The Gamification of Fjell Fortress

Vision document

Version 3.0

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Revision History

Date	Version	Description	Author
19/01/2022	1.0	Iteration 1 of vision document	Griffin, Oneal, Simon
24/02/2022	2.0	Almost completely rewritten, and translated to english	Simon, Griffin, Oneal
28/02/2022	2.1	Updated changes to problem	Simon, Griffin, Oneal
20/05/2022	3.0	Minor changes to all chapters	Griffin, Simon, Oneal

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1. Introduction

HVL Medielab, as of writing this document, just finished development of the mobile game Batteri Fjell 1945. This game is intended to be used in lecturing 9th grade pupils in some of the problems following the end of the 2nd world war. This was done under funding from Arts Council Norway.

The VR version has been under development simultaneously. Based on the same storyline as the mobile version, the VR version allows for an even more captivating experience. There have previously been two other bachelor groups working on different parts of this project. The first group 3D scanned the area on Fjell, and the second group combined these scans with data from The Norwegian Mapping Authority to create a complete 3D representation of the compound in the game engine Unity.

The goal is to shape this foundation into an engaging interactive learning experience for students.

2. Summary of problem and product

Problem summary	
Problem with current solution	**Mobile version:** - Uses geolocation, meaning players have to be present at Fjell fortress to play. This narrows the player base considerably. - Is a top down 2D game. It is difficult for players to get a real sense of what the fortress might have looked like in 1945, and the scale of the compound. **VR version:** - Lack of gameplay elements and voice lines - The compound currently feels empty and lifeless, both in terms of the natural environment, and the amount of people there. - Uses outdated VR frameworks that causes the game to be unplayable on a multitude of VR headsets - Bad performance even on high end gaming pc's
Which stakeholders are affected	Museum Vest, HVL Medielab and users
Impact of problems	It is difficult to keep students engaged and interested for the entire game. Ideally users should be interested in replaying the game Bad performance in VR leads to a bad experience. Most schools do not have access to or can justify spending money on high end gaming machines. Game does not work on most VR headsets, including Oculus Quest 2 which is as of february 2022 the headset of choice for 46% of VR users on SteamVR (Ridley, 2022)
What would a well rounded solution look like	A good solution would result in a VR game that could easily be used in classrooms anywhere in the country to educate students on some of the issues people experienced at the end of WW2 with particular focus on ethical dilemmas. It can be run on most new VR headsets that run from PC with a smooth frame rate of ~90 fps on mid to high tier gaming PC's. A successful solution is a solution that can be used in teaching, and create a good user experience. It provides the users with an immersive experience that depicts what the fortress might have been like in 1945.

Product summary	
Who is the product for	The product is to be used by Museum Vest for educational purposes. The plan is for the game to be used in classrooms or on museum grounds to educate students on some of the events happening on the fortress after the second world war.
Product name	Fjell Festning 1945
Main benefits of the project	The game allows for an immersive interactive learning experience that portrays the problems and ethical dilemmas soldiers, prisoners of war and locals experienced after the war ended, as well as working as a digital recreation of the fortress as it may have been in 1945.
Today's competitors	Oslo Havn 1798 (Tidvis AS, 2019) Falstad reconstruction (Falstad Centre Foundation, 2018)
What are the biggest differences from Fjell Festning and other projects	Fjell Festning 1945 allows for a more immersive experience by telling a story as well as placing the player in an accurate 3D environment. It allows for a unique way of portraying the fortress, not only displaying what the compound looked like, but also showing the impact the war had on people of different backgrounds

3. Description of stakeholders and users

Stakeholders		
Name	**Description**	**Their role under development**
Museum Vest	Museum Vest is the organization running the Fjell Fortress museum. They will be the owner of the finished product.	They will provide the group with all information needed to accurately recreate Fjell Fortress including the script.
Medielab	Medielab is the university college's competence unit for the development and use of digital media, new technology in teaching and research. They are responsible for development of both the mobile game Batteri Fjell 1945, and the Fjell Festning 1945 VR game.	Medielab is the group's main source of information regarding technical information. They are also the most available when it comes to general project information. Medielab will, through their branch Læringslab, supply the group with relevant hardware needed for development. This includes head mounted displays, iPad Pro's for 3D scanning, etc.
High Schools	The finished product may prove to be a useful teaching tool in education	Will most likely not play a part in development, however if the development team finds themselves ahead of schedule, gameplay tests.

