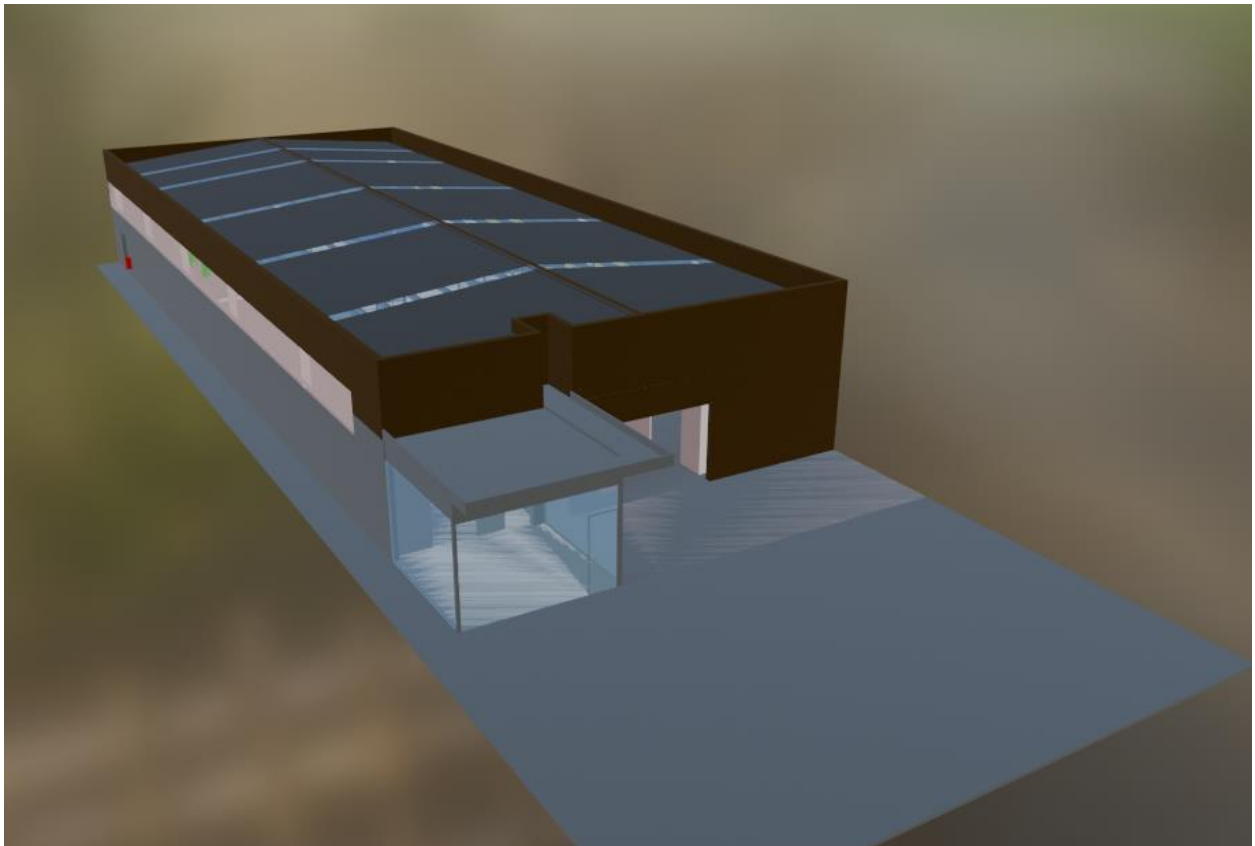


DOWSON DIGIFAC

GAMEDEV PROJECT



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Maryam Abbas

Technical report

number: 01

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ABSTRACT

In our factory, we make pumps for bottles using complex machines. These machines are essential but sometimes break down, causing delays and costing a lot to fix. We often need to hire expensive experts for repairs, which isn't always practical. Plus, our workers don't have the training to handle these repairs themselves. To solve these problems, we're creating a digital twin of our factory using Unity. This is a virtual model of our factory that lets us monitor the machines in real-time, spot problems early, and diagnose issues more accurately. With sensors data into this virtual model, we can simulate different machine breakdowns and use these simulations to train our workers. This digital twin will help us keep our machines running smoothly, save money on repairs, and train our workers to handle issues themselves. By using this technology, we aim to reduce downtime, cut costs, and improve our production efficiency, making our factory more productive and competitive.

INTRODUCTION

In this report, we discuss creating a Minimum Viable Product (MVP) of a digital twin for a factory using Unity. A digital twin is a virtual model that represents a real-world object or system. Our primary focus was on simulating the factory's operations, meaning we aimed to create a digital version of the factory that accurately mimics its real-life activities and processes. This simulation allows us to observe and analyze the factory's performance without needing to be there physically. By using Unity, a widely-used software for building 3D environments, we were able to construct this digital model. The purpose of this digital twin is to help us understand and improve the factory's operations, identify potential issues, and test changes in a virtual environment before applying them in the real world. This approach aims to enhance efficiency, reduce downtime, and optimize overall productivity.

Background information

In our factory, we make pumps for bottles using a variety of machines. These machines are important for our production, but sometimes they don't work properly. When this happens, it slows down our production and costs us a lot of money to fix. We usually have to hire highly skilled professionals to repair the machines, and they charge high fees. These experts aren't always available, which means our machines can be down for longer periods.

Most of our workers in the factory are less skilled and don't have the training to fix these complicated machines. This means we can't handle repairs ourselves and have to rely on outside help, which increases the costs and causes delays. We need a better way to manage and fix our machines. If we can detect problems early and train our workers to handle basic repairs, we can keep our production running smoothly and save money on expensive professional services.

Objective and scope

To address these challenges, we're developing a digital twin of our factory using Unity. This digital twin is a virtual replication of our physical factory. By using it we can detect and solve machine problems more efficiently even before they become major issues. This means we can fix problems

faster and at a lower cost, without always needing to rely on expensive outside experts. The digital twin will also be a great training tool for our workers. We can use it to simulate different machine problems and teach our staff how to fix them. This will help us build a more skilled workforce that can handle repairs on their own. By doing this, we'll save money, reduce downtime, and increase our production of bottle pumps. Our goal is to improve efficiency, boost productivity, and cut costs using this innovative technology.

SOFTWARES

- We used Unity as our main platform for creating the digital twin, leveraging its powerful features for building 3D environments.
- We utilized C# scripts within Unity to handle the simulation's logic and functionality, allowing us to accurately duplicate the factory's operations.
- To bring the factory into the digital form, we used Blender, a 3D modeling software, to import the factory file.
- Blender enabled us to create detailed models of the factory.
- This combination of Unity, C# scripts, and Blender allowed us to create a realistic and functional digital twin of the factory.

METHODOLOGY

1. Factory Model:

First I watched a couple of videos on YouTube related to unity. Then I added the blue print of factory in unity and made the structure of factory on it. But then I came to know that I already had a 3D file of factory and making the structure of the factory from scratch wasted a lot of time. So, then I added the 3D file of the factory in the unity using blender to convert the file because only .fbx file is supported in unity.

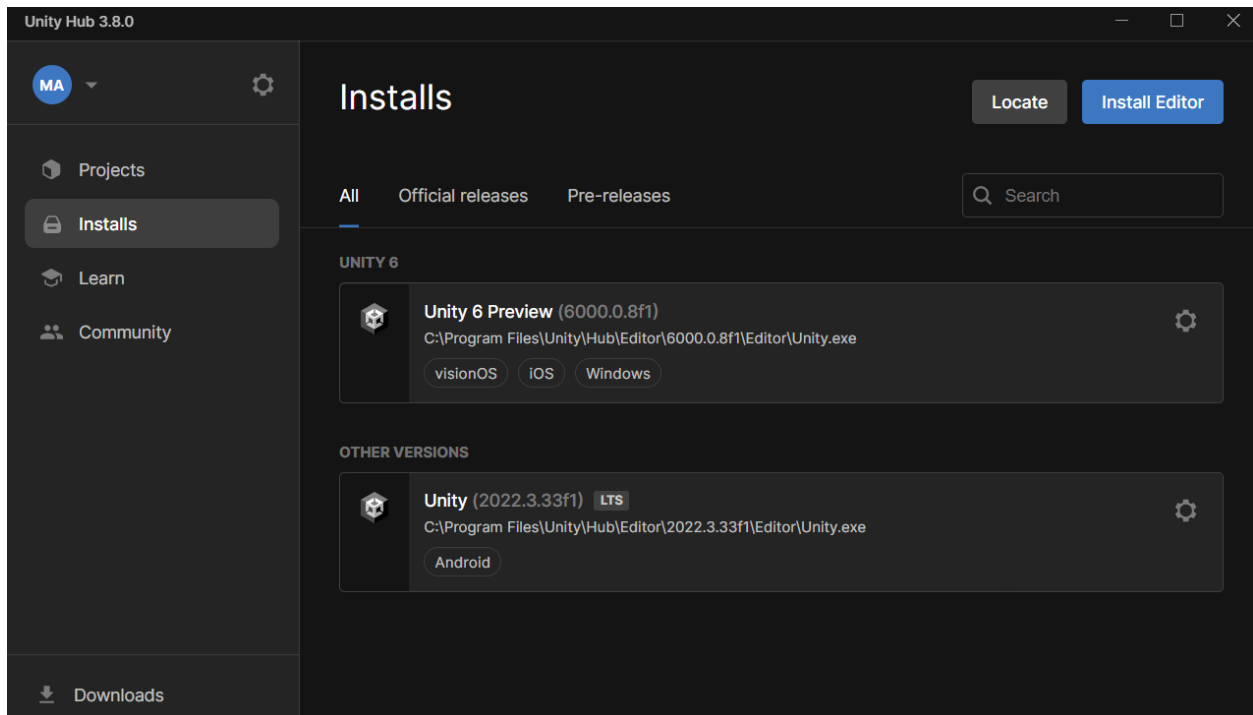
I made some changes and modifications in the factory. I added some components in the warehouse and added a road and turf outside the factory so we can detect the parking area easily.

