Virtual Campus for Navigation and Evacuation

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Abstract— The development of a Virtual Campus for navigation and evacuation is essential for enhancing emergency preparedness and safety on campus. This project provides an interactive platform for training students, faculty, staff, and emergency responders on evacuation procedures and routes, enabling them to familiarize themselves with the campus layout and learn the best evacuation routes in a realistic virtual environment. Through accurate depictions of buildings, outdoor spaces, and various emergency scenarios, users can practice making informed decisions and navigating safely during crises. While simulated obstacles and interactive elements prepare users for real-life challenges. The project will benefits students, faculty, staff, emergency responders, administrators, and visitors to know how the campus looks and also improves knowledge of evacuation procedures, facilitating better coordination during emergencies, and identifying areas for safety infrastructure improvements. Additionally, its accessibility from anywhere makes it a cost-effective and inclusive training tool, ensuring that everyone involved in the campus community is well-prepared for any emergency.

I. Introduction

The primary goal of the Virtual Campus project is to enhance emergency preparedness and safety on campus through the development of an immersive virtual environment. The specific objectives include many things like

- Training and Education: Provide a realistic platform for training students, faculty, staff, and emergency responders on evacuation procedures and routes.
- Accurate Representation: Design a virtual environment that accurately depicts the campus layout, including buildings, rooms, corridors, and outdoor spaces.
- Interactive Elements: Incorporate interactive elements such as signage, maps, and directional guidance to aid navigation and decision-making during emergencies.
- Simulation of Emergency Scenarios: Simulate various emergencies to allow users to practice responding appropriately.
- Accessibility and Inclusivity: Ensure that the application is accessible to all users, regardless of physical location or ability, by making it available online and user-friendly.

The designed environment is a digital representation of the campus, including buildings, walkways, green spaces, and parking areas. The environment is designed with realistic textures and lighting to provide an immersive experience.

Figure 1: Campus Overview

Figure 2: Building Interior

Figure 3: Emergency Scenario - Fire

Figure 4: Directional Signage:

Accurate Campus Layout: Detailed representation of all campus buildings and outdoor areas. Emergency Scenarios: Simulations of fires, earthquakes, and other hazards to train users on emergency response. Navigation Aids: Clear signage, maps, and directional guidance to help users find evacuation routes. Interactive Elements: Users can interact with objects, open doors, use emergency equipment, and communicate with virtual responders.

Target Audience:

The VR application is designed for a wide range of users including:

Students, Faculty and Staff, Emergency Responders, Administrators, and Visitors to familiarize themselves with campus layouts and emergency procedures to improve their knowledge of evacuation routes and procedures. For training and planning purposes, enabling better coordination during real emergencies. To assess and improve campus safety infrastructure.

Intentions and Importance:

The intention of this project is to create a virtual environment that serves as a valuable training tool for emergency preparedness and evacuation procedures.

By providing a realistic simulation of campus spaces and emergency scenarios, users can gain practical experience and confidence in responding to crises. This application is essential for improving overall campus safety, reducing response times during emergencies, and ensuring that all members of the campus community are well-prepared and informed.

This application is useful because it provides realistic training for emergency situations which enhances the preparedness of students, faculty, staff, and emergency responders. Identifies areas for improvement in campus safety infrastructure. And also ensures inclusivity by being accessible to all users. Offers a cost-effective and scalable solution for ongoing training and education.

II. Related work :

The study on "Virtual reality as a tool to enhance the efficiency" by Rami Al shawabkeh, Mai Arar addresses the challenges of data scarcity and integration in virtual reconstruction for heritage preservation. It proposes a user-friendly method using Unreal Engine to transfer virtual reconstruction to VR, enhancing communication and efficiency in the peer review process. The work on "Building enriching realities with children: Creating makerspaces" by Naseem has explored using interactive technologies like tablet devices, video games, and virtual reality (VR) for therapeutic purposes with children in healthcare settings, such as reducing procedural anxiety through distraction or helping develop pain management skills. However, less research has investigated how VR can be used to provide enrichment and enjoyment for pediatric patients beyond just achieving clinical outcomes. Valle Abad et al. (2022) focus on digital heritage visualization, aiming to bridge the gap between cultural heritage and society through digital means, possibly including VR and other digital technologies.

III. Implementation:

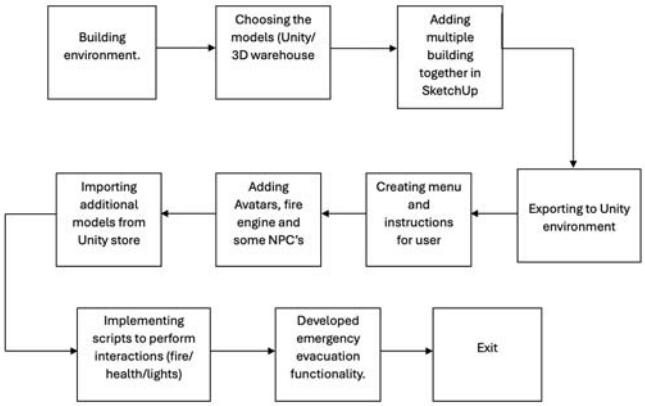

Figure 5: Implementation design.

