AIRPORT SIMULATION FOR EMERGENCY SITUATIONS

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***Abstract*— Virtual reality (VR) airport simulations will help pilots, airport staff members, and security teams get more proficient in what to do in a situation like this. That's the purpose of this project. Real-life events like weather-related incidents, navigating difficulties, fires, and terrorist threats are utilized in the simulation to make the training more accurate. Pilots, airport workers, police officers, and schools looking for useful educational choices are all people who can benefit. VR technology is being used in the project to create a training tool that is exciting and engaging. This tool will help users improve their skills in a controlled and secure setting.**

***Keywords*— Airport simulation, Virtual reality, Emergency training, Pilot training, Security personnel.**

I. INTRODUCTION

A. Goals and Objectives

The primary goal of this project is to develop a virtual reality (VR) simulation of an airport that is exceedingly realistic and immersive to ensure that pilots, airport workers, and security agents can learn how to deal with situations well. One of the main goals is to offer pilots thorough training courses that help them handle a wide range of emergency circumstances such as when they run into difficulties or the effects of the changing climate. They also want to teach airport staff and security guards how to cope with fires and terrorist threats.

B. Description of the VR Environment

Unity 3D's high-fidelity images and videos will be used for creating exact copies of airport buildings, airplane runways, and planes in the realm of virtual reality. Bad weather, congested runways, fires, and terrorist attacks are just some of the situations of emergency that will be acted out [3]. This will alter the teaching environment while making it hard. When people use the app, they may interact with realistic airport scenarios and get a sense of how difficult it is to handle emergencies.

C. Target Audience

It is the task of airport workers to keep passengers safe, and it is the job of security workers to identify and prevent any potential dangers. This VR simulation is for pilots who want to become better at handling emergencies. This simulation may additionally be utilized by training institutions to provide students with practical practice managing emergencies in airport situations.

D. Overview

This project plays a role in the educational environment and in real life because it makes an advanced teaching tool that ties together the things that are learned in the classroom with what happens in real life. Users become immersed in real airport conditions in the VR simulation. This helps with direct learning and gives people a safe place to practice making significant decisions and organizing how to handle emergencies. The primary objective of the project is to provide aviation professionals with more effective ways to handle instances in airports so that flying is simpler, quicker, and more protected.

II. RELATED WORK

According to Sharma's research paper, making an airplane simulator game with the Unity 3D game engine will provide people with an accurate representation of flying. The article describes how to create a virtual reality aircraft simulator that feels and looks like a real airplane interior. To make the overall experience smoother for the user, things such as including accurate physics and environmental effects are employed. The Unity 3D engine in the game allows players to take off, run, and land airplanes in a virtual world. The paper explains how airplane simulation is useful for numerous tasks, like researching, training pilots, and developing planes. It explains what differentiates fixed-base simulations and full-motion scenarios and what each one can be employed for. The study shows that it is an excellent plan to use Unity 3D to develop a flight simulator game that is interesting and enjoyable to play. This makes flight simulation equipment better and helps in numerous ways that it is used to train pilots and conduct research in real life.

The research article that Bein Fahlander and Mossberg composed is about a simulation system that can

demonstrate and guess how individuals move through airports. As a demonstration, they utilize Arlanda Airport. By combining modern game software development instruments with traditional agent-based modeling approaches, the method produces agents in the world that behave and fly like real people, using real timetables for flights and behavioral trends. The system does an adequate job of simulating people leaving Arlanda Terminal 5 with the help of live flight information and Unreal Engine to simulate them. This shows that it can be used on bigger scales and could be helpful for people who handle airports. Most of the time, the prototype can correctly predict how people will proceed through security (79.4% of the time), but it constantly guesses with too many simulated agents due to issues with flying data from the past. The results presented demonstrate that crowd emulation in airport administration can be accomplished using advanced game-creation tools. They also show which modifications need to be made to anticipate before they become employed in the real world to make them more reliable, stable, and useful. This study makes simulation instruments better so that operations at airports run more easily. It also shows how crucial it is to speculate about optimizations in practical problems in airport environments.