2. Adding character:

To show some kind of simulation I added a character in the factory so that it can move or walk in the factory. I watched some videos to add animation to character in order to make it move. I imported the character that looked like the factory worker to make it look more real. I faced some challenges while adding animation to the character because I was learning to use unity at the same time but eventually with a lot of effort I made the character more.

STEPS

1. First, I created a Unity account by visiting the link <https://learn.unity.com> link
2. Then I downloaded the unity hub and installed the unity editors.



3. Next, I accessed the tutorial on digital twins available at Introduction to Digital Twins with Unity. This tutorial provided me with an understanding of what digital twins are and detailed instructions on how to create them using Unity.
<https://learn.unity.com/tutorial/introduction-to-digital-twins-with-unity#>
4. After gaining some foundational knowledge, I proceeded to download and install Unity Hub, which is a management tool for Unity projects and installations. Using Unity Hub, I also installed the necessary Unity Editor to start developing.

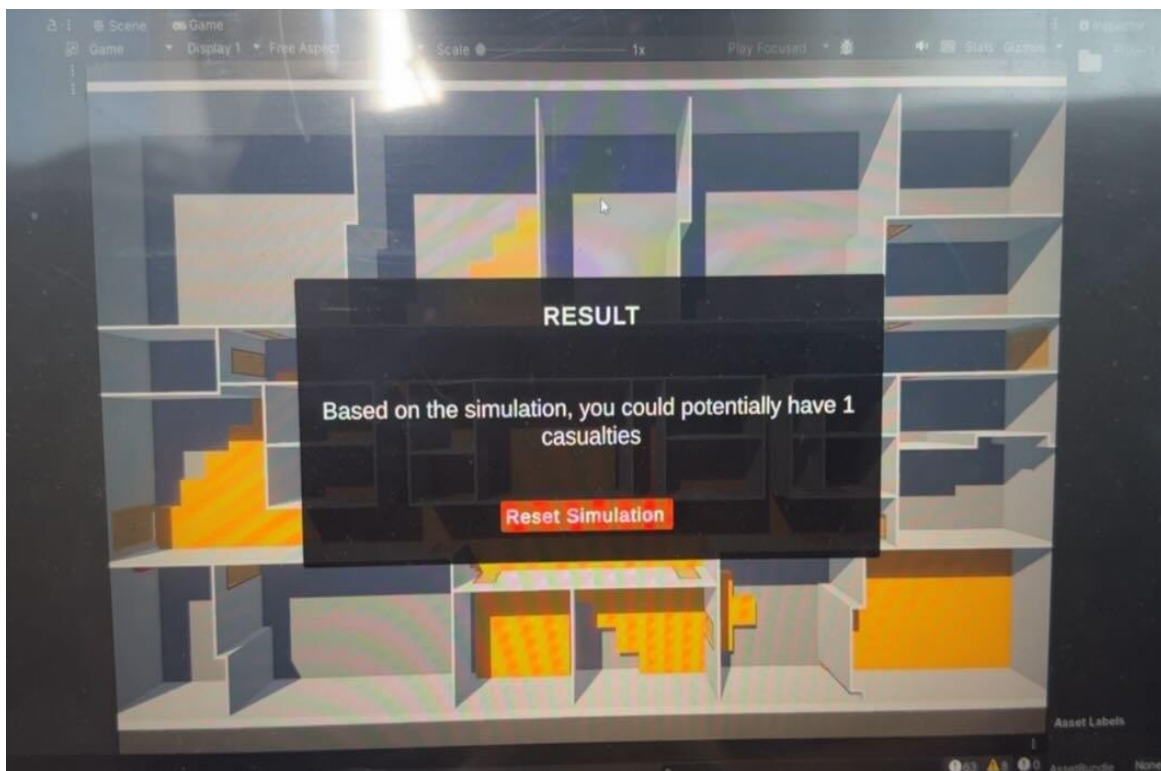
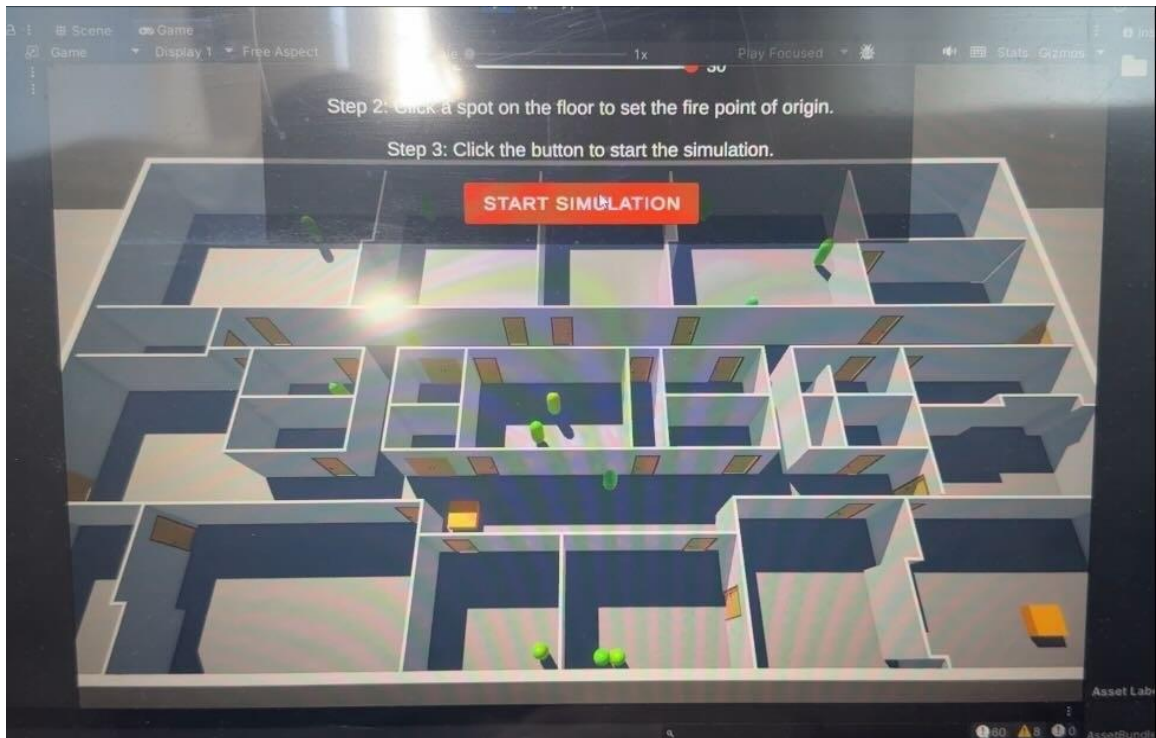
5. Then I downloaded a digital twin project from the same tutorial link Introduction to Digital Twins with Unity. This project served as a practical example and starting point for creating my own digital twin.

