# Deliverable E: Project Plan and Cost Estimate

**University of Ottawa**

**GNG1103: Engineering Design**

**February 25th, 2024**

**Group 14**


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**Abstract**

The abstract for the following deliverable outlines our group's approach to planning the development of the entire project while adhering to time and budget constraints. This report details the group's strategic planning process, including task scheduling, cost estimation, and the integration of client feedback into our project's development. Notably, we revised our conceptual design to incorporate a minimalist radio-based narrative mechanism rather than a TV that would allow the person to see and immerse themselves into multiple different settings. This change will significantly reduce development labor while enhancing emotional engagement. The group also meticulously listed all necessary equipment and formulated a Bill of Materials (BOM), carefully managing resources to keep the total cost at $44 while gathering the assets, scripts, and setting necessary to bring the concept to a VR environment. Additionally, we identified potential risks and devised mitigation strategies, ensuring a proactive stance towards any challenges. This deliverable sets a solid foundation for our project, "Echoes of Tomorrow," aiming to deliver a poignant VR experience that navigates the complexities of a post-apocalyptic world dominated by autonomous weapons. Through diligent planning and responsive adaptation to feedback, we are positioned to achieve our project goals within the specified timeframe and budget, ultimately contributing to the field of virtual reality with a narrative that resonates deeply with users.

# Table of Contents

# Introduction

The following Deliverable lists all the equipment that the need will require to complete our project starting from February 25th until Design Day. The purpose of the deliverable is to reinforce what needs to be employed to complete the project, when each task must be done, what must be acquired, and how much money can be spent to fit under budget while meeting the expectations of achieving an A+ grade and meeting the deadline.

The Deliverable is split into two portions, the concept summary, and the project planning.

The Concept Summary includes a detailed sketch of the design that our group had agreed upon in the previous deliverable, with the inclusion of the feedback that we were given upon our first client meeting. This portion will recap what was written in Deliverable D and will introduce what has changed and how it now looks.

The second potion of the deliverable is the project planning, which is more comprehensive and expanded upon in the following document.

Table 1 outlines a neatly organized plan in terms of when each task will be completed, how many days we have to work on the task, which tasks are dependent on each other, and who has agreed to work on it.

Table 2 outlines the bill of materials needed to begin the prototype phase (while fitting under a budget of $50), and hopefully, the entire project by the deadline of design day.

Tables 3 & 4 list the specific hardware and software equipment needed for the development and testing portions of our project.

Table 5 discusses the risks regarding our approach to completing this project and the contingency plan that the group has developed.

Table 6 dives in specifics into the prototype test planning to get a better idea about what to test, and how to test it.

## Related Work

Group 14 has already completed the 4 previous deliverables, which is key to understanding before continuing in reading the content of the following deliverable.

In Deliverable B, which can be accessed through the hyperlink, outlined all the needs described by the clients that had to be taken into account when designing a conceptual design, with the needs being neatly organized into categories such as Accessibility, Storytelling, Communication, Logistics.

In Deliverable C, which can be accessed through the hyperlink, all of the identified needs were subsequently divided into a list of functional requirements, non-functional requirements, and constraints. In part A) all needs are listed and organized into a chart that separates all requirements, then in part B), all of the group's findings in regards to these criteria were benchmarked with other groups project's and other public VR simulations. This helped the group to better understand where to focus and how to change our list of criteria, as well as to set target specifications for the optimization of our design.

In Deliverable D, which can be accessed through the hyperlink, the group had brainstormed several different conceptual ideas in regards to the needs, requirements (functional, non-functional), and constraints identified from the previous deliverables, and merged ideas in order to create a global concept that best fit the client's expectations. The global concept chosen in the referenced deliverable is the one the group will continue to refer to for the duration of this Deliverable.

These deliverables all built on each other, and they built on the various concepts we learned in class about the design process.

## Feedback From Client

After meeting with the client, we have revisited our global concept that was originally introduced in Deliverable D in order to adjust to their criticisms and feedback.

