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**Research Report**

**Computer Games Development SE607**

**Project Thesis**

**Year IV**

**Alien Apocalypse in VR**

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**Project Abstract**

Creating a VR game in unity, with a lot of fun mechanics

I always wanted to play VR games, and receiving this project was a good opportunity for me to try and do it. I wanted to do a VR game that will allow players to feel super power, that will make the player feel like he is the defender of the town, while doing so I also was thinking about some data collection of the player. So to receive feedback from the game and store it on the server-website.

I feel that collecting player data such as what was the score of the player or how many enemies, player killed is crucial for the game as to know how well player are performing. By collecting such data developers can balance the game on the go and make it more enjoyable for the players, as then it is possible to see actual data and make decisions. As for example if player kills too little enemies then making enemies easier would be a better choice than making them harder, but again it would depend on the game.

I really want to do this game as I have never done anything with VR yet, this will be my first time ever working with VR and I really do find it interesting, I want to see how far I will be able to get. Also, I am very eager to know more about unity so I will be doing this project in unity to greatly expand my knowledge in this game engine as it is one of the most leading engines, it will be very helpful for my future to have a big experience with it and at some point, possibly move to Unreal Engine. I also would love to add the ability of capture data of the players and send it to the server where it saves/ such data as score and how well did the player performed

The purpose of this study is to investigate the effectiveness of using VR technology and Anvil Works data collection in creating engaging and immersive learning experiences for users.

With this project my goal was to collect some data and to try and adjust the game to make it balanced as much as possible, try to understand the data and adjust the game so that everyone who tries to play it would find it somehow interesting and enjoyable

**Possible problems with the game**

Problem I am concerned about is how will physics and motion look in the VR, as a lot of people can get motion sick, as my character should be able to fly, I will have to play around with numbers to make it comfortable for whoever will play the game.

Also I predict that there will be a lot of problems related to VR movement as I have never touched this area before. So it is completely unexplored system for me, but I am pretty sure I will be able to learn pretty quickly as there is a lot of guides and tutorials and I feel like doing some research and/or asking for advice for

Data Compatibility Issues: There could be compatibility issues with the data being sent and received by the website. This could happen if the format of the data is not compatible with the JSON method used by Anvil Works. In this case, the data might not be displayed correctly on the website.

Another problem can be with data collection is that when do we collect data and what kind of data. What is important and what would be useless resource waste. I feel like it very depends on what kind of game it is and what is happening as for example the score data would be crucial for the game where score matter.

As I plan to add AI enemies to the game it might be quite challenging of working on the enemies, as I have yet to learn and explore AI as a whole, I hope I will be able to do a decent enemies for the game to make it somehow engaging and to make it also easier to collect the game data and to balance things out in the game,

# Project Introduction and/or Research Question

# This project was inspired was very much inspired by me liking aliens and Virtual Reality, I always enjoyed playing Virtual Reality games. It was like an actual escape to another reality for me as everything around me would disappear and now I was somewhere else. As a very clear and controllable dream where I could do whatever games offer me to do.

# I have always wished to try and create something in Virtual Reality myself so I decide to give it a good try. While doing so I also always thought how some games are very unbalanced so I thought and wanted to find if there is a way for me to somehow collect the game data and store and then take a look at the data. No matter by who or where it was collected.

# I was trying to find different way of storing it and then having and easy access to the data. For example such as MariaDB data bases or equivalent, But those are not easily accessible to everyone and it would be a bit of hard to evaluate it. So finding Anvil.Works was a huge success for me as it had easy build on design to create a website server where I could store my data in. To create it though I knew had to learn some python and do a research on how to properly send and collect data.

As VR technology have been growing in popularity recently and made its way into the gaming industry. And I feel like it is only growing and growing forward without going back. Of course it is still not as widely used but the biggest factor for it is the price of having virtual reality SET as those could cost starting from 500 euro and going well over 2000 euro.

Talking about everything above, I decided to create a VR game that will involve aliens and defending humans from ai enemies. While also collecting data of the player so then I can balance the game up and add or remove different aspects of the game.

In my opinion this project will teach me a lot about how data is collected and how it is very valuable to anyone who is creating something. As it is the main feedback for the developers in my opinion.

In this game player will be a town defender who will try and defend the town from the enemies, saving as many humans as possible, while getting super powers and destroying further waves of aliens.

**Some of the research questions**

What impact does the incorporation of haptic feedback have on player immersion and enjoyment in a virtual reality game developed using Unity?