<https://learn.unity.com/tutorial/introduction-to-digital-twins-with-unity#>



6. Then I followed the steps written in the digital twin link.

<https://learn.unity.com/tutorial/introduction-to-digital-twins-with-unity#>



7. Then I watched the videos from YouTube for better understanding and working of unity.

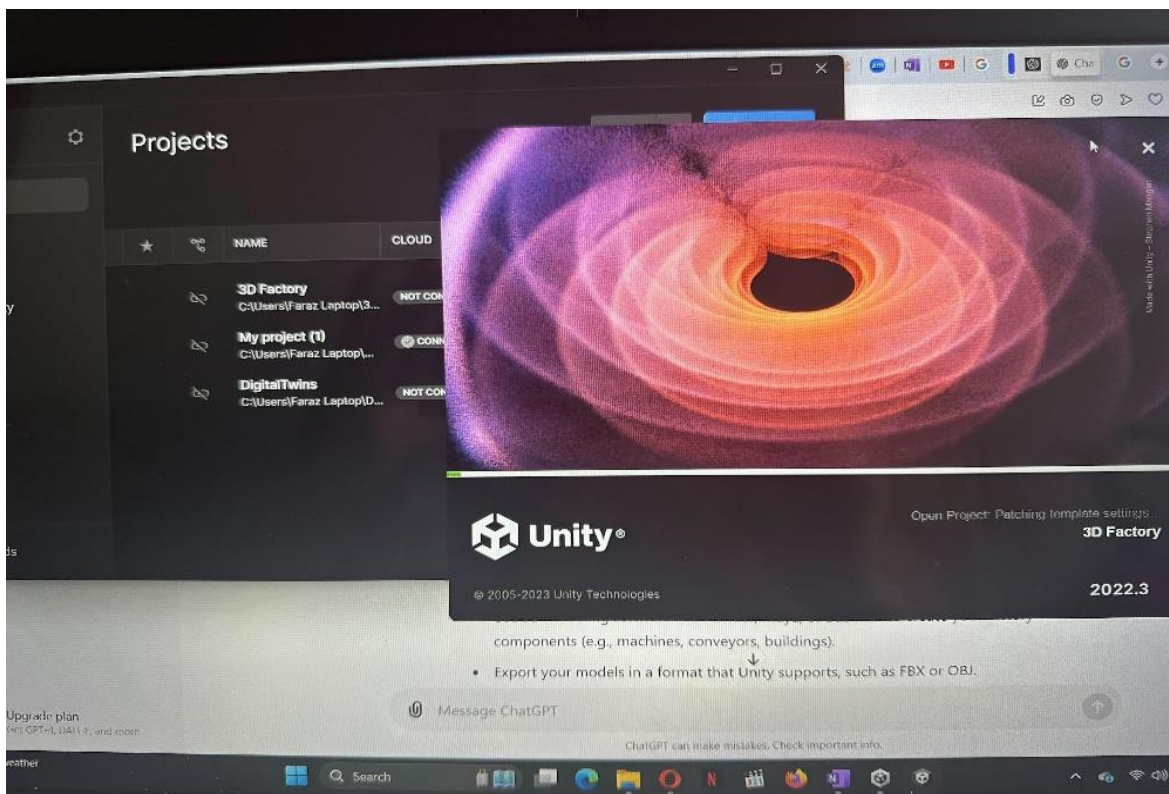
8. These YouTube videos were very helpful in learning unity environment and were related to creating factory from blue print.

<https://youtu.be/iVS-AuSjpOQ?si=eqqP-KLT4WJ-6miO>

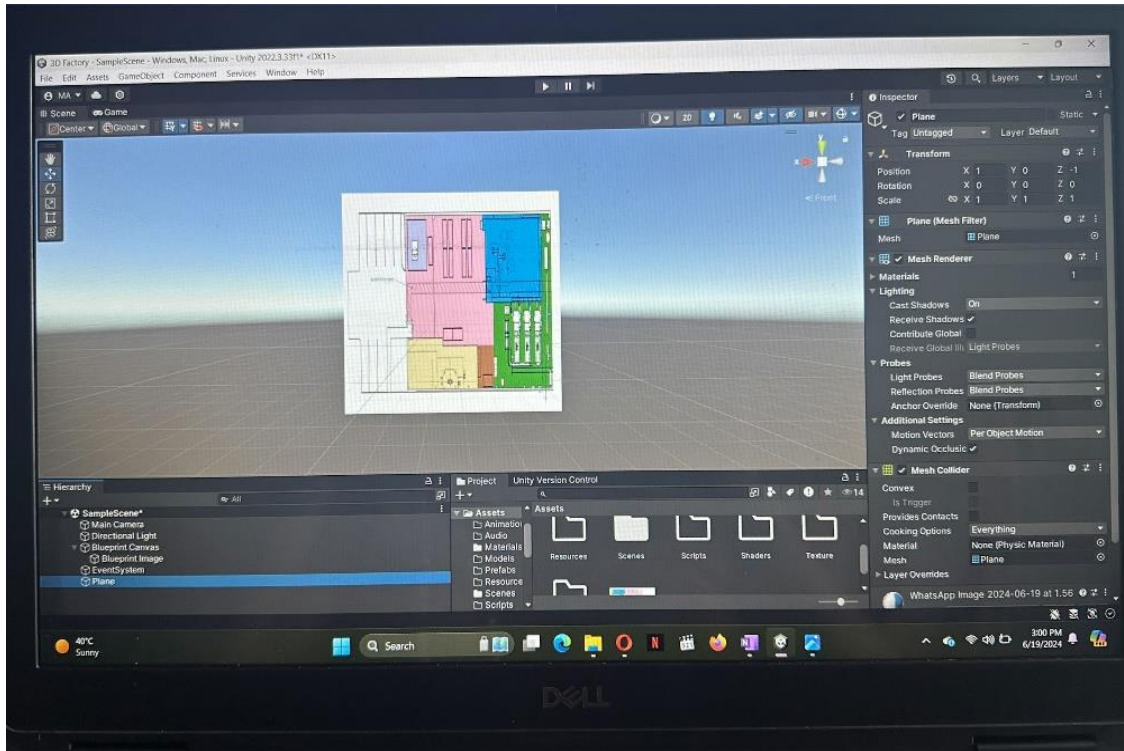
<https://youtu.be/Pn4QTBucbMM?si=8gwsN88gZ0Yp7I10>

<https://youtu.be/cfbKR48nSyQ?si=K6ODmdIX9kaB38R1>

9. I made a new project named as “3Dfactory” in unity.



10. I added the blue print which is the map of the Dowson factory by dragging and dropping a .png format image in unity



11. Then I watched videos from following links regarding digital twin.

<https://youtu.be/I5M4sqaRd6w?si=h1TF0k2PePCN9nqh>

<https://youtu.be/VW-dOMBFj7o?si=ZpvDjkxqpDupmCMY>

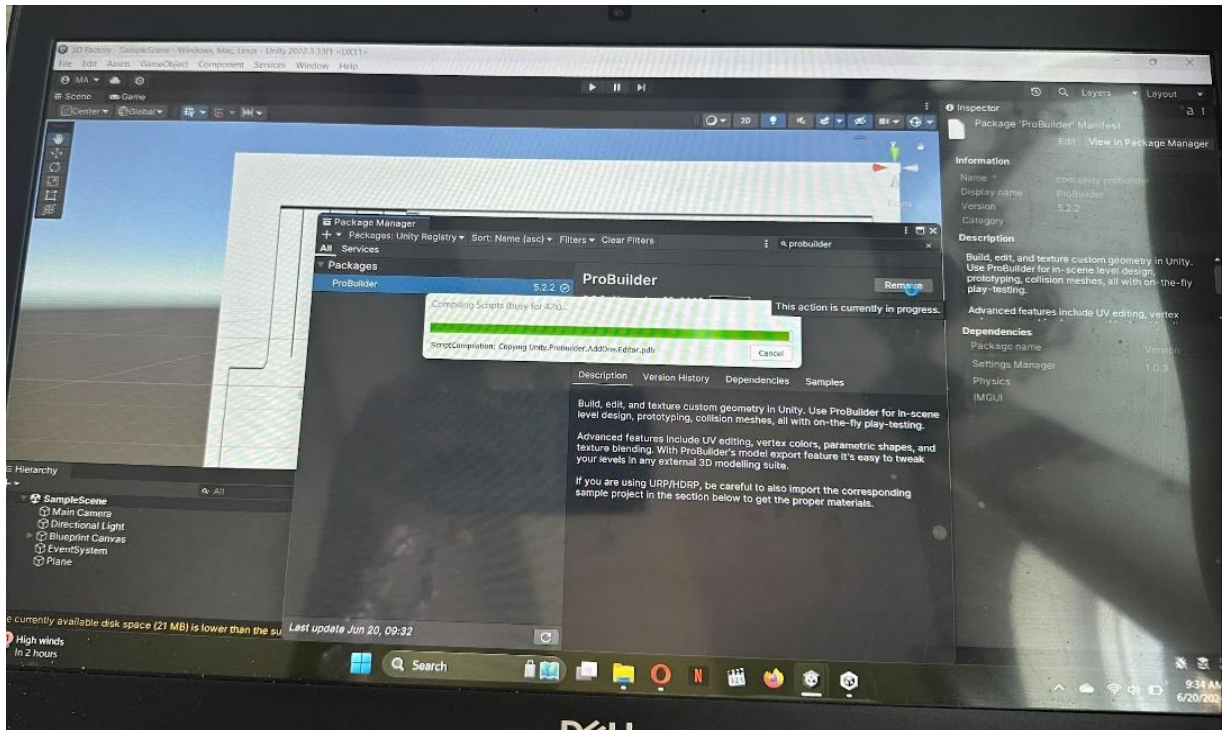
https://youtu.be/6uUC63qD9vE?si=xrLwTBwgAwi_ppsf

