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Fire Guard VR: Mastering Fire Safety through Virtual Extinguisher Training

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Abstract
Addressing the shortcomings of traditional fire ex- tinguisher training, our groundbreaking solution harnesses the power of Roblox Studio to create an innovative VR app. This cost-effective and scalable platform offers immersive simulations of real-world fire scenarios, revolutionizing safety education. By eliminating the need for costly physical drills, our app enables largegroupstopracticeextinguisherusevirtually.Features like progress tracking and customization enhance accessibility, making fire safety training efficient, affordable, and engagingfor all.

Index Terms—Roblox Studio Development, Virtual Reality (VR) Application Design, Game Development Platforms, User Interface (UI) Design in VR, Educational Game Design, Interac- tive Simulation Development

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I. INTRODUCTION

In the dynamic landscape of safety education, we presentanunparalleledadvancement:thefusionofand VirtualReality (VR) in fire extinguisher training. Amidst the challenges of costly and resource-intensive traditional methods, our project stands as a beacon of innovation. Leveraging the robust capabilitiesofRobloxStudioandthescriptinglanguage Luau, we've crafted a transformative learning experience. Through immersive simulations of diverse fire scenarios, users gain a comprehensive understanding of extinguisher operation, un- bound by physical limitations.

Our VR program extends its reach from bustling corporate settingstointimateresidentialspaces,fosteringauniver - sal culture of safety. This isn't just about affordability or scalability—it's about empowering individuals globally with practicalskills.Theapp'sfeatures,includingprogresstr acking, customization, and regular updates, ensure a tailored and evolving training platform. We're not just revolutionizing safety education; we're catalyzing a shift towards proactive safetyconsciousness.Byequippingcommunitieswitht hetools to respond effectively to modern fire emergencies, our project heraldsaneweraofsafetyeducation,whereknowledge meets innovation.

A.ApplicationsacrossIndustries

In the realm of fire safety education, the future holds a transformative promise with the advent of AR and VR-based fireextinguishertrainingmethods.Firefightersandsafe tyedu-
catorswillnowhaveapowerfultoolattheirdisposal,ena bling them to provide interactive, cost-effective, and safe training sessions for individuals of all backgrounds. Through immer- sive simulations of real-world fire scenarios, this innovative approach ensures that participants can master the proper useoffireextinguishersinacontrolledandengagingenvi ronment. With the ability to customize training experiences and track progress,firefighterscantailorsessionstomeettheneed s of diverse groups, ultimately enhancing the effectiveness and accessibility of fire safety education. This technology

heraldsanewerawherefireextinguishertrainingbecomesnotjust a necessity, but an interactive and empowering experience for all.

II. LITERATURESURVEY

ThisarticleintroducesagroundbreakingAugmentedReality (AR) App [1] poised to revolutionize musical education for children. The App's core functionality involves validating the correct colouring of musical note sequences on a printed pentagram (target). Simultaneously, an enchanting AR ani- mation unfolds, featuring a lively 3D character synchronized with the melody, creating a multisensory learning experience. Rigorously tested with six children, the results demonstratetheApp'ssignificantpotentialinenhancingmusicaleducation. By seamlessly merging traditional musical notation with im- mersive AR elements, this tool transcends conventional methods, making learning engaging and dynamic. This innovative approachnotonlycaptivatesyounglearnersbutalsofosters a deeper understanding of musical concepts. The successful outcomes from the trial underscore the efficacy of this fusion, signalling a promising future for leveraging AR technology to enrichand elevate children's musical education worldwide.

Owingtotheexecutivefunctioningchallenges inherent in autism spectrum disorder (ASD), individuals with ASD encounter impediments in acquiring adaptive living skills and achieving independence, as specified in [2]. Learning tasks such as processing information, navigating social interactions, and engaging in public speech within bustling environments prove particularly challenging for them. While Virtual Reality (VR) has been explored in previous studies to aid ASD individuals in acquiring daily living skills, real-world task completion may remain elusive despite virtual training. This paperintroducesParaShop,amobileAugmentedReality(AR) applicationforAndroidandiOSdevices,specificallydesigned to guide individuals with ASD through supermarket shopping sequences.