The feedback given to us by the client was that the group was attempting to fit too many aspects into our presentation, which would ultimately be unfeasible to complete by our deadline (April). Specifically, the client had pointed out the complexity of us incorporating many different settings into our video by letting the player immerse themselves through the TV while the News is playing to see catastrophes that the robots are causing at first-hand. Instead, the client had suggested to use a simple radio, with a radio host talking faintly in regard to many different events instead of making a setting for every scene in the TV. This would greatly reduce labour on these scenes, would fit in better in our theme of an apocalyptic world where people don't trust technology (as a radio is more secure than a TV), and a radio can still effectively convey emotion and information (logos and pathos) in regard to the specific problem of paranoia regarding technology due to autonomous weapons.

The pros and cons of this idea give a good perspective about how the project planning and cost estimate will look. For instance, due to the idea's minimalist design and reliance on emotional engagement, the group does not need to spend too much time and money on assets or labour.

# Concept Summary

## Recap of Design with Implemented Feedback

According to the global concept introduced in Deliverable, which was then adjusted by our client's feedback, the summary regarding our design is as follows:

*"A VR environment set in a post-apocalyptic home adopts a simplified and minimalist approach, focusing on delivering the message through an emotional lens through the degraded life of a family living in a household during an era were autonomous AI robots control society. The setting showcases a run-down home where all technology has been destroyed in fear of the autonomous robots, except for the television where the family is fed the news in regard to what other catastrophes are ongoing. The house will provide a setting for the group to deliver how the quotidian life of a family (husband, wife, children) has dramatically affected, and will showcase a dramatic decrease in quality of life. Additionally, there will be a radio that acts as a gateway to information of what's going on outside, where the group can learn more about the problems that are happening due to the effects of autonomous weapons."*

Storyline:

*"The story unfolds in a family's home, where a husband, wife, and their child start their day in a kitchen with broken modest technology. While the parents prepare lunch, the innocent child, eager to play outside with his teddy bear, is told he cannot, without explanation, due to a robotic threat. As the husband listens to the radio, the broadcast morphs into scenes of robotic violence, including a mistaken attack on a homeless shelter and other events. Suddenly, the narrative returns to the father, who discovers his son missing. Frantically searching, he finds him outside playing in the snow, just as a patrolling robot fatally shoots the child, mistaking his movements for a threat."*

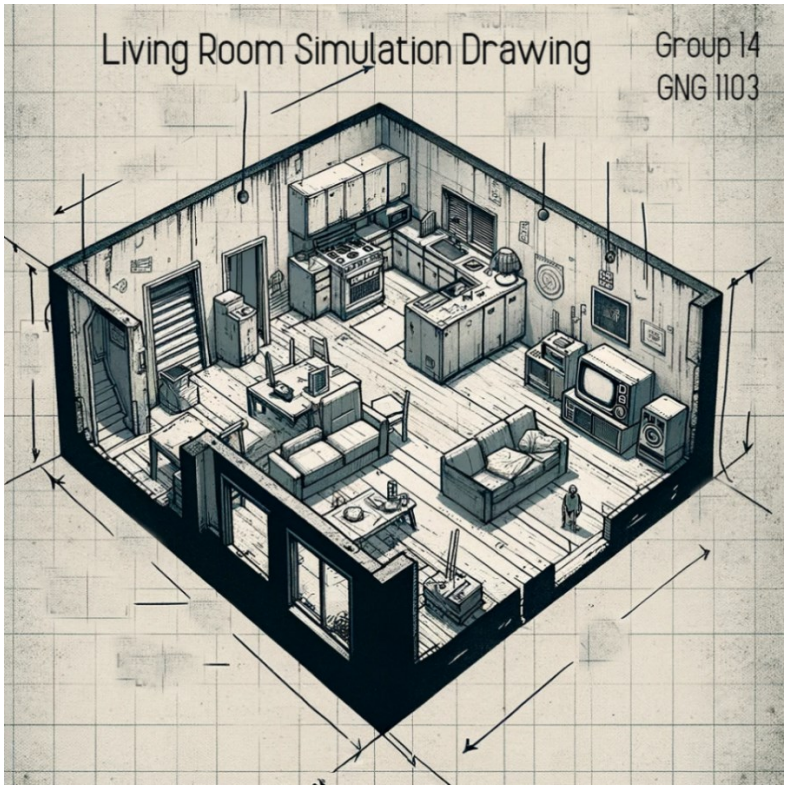
| Pros: | Cons: |
|---|---|
| - Minimalist & Easy to develop | - Reliant on Animation |
| - Multiple Camera perspectives | - Limited Interaction: |
| - Emotional Engagement | - Narrative Constraints |
| - Cheap to build due to the one setting | - Extremely Limited Replay Value |