<https://youtu.be/-VQLqs6s9y0?si=96hiKr84V9HJDUat>

https://youtu.be/3SMm0YTk7fY?si=7sJzIX23QmYAa_K

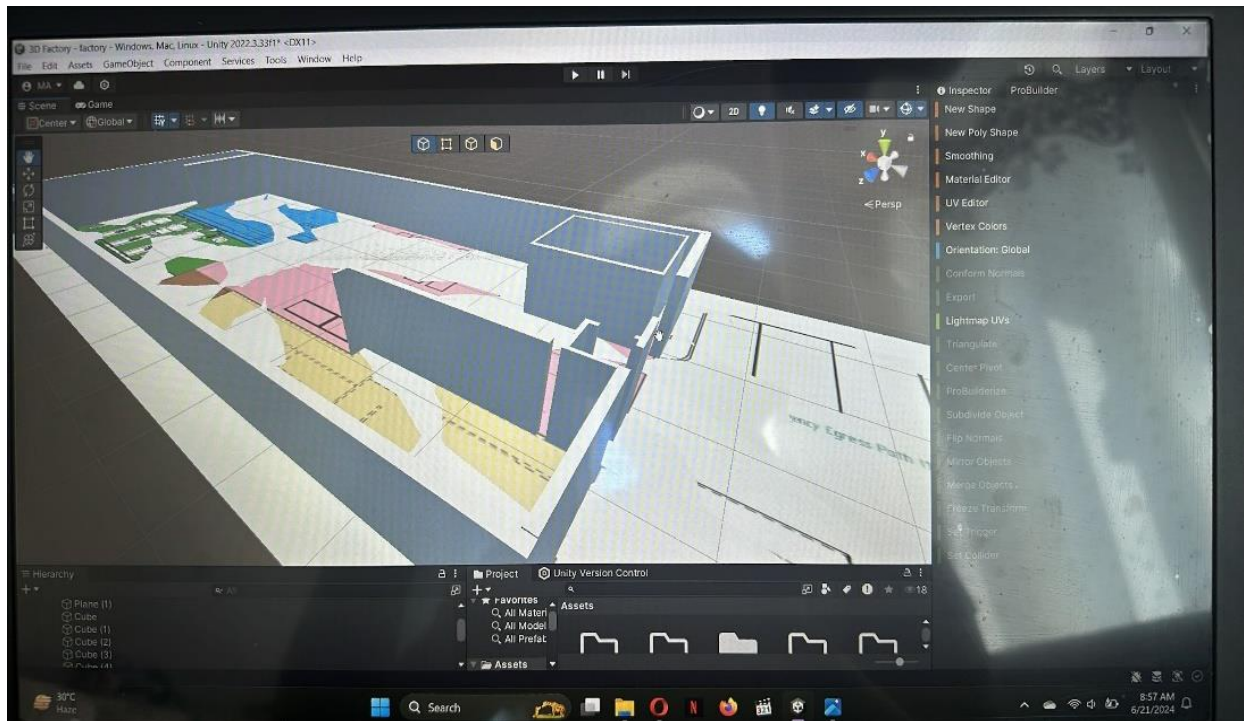
12. I downloaded pro-builder asset in unity from package manager.

13. The pro builder asset was installed that allowed me to add shapes in unity.



14. I started building the structure of the factory on the blueprint.

15.By using cube tool, I started building the walls of the factory according to the design of blueprint.



16.I watched videos from the following links

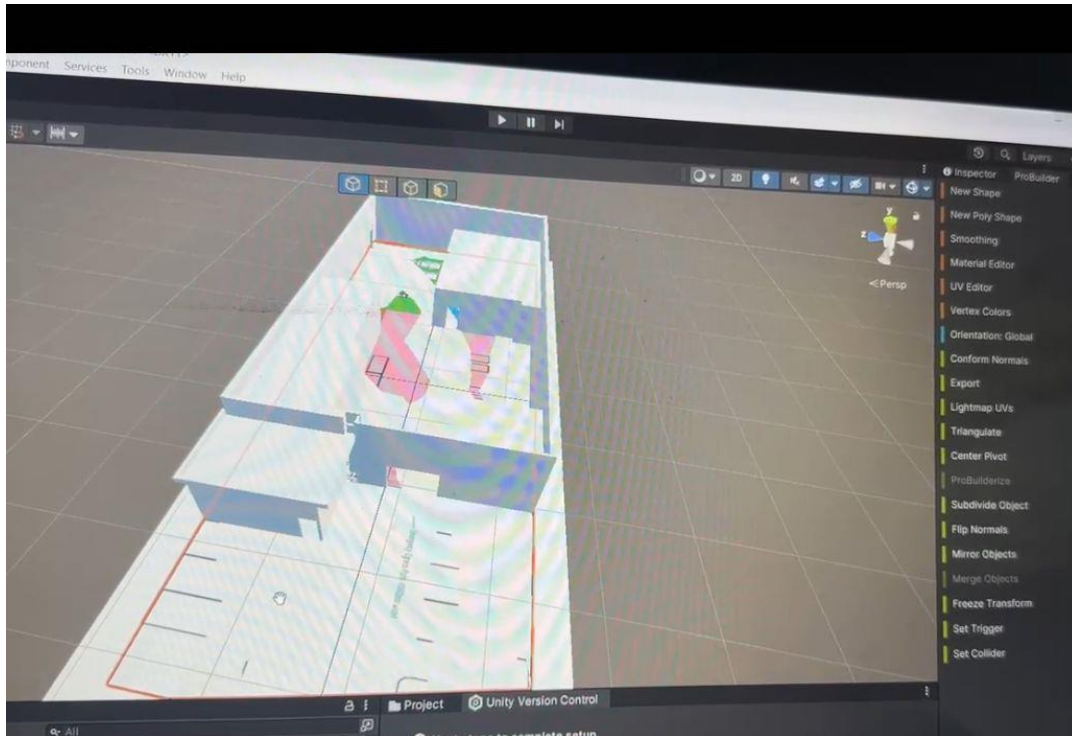
17.These links were related to building the walls of the factory on blue print using cube tool of bro builder asset

18.These videos contained information for adding textures and materials in unity and assigning them to the objects.

<https://youtu.be/UJaF5DqfJs0?t=7>

https://youtu.be/SyFxLeSB5_s

19. I made this final structure of the factory and came to know that of this hard work was useless because I did not pay attention to the information provided to me.



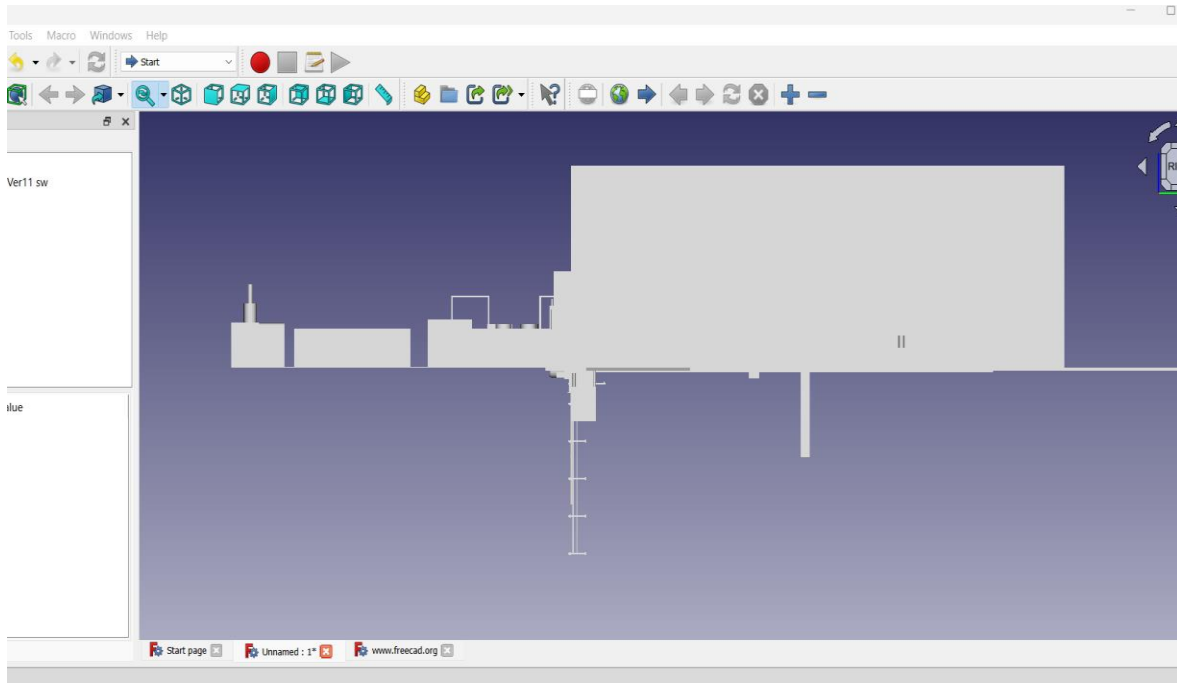
20.I was already provided with a 3D step file of the factory that I missed looking.