Users			
Name	**Description**	**Their role under development**	**Represented by**
Teachers	The teacher will integrate this product into their course		
Students	The main user base. The ones the game is intended for, and ultimately who will spend the most time playing the game	In this development phase, user tests in this group will be minimal due to time constraints	
Medielab	Interested in conducting a study comparing the learning outcomes of this game, and the mobile counterpart Batteri Fjell 1945.	Project manager and main source of technical information	Øyvind Fosse

| Museum Vest | The owners of the finished project. May use the product on site on Fjell, or in cooperation with schools use it in classrooms. | Ultimately decides how the product will be distributed and used. Provides the group with historical information, scripts and input. | Vigleik Mathisen |

3.1 User Environment

The application can be run on most VR headsets that can run from machines. This includes Oculus Quest 2 using Oculus Link. Initially Medielab wanted for the game to be able to run on mobile VR headsets, however this has proven to be too ambitious for the group to undertake in such a short period of time. Users will need a moderate to high performance gaming PC and a VR headset that can connect to a PC. Keep in mind that higher display resolutions may lead to worse game performance. The users will be located at various schools with access to a computer that can run the game.

3.2 Summary of the user needs

Their needs	Priority	Affects	Todays solution	Proposed solution
Learning outcomes	1	Students, Teachers and Museum Vest	The player walks around and interacts with different people in the environment.	Users can interact more with the scene. A more realistic environment
Flexibility	1	Teachers, Museum Vest, may affect HVL Medialabs studies, and narrows the market of other potential players.	The game supports few VR headsets. The project does not support an eventual port to mobile.	Make the project mobile compatible and switch to the more flexible OpenXR input system.
Good performance	1	All users and developers	Project size makes development slow. Low frame rate leads to bad user experience, and can cause nausea and headache	Use URP (Universal Render Pipeline), LODs, culling, baked lighting, lower render distance, simplify models and textures and more.
Fun	2	Student learning outcomes, general user experience	The player/student wanders around and interacts with different NPCs.	More ways the player can interact with the environment. A more lifelike and realistic world
Historically correct	2	The game will look more appealing for schools and	Historically correct terrain and real stories.	This means maintaining the realism of the story, and at the same time modifying

		museums.		the terrain
Physics	2	Objects you can move and interact with.	Everything in the scene is static.	More objects you can pick up and throw.
Futureproof	3	Should make the game such that it is easy to maintain	The project is large and the file organization is cluttered. Today it is hard to maintain the structure of the project.	Remove unnecessary files and assets. Document the code and sort assets.

3.3 Alternatives to our projects

Alternate projects will be products that are aimed for teaching. Schools and students do not have time to incorporate every historical learning experience out there into their schedule so other projects today that are aimed at teaching and education for example Oslo Havn 1798 (Tidvis AS, 2019) and Falstad reconstruction (Falstad Centre Foundation, 2018) might be considered competitors. However these are digital recreations and not games.

When compared to Oslo Havn 1798, Fjell Festning 1945 offers a 3D environment that also allows the user to interact with the environment in various ways. Falstad provides a digital tour that uses AR to display the buildings, that are long since demolished, on the screen. Fjell Festning 1945 will be a fully 3D VR environment where instead of being told the history by a narrator, or by reading some text, you interact with characters you encounter through dialogue. As far as the group and Medielab know, there are no digital museum experiences directly similar to Fjell Fortress 1945 in the way the story is being conveyed to the user.

4. Product Overview

4.1 The products role in the user environment

The product is mainly for teachers and students in junior highschool, therefore, the group has to focus on that the product must be entertaining and educational. The game should be used as a platform for learning, for both the history and ethical aspect of the fortress. The goal is to create an interest around local Norwegian history and the ethical issues they encountered.

If the project is successful, the product can be used as an example of hot digital museum experiences that can be used in the future to offer experiences that were not previously possible before.

Also, HVL Medielab wants to use the game in a study that compares the learning outcomes of a VR game and a mobile version. It is therefore important that the VR version does not deviate too much from the mobile version to the point that they are not comparable. At the same time, this is a great opportunity to show the strengths of VR headsets and to take advantage of the opportunities this gives the group.

4.2 Assumptions and Dependencies

VR technology is constantly evolving. The Unity project from 2019 used Valve's SteamVR VR solution, but this is already being phased out in 2022. Today, people are using the OpenXR solution, which is an API that allows developers to easily develop for almost all reality headsets. The group wants to deviate from the SteamVR solution and adopt OpenXR in order to expand the lifetime of the product. However should VR headset manufacturers stop supporting OpenXR, it will potentially result in the game not working with new VR headsets.