## Sketch and Summary

The environment is intentionally sparse in a constrained area, reflecting the degradation of daily life and the fear of technology that has led to the destruction of all technological assets except for a crucial piece: the radio. This radio, placed prominently in the living room, serves as the primary means of conveying the outside world's state to the family, aligning with the client's suggestion to simplify the narrative delivery mechanism. The shift from a multi-scene TV immersion to a single, radio-based narrative allows for a focused, cost-effective development process that emphasizes storytelling and emotional resonance over complex visual or interactive elements.

*Figure 1: Sketch of Living Room of VR Environment*

This graphic image was made by Group 14 through a graphic design program.




This approach aligns with the pros of a minimalist design—ease of development, emotional engagement, and reduced costs—while addressing the cons such as reliance on animation, limited interaction, narrative constraints, and replay value. The VR experience will be about 10 meters wide, with a square base. This should allow enough space to fit all props and assets into the environment while conveying all symbols and themes regarding the apocalyptic nature of living in a paranoid world with autonomous weapons. This living room is the main setting, however, the hallway in the left side of the setting (near the back-left of the room) will be the area of the environment that will connect to a tiny bedroom with a window, which will be the scene where the kid is seen outside playing with a robot. The addition of this hallway, rather than the scene taking place through the living room window, introduces narrative potential and spatial depth, offering a hint of further exploration within the constrained setting.

# Project Plan and Schedule

The following table lists the upcoming steps that the group must achieve before the deadline, including the deliverables, customer feedback, and prototyping. Each task has been categorized by a number, so that all dependencies for the future tasks can be clearly outlined in column 3. Each task has a due date that corresponds to the class syllabus' schedule, and the amount of time needed to complete each task (duration) has been clarified on the 2nd most right column along with who has agreed to work on it. All of the tasks, dates, and responsibilities were based from the Trello board. (Refer to the links at the end).

| Number | Task | Dependencies | Due Date | Duration | Workers |
|---|---|---|---|---|---|
| **1** | Client Meeting 1 | None | 12/02/2024 | 1 Session | Everyone |
| **2** | Deliverable E: Project Plan & Cost | Deliverable D | 25/02/2024 | 13 days | Everyone |
| **3** | Build Prototype 1 | Deliverable D and E | 03/03/2024 | 7 days | Everyone |
| **4** | Gather Customer Feedback | Task 3 | 03/03/2024 | 7 days | David, Marc |
| **5** | Deliverable F: Prototype 1 & Customer Feedback | Tasks 3 & 4 | 03/03/2024 | 7 days | Everyone |
| **6** | Client Meeting 3 | Task 5 | 04/03/2024 | 1 Session | Everyone |
| **7** | Organize Client Feedback | Task 6 | 06/03/2024 | 2 hours | David, Ben |
| **8** | Iterative Prototyping & Prototype 2 | Task 6 & 7 | 08/03/2024 | 2 days | Everyone |
| **9** | Customer Feedback for Pr. #2 | Task 8 | 08/03/2024 | 2 days | Everyone |
| **10** | Deliverable G: Prototype 2 & Customer Feedback | Tasks 8 & 9 | 10/03/2024 | 7 days | Everyone |
| **11** | Iterative Prototyping & Prototype 3 | Tasks 9 & 10 | 22/03/2024 | 12 days | Everyone |
| **12** | Deliverable H: Prototypes 3 & Customer Feedback | Task 11 | 24/03/2024 | 14 days | Everyone |
| **13** | Deliverable I: Design Day Presentation Materials | Task 12 | 04/04/2024 | 11 days | Everyone |
| **14** | Design Day | Task 13 | 04/03/2024 | 1 Session | Everyone |
| **15** | Deliverable J: Project Presentations | Task 14 | 04/04/2024 | 11 days | Everyone |
| **16** | Deliverable K: User & Product Manual | Task 15 | 10/04/2024 | 6 days | Everyone |