21. To learn the steps of importing the step file into unity I watched the following videos .

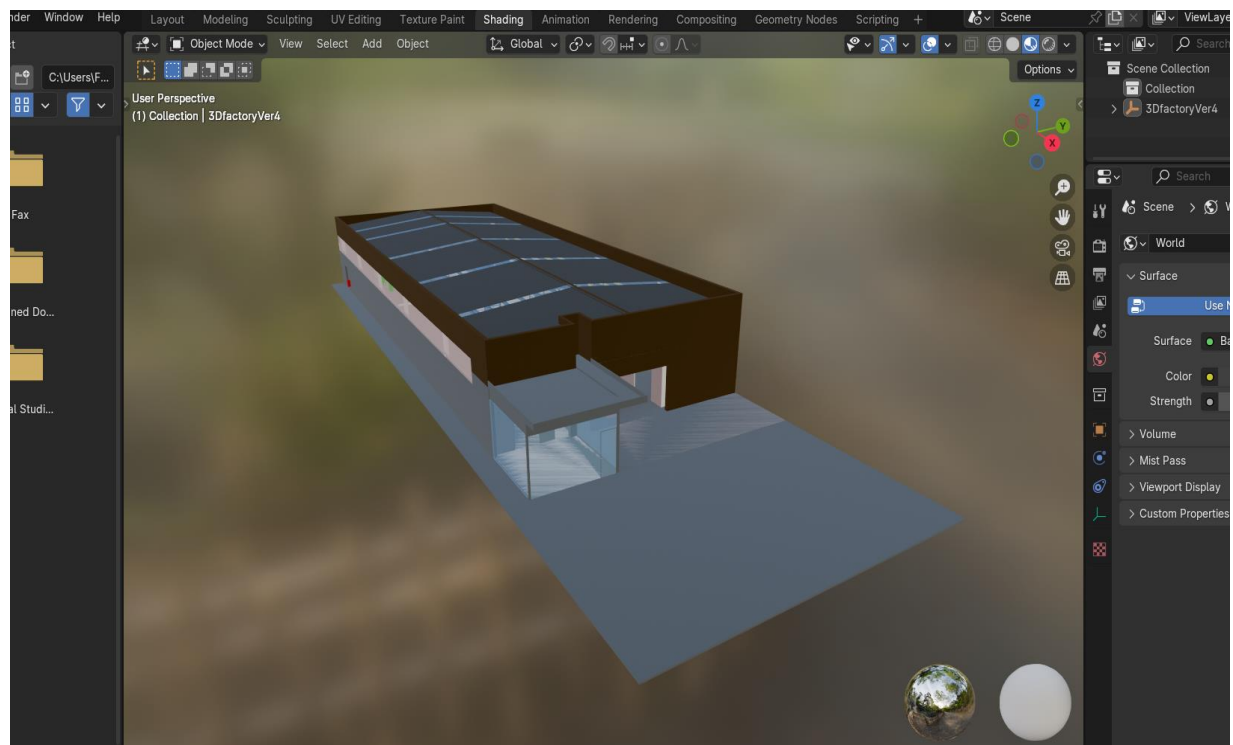
<https://youtu.be/j8WefhRmeQ8?si=wWE0mD29tview4n3A>

<https://www.youtube.com/watch?v=5UZ-niuRWz8>

22.I converted the .stp file to .glTF file using Free CAD application.