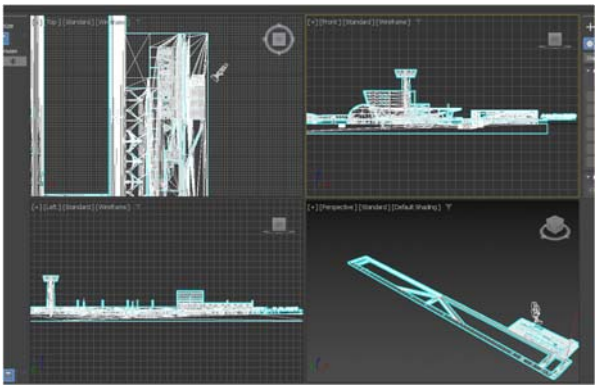
Numerical simulations of how airports escape during fires are the focus of a study by Jasztal, Omen, Kowalski, and Jaskóowski. The goal is to discover the frequency with which fire threats show up and how long it requires for everyone to leave safely. To find out the amount of time it takes individuals to get out of the building, the study uses PyroSim and Pathfinder tools to simulate various incidents of fire with various fire sources, computational mesh arrangements, and component sizes. If there is a fire, computer simulations that use Pathfinder demonstrate that it takes 46 seconds for 50 individuals to evacuate and 82 seconds for 600 people to leave. Some of the most significant variables that were looked at were how the outside temperatures were spread out and which direction the most smoke originated from. By simulating those occurrences with PyroSim, one can see that the outside temperature and smoke levels stay underneath what is needed for safety evacuation. When the simulation results are evaluated, it's clear that people are capable of leaving the building before certain fire risks are met. This demonstrates that the tested approaches to get out of the airport when there was a fire hazard worked well. The comprehension of how to enhance security at airport environments and enhance evacuation processes has been significantly enhanced by the results of this study.

III. Modeling

A. Modeling

The scene consists of a minimalistic airport model including an entrance, waiting area, a terminal, runways, doors, multiple floors, and aircraft. There is also terrain used to add a natural feel to the environment.

- The airport model is downloaded from sketchfab website and imported to 3ds max for designing as required. Later it is exported to unity 3d.



- Fig 1. Model imported to 3ds max
- The scene has a minimalistic design and feel. Sporting recognizable geometry with textures that are not very large on the devices running it, animations for character movement, and actions, and terrain tools for a natural feel.

B. Exporting to Unity 3D

Unity 3D is a robust game engine that is known for being adaptable as well as simple to use. Once the 3D models have been completed, they are uploaded there. Unity is where the assets, textures, animations, and coding for the VR simulation all come together. It's simple to import the files back into Unity when they have been exported. Establishing and arranging them in order makes the virtual airport environment [7]. It's simple to get started with Unity, and it offers numerous features that help developers make models that move and feel real, bringing their concepts to life.

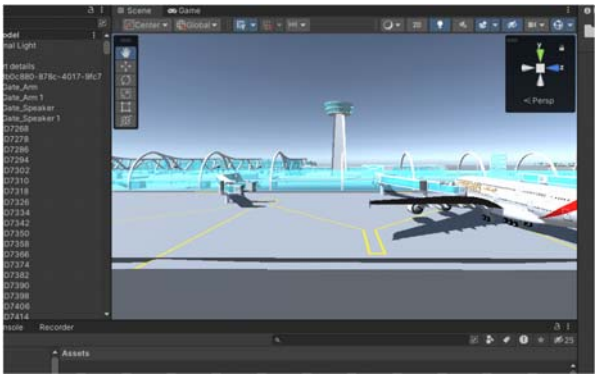


Fig2. Exported model from 3ds max is imported to unity3d

IV. Functionality

A. Vision

Virtual reality airport simulations utilize 3D models and graphics that were carefully made to properly recreate the complex characteristics of an airport environment. There is a lot of precision in everything, from the airport buildings to the aircraft planes, so people feel truly like they are there. People may move around in the virtual world with less effort and it looks more genuine when images and 3D models are utilized [6]. For vision as a

means of adding detailed information to the project, text UI objects were used extensively. From warning the player to mission status and objectives.

Fig 3.0 In this instance, the aircraft controls and weather events are shown using text.

Fig 3.1 The mission objective is shown here using text

B. Sound

There are precise sounds from the region added to the simulation to make it feel like an actual airport. Several audio tracks such as gunshots, footsteps, fire burning, aircraft engine and so on were used to improve immersion and make the experience more realistic.The sound effects give the virtual world an additional dimension and realism, enhancing the feeling of engagement.

Fig 3.2 Guard engaging terrorists with gunshot sounds heard clearly

C. Animation

The player character, the NPCs, and the criminals were all animated to carry out actions like scurrying for cover, moving around, and firing weapons.

Fig 3.3 Animations visible on main character and terrorists

D. Interactivity

Users can make a variety of events happen which connects them to the virtual world. Getting into the plane, landing the plane, crashing the plane, triggering the fire alarm,
succeeding in any mission are all examples of user triggered events in this project.