*Table 1: Plan for the completion of all Tasks before the end of the Course Term*

# Bill of Materials

The following tables includes a list of materials that will be used in the process of developing the VR experience. This table breaks down how the given budget will be used (tax not included).

| Item Number | Description | Quantity | Store | Price (CAD) |
|---|---|---|---|---|
| #1 | House Model with Interior | 1 | Unity Asset Store | $25 |
| #2 | Footstep Sound Effects | 2 | Unity Asset Store | Free |
| #3 | Smartphone Model | 1 | TurboSquid | Free |
| #4 | Radio Model | 1 | Unity Asset Store | Free |
| #5 | Boarded Window Model | 1 | TurboSquid | Free |
| #6 | Furniture Model Pack | 1 | TurboSquid | Free |
| #7 | Gunshot Sound Effect | 1 | Unity Asset Store | Free |
| #8 | Drone Model | 1 | TurboSquid | Free |
| #9 | Gas Lantern Model | 1 | Unity Asset Store | Free |
| #10 | Newspaper Model | 1 | TurboSquid | Free |
| #11 | Book Stack Model | 1 | TurboSquid | Free |
| #12 | Realistic Young Kid Model | 1 | Unity Asset Store | $19 |
| #13 | Animation Script<br>Walking \| Playing \| Sitting | 3 | Mixamo | Free |
| Total | - | - | - | **$44** |

*Table 2: Bill of Materials*

# List of Equipment

Table 3 lists the physical equipment necessary for the development and interaction with virtual reality environments we are creating, and to facilitate users to interact with our content.

| Equipment | Description | Quantity | Prototype # | Source |
|---|---|---|---|---|
| Computers | A strong enough computer to run the VR software | 1 | 1, 2, 3 | Makerspace |
| VR touch controllers | Used to interact with the VR experience | 2 | 1, 2, 3 | Makerspace |
| Charging cables (USBC-USBC) | To keep the system running and operating efficiently | 1 | 1, 2, 3 | Makerspace |
| VR headset | The main medium from which the VR experience will be presented | 1 | 1, 2, 3 | Makerspace |
| Glasses Spacer | To accommodate for anyone with glasses | 1 | 1, 2, 3 | Makerspace |

*Table 3: List of Physical Equipment*

Table 4 outlines the essential software tools required for designing and developing virtual environments and elements within them. Additionally, the table lists key asset and script sources which provide a vast range of resources for us to use during development.

| Description | Tools Chosen | Prototype # |
|---|---|---|
| Design software. | **Unity**<br>*Main 3D software used to design environment.* | 1, 2, 3 |
| Asset and Script sources | **Unity Asset Store**<br>**TurboSquid**<br>**Mixamo** | 1, 2, 3 |

*Table 4: List of Software Needed*

While it might seem like VR requires a lot of gear, the essentials can be quite streamlined, focusing on delivering a deep, interactive experience. The equipment required for a virtual reality (VR) experience primarily includes equipment that deal with the two senses, vision & hearing, along with a way to move around in the environment. This is done through a VR headset, touch controllers, and a computer or gaming console powerful enough to run VR software. All other tools, such as glasses spacer, are non-functional additions. However, the software equipment for a VR experience is crucial because it directly influences how accurately we can convey our design into a virtual environment that the user can create and interact with. The right software tools enable us to craft detailed, immersive experiences that work smoothly.