This VR application is highly valuable for enhancing campus safety, navigation, and visitor experiences within the university community. By simulating realistic evacuation drills, it prepares students, faculty, and staff for emergencies, improving their response capabilities and overall safety. Additionally, the virtual tours feature allows prospective students, visitors, and new staff to explore the campus remotely, aiding in familiarization before physical visits. This can positively influence enrollment decisions and improve visitor satisfaction.

Virtual reality (VR) is the ideal technology for this project due to its immersive and interactive nature. It provides a lifelike simulation that closely resembles real-world scenarios, offering a more effective training method than traditional approaches. Users can interact with objects, navigate spaces, and engage with virtual characters, creating a realistic training environment. Moreover, VR offers scalability and flexibility, making it accessible to all members of the campus community, including remote users.

This VR application offers significant benefits for campus safety, visitor engagement, and navigation. It's realistic simulations and interactive features make it an indispensable tool for training, familiarization, and emergency preparedness within the university environment.

Several challenges and remaining shortcomings were encountered during the development of the VR application, indicating areas for future work:

Realism and Interactivity: While the application provides a realistic experience, further refinement of textures, lighting, and interactive elements is needed

to enhance realism and engagement. This includes improving the fidelity of 3D models, optimizing animations, and adding more interactive scenarios to increase user immersion.

User Interface Enhancements: Improvements in the user interface elements such as menu pages and health bars are necessary to enhance user experience and navigation within the virtual environment. This includes refining the layout, design, and functionality of these elements to make them more intuitive and user-friendly.

Accessibility: Ensuring that the VR application is accessible to all users, including those with disabilities, is essential. Future work may involve incorporating features such as voice commands, haptic feedback, or screen reader compatibility to improve accessibility for users with diverse needs.

Integration with Real-World Systems: Integrating the VR application with real-world emergency systems and protocols could enhance its effectiveness for evacuation drills and emergency preparedness. Future work may involve collaborating with campus safety officials to synchronize the virtual environment with existing emergency procedures and infrastructure.

IV. FUNCTIONALITY SECTION:

To complete our project on Virtual campus tour with emergency fire evacuation we have used some of the models for classrooms and other building from 3D warehouse and unity store. Buildings such as classrooms, gas stations, houses and some other apartments were included from 3D warehouse and Unity store. To make the audience immerse in the virtual space we have used some of the sounds like background noise and fire sound when fire comes.

We have added objects like trees, roads, tables, benches, avatars, and other objects like fire engine. We added some of the way points for some avatars and to the fire engine so that they will travel in the directions as soon as they get to the time or with the help of keywords, for animations we have created multiple avatars and implemented script for them to perform so predefined animations. We have implemented multiple interactivities like two avatars talking to themselves, auto fire after some defined time, health bar reduction when we are close to the fire. We have implemented proximity, time sensors in our project.

Player is controlled using the keyboard and mouse, we employed the use of W, A, S and D to move around in the map and use the mouse to look around.

We have added main menu, a pause menu and other timely instructional panels for the interface elements.

We have used PUN to enable multiplayer functionality where a maximum of 20 players can be online at the same time,

V. CONCLUSION:

The VR application developed for the virtual university environment encompasses various features aimed at creating a realistic and engaging experience. This includes the geometric structure of buildings, interactive interior elements such as doors and objects, and 3D models of plants and other objects for immersion. Utilizing Unity as the primary software, the environment is enhanced with textures, lighting, and automated NPCs to add life to the virtual world. The goal of this implementation is to provide users with a platform for conducting evacuation drills, campus tours, and navigation efficiently.

One effective approach to addressing these needs is through collaborative training modules and virtual evacuation drills (Sharad Sharma, 2020).The VR application proves to be useful in several ways. Firstly, it serves as a valuable tool for training and preparedness by offering a realistic simulation for evacuation drills. Users, including students, faculty, and staff, can practice emergency procedures in a safe and controlled environment. Additionally, prospective students, visitors, and new staff can benefit from virtual campus tours, gaining familiarity with the environment before visiting in person. Moreover, the application aids in navigation, allowing users to find buildings, rooms, and facilities easily.

Various aspects of the VR application cater to different users. Students can use it for practicing evacuation drills and navigating the campus effectively. In this work, the system has been redesigned to handle larger groups of buildings, moving toward a full-campus evacuation system (Guest et al., 2014). Faculty and staff can utilize it for training purposes and familiarizing themselves with campus layouts. Visitors, including prospective students and guests, can take virtual tours to explore the campus and its facilities remotely.

The benefits of the VR application lie in its realism, engagement, cost-effectiveness, and scalability. The

immersive environment and interactive elements enhance engagement, making training more effective. By eliminating the need for physical mock drills and tours, the application saves time and resources. Its multiplayer feature enables collaborative activities and training sessions, enhancing scalability.

Despite the significant role of built environments in determining human movement, a disconnect often exists between the features of the real world and their representation in simulation environments (Lochhead & Hedley, 2018). However, there are some challenges and remaining shortcomings to address for future work. Ensuring high realism and interactivity may require further refinement of textures, lighting, and interactive elements. Compatibility and performance across different hardware setups need attention, especially for resource-intensive features like multiplayer functionality. Improvements in the user interface elements such as menu pages and health bars can enhance the user experience. Additionally, ensuring accessibility for all users, including those with disabilities, and integrating the application with real-world emergency systems for enhanced effectiveness are areas for future development.

VI. References

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