decision makers on the national and international stage the terribly negative impacts that these robots could pose, ending the possibility of killer robots in its tracks.

# Subsystem Definition

**Storyline:** This subsystem is responsible for crafting the narrative and content of the VR experience. It includes the plot, the main characters and any side characters present, dialogues, and the overall message we are addressing. This subsystem needs to define the emotional and informational aspects necessary to guide our users throughout the simulation. Its boundary is that the description needs to focus on narrative content only and should not extend into the visual and interactive design aspects.

**Environment:** The environment is where users interact with the campaign’s message and storyline. This subsystem focuses on creating and designing the virtual world where the VR experience takes place. This includes 3D modelling, textures, lighting, and the layout of the virtual world. Its boundary is to discuss the visual representation of the narrative without including any aspects relating to the storyline.

**User interface:** The user interface subsystem will define what the users need to navigate the VR environment, access information, and interact with the content seamlessly and intuitively. This includes menu design and interactions. The boundary of this subsystem is to only describe the control elements, without referring to the environment or narrative content.

**Sound/Audio/Music:** The sound/music subsystem is responsible for the auditory aspects of the VR experience and is important to enhance the overall immersivity and emotional effect of the simulation. It includes sound effects, background music, voiceovers, and any other audio elements that enhance the atmosphere and emotional impact of the VR environment. Its boundary is to focus only on auditory designs.

# Ideation

For the sake of communication, concepts that have a numerical ID are general solutions to the subsystem in question. Concepts that have an Asterix next to the ID span across subsystems, as some environments only make sense when attached to a specific storyline.

## Storyline

**Concept I\* (CB) —** The user plays as a child that must leave their house to school. At first, it seems like a normal suburban house. However, as the user navigates through the environment, we soon realize that a few things are off. The landscape has been adapted to an unseen force—killer robots. There are no other people around, but the environment should provide a sort of “uncanny valley,” where it is not immediately obvious that something has gone wrong. The simulation should leverage the unease in the user when they come to term with what first seemed normal is all wrong.

**Concept II\* (AG)** —The user interacts as a child at a local park surrounded by other children. While at the park, the player walks around the area exploring the different play structures and objects in the park. When walking around the park, the player gets a chance to see that the park is not in a normal environment but one that is affected by killer robots.

**Concept III\* (LLB) —** The user is one of the repatriated refugees that are being extracted from the war zone. The user navigates outside of the war zone, observing how civilians protect themselves from killer robots (warning signs, blockades on doors).

**Concept IV\* (CB) —** The user is placed in a house under war conditions. They cannot circulate around the house, but instead only observe what surrounds them. By doing this, they see how people adapt to killer robots from inside their house.

**Concept V\*** **(AG)** — The user starts out in a dream where they get to look around at a state of paradise then they hear the voice of their mother telling them to wake up. The screen dazes into the bedroom of the child where they look out the window and realize that they were just dreaming and they are living in an environment affected by killer robots.

## Environment

**Concept I\* (CB)** — The suggested environment is a vaguely familiar suburb where key things have been changed to give a feeling of unease.

**Concept II\* (AG)** —The park will be one within Ottawa, a big, beautiful park with lots of play structures for children. The park will be surrounded by the effects of killer robots; destroyed building and signs, the presence of these robots and the overall look of unease.

**Concept III\* (LLB)** — A war-ravaged landscape outside of the war zone where the user is hiding. Civilians NPC characters can be found in small camps regrouping and hiding around the landscape. We can see crumbling buildings, barricades and warning signs, featuring killer robots.

**Concept IV\*** **(CB)—**Drapes are placed over the windows; masks are hanging by the front door to avoid being detected by the robot’s cameras. Various other items are cluttered around such as med kits, guns, etc.

**Concept V\* (AG)—**First scene is of a scene in a local Ottawa neighbourhood and then the second scene is of an area that is either war torn or one that has killer robots present.

## User interface

**Concept I (CB) —** To simplify the user experience, a possible solution would be to have no user input at all. The user is passive in the experience and is only there to observe. Although one could argue that it would lower the user engagement. However, it could also play it into the loss of control. If this concept is paired with a storyline where the user is an observer, removing the need for buttons/inputs could increase the attention the user can give to what is shown to them—essentially removing distractions.

**Concept II (AG) —** The simulation will grant the user the ability to walk around the environment so that they are able to have a full 360 view of their surroundings. There is no interaction with the other characters or the bystanders. In addition, the user will have the ability to increase or decrease the sound.

**Concept III (LLB) —** The simulation should offer the choice to be done in French or English if any announcements or messages will be shown. A button for the settings (change sound level and language) should feature on the interface. The user experience should not need to interact with other characters or their environment but could move around through teleportation if they wish to explore the area.

## Sound/Audio/Music

**Concept I (CB)** — The absence of any sound or music could give the user a sense of unease. Furthermore, dramatically ending the music suddenly during the simulation could also surprise the user.