# Project Risks and Contingencies

The project risks mentioned below have two parts which have not been outlined but can be noticed. The first part is about delays and group related problems and the second part is about risks during and post construction of the product. The group's general plan is to follow the timeline as closely as possible while maintaining communication using the application currently being used to finish our project efficiently however certain problems may arise and some contingency plans have been prepared in case of any type of situation that have been mentioned in the table below:

| **Group related risks** | **Chance** | **Impact** | **Contingency** |
|---|---|---|---|
| Group member(s) are unable to finish work on time | Moderate | High | All available group members (hopefully some) divide the work equally in a way that it is doable within time constraints |
| Group member(s) fail to communicate on a daily basis | Moderate | Moderate | Any decisions taken cannot be argued by inactive members and all decisions taken by active group members will be communicated via group chat |
| Group member(s) have personal problems affecting the project | Moderate | High | All group member(s) communicate regularly, and any extra work will be distributed evenly among active members |
| Group fails to use purchased materials due to shipping/accessing delays (seller's problems) | Moderate | Moderate | Group will use available resources to make up for the problems and if it is not possible, we will use alternative options and modify the project |
| Lack of accountability relating to issues where a group member(s) does not own up to their mistakes | Low | Moderate | All problems are discussed by the group and resolved as a group, but problems must be discussed during meetings |
| **Equipment related risks** | **Chance** | **Impact** | **Contingency** |
| Design related data is lost | Moderate | High | Frequent cloud backups can be done to reduce the chances of data loss |

| | | | |
|---|---|---|---|
| Program crashes during design | Moderate | High | Seek help from TAs and make sure that progress is saved by backing up all information |
| Hardware/equipment failure during design | Moderate | High | Have backup equipment which has been tested for perfect functioning |
| **General risks** | **Chance** | **Impact** | **Contingency** |
| Project fails to implement client feedback | Low | High | Group will take regular notes during feedback sessions and the group will discuss notes and decide on ways to implement it into the project |
| Purchased resources go over budget constraints | Low | High | Group must make sure to purchase services that are necessary and try to minimize spending as much as possible by using free resources |
| User/Client dissatisfaction after finishing the project | Moderate | High | Thorough testing will be done to ensure all required constraints and feedback are included as a part of the finished project |

*Table 5: Risks and Contingencies*

# Prototyping Test Plan

In order to get a better idea about what to test and how to test it, we have made the test plan that is seen below.

| Test ID | Test Objective (Why) | What is being figured out (What) | Testing Method (How) | Attributes to Observe / Record | Duration (When/How Long) |
|---|---|---|---|---|---|
| **1** | Test if the virtual experience is VR compatible. | Can a user wearing a VR headset interact with the world? | Connect the VR headset to the virtual world and test the controls. | Observe if the movement follows the commands issued on the controls. | Test it in all prototypes as a precaution. It should take under 5 minutes for sufficient testing to be conducted. |
| **2** | Test if the virtual experience runs smoothly. | Does the game run smoothly or is there lag? | Connect the VR headset to the virtual world and move around. | Observe if there is a time lag between movement commands and actual movement or during movements. | Test it in every prototype as a precaution. It should take under 5 minutes for sufficient testing to be conducted. |
| **3** | Test if the controls are simple and easy to comfortably use. | Are the controls simple, easy to remember and can be used without physical discomfort? | Connect the VR headset to the virtual world & move around, and ask for feedback from users. | Observe if the users get the hang of the controls, if they show any visual difficulty or discomfort during use, and their feedback. | Test in every prototype. It will take as much time as the user spends in the VR world. |
| **4** | Test if the VR experience is accessible. | Is the VR experience safe for use for those with sensitive audio or visual senses? | Observe and ask users for feedback. | Ask users if they feel that it could put people at risk. | Test in comprehensive prototype until 90% or more users say that it is safe if there are 10 or more different testers, otherwise test until all users say that it is safe. |
| **5** | Test that the VR sensory experience is realistic. | Are the audio and visual experiences | Ask for feedback from users. | Observe the opinions of the users. | Test in every prototype. It will take as much time as |