Emerging technology has made the application of aug- mented reality increasingly extensive, as detailed in [3]. The application is developed based on ARFoundation, encapsulat- ing SDKs of ARCore and ARKit. ARFoundation can scan the environment and continuously improve the understanding of the environment by detecting feature points and planes in real scenes.Theappcreatesaninteractiveplanewhereroleobjects are placed. Users can select modules, set parameters to define the role's code logic, and see the results in real-time. The project's goal is to enable children to merge practical skills with visual effects, thereby fostering a more comprehensive developmentoftheirintellectualabilities.Thispaperintroduces an augmented reality (AR)–based application for guitar chord training, as outlined in [4], featuring high-quality 3D models andanimatedinstructions.Theapp'susability,measuredby a System Usability Scale (SUS) questionnaire, scored 82.0, indicatingexcellentuserexperience.Thestudy,encompassing individuals with and without musical experience, concludes thattheapplicationoffersavaluablelearningapproachfor all participants. Notably, those with prior musical experience exhibited faster learning. The research also identifies gender- based differences, with males learning faster, potentially attributedtospatialawarenessvariances.Thesefindingssuggest promising avenues for further exploration in spatial reasoning within AR-based musical instruction.As outlined in [5], aug- mented reality (AR) is increasingly integrated into education, particularlyinchallengingsubjectslikeelectronics.Thisstudy introduces an interactive AR app focused on electrical cir- cuits to enhance students' comprehension. The app facilitates circuit manipulation, computes voltage and amperage using the loop method, and applies Kirchhoff's voltage law. The researchaimstogaugestudents'intentiontousetheAR app,exploringpotentialinfluenceslikesurveymethods (online or face-to-face) and gender. [6] In our contemporary world,the issue of information overload has gained unprecedented significance. Addressing this challenge involves employing three primary methods: website navigation, search engines, andapplications(APPs).Websitenavigationstrategicallyorganizesrenownedwebsites,categoricallyalleviatinginformation overload.Searchenginesmanagethisinfluxbyindexing vast web pages. Yet, when users struggle to articulate their needsexplicitly,traditionalmethods falter,makinganimation-

orientedAPPsaviablesolution.[7]Thisstudy aimedtocreate an AR-based application, AIEduAR, to facilitate AI learning for students not majoring in engineering and to evaluate its educational impact. AIEduAR provides a visual platform that demonstrates machine learning processes. The study involved 88 undergraduate students with no prior AI education.They weretaughtAIprinciplesandtaskedwithsolving10problems using AIEduAR. [8]The article presents a new

virtual tool for learning human anatomy based on the idea of body ownership and embodiment. Body ownership is the feeling that our body is ours and different from others, and embodiment is the process of learning through physical actions and sensations. The tool is called the human muscular arm avatar (HMAA), and it uses virtual reality (VR) and augmented reality (AR) to let users explore the muscles of the hand and forearm.
[9],Thearticlereviewstheuseofaugmentedreality
(AR) for learning in engineering studies. It aims to answerfive research questions: RQ1) Which engineering disciplines have used AR; RQ2) What kinds of educational activitieshave used AR; RQ3) How AR has affected students and instructors;RQ4)WhatfeaturesARappshave;andRQ5)how interactive AR apps are. [10]The article describes how a new app is developed to showcase campus culture using VR and metaverse technology. 3D modelling was used based on the data collected by a UAV with different sensors. The contents of the app were chosen based on user demand analysis using three methods: the fuzzy Kano model, the entropy weighting method, and the TOPSIS method.

III. PROPOSEDMETHODOLOGY

A. Workflow

To develop a comprehensive fire extinguisher training sim- ulation using Roblox Studio and Luau scripting, begin by masteringtheStudio'sinterfaceandbasicobjectmanipu lation. Next, delve into Luau scripting to create user-defined scripts that simulate fire extinguisher actions like spraying foam and deployment.