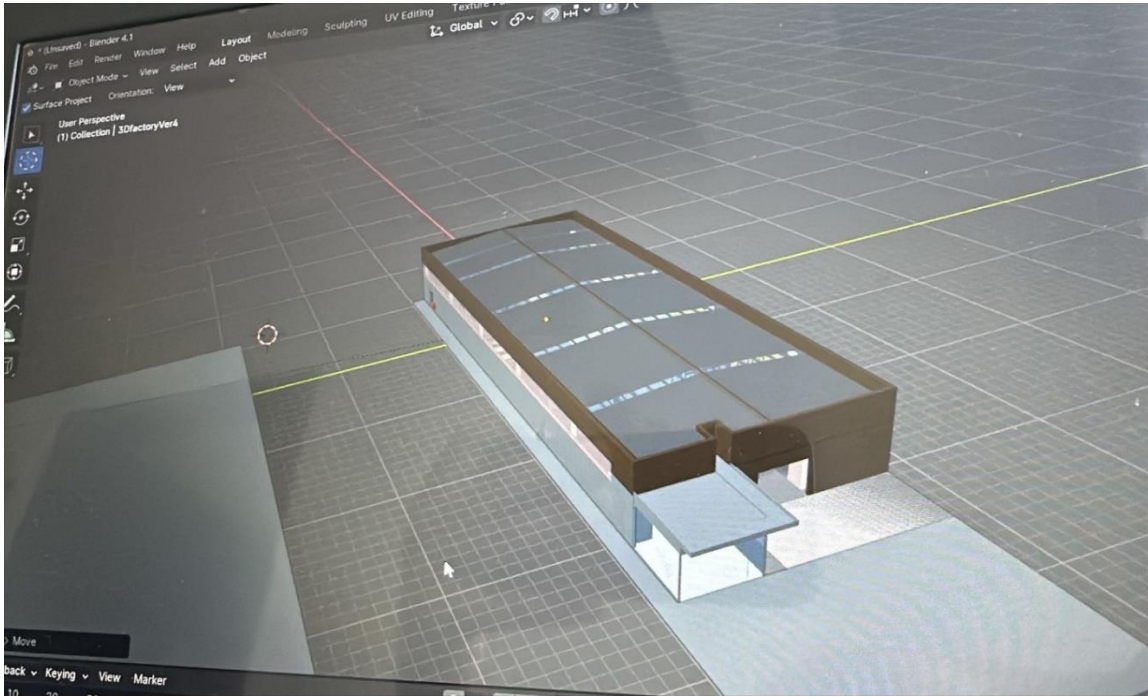


23. Then I added the converted .glTF file to blender application.



24. The file was then exported and saved as a .blender file

25. I added the .blender file into unity.

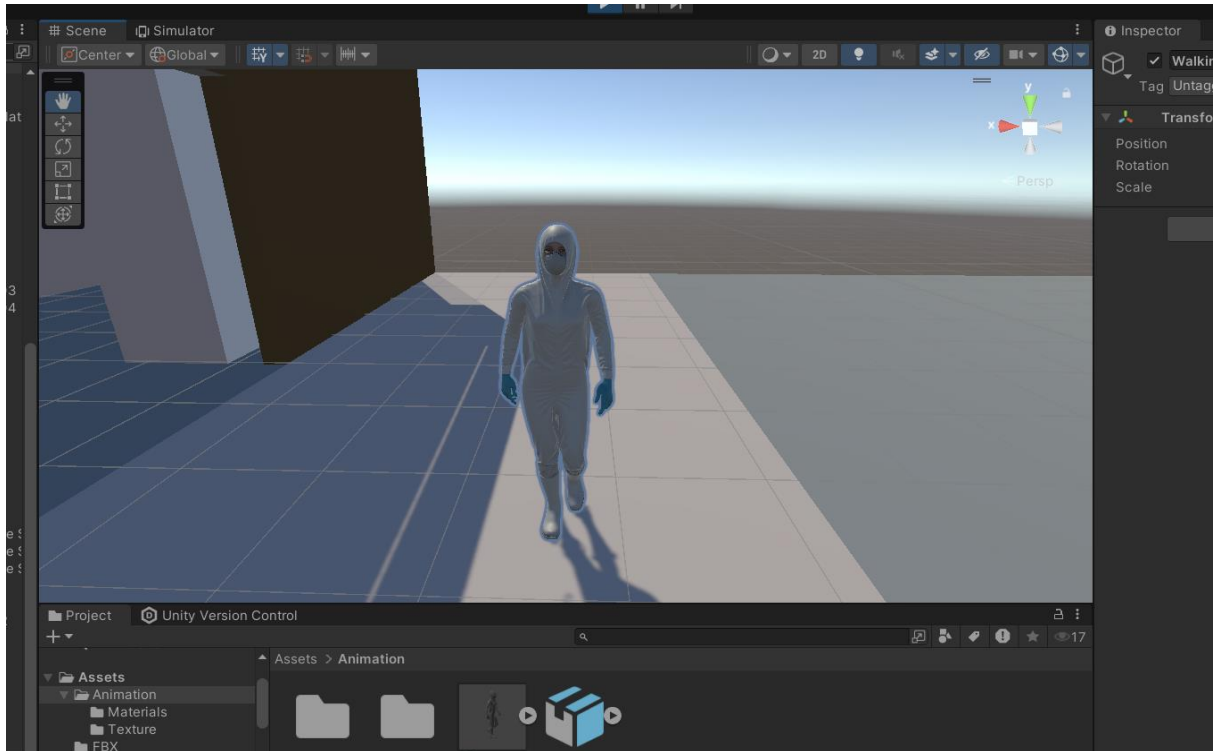


26. Then I watched this video

https://youtu.be/76Lh0UApjNI?si=xRPK_gZGOPZd3Rca

27. This video helped me in adding a humanoid based character in the factory

28. It also contained the information that made the character walk in the factory by adding animations.



29. Then I added animation to the character by watching and implementing the steps from the following videos.

<https://youtu.be/WDkA3H8ykXI?si=KJ5cP11nRUHPcBFX>

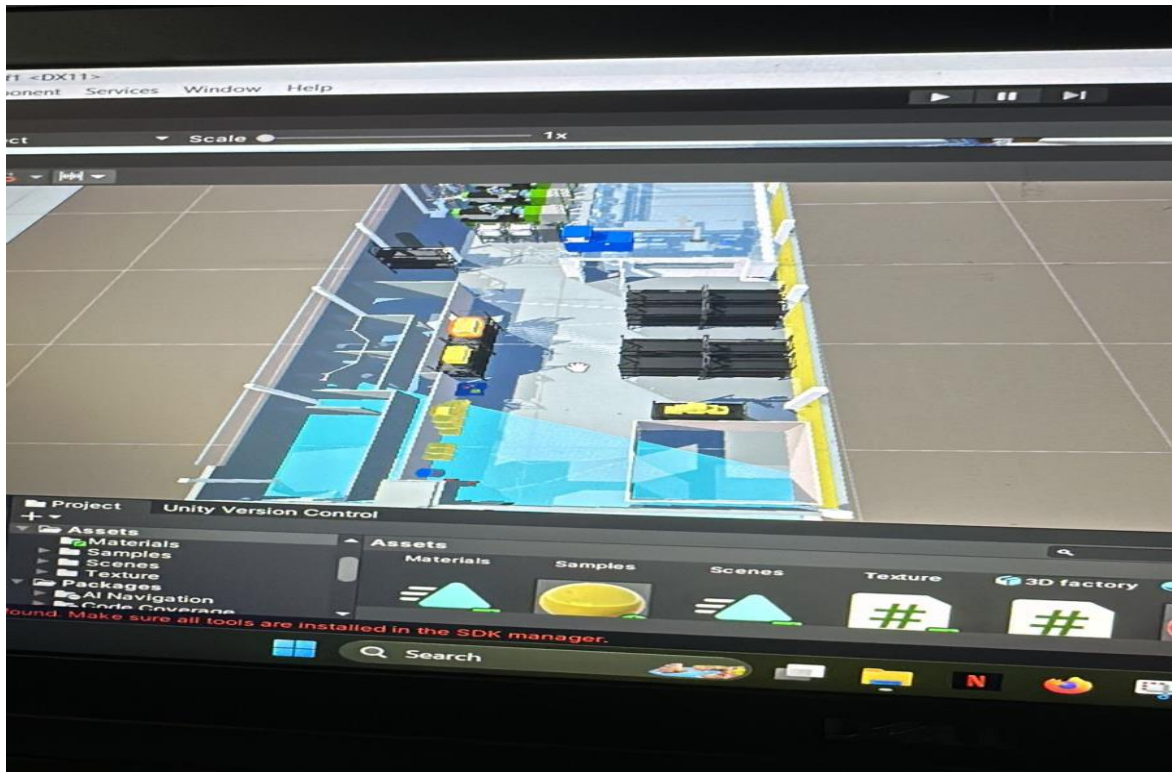
<https://youtu.be/CrCvIb-Goi8?si=dCF4w-6wc6dHfnHv>

<https://youtu.be/cc7u1RhJzKs?si=r8Lv8qcRlpRL2bn4>

<https://youtu.be/HOxUI7aFskY?si=Wdw-cwZIPM1lsBFB>

https://youtu.be/ft9Srnt122c?si=ne6_2L7sAB4hPiRz

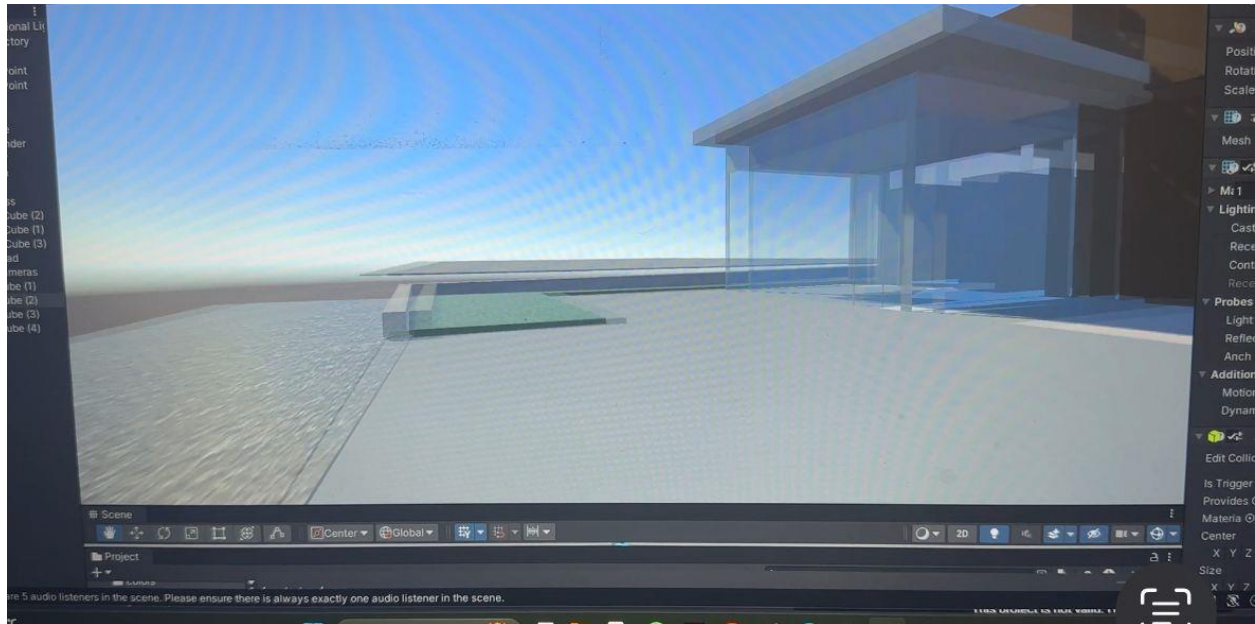
30. Then I added different components in the factory like boxes on the racks.



31. Then I added a door shutter to the building of the factory.



32.A road was designed by adding the image to the base outside the factory.



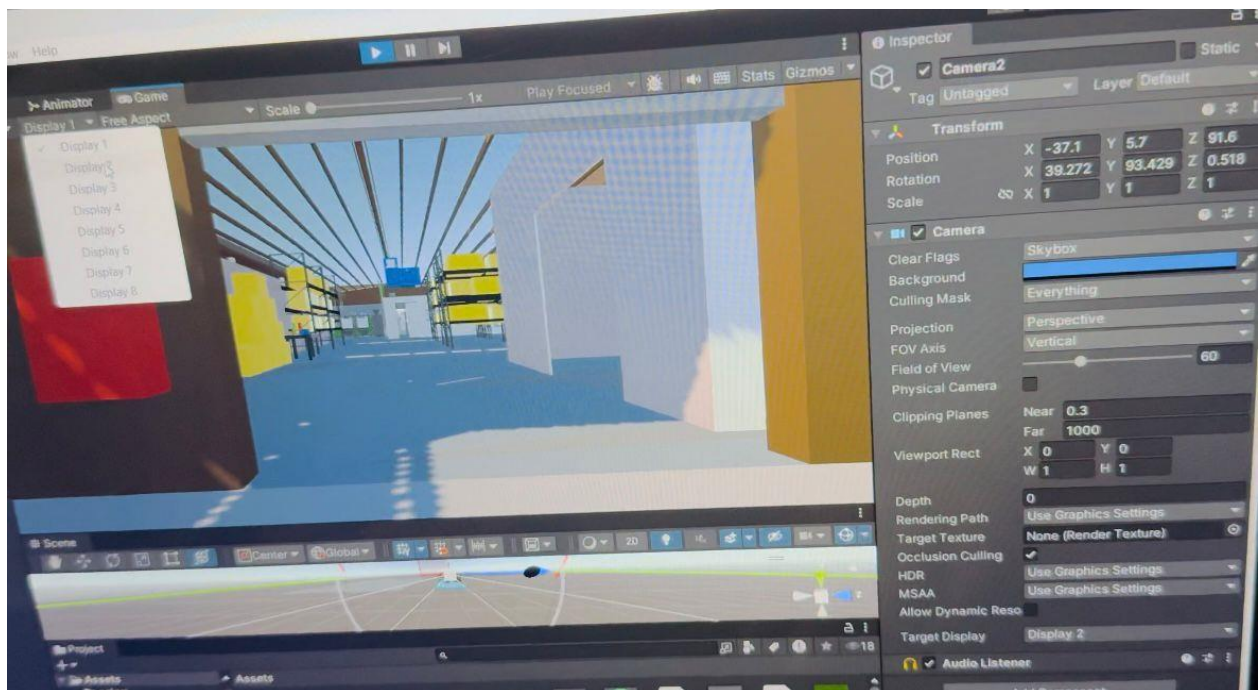
33.I also added a turf two sided of the parking area outside the factory.