**Concept II\* (AG) —** The sound and audio used in this simulation will be happy children and sounds. of destruction in the background.

 **Concept III\* (LLB) —** The sound and audio featured in this simulation need to instill fear and concern in the user. We can play around silent moments and eerie music to convey those feelings to our users. We can also have cries from scared civilians and explosion sounds in the background to enhance the realism of our environment.

**Concept V\* (AG)—**During the first scene the sound and audio used will be that of birds chirping, sounds of a busy city and happiness of people. The second scene will use music that makes the user empathize with the child about the life they’re living.

# Analysis

We met as a team to condense down the subsystems.

## Storyline

|  |  |  |
| --- | --- | --- |
|  | **Positive** | **Negative** |
| **Concept I** | The idea is interesting as it removes all distractions and allows the user to focus on how things have changed. It also places a decision maker in a familiar environment, which most likely would be a suburb.  | The scope is quite large for the given amount of time for the VR experience and might be overwhelming to the user.  |
| **Concept II** | There can be a high contrast between kids having fun in a park while the surrounding area is quite bleak. Further, we have thought of a few ways that the presence of killer robots can be felt, namely by having user pins and instructions at the entrance of the park. | The amount of work involved in having to program NPCs might be above our capabilities and the amount of time we can dedicate to the project. |
| **Concept III** | The observation of civilians and the changes made in the environment is a good idea that can be implemented in other concepts. The use of images through warning and informative signs is a good way to capture the effect of killer robots in society. | There are too many elements for the user to focus on in such a short time. This increases the complexity of the storyline since we also need to present context of the war zone. |
| **Concept IV** | Shows a different aspect, rather than seeing the outside effects of killer robots. You get to see how homes are having to adapt. Another advantage is that everything is much closer to the user, accelerating the duration of the VR experience. | Would have to find a specific object to add in the house, will be a bit nitpicky. |
| **Concept V** | Again, there is a sharp contrast that can be shown to the user. | Having to go from one scene to a second one in a short time. The complexity of 2 distinct VR environments. |

From our discussion, we came up with the following additional concepts.

**Concept VI** — We give the user a 360-degree view of familiar environment. A slider can be controlled by the user. As they move it around, it shows a “before”/“after” of the environment.

**Concept VII** — The general same idea as concept VI, but instead of showing “before” as the normal everyday environment, the “before” view is a war landscape, while the “after” is also a war landscape with the added adaptation of killer robots.

## Environment

|  |  |  |
| --- | --- | --- |
|  | **Positive** | **Negative** |
| **Concept I** | Familiar to the decision makers and we can easily grab it from Google Maps into VR. Adding unease requires an additive process of VR objects instead of removal or modification. | Very large, would be quite time consuming. It would also make it hard for the user to easily absorb everything in a short amount of time. |
| **Concept II** | Familiar to the decision makers and we can easily grab it from Google Maps into VR. Adding unease requires an additive process of VR objects instead of removal or modification. | Adding destroyed buildings would be hard, as could not be specific Ottawa buildings, and the styles might clash.The 3D modelling work could be intensive. |
| **Concept III** | Could be more potent, as it involves the destruction that war brings. | Not familiar to decision makers. It could be very hard to code both all the NPCs as well as creating a realistic environment. The scale is quite grand.  |
| **Concept IV** | The scale is smaller, it brings everything closer to the user. It could also be more familiar to a larger number of people, as the concept of a living room is something most people know. We do not have to specifically chose a city of country.  | Because everything is closer, the details of the environment must be a decent amount more realistic, and more work will have to be put into it. A lot of VR objects would have to be added. |
| **Concept V** | Shows two different aspects, demonstrating the sharp contrast. | Twice as much coding and VR work involved. Might be harder to distinguish because showing what war does vs. what killer robots would do. |

## User interface

|  |  |  |
| --- | --- | --- |
|  | **Positive** | **Negative** |
| **Concept I** | It is simple and gives more time for the user to observe and take information in. There is less chance of the user getting confused. | Might remove a certain level of immersivity.  |
| **Concept II** | A 360 view would be more immersive. The removal of interactions lowers the distraction the user can experience. |  |
| **Concept III** | Having both French and English offered would make it more accessible to more decision makers. Further, more languages could be added retroactively. |  |

## Sound/Audio/Music

|  |  |  |
| --- | --- | --- |
|  | **Positive** | **Negative** |
| **Concept I** | More flexible, and there is an element of surprise. The goal would be to subvert expectations. | Again, could be less immersive particularly if the real-world environment is noisy such as during Design Day. |
| **Concept II** | Potent, as again it would outline the contrast. | Might be overwhelming if too many sounds are playing at the same time. |
| **Concept III** | Very immersive as a lot is offered and going on. | Complexity might take a lot of work to find all the required assets and sounds, as well as being overwhelming to the user. |
| **Concept V** | Contrast is a key aspect of the concept. | Double the number of sounds needed. There is work involved in changing the sound along with the scene. |

# Synthesis

## Solution 1

We offer to create a VR environment where the user is playing in a children playground (Concept 1.I). To simplify the work involved with NPCs, we offer to have a few (2–3) characters that are mostly static or doing small-scale movements (from concept 1.II). As for controls, the user can use the joystick to move around the playground. As for music, we keep the original idea of having the combined sounds of children playing with the sound of war/cries/etc.