5. Product features

List of features we intend to implement. Due to time constraints, there will likely be some features that do not make it to the final version

- **Player movement**: This includes camera movement with head tracking, and character movement. Allow for players to choose between teleportation and continuous move.

- **Universal Render Pipeline**. Provides a boost in performance and opens the door for building the project to more platforms, including mobile VR.

- **OpenXR input system**. Allows for input for almost all VR headsets, including those provided to the group for development. Must change the VR controller object for both the intro scene, and the main scene.

- **Hands**. Crucial for interaction with objects to work. It must also be properly animated so it looks correct when holding objects, tapping buttons, etc.

- **Interactable objects**. Different objects the player can pick up, inspect, throw and possibly use for something.

- **Achievement system** that displays the amount of information the players have gathered and how much is remaining.

- **Timer** that displays time remaining. You may also find certain items giving you extra time.

- **Reward system** gives the player extra time if they complete a small task. Current idea is to have a throwable object you must throw at a target in order to gain some time.

- **Notes** the player can find containing useful information about the events

- **Reworked dialogue system**. The dialogue system must unfortunately be remade as the dialogue system plugin used in the project is no longer supported and is causing the editor to crash. The previous dialogue system also did not have general VR input support meaning it would not work on the controllers supplied for development. Voice lines were also not present.

- **NPC voice lines.** Import and implement the audio files for the characters, and have them play as a response to the appropriate questions.

- **Facial animations** for essential characters.

- **Notebook**. The notebook is mainly used to interact with the NPCs around the player. It functions as the user interface in which the player interacts with to choose which questions to ask. Also contains the settings menu.

- **Improved nature**. Includes improving the terrain textures, adding more plants, foliage and rocks, modifying the terrain shape to more accurately represent the terrain at Fjell, removing unnecessary parts of terrain

- **Skybox** from Fjell. Places the scene into a 360° image of Fjell, allowing the player to see out towards to actual sea, or up towards the mountain behind the fortress

- **More NPCs**. These will likely not be intractable as no more voice lines will be recorded by Medielab.

- **Add more objects** in order to make the scene less empty. Note: these objects cannot be too detailed, or it will have a negative impact on performance.

- **Add animations** for non-interactable characters in the scene. For example, some NPCs will be able to walk around the fortress.

- **Remodel photos scanned objects** in Blender. Certain photo scanned objects in the scene are too detailed and have too many vertices.
    - Bunkers
    - Both 35P8 machine gun towers
    - Brick wall by the guard house (vaktbu 1)

- **Remove unnecessary objects, textures etc**. The bunker under the cannon tower can not be accessed so it should be removed. This also means we have to patch up the end of the corridor.

- **Lighting improvements.** Visual improvements to lighting. This also includes changing the lighting from real time to pre baked lighting. If time allows, the use of light probes to send lighting data to moving objects can further improve performance.

- **Fix buggy 3D models**. Some models are not rendering correctly when used with baked lighting. These same models are more complex than they need to be, and a possible quick fix would be to simplify the models

- **Post processing effects** to improve the visual fidelity of the game.

- **Fog** can help boost performance by hiding distant objects. It can also help remove some visual artifacts on some distant objects and create a moody atmosphere

- **Vehicle Animations.** This includes animations for the truck that the player meets on the southern road and crashes on the northern side.

- **Minefield and grenades.** Grenades are fun, when they aren't real of course.

- **Intro car ride and title.** New intro scene where the player drives towards the fortress.

- **Particle effects** like smoke, embers, dust etc.

6. Non-functional requirements

- **OpenXR** as the new input system. This ensures the game can be used with almost any VR headset.

- **Unity 2021.2.** The earlier project was made in Unity version 2019.3.7f1. However to use OpenXR to the full extent of its capabilities the project must be updated to a newer version of Unity. We have landed on 2021.2, as it is the latest stable version of Unity.

- **VR for PC.** The project in its current state is too compute intensive to run on mobile VR headsets like Oculus Quest, and Quest 2. It is unlikely that during this development phase the game will meet the performance requirements of any current generation mobile VR headsets. For that reason the game will only be available on PC.

- **Universal Render Pipeline,** or URP, is one of the render pipelines you can choose in Unity. The project originally ran on the HD render pipeline, however this does not support mobile VR, and is about 20% more performance heavy. In an effort to improve performance, as well as the possibility of a future mobile VR version, the project will be switched to URP.

7. References

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