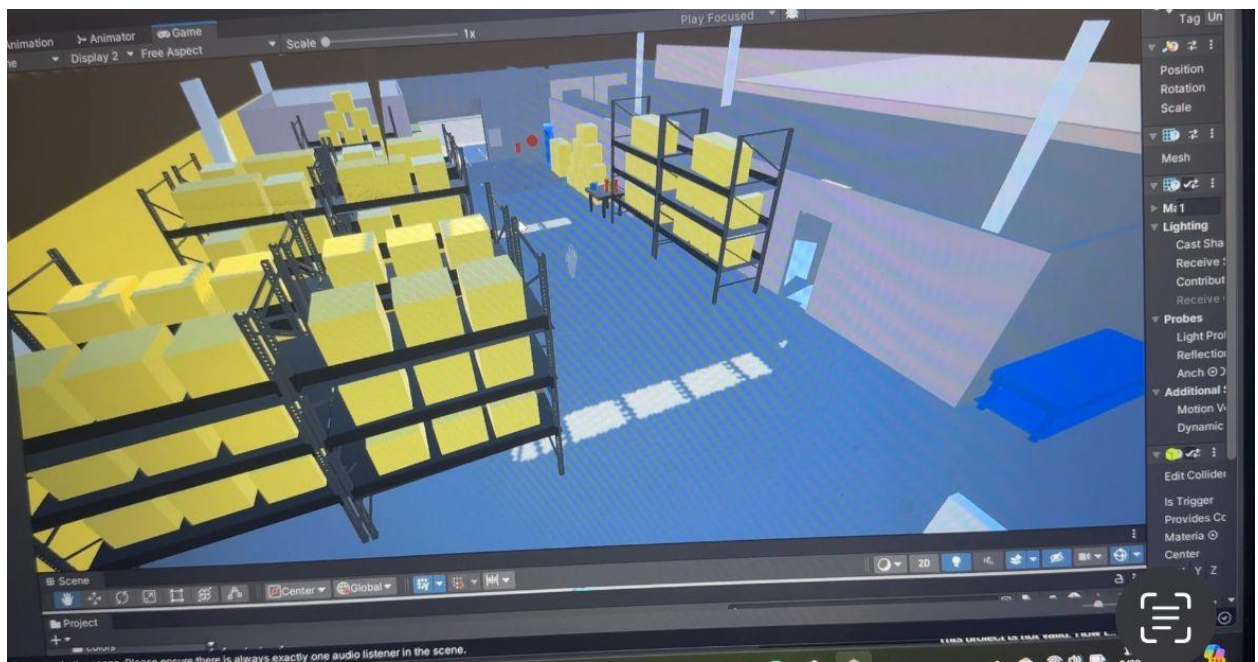
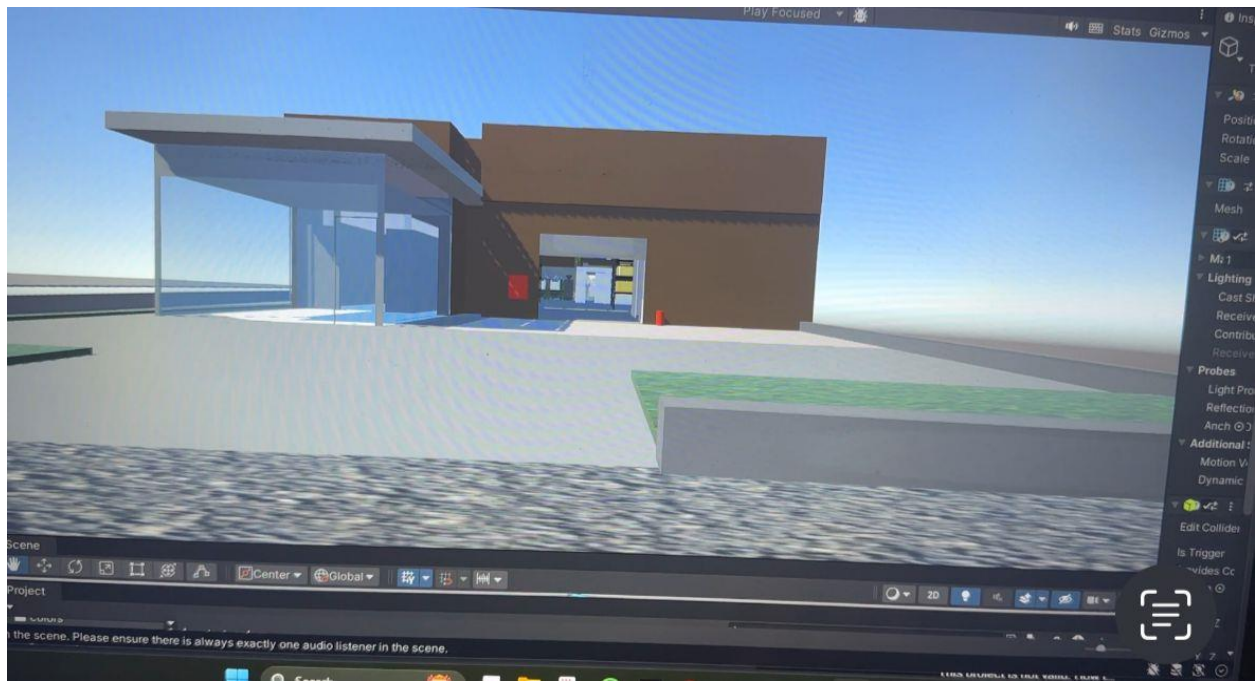
34.To make it look more realistic I added image of grass to the turf in the parking area outside the factory.

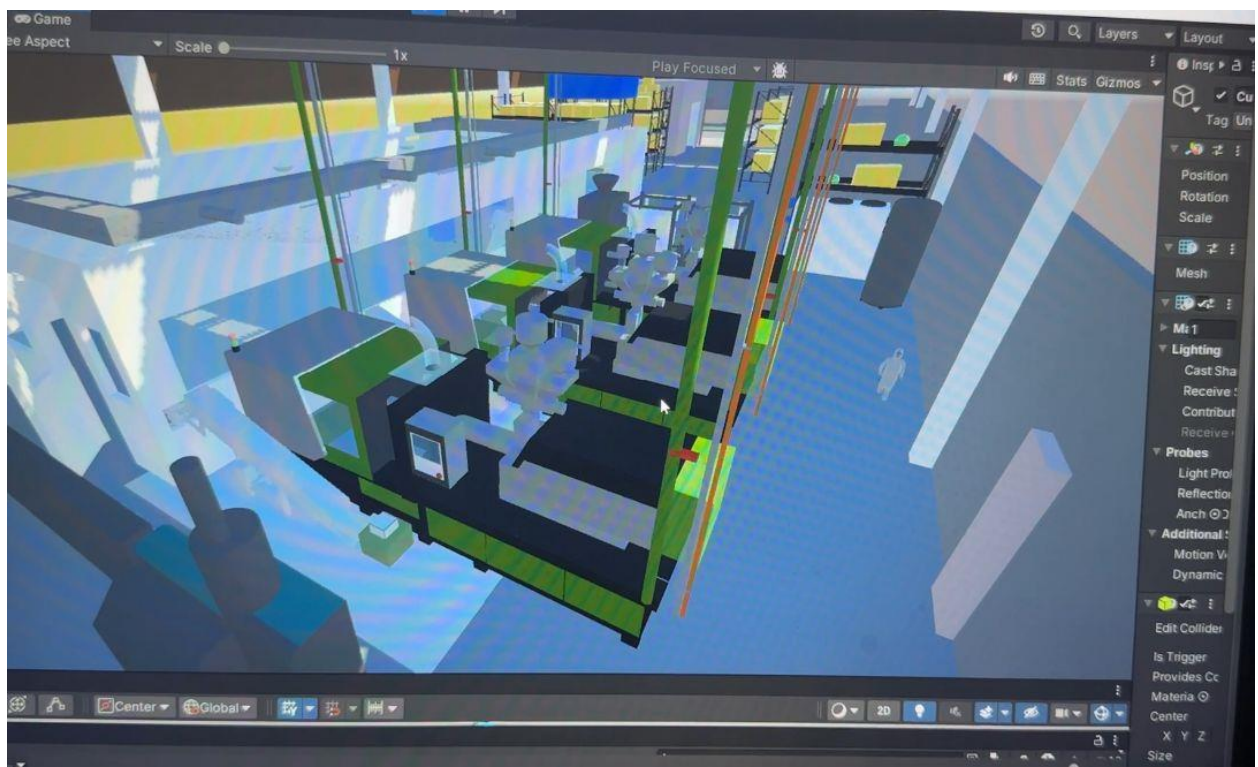
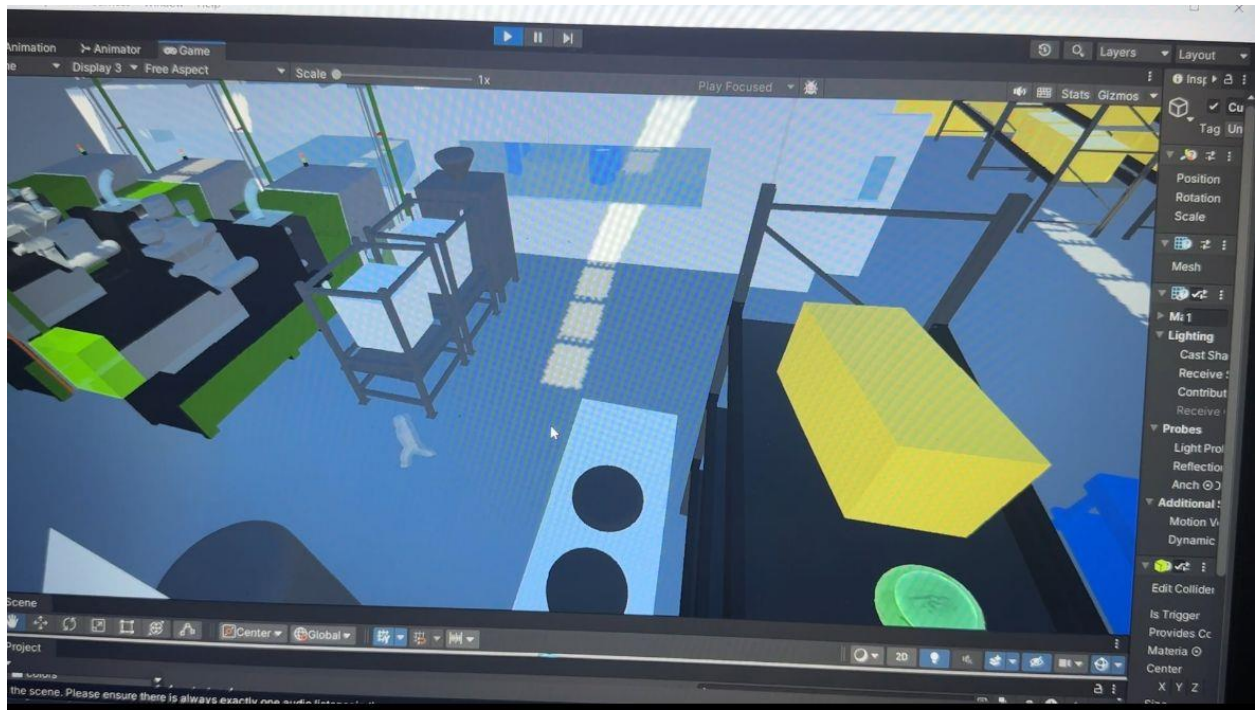