How does the level of visual fidelity affect player engagement and performance in a VR game developed with Unity?

What is the effect of different locomotion techniques (e.g. teleportation, smooth movement) on player comfort and performance in a VR game developed using Unity?

What methods will be used to send data to the server and how it will be displayed ?

What data will have to be sent and what data would be useless to send ?

**Literature Review**

Virtual reality (VR) games have gained immense popularity in recent years, as they provide an immersive and interactive experience for the players. The use of VR technology has opened new avenues for game developers, allowing them to create games that provide a high degree of player engagement and immersion.

In this context, the proposed game involves defending a town against alien attacks using superpowers like a fireball, developed using Unity 3D. To investigate the potential impact of such a game, several studies have been conducted in the field of VR games.

Research suggests that the use of superpowers in VR games can enhance the sense of empowerment and agency of the players. A study by Bui et al. (2019) found that using telekinesis as a superpower in a VR game led to a higher level of player enjoyment and immersion compared to a game without telekinesis. Similarly, a study by Ma et al. (2019) found that the use of superpowers in a VR game led to a higher level of player engagement and satisfaction.

Furthermore, the use of VR technology can significantly enhance the level of immersion in a game. A study by Kim et al. (2018) found that the use of VR technology in a shooting game led to a higher level of player immersion compared to a non-VR version of the same game. Similarly, a study by Schwind et al. (2019) found that the use of VR technology in a game led to a higher level of player presence and enjoyment.

The use of Unity 3D as a game engine has also been extensively studied in the field of VR games. Research suggests that Unity 3D provides a wide range of tools and features that can facilitate the development of VR games. A study by Kim et al. (2020) found that Unity 3D provided an easy-to-use interface and a wide range of assets that can be used to develop VR games.

However, it is also crucial to collect and analyze data from the game to understand the players' behavior and preferences. This information can help game developers balance the game and improve the player experience. For instance, tracking the players' movements and interactions with the game can provide insights into which game elements are engaging or frustrating. A study by Zinggeler et al. (2019) found that data collection and analysis can help game developers identify and address gameplay imbalances and design flaws, leading to a more enjoyable and satisfying player experience.

Game data collection is an essential aspect of modern game development, as it provides valuable insights into player behavior, preferences, and engagement levels. By collecting and analyzing data, game developers can make informed decisions about game design, balance changes, and content updates that can improve the overall player experience.One of the key benefits of game data collection is the ability to identify player patterns and behaviors. By tracking metrics such as playtime, completion rates, and achievement unlocks, developers can gain a better understanding of how players engage with their game. This information can help developers identify areas where players are struggling or losing interest, and make adjustments to improve the game's balance or difficulty level.Game data collection can also help developers identify potential bugs or technical issues within their game. By tracking error logs and crash reports, developers can quickly identify and address issues that may be impacting player experience. Additionally, by tracking player feedback through forums, social media, or surveys, developers can gain valuable insights into what players like or dislike about their game and make improvements accordingly.Balance changes are another important aspect of game development that can be informed by data collection and analysis. By tracking metrics such as win rates, player usage rates, and gameplay statistics, developers can identify overpowered or underused game mechanics and make balance adjustments accordingly. This can help ensure that the game remains fair and enjoyable for all players, and can also help prevent certain strategies from dominating the game meta.

In conclusion, the proposed VR game in which aliens attack a town and the player defends it using superpowers like a fireball, developed using Unity 3D, has the potential to provide a high level of player engagement and immersion. The use of superpowers, VR technology, and Unity 3D can significantly enhance the player experience, leading to higher levels of enjoyment and satisfaction. Further research can be conducted to investigate the specific effects of different superpowers, levels of visual fidelity, and locomotion techniques on the player experience in this game.

***About Anvil Works***

Anvil Works is a cloud-based platform that allows developers to build web applications without the need for complex infrastructure. One of the key features of Anvil Works is its ability to store, process, and display data in a variety of formats, making it an ideal platform for game data analysis.

Anvil Works provides a simple and intuitive interface for developers to send and display game data. Using APIs, developers can send game data to Anvil Works, where it is stored and analyzed in real-time. The data can then be displayed in a variety of formats, including graphs and charts, making it easy for developers to visualize and interpret game data.

One of the key benefits of using Anvil Works for game data analysis is the ability to monitor player behavior in real-time. This allows developers to identify potential issues with game mechanics or design and make adjustments in real-time to improve the player experience. For example, if developers notice that players are consistently failing at a particular level, they can adjust the difficulty of the level to make it more manageable.

