SmartSteps VR:Training Kids for Emergency Situations in Virtual School

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***Abstract*— There is a growing need for innovative, experiential learning methods to teach children critical thinking, safety awareness, and real-world problem-solving skills. This project is important because it leverages Virtual Reality (VR) to create a safe, immersive environment where children can experience and respond to simulated emergency situations, such as fire hazards, and toxic gas leaks. The VR environment showcases an interactive school setup with AI-guided conversations, door code challenges and all designed to foster cognitive development and decision-making abilities. This project will benefit children by enhancing their practical skills, and it will also support educators, child development researchers, and emergency preparedness trainers in creating more engaging and effective learning experiences.**

Keywords*— *Virtual Reality, Interactive Learning, Child Safety, AI Partner, Emergency Response, Educational Simulation, VR Training

I. Introduction

Virtual Reality (VR) has revolutionized interactive learning by providing immersive environments that enhance engagement and cognitive development. This research focuses on developing a VR-based school environment where players, represented as child characters, navigate realworld challenges such as fire hazards, and toxic gases while applying problem-solving and decisionmaking strategies. The system integrates AI-driven interactions, course modules, emergency exit mechanisms, access-controlled rooms requiring codes, and a car-driving simulation to create a comprehensive educational and emergency preparedness experience. By combining learning with interactive scenarios, this project aims to improve children's adaptability, logical reasoning, and situational awareness in a controlled virtual setting. Traditional classroom environments often lack hands-on training for emergencies, but VR offers a safe space for students to experience and respond to critical situations. This research contributes to the advancement of educational VR applications by bridging the gap between theoretical learning and practical skill development.

A. Goals and Objectives

The primary goal of this research is to develop an interactive Virtual Reality (VR)-based school environment that enhances children's learning, cognitive development, and emergency preparedness. The VR system is designed to simulate real-life scenarios, allowing players to navigate challenges such as fire hazards, enemy attackers, and toxic gases while applying problem-solving strategies. Additionally, the integration of AI-driven interactions, access-controlled rooms, and a car-driving simulation aims to improve logical reasoning, adaptability, and situational awareness in an immersive setting.

B. Modeling

The VR environment is built efficiently, considering all the factors to make navigation easier for the individual. The environment contains a parking lot, which contains various elements like building around, bus stop, roads. The environment is made very lively by adding library and ambient city sounds which improve the user interactivity. There are few interactive actions which can be performed like unlocking doors. All these are vital to enhance the user engagement. The individual can have a soothing experience throughout the environment. The questionnaire will be available for the individual while exploring the environment.

The VR school environment is meticulously modeled using industry-standard 3D design tools to ensure realism and immersion. Every aspect of the school, from the layout of hallways to the positioning of fire alarms and emergency exits, is crafted to provide a lifelike experience. The classrooms are designed with desks, chairs, whiteboards, and learning materials, creating an authentic academic atmosphere. The hallways feature lockers, bulletin boards, and windows that allow natural lighting to change dynamically over time. The playground is populated with swings, slides, and benches, providing a contrast to indoor spaces and offering areas for relaxation and interaction. The VR environment is populated with AI-driven non-player characters (NPCs) representing students, teachers, and emergency responders, each following scripted behaviors that react dynamically to in-game events. The fire and gas hazards are represented with buzzer sound. Emergency exit pathways are clearly marked but may be obstructed in some scenarios, requiring the player to adapt and find alternative routes. The AI partner is designed as an interactive entity capable of engaging and text-based conversations, providing guidance, warnings, and hints when necessary. The room access system features digital keypads that require code entry, and failure to input

the correct code may trigger alarms or additional obstacles.. The modeling process integrates physics-based interactions to govern object movements, ensuring that doors open with natural motion, fire extinguishers disperse foam realistically. The entire environment is optimized to run smoothly, balancing graphical fidelity with performance to ensure accessibility across various VR platforms.