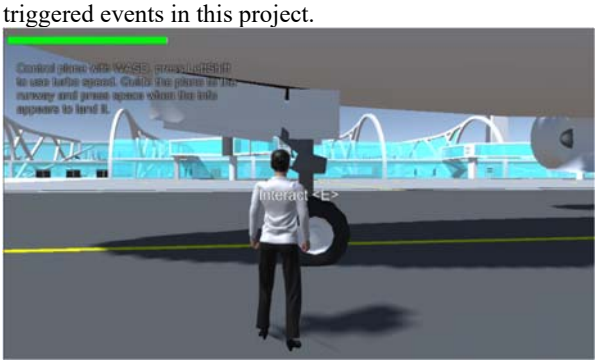


Fig 3.4 Interaction to take over and fly the plane.

Fig 3.5 interaction to trigger the alarm

E. Character/Avatars

The NPCs that attempt to escape the airport after a fire alarm is tripped all use pathfinding to locate the door and head out.

Fig 3.6 Characters escaping using pathfinding

F. Sensors

Proximity,touch and time sensors are used on the scene. The pilot interactis with the airplane using touch, the staff objective uses a time sensor and the pathfinding and escaping NPCs uses a proximity sensor.Doors will automatically open using proximity sensors.


Fig 3.7 Time based objectives sensor for the staff mission

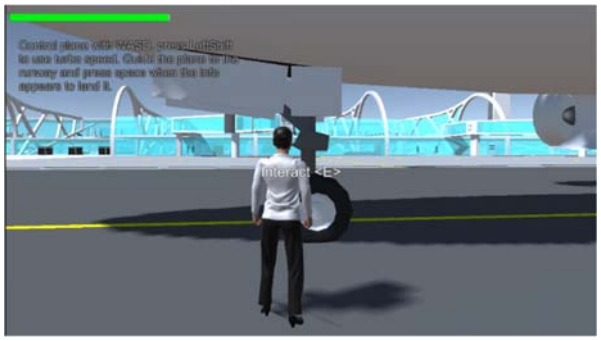


Fig 3.8 Touch based sensor for the pilot

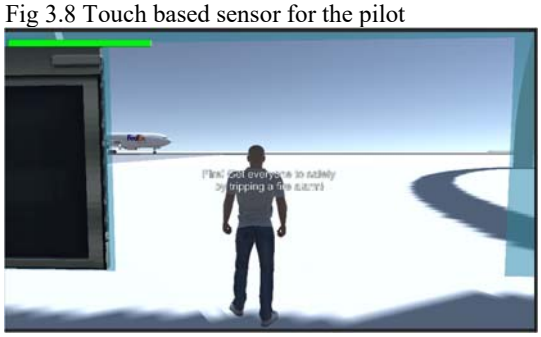


Fig 3.9 proximity sensor to open and close the doors

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G. Player

A player controller has been integrated into the simulation so that viewers can join the virtual world instantaneously. The scene features a third-person controller for all characters.

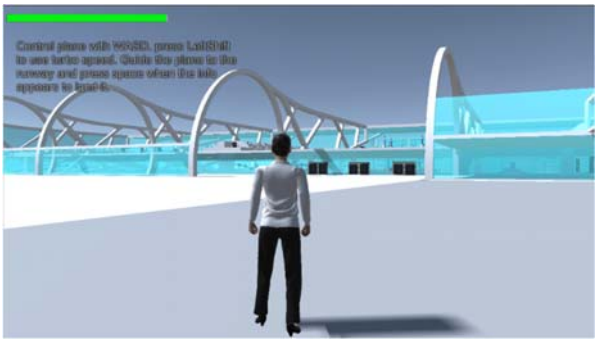
Fig 3.10 Third person controller

H. Interface Elements

For the user interface, UI elements like buttons, sliders, images and panels were used.The user-friendly design of the simulation has made it simpler and easier for people to navigate and use [4]. Its features can be utilized without any difficulties.

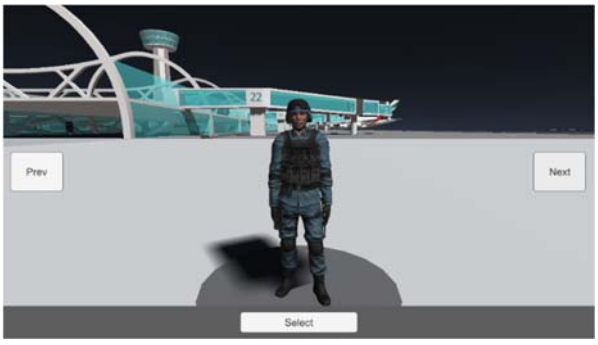

Fig 3.11 Scene showing UI elements like buttons, texts and images.