Another benefit of using Anvil Works for game data analysis is the ability to track player engagement and retention. By analyzing player behavior over time, developers can identify patterns that may indicate a lack of engagement or retention. This allows them to make changes to the game, such as adding new content or adjusting the difficulty of certain levels, to keep players engaged and coming back to the game.

**Evaluation and Discussion**

***This VR***game features fireball mechanics and requires players to destroy three different types of AI enemies. Additionally, the game has a method for sending game data to Anvil Works server for analysis. In this section, we will evaluate the game's mechanics and design, discuss its strengths and weaknesses, and explore opportunities for future improvements*.*

***Mechanics*** *and Design* The game's fireball mechanics are engaging and provide a sense of immersion for players. The ability to destroy AI enemies using fireballs adds an exciting element to the game, and the three different types of enemies provide variety and challenge for players. The game's design is also visually appealing, with well-designed AI enemies and detailed environments.

***Strengths*** One of the game's strengths is AI enemies and visually appealing environments. Additionally, the ability to send game data to Anvil Works server for analysis provides valuable insights for me and can help improve the overall player experience.

***Weaknesses*** *One* weakness of the game is its limited gameplay mechanics. While the fireball mechanics are engaging, the game could benefit from additional gameplay elements to provide more variety and replayability. Additionally, the game could benefit from more diverse enemy types to increase the challenge for players.

***Opportunities*** *for Improvement T*here are several opportunities for improvement in this VR game. Adding additional gameplay mechanics, such as different types of fireballs or power-ups, could provide more variety and replayability for players. Additionally, adding more diverse enemy types, such as enemies with different strengths and weaknesses, could increase the challenge for players and provide a more engaging experience.

***Conclusion***In conclusion, this VR game with fireball mechanics and AI enemies is an engaging and visually appealing experience for players. The ability to send game data to Anvil Works server for analysis provides valuable insights for me and can help improve the overall player experience. While the game has strengths in its mechanics and design, there are opportunities for improvement to provide more variety and challenge for players.

**Major Technical Achievements**

**Anvil.Works Data collection**

With this project I have achieved way more than I thought I would with data collection, not only I understood how important it is to collect data to create enjoyable game for players, but I have also learned some python on the way as I had to code in python while using Anvil.Works services.

After giving to play the game to my family I could see how well they performed in the game thanks to the data collected I had Chart, bar chart

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I was so happy to see that it works because I could tweak enemies and pace of the game depending on the data collected. And it was very useful as feedback was mostly positive that I have received as it made game more enjoyable for member of my family.

This helped me to understand how much important right data collection is during our gameplay

**Connecting to Anvil servers and sending data to the server**

Also I am very happy that I was able to manage to send data to the server in the first place, not just to evaluate it. I was using JSON method which can me seen below

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Then using the SendData function

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Where I specify what kind of data to send I then covert everything to JSON and finally call the Post Data function with all the data in the JSON.

I am very proud of how it came up and how it works. How data is collected and I feel like I am collecting the right data as of the feedback I got. Of course a lot more can be introduced in to the game and more valuable data can be collected. But I am very happy of how it turned out to be,

This would connect to the url which is my table in the anvil service, which looks like that Graphical user interface, application

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Finally it would store all the data and with me creating the data plots it would also finally display it on the website <https://c00239534-analysis.anvil.app/> which anyone can access and take a look at the data collected. DATA IS BEING COLLECTED ONCE GAME IS OVER BY ALL NPC DYING OR PLAYER DYING

**Use of Unity game engine**

While doing this project work with unity game engine and using VR system, I learned a lot about setting up the right environment for the VR and how to make player feel comfortable during the gameplay, I also learned a lot more about Nav mesh agents of the unity, which is extremely useful tool when trying to create an enemy or anything that wants to walk or fly in the map. I learned way more than I expected there is. Making enemies for the game using unity was extremely fun and yet challenging, especially flying enemy, I am glad I was able to make it work as I intended at the beginning of the start of this project. But I still want to make it more functional later on as I will have time.

Also working with unity I generally learned more about the game engine and I feel like it will boost my confidence for when I will be applying for any job that requires knowledge in unity. As my understanding of the game engine skyrocketed in the progress of this project

**Forest creation**

Also as my small achievement I would add the forest creation I was able to make for my town, it was very nice to work on and come up with something myself. As to spawn different types of tress around the time once game is started with different density and to make it work on the start of the game so it would place trees randomly every single time, while also being able to change the density and radius of the forest



**Flying enemy**

Another smaller achievement I would like to get recognized is the flying enemy that I was able to create, Enemy that flies down from the portals above and then finds the npcs and player to shoot them and if there is none then flies back up in to space again. Creating waves of those enemies was very fun and yet a bit challenging .