C. Programming

The simulation is developed using Unity 3D and programmed in C#. Player controls include movement, object interaction, and conversation with the AI partner. AI behaviors are implemented using Unity's NavMesh system, allowing NPCs to navigate dynamically. Fire and gas hazards are scripted to spread and affect the player based on proximity. The emergency exit system triggers different escape scenarios, testing player decisionmaking. Room access is managed using a coded door system, requiring players to retrieve and input the correct codes. The car-driving mechanics include scripted acceleration, steering, and collision detection, ensuring an interactive and immersive experience.

II. Related Work

The use of VR simulations to teach people in emergency

contrast to conventional training techniques, their study discovered that immersive training improved safety procedure implementation and recall. Similar to this, Lee and Park (2018)

investigated the effects of providing kids with VR-based fire escape instruction. According to the findings, kids who received virtual reality training demonstrated enhanced situational awareness and quicker reaction times during mock fire drills.

Furthermore, Johnson et al.'s 2020 study looked into VR applications for teaching people how to prepare for disasters. The advantages of interactive virtual reality environments in strengthening important emergency response techniques were emphasized in their study. The researchers stressed that gamification and instantaneous feedback improved children's learning results and engagement.

Our suggested VR simulation expands on these discoveries by developing an entertaining and dynamic emergency education curriculum for kids in schools. In contrast to other research that concentrates on a single emergency scenario, our effort incorporates several emergency scenarios—such as fire, enemy attacks, and hazardous gas leaks—into a single immersive setting. This all-encompassing strategy guarantees thorough emergency preparedness instruction for kids in a secure online environment.

I. Implementation

The implementation of our VR simulation consists of four main components:

A. Modelling and Environment Design

3D modelling tools like Blender and SketchUp will be used to create the virtual learning environment. Hallways, classrooms, exits, and danger areas are important components.

The application of virtual reality (VR) to training and education has drawn a lot of interest lately. Numerous research have investigated how well virtual reality (VR) may improve educational experiences, especially in the areas of safety training and disaster preparedness.

configuration of scene transitions, lighting, and physical interactions.

There will be checkpoints and guidance routes to help kids navigate the emergency situations.

B. Interactivity and User Engagement

Fire extinguisher exits, buttons, and evacuation routes are just a few of the multimedia components that will be included in the simulation.

Real-time activities will be provided to players and onscreen NPCs are interacting with each other.

NPCs, such as instructors and fellow students, will offer reactions and recommendations to mimic actual emergency scenarios.

C. Testing and Optimization

A limited sample of users will utilize the game in order to assess its efficacy and usefulness.

To guarantee seamless operation on virtual reality software efficiency improvements such as texture compression and rendering enhancements will be implemented. In order to improve user participation and educational results, final modifications will be made in response to feedback.

3- Core Functionalities:

used. Realistic emergency situations will be created by dynamically rendering the impacts of fire, smoke, and gas leaks.

D. Integration into Unity

The primary creation system, Unity 3D, will be utilized for importing the 3D assets.

A complete immersion will be guaranteed through the

The below are few core functionalities which we would like to include.

Interactive School Environment:

We would like to include a realistic 3d school with a classroom, cafeteria, ground, emergency exits. By implementing the ability to navigate from a place to other place and interact with the objects included, access technology ,aI models with sound effects.

Fig 1: School Environment and play area.

2. Emergency Scenarios:

For players to locate the fire extinguishers, avoid smoke and follow the particular routes (Evacuation Routes)

Fig 2: school environment library

Exit Scenario: Hiding techniques, Safe escape routes and lockdown procedures are taught for the player to get escaped from enemy with buttons.

3. Decision-Making Challenges:

Specific selection assignments for enhancing rapid reasoning. Player-chosen outcomes (e.g., safe exit vs. improper action).

Fig 3: Reacting to emergency buzzer.

4. Interactive Lectures and Courses:

Participants are guided thorough evacuation procedures by digital teachers. Window texts or narration highlight important security ideas.

Fig 4: Course modules in the classroom environment.

6. Technology for providing immediate input and achieving:

Following what they say, players get comments. Scores, emblems, and ratings are examples of gaming components.