| | | | | | |
|---|---|---|---|---|---|
| | | realistic and immersive? | | | the user spends in the VR world. |
| **6** | Test that the story is simple, immersive and conveys the message. | Is the VR experience effectively conveying the intended message? | Observe and record user experiences. | Ask users about their thoughts on killer robots before the experience. After the experience, ask the same question as well as their thoughts on the story as a whole. | Test in comprehensive prototype until 80% or more users have worse opinions on the autonomous weapons and positive opinions on the story if there are 10 or more different testers, otherwise test until all users but one have worse opinions on the autonomous weapons and positive opinions on the story. |

*Table 6: Prototyping Test Plan*

# Verifying Feasibility

Given that our project primarily involves software development, feasibility depends on the capabilities of our equipment and what we, as students, can achieve within the given time constraints. The project's reliance on minimal physical resources demonstrates its feasibility, especially with the necessary equipment already provided through the university.

# Trello Links

**Group Tasks:**
https://trello.com/invite/b/BVQUyzOo/ATTIffa561593f1eb68dd5f7bae366d91099C0403DE3/gng1103-group-14

**Group Deliverable Progress:**
https://trello.com/invite/b/nBKqHlud/ATTIedb77cf20bf59f8d9431a337a519c81e59084991/gng1103-project

# Conclusion

In conclusion, this Deliverable has charted our project's trajectory towards the prototyping stage, emphasizing a strategic approach to scheduling, cost estimation, and prototype development within the stipulated timeframe. Following the feedback gathered from our clients, we pivoted from the initial concept of utilizing a TV setting to a more simplified and labor-efficient approach using a radio. This adjustment not only aligns with the thematic essence of our post-apocalyptic VR simulation but also significantly reduces development labor, focusing on conveying the emotional and chaotic ambiance of the surrounding world through auditory means.

Furthermore, our group had devised a detailed Bill of Materials (BOM) that lists all of the assets, settings, and scripts necessary to bring our concept into a VR environment, bringing the total cost to only $44, underscoring our commitment to maintaining a lean budget without compromising on the quality and immersive experience of the VR simulation. The identification of all necessary equipment and a comprehensive list of risks, accompanied by corresponding mitigation strategies, underscore our proactive approach to project management and problem-solving.

This report encapsulates our efforts in laying a solid foundation for the project by addressing to client feedback, budget constraints, and preparing for all of the potential challenges that groups doing this project have usually encountered. Through risk assessment, and equipment identification, our group hopes to have set the stage for the seamless development of our initial prototype. As we move forward, the insights gained and the adjustments made in response to feedback will guide our efforts in creating a VR experience that not only meets but exceeds the expectations of our clients.

# Future Work

In the next week, the group will be working on Deliverable F, which focuses on the initial phase of prototype development in the design phase, urging us to craft our first prototype according to all the information we have listed in our previous deliverables. Deliverable F emphasizes that this initial prototype should not merely extend the project work but rather address specific, targeted objectives with clear, measurable outcomes. This will involve conducting a straightforward analysis of critical components while meticulously documenting the prototyping process—including tests, analyses, and results with detailed imagery. Furthermore, it necessitates updating target specifications, designs, and the Bill of Materials (BOM) based on the insights gained from testing and feedback. Preparing for the subsequent phase, we will also formulate a test plan for our second prototype, guided by principles such as communication effectiveness, feasibility verification, and risk mitigation, as outlined in a provided template while cost-effective and easily accessible materials.

# References

[1] Freesound, “Freesound,” *Freesound.org*, 2012. https://freesound.org/

[2] Unity, “Unity Asset Store - The Best Assets for Game Making,” *@UnityAssetStore*, 2000. https://assetstore.unity.com/

[3] Blender Foundation, “blender.org - Home of the Blender project - Free and Open 3D Creation Software,” *blender.org*, 2019. https://www.blender.org/