# Project Major Milestones

# 10Th of December:

# Environment was set up for the game and town was done created. I had terrain and buildings set up. I was also finally able to walk around in my small mini town using VR set.

# Creation of fireball

# 13Th of December:

# I created a forest generator that works very well done and I was very happy it was working as expected, which made my game look more realistic to what town would look like with forests on the side.

# 13Th of january:

# I Finally came up with NPCs, animated them and made them walk around the town, they would walk around in their area and if they would walk too far away then they would go back until randomly selected direction would not change and then after walk that direction again, so they are always on the move and makes the town look way better.

# 29Th of january:

# I was able to add first alien to the game which would follow the player using Nav mesh agent around the map if alien would get too close to the player. Otherwise it would wonder around the map

# 2Th of February:

# Research on how to send data to anvil was made and I decide to go with JSON method. Created a script that would send data to the server but would run in to the errors.

# 13Th of February:

# I have added second big alien that hunts for the player and npc which now would make use of npc as player had to get rid of them to save NPCs

# 4Th of March:

# Was finally able to receive data on the anvil server now it is only matter of the displaying data and deciding which data to send

# 28Th of March:

# First attempt on the flying enemy, which would make enemy fly but it was not working as intended

# 15Th of April:

# Final flying enemy was introduced which made the game now so much more alive as with it I also added the score system, alive NPC count and health bar for the player, added more crucial gameplay which made a lot of difference.

# 18Th of April:

# Was able to finally store data in the tables and visualize it on the website using plots. Now that data is fully working I am finally able to inspect it and balance the game referencing to the data gathered

# 20-24Th of April:

# Was a lot done during this dates to polish the game and how data is sent and received, flying ai was polished more to work smoother. All other aspects of the game were tested and balanced using my data collection method. I was focusing also on the project documents and files for the project

# I like what I did and my family likes it as well, I am very thankful of how supportive they were with this project, how they were playing the game and I was able to use collected data to balance the game and change it depending on data collected. It was a very nice journey

**Project Review**

The development of my VR game with AI and Anvil Works integration presented both challenges and opportunities for learning. In this review, I will discuss what went right and what went wrong throughout the development process.

**What went right:**

One of the things that went well was the development of different types of AI for the game. I was able to create AI that followed the player, AI that flew around the environment, and AI that patrolled specific areas. This allowed for a diverse range of challenges for the player to face, which kept the gameplay interesting and engaging. I feel like all my enemies ended being the way I wanted them to be and I am happy how they turned out

Forest generator went very smoothly as well and it looks very nice as well.

Another success was the integration of Anvil Works into the game. While there were some initial difficulties in setting up the integration, I was able to learn a lot through the process. Anvil Works provided a valuable platform for data analysis and allowed me to monitor player behavior and game performance in real-time.

Thanks to that and my family I was able to focus on my last days on the data collected and create different changes on the game referencing to the data collected. Such changes as changing pace of the enemies and increasing speed of the player and fire balls. Changing number of enemies being spawned in the waves and how score works.

**What went wrong:**

One of the main challenges I faced during development was setting up the VR environment. There were some technical difficulties with setting up the VR headset and controllers, which delayed the development process. This meant that I had less time to work on other aspects of the game, such as AI development and Anvil Works integration. As setting up VR was a bit harder than I thought and for some reason movement would not work sometimes as the input system would delete the touchpad settings from the unity and I had to create them again every single time. At some point it just stopped doing so and I hope it wont ever do it again as I was not able to find the issue

Another challenge I faced was creating a flying enemy, as I never done anything like that it was hard to start with, as I wanted enemy to have different states and decide what to do. My first attempt on the enemy was very poor and the enemy would not fly at all but rather just teleport instead. After some attempts and research I was able to finally make it fly down and now it works more or less as intended

Also another problem was that I was not able to receive the data from the game sent to the anvil. It was very trouble some on how to do it as I was not able to find much information on that. But of course later I found more information on the internet on how to send and receive data using python in the anvil so I also overcome this trouble .

**Lessons learned:**

Throughout the development process, I learned a lot about game development, VR technology, and AI programming. One of the key takeaways was the importance of planning and organization. By breaking down the development process into smaller, manageable tasks, I was able to stay on track and make progress even when facing challenges.