Fig 5: Outside assets showing road

7. Safe Practice Mode:

Gives kids the opportunity to simulate emergencies reactions on a regular basis in a stress-free setting. Explore the institution's grounds at your leisure to become acquainted all the escape routes for emergencies.

Fig 6: Implementing exit drill after alert buzzer.

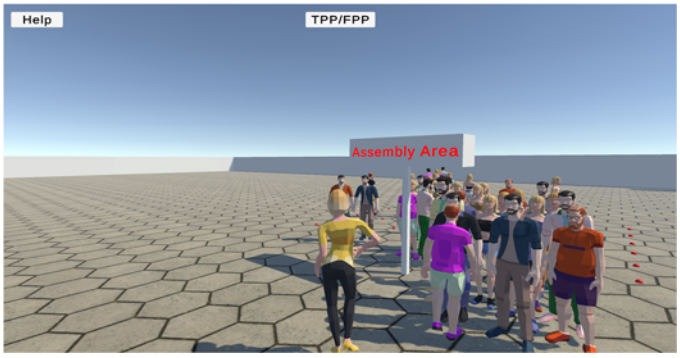

Fig 7: Moving to the safe area at end of emergency drill.

8. **AI Integeration :** The chatbot support with artificial intelligence

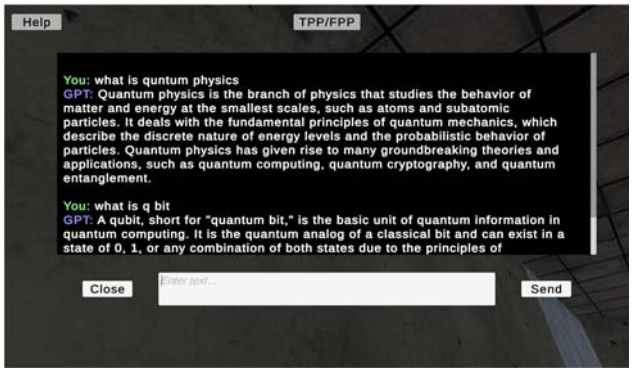

Fig: Chatbot support by artificial Intelligence.

5. **Interactions with security :**

The VR environment includes an AI-powered chatbot that assists players by answering questions and providing guidance during emergency situations. To enhance security, access to different rooms is controlled through door codes, preventing unauthorized entry by unknown persons or potential attackers. This setup trains players to think critically under pressure while reinforcing safety protocols.

Fig: passkey security setup to prevent unauthorized entries.

6. Adaptive Difficulties:

With predefined paths multiple exits are created to execute the drill. Depending on position of participant performs, the directions get changed.

A. Conclusion

The VR-based school safety simulation provides an immersive and interactive learning environment where children can develop essential emergency preparedness skills. By incorporating realistic scenarios such as fire hazards, toxic gas leaks, and hostile attackers, the simulation enables players to practice problem-solving and quick decision-making in a controlled virtual setting. The inclusion of an AI partner enhances the learning experience by offering real-time guidance and feedback. Interactive elements such as coded door access, emergency exits, and a car-driving module further enrich the simulation, making it a comprehensive educational tool. Through advanced 3D modeling, physics-based interactions, and AI-driven mechanics, the VR experience is designed to be both engaging and educational. This simulation not only reinforces critical safety knowledge but also helps build confidence in young learners, preparing them to respond effectively in real-world emergencies.

B. Acknowledgment

We would like to express our sincere gratitude to everyone who contributed to the development of this VR simulation. Special thanks to our mentors and instructors for their invaluable guidance, encouragement, and expertise throughout the project. We appreciate the support of our peers, whose feedback and insights helped refine various aspects of the simulation. Additionally, we acknowledge the developers and researchers in the field of VR and AI whose work inspired and informed our approach. Lastly, we extend our gratitude to the technology platforms and tools that facilitated the creation of this project, including Unity 3D, C#, and advanced 3D modeling software. Without the collective efforts of these individuals and resources, this project would not have been possible.

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