Behaviours of characters

Each character has a different set of objectives to perform from the pilot, to the staff

Pilot

Fig 4.0 Pilot

The pilot has the task of safely flying and landing airplanes

Guard

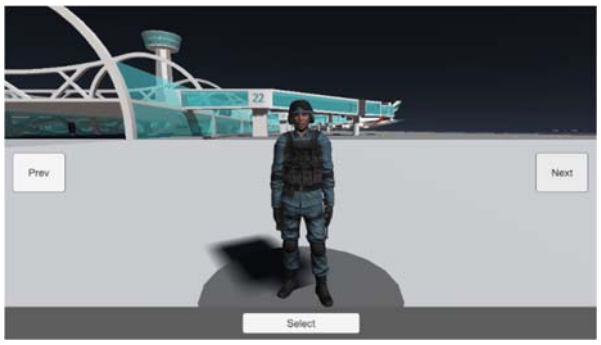

Fig 4.1 Guard

The guard has the duty of ensuring the airport is safe by killing off terrorists that come to attack the airport

Staff

Fig 4.2 Staff

The staff has the responsibility of ensuring all passengers get to safety in the event of a disaster

The project features a minimalistic 3D scene with few details depicting an airport with all its parts.

Staffers are required to carry out their different responsibilities in an objective-based system. Animations from Mixamo are used to make the scene more realistic and lifelike.

This application will be used to give staffers, first-hand knowledge of how to navigate unforeseen circumstances on the job. They will learn how to carry in their objectives under stress in life-like scenarios.

This program is useful because it can expose staffers to the rigors of the job without them actually being there. They learn to follow the training when the real thing happens.

Virtual reality is appropriate because of the spatial factor it brings. Players can experience things like they are actually there.

More detailed 3D models would make the project more life-like, immersive and realistic

Fig 5.1 Airport main area. This is where ticketing and the wait for flights happen. The staff has the responsibility of making sure customers here are safe

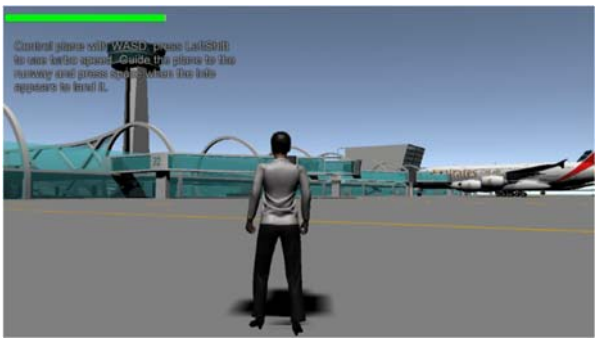

Fig 5.2 Airport terminal area. Passengers get on the plane from this area. The pilot is tasked with flying the passengers from this area, to their destination.

Fig, 5.3 Airport runway. The runway is where the airplane is found. From here it can take off and land if done successfully.

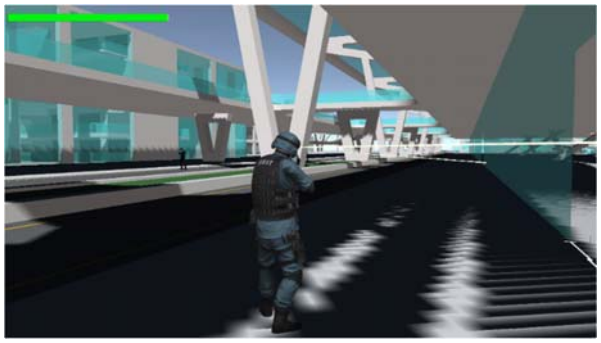

Fig 5.4 Airport entrance. Passengers get into the airport complex through the main entrance connecting to the city.

VI. Conclusion

There are real graphics, intense sound, interactive components, and AI-driven behaviors in the VR airport simulation which all function well together to provide a dynamic and intriguing training experience. Great training assists pilots, airport staff members, and security officers learn how to manage situations and make things run more smoothly. Airlines that want to provide their employees with real-life experiences and training centers that would like to give their trainees realistic simulations both achieve. Making AI algorithms act a little like real people and making graphical user interfaces easy to use are some of the challenges that have been named. The simulation will be changed more realistic in future versions, and problems will be rectified. User feedback will be utilized as well to keep the simulation smoother.

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