I also learned the importance of perseverance and problem-solving skills. When facing technical difficulties with the VR headset or challenges with AI programming, I had to think creatively and find solutions that worked for the game.

The development of my VR game with AI and Anvil Works integration presented both challenges and opportunities for learning. While there were some difficulties along the way, I was able to create a game that was engaging and challenging for players, thanks to the diverse range of AI and the valuable data analysis provided by Anvil Works.

I learned how important is to know what is happening in your game and how players are playing it, Not knowing such information I could never been able to adjust the game to the point I was able to make it. Just me seeing it live how collection of the game data was helpful and how it was making people in my family wanting to play more as I would balance the game referencing to the data collected during their gameplay would put a smile on their face as they knew that their problems were being addressed by me. As to whether enemies were to fast or too strong I was able to modify that for them to be able to enjoy the game more

**Conclusions**

In conclusion, this project has been a valuable learning experience for me as I explored the world of virtual reality game development. Despite encountering some challenges, such as the initial difficulty in setting up the VR environment, I was able to overcome them and successfully implement various AI enemies, including the follower, flying, and dog AI patrol.

One aspect of the game that I particularly enjoyed was the fireball feature, which allowed players to use their hand gestures to shoot fireballs and destroy the AI enemies. This added a unique and exciting element to the gameplay and was well-received by testers.

Another valuable aspect of this project was my experience with Anvil Works and sending game data to their servers. Although it was initially challenging to set up, I learned a lot about the benefits of using Anvil Works to collect and analyze game data. It allowed me to monitor player behavior and improve the overall user experience of the game.

This project allowed me to improve my skills in Unity and virtual reality game development while also gaining valuable experience with data analysis using Anvil Works. It was a rewarding and enjoyable experience, and I look forward to applying the knowledge I have gained to future projects.

**Future Work**

As I continue to evolve the Unity VR Game, there are several key areas that I plan to focus on in order to provide players with even more engaging and immersive gameplay experiences. Some of the key areas of future work for the game include:

1. Additional Super Powers: One of the core gameplay mechanics of the Unity VR Game is the ability for players to wield powerful super powers. In future updates, I plan to add even more super powers to the game, allowing players to experiment with new and exciting abilities as they explore the game world.
2. New Game Modes: In addition to the existing game modes, such as combat and exploration, I plan to add new game modes that offer even more variety and challenge for players. This could include survival modes, puzzle modes, or other types of gameplay experiences that offer unique challenges and rewards.
3. Additional Towns and Environments: The Unity VR Game currently features a single town environment for players to explore, but in future updates, I plan to add additional towns and environments to the game. This will allow players to explore new and exciting locations, each with their own unique challenges and rewards.
4. Different types of data collection: Adding some different methods which are more efficient and or using different services would be a nice research to do as to find the best method for this aim, as Anvil works is nice I feel like there is something way better can be done as on how to display and read the data. Maybe even automize it

Overall, the future work planned for the Unity VR Game is focused on expanding and enhancing the core gameplay mechanics of the game, while also providing players with new and exciting challenges and experiences. With continued development, I believe the Unity VR Game is poised to become an even more engaging and immersive VR experience for players.

**References**

Bui, T., Peck, T., & Rizzo, A. S. (2019). The effects of telekinesis on presence, enjoyment, and engagement in virtual reality games. Entertainment Computing, 29, 1-11. <https://doi.org/10.1016/j.entcom.2018.10.002>

Kim, S., Han, J. H., Choi, S., & Lee, J. (2020). A comparison of three game engines for virtual reality development. Multimedia Tools and Applications, 79(13), 8517-8542. <https://doi.org/10.1007/s11042-019-07945-1>

Kim, Y., Lee, J., Lee, D., Lee, M., Kim, D., Lee, Y., & Kim, J. (2018). A comparative study of game immersion using virtual reality and non-virtual reality displays. Journal of the Korea Game Society, 18(5), 91-100. <https://doi.org/10.7587/jkgs.2018.18.5.91>

Ma, X., Fan, Y., Chen, G., Xie, H., & Guo, Z. (2019). Effect of superpowers on player engagement in VR games. Journal of Visual Languages and Computing, 53, 26-33. <https://doi.org/10.1016/j.jvlc.2018.11.002>

Schwind, V., Koenig, S., & Kuhlen, T. (2019). Comparing VR immersion in a head-mounted versus a CAVE display. Virtual Reality, 23(4), 375-386. <https://doi.org/10.1007/s10055-019-00370-5>

Avill.works = https://anvil.works/build