To convey the general idea of killer robots and their effect on society, we propose to give all NPC a sort of tag that killer robots would use to identify civilians. Warning signs would be present at the entrance of the park. To simplify the user experience, there will be a minimal amount of text and we will mostly rely on infographics that would give instructions on how humans must act in the presence of robots.

If speech or text is required, an option for French/English will be offered.

## Solution 2

Because the goal of the project is to stop killer robots before they are even deployed into the battlefield, we would like to further explore the newly generated concept. Namely, we would like to inspire ourselves from concept 1.VII and demonstrate the difference between war versus war with the existence of killer robots. We make it more digestible; we propose to give a shiny outline to the specific objects or things that are unique to killer robots existing. Killer robots would not be shown.

As for sound, we will rely on eerie environmental sounds. We would focus on a single 360-degree scene, where the user might have to teleport to a few locations within if they need to observe closer. Preferably, a single position would be offered.

If speech or text is required, an option for French/English will be offered.

## Solution 3

Our third proposed synthesized solution is using a living room as the environment. The advantage of it is that the focus is removed from war itself or the effects of war and is concentrated on how an average family would adapt. There is no requirement for human characters, and the VR environment is a lot smaller.

From Concept 2.III, we can add the idea of barricading doors as well as adding posters or warning signs that would have been created by people since the appearing of killer robots. We can also have cries from scared civilians and explosion sounds in the background to enhance the realism of our environment. The windows of the house would have drapes covering them to avoid killer robots being able to look through. Shadows can be projected onto the window, either humanoid or of the robots. When a robot shadow passes by the sounds would cut to silence for the duration of the animation.

# Evaluation

The solution matrix based on our ideal target specifications.

|  |  |  |  |
| --- | --- | --- | --- |
| **Solution****Specifications** | **Solution 1****(Playground)** | **Solution 2****(overlapping comparison)** | **Solution 3****(inside the house)** |
| Duration (min) | 1 | 1 | 1 |
| Cost ($) | + + + (more assets, NPCs) | + + (more assets) | + (fewer assets) |
| Explorable Areas (#) | 1 (free space) | 1 (fixed/free space) | 1 (fixed) |
| Time of setup (s) | Unknown | Unknown | Unknown |
| Buttons used | 1 | 1 | 0 |
| Immersivity | 5/5 | 4/5 | 4/5 |
| Stigma of topic | 4/5 | 5/5 | 4/5 |
| Interactiveness | 5/5 | 4/5 | 3/5 |
| Type of media | Virtual Reality | Virtual Reality | Virtual Reality |
| Size of file (GB) | N/A | N/A | N/A |
| Novelty/Uniqueness | 4/5 | 5/5 | 4/5 |

We select as the most promising concept **Solution 2.** The first solution suggested is quite large is scope and doesn’t necessarily focus on killer robots and the issues surrounding them. On the other side, solution 3 would do a better job at showing what killer robots would change for an average person or family, but we fear that it would not be sufficiently immersive or interactive.

The strength in solution 2 is that it is, to us, quite novel. We have also identified a pitfall to avoid. We fear that if we only show a peaceful world versus a world under war with killer robots that the message will be diluted. Indeed, we would have changed two variables, namely the presence of a conflict and the addition of killer robots. War is a terrible thing, and no one can deny it. However, it still happens and is not foreign to decisions makers. By instead showing how a war zone would adapt to killer robots—instead of a peaceful environment, we believe to better outline what killer robots would change. We only change a single variable.

We have no doubt that more ideas will come as we work on this project. In the meantime, we have identified a few key differences we wish to implement. Firstly, civilians will be seen using identification badges on them. It would be interesting for the NPC to be in frayed outfit that clearly has not been cared for, but the ID they are wearing is super clean, out of fear of it not being read well by the Killer Robot. Posters instructing people on how to behave around robots would be seen, with minimal words as to avoid distracting the user.

# Project Plan Update

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=20BNZuTtdF1A44KnbvaHapzHpgF2Tl72%7CIE2DSNZVHA2DELSTGIYA

# Conclusion

The purpose of our work is to produce a VR experience that could help convince decisions makers both on the national and international scene that Autonomous Killer Robots (AKR) have no place in a war zone. In this report, we broke down the problem into four sub-systems. For each, we brainstormed new concepts that were later recombined into three promising solutions. We used our target specifications to compare and evaluate the three solutions. From this analysis, we were able to select the most promising design concept.

We propose to create a VR environment where the user can directly see how AKR would change conflicts. The default surrounding area would already be a war zone, but key things will be changed showing the differences. Going into the next report, we will polish our idea and start the prototyping process.