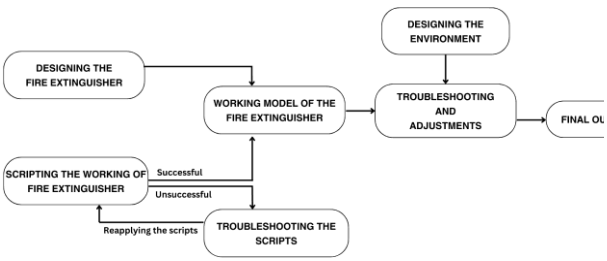

Fig.1:ArchitectureofFireGuardVR

Researchthemechanicsofrealextinguishers,understan ding fire types and proper handling. Design a detailed 3D model of theextinguisher,completewithtexturesandlabels.Inte grate
these elements into an interactive simulation where users can pick up, aim, and extinguish virtual fires. Implement feedback systemsandprogresstracking,refiningthesimulationth rough
playtestinganditerativeimprovements.Oncepolished, publish the simulation to the Roblox platform, providing clear user guides for an engaging and educational experience.

B. Softwaresused

- **Roblox Studio**:Roblox Studio stands as a dynamic game development platform, offering a robust toolkit for cre- ating immersive experiences. With an intuitive interface, userscancraft3Dworlds,designintricategamemechan- ics, and script interactive elements using the Lua-based
language,Luau.Thispowerfulsoftwareempowersdeve l- opers to bring their ideas to life, from simple simulations
tocomplexmultiplayergames,withinthevibrantRoblo x ecosystem.

C. How to use and standard procedures - Fire Extin-guisher

Pull the pin to break the seal and unlock the lever. Aim the nozzle or hose at the base of the fire, not the flames. Squeeze the lever to release the extinguishing agent. Sweepthenozzleorhosefromsidetoside,covering the entire area of the fire.Keep a safe distance of 6 to 10 feet(1.8to3m)fromthefireandmovecloserasthe fire dies down. Once the fire is out, back away from the area and keep an eye on it. If the fire re-ignites, repeatthePASStechniqueuntiltheextinguisherisempt yorthe fire is completely out. Do not turn your back on the fireor leave the scene until the fire department arrives.

D. UsabilityStudy

Here'stheusabilitystudyonthefireextinguishertrainin g
projectamong57participantsfromvariousbackground s: –**Knowledge Gap**:73.7 percentage of participants ad-
mittedto notknowing howto use afire extinguisher, with21.1percentagereportingpriorencounterswith fire accidents.

– **Confidence Boost**:When asked if given hands-on experience, 78.9 percentage expressed confidence in their ability to de-escalate fire situations.

– **Lack of Training**:Surprisingly, 89.5 percentage of respondents had not received any formal fire extin- guisher training.

– **Preference for VR Training**: A resounding 96.5 percentage favored learning through animated VR games, highlighting a strong interest in interactive methods.

– **VR Simulation Preference**: When given the choice betweenVRsimulationsandtraditionalmethods, 71.9 percentage opted for the immersive VR experi-

ence.
This study indicates a clear need for accessible and engaging fire extinguisher training. The overwhelm-inglypositiveresponseunderscorestherelevanceand

potential impact of this innovative project. Partici-pantsshowedawillingnesstoembracetheVR-based training,demonstratingitspotentialtobridgethegap in fire safety education effectively.

IV. RESULTS

A. How Useful was FireGuardAR on learning Fire Extinguisher Training

Theusabilitystudyconductedamong57participants across diverse backgrounds sheds light on thepivotal role of the fire extinguisher training projectin educating individuals about fire safety. A striking finding reveals a substantial knowledge gap, with a staggering 73.7 percentage of participants admitting to lacking familiarity with the operation of fire extinguishers,despite21.1percentagereportingprior encounters with fire accidents. However, the project emerged as a beacon of empowerment, with 78.9 percentage expressing newfound confidence in their ability to de-escalate fire situations after receiving hands-on experience through the simulation.