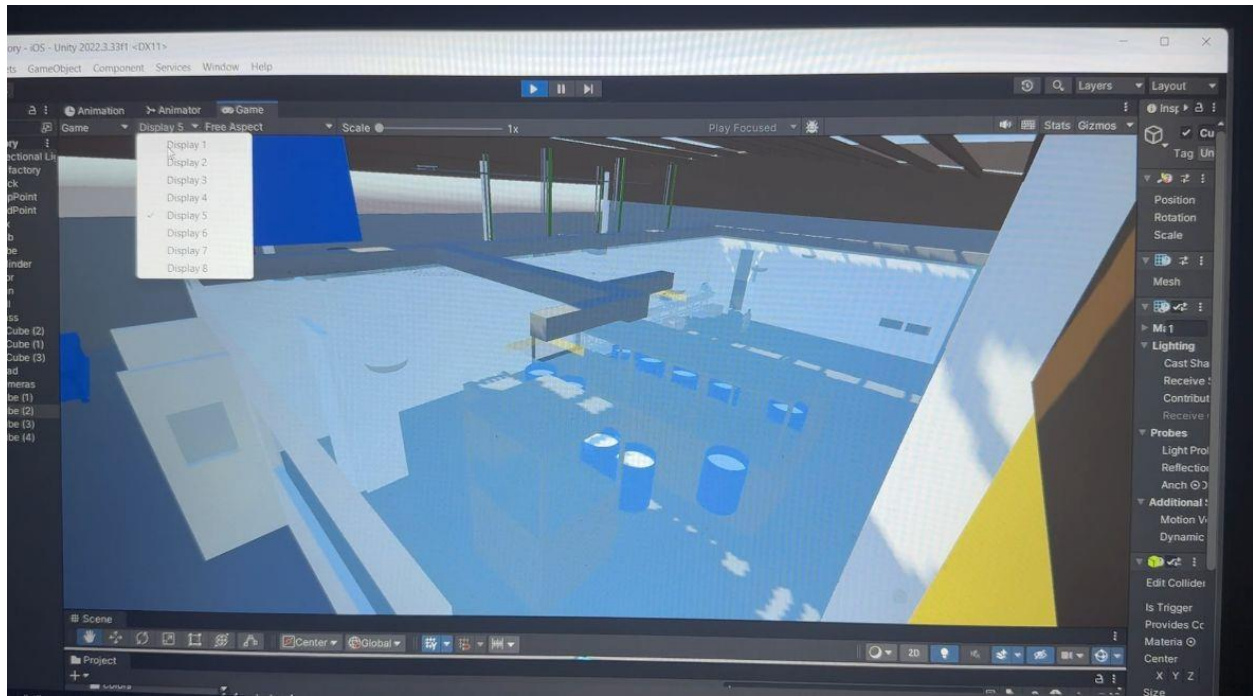
35. Then I added some different camera displays in the factory so in the game view we can see factory from different camera angles.

36. These cameras were set to watch the character walk in different directions.









37.This was my complete project for the month of June.

38. It was basically a mvp of the factory.

39.I then submitted my project file to my boss.

RESULTS:

We successfully created a simple digital twin of a factory to simulate its operations. In this simulation, a character can walk around the entire factory using keyboard controls. We faced many challenges, such as importing 3D models, adding animations, and managing our tasks. However, by clearly understanding our goals and keeping detailed notes, we managed to overcome these issues. In the end, we demonstrated a working factory simulation and finished the project on time. This result shows that digital twins can help improve factory operations, making them more efficient and productive.

DISCUSSION

Challenges:

I faced challenges while developing the MVP of the factory.

Here are the key difficulties:

- One of the hurdles was importing the 3D model of the factory and the character into the Unity project.
- Ensuring that these elements were correctly imported and functional was time-consuming and complex.
- Adding humanoid animations to the character posed another challenge.
- I struggled with applying realistic animations to the character to ensure smooth and believable movements.
- I had trouble understanding the goals and objectives of the project.
- This lack of clarity affected my work.
- I did not read or access all the available information about the project.
- This led to misunderstandings and incomplete implementation of required features.
- I failed to maintain proper and descriptive notes on a daily basis.
- This also included not reporting my progress regularly, which caused my ability to identify issues.
- I did not create a structured daily plan.
- Without a clear plan, I struggled to prioritize tasks.
- I often mixed tasks together, which led to confusion.
- Poor management of time and priorities was issue.

- I found it challenging to manage time to each task.
- I was unable to complete the technical report before the deadline.
- This delay affected the overall progress of the project.
- Connecting my Unity project to a version control system and collaborating was problematic.
- I faced difficulties in setting up version control and managing it.

Improvement for future:

To make sure the project goes well, following are the improvements for future:

- First, we must clearly understand the project's goals and objectives.
- We should know exactly what we aim to achieve helps keep us focused.
- We should avoid mixing tasks.
- Working on one thing at a time helps us stay organized.
- It's important to complete tasks on time.
- We should focus on what needs to be done first.
- We need to report everything on time, so everyone knows what's happening and can help if needed.
- Taking detailed notes right away is very important.
- Include all important links and information in OneNote to keep everything in one place.
- Before starting any task, we should read and understand all the provided information.
- This helps us do the job correctly.
- Always focus on the success criteria: finish the project on time, stay within the budget, and ensure good quality.
- This approach will help us achieve our goals successfully.

CONCLUSION

We created a basic digital twin of a factory to simulate its operations. In this simulation, a character can walk through the entire factory using the keyboard. We faced many challenges, like importing 3D models, adding animations, and managing our tasks. By clearly understanding our goals and keeping detailed notes, we overcame these issues. In the end, we successfully showed the factory simulation and finished the project on time. This project demonstrates how digital twins can help improve factory operations.

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2. [2. https://learn.unity.com/tutorial/introduction-to-digital-twins-with-unity#](https://learn.unity.com/tutorial/introduction-to-digital-twins-with-unity#)
3. <https://learn.unity.com/tutorial/introduction-to-digital-twins-with-unity#>
4. <https://learn.unity.com/tutorial/introduction-to-digital-twins-with-unity#>
5. <https://youtu.be/iVS-AuSjpOQ?si=eqqP-KLT4WJ-6miO>
6. <https://youtu.be/Pn4QTBucbMM?si=8gwsN88gZ0Yp7I10>
7. <https://youtu.be/cfbKR48nSyQ?si=K6ODmdIX9kaB38R1>
8. <https://youtu.be/UJaF5DqfJs0?t=7>
9. https://youtu.be/SyFxFLeSB5_s
10. <https://youtu.be/j8WefhRmeQ8?si=wWE0mD29tvew4n3A>
11. <https://www.youtube.com/watch?v=5UZ-niuRWz8>
12. https://youtu.be/76Lh0UApjNI?si=xRPK_gZGOPZd3Rca
13. <https://youtu.be/WDkA3H8ykXI?si=KJ5cP11nRUHPcBFX>
14. <https://youtu.be/CrCvIb-Goi8?si=dCF4w-6wc6dHfnHv>
15. <https://youtu.be/cc7u1RhJzKs?si=r8Lv8qcRlpRL2bn4>
16. <https://youtu.be/HOxUI7aFskY?si=Wdw-cwZIPM1lsBFB>
17. https://youtu.be/fT9Srnt122c?si=ne6_2L7sAB4hPiRz