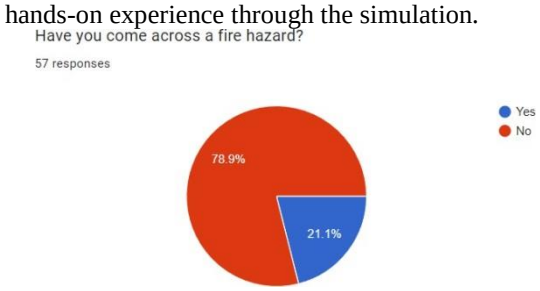

Fig.2:Haveyoucomeacrossafirehazard

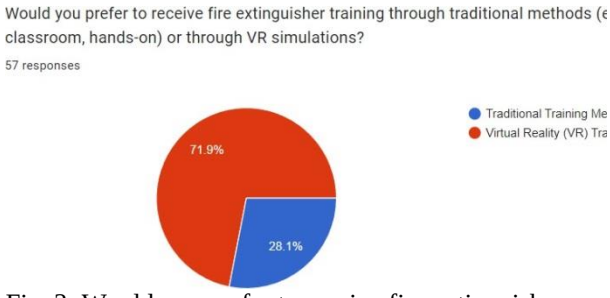

Fig. 3: Would you prefer to receive fire extinguisher train-ing through traditional methods (eg: classroom, hands-on) or through VR simulations?

Moreover, the resounding preference for VR-based trainingwasresoundinglyclear,witharemarkable 96.5 percentage of participants indicating their enthusiasm for learning through animated VRgames.Thispreferencereflectsastrongdesire

for engaging, interactive, and practical learning experiences. When given the choice between traditionaltrainingmethodsandVRsimulations, 71.9 percentage opted for the immersive virtual environment, showcasing the project's effectiveness in captivating and educating users.

Fig. 4: Have you received formal training on how to use a fire extinguisher?

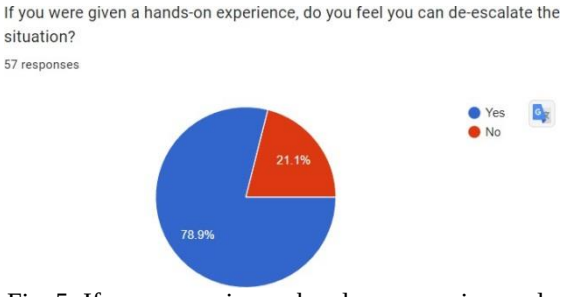

Fig. 5: If you were given a hands-on experience, do you feel you can de-escalate the situation?

These compelling results underscore the project's significant impact in addressing the critical need for accessible and engaging fire extinguisher training. By providing a platform that not only educates but also boosts confidence in handling fire emergencies, this project stands as a vital tool in enhancing fire safety awareness and preparedness.

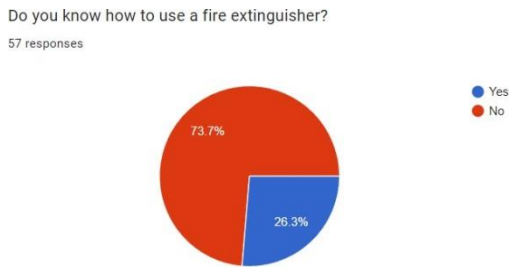

Fig.6:Doyouknowhowtouseafireextinguisher?

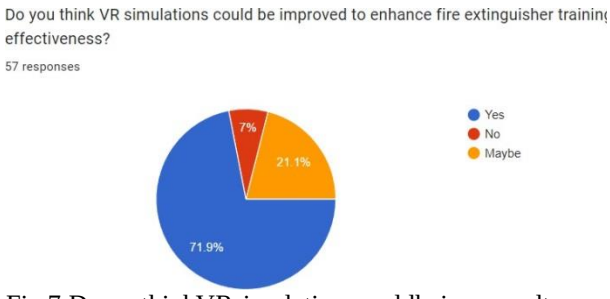

Fig.7:DoyouthinkVRsimulationscouldbeimprovedto enhance fire extinguisher training effectiveness?

With its immersive and interactive approach, it has the potential to revolutionize fire safety education, equipping individuals with the knowledge and skills needed to respond effectively to fire incidents.

V. CONCLUSION

In conclusion, the fire extinguisher training project hasproventobearesoundingsuccess,bridging theknowledgegapandempoweringindividualswith vitalfiresafetyskills.Theoverwhelmingenthusiasm for VR-based training, coupled with the newfound confidence expressed by participants, highlights the project'seffectiveness.Thisinnovativeapproachnot only educates but also instills a sense of preparedness, ensuring a safer and more resilient community against fire emergencies.

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