Low-Cost 3DOF Virtual Reality First Aid Training Programs

Kevin Dudeja, Sambaran Baidya, Sahil Gupta, S. Graceline Jasmine

Abstract: Virtual Reality (VR) devices are now more affordable and accessible for researchers to explore its advances for development of educative, learning and training applications.The aim of this project is to develop suitable first aid medical training programs utilizing low-cost VR headsets like Google Cardboard, Samsung VR and Oculus Go, which offers no spatial movement and hand interactivity. In this paper, we have proposed two novel training programs. The first prototype, we conduct the training through an interactive questionnaire and the second prototype is a picture-based point and click narrative experience (PBPCNE). The training applications, made using Unreal Engine 4 and Maya 3ds Max is executed directly on the Oculus Go headset, tests the user's knowledge on road safety, first aid knowledge, important emergency helpline numbers, Basic Life Support (BLS) guidelines and on the approach to handle victims in emergency situations.Our motive for these simulations is to create cost-effective tools for transferring skills and knowledge to the user by reducing the time and money invested in traditional training.

Index Terms*: *E-Learning, First Aid, Interactive Training, Point and Click, Virtual Reality

I. INTRODUCTION

The principle of virtual reality [1] e-learning is to impart, practice and check a user's knowledge using interactive scenarios and environments to reflect real-life situations. In emergency situations, the assessment of the victims and the care they will receive should be effective, with a view to the reduction of injury and prolonged survival. A study carried out by St John Ambulance show that there is about 140,000 people annually who have died in a situation where the use of First-Aid could have saved their lives.Back in 2009 'Mother and Baby Magazine' conducted a 'Save a Life' survey amongst 2,000, because of lack of knowledge on first aid care, 1,640 parents out of 2,000 who wouldn't be able to save their child's life in an emergency.Therefore, the layperson's qualification to provide early care in emergency situations and basic life support (BLS) decides how and what decisions he takes in a high risk situation. It is vital to invest time and money in the first aid training of faculties and students in colleges and universities. Application of virtual reality and augmented reality [2] are showing to play a vital role in the education, performance and engagements of trainees and students in different professions and overcome drawbacks of conventional training [3][4][5]. The applications have been developed for treatment and rehabilitation [6][7][8][9][10], medical training [11][12][13][14] and industrial maintenance and assembly task[15][16].

Our aim was to create interactive and gamified [17] first aid training program using virtual reality. This paper presents two non-immersive virtual reality first aid systems. The first is a testing system and the second is a narrative guided experience on the correct responses for the first responders.Both the systems follow the DRSABC Action Plan, which is a set of guidelines a first responder must follow when administering first aid to a victim in an emergency situation

D – Look for Danger and remove potential hazards
R – Check for the Victims Response
S – Send for help
A – Check and open the airway
B – Check for Breathing
C – Do CPR

II. LITERATURE REVIEW

The paper entitled as "Virtual reality versus master class: a comparative study" [17] by Eva Jimenez, Gonzalo Mariscal, Manuela Heredia, Guillermo Castilla presented a study to comprehend the impact on a person's ability to learn and perform by varying the mode of conduct of teaching between virtual reality and classroom teaching. Their study conducted performance testing and user experience testing and concluded that the use of virtual reality technology enhances the learning and academic results of the students, by engaging them in fun and immersive applications and also motivates them to enjoy the subject. The paper entitled as "Virtual reality training system for maintenance and operation of high-voltage overhead power lines" [15] by Andrés Ayala García, Israel Galván Bobadilla, Email, Gustavo Arroyo Figueroa, Miguel Pérez Ramírez, Javier Muñoz Román developed a cost-effective non-immersive virtual reality training system for workers maintaining high-voltage overhead power lines that reduced the time and money invested in the training.The paper entitled "Low Cost Virtual Reality for Medical Training" by Aman S. Mathur shows the practicality of virtual reality training programs. It is important to understand that the hardware capabilities also affect the making of the simulation and its game mechanics [11].

III. EXISTING SYSTEMS

There are quite a few studios who have made immersive first aid VR content for training a person by putting them in a 3D simulation and using devices like HTC Vive and Oculus Rift to teach them how to react, what to do and not to do. These simulations gives a person an ability to learn and refresh their knowledge of this vital skill in a convenient and engaging way.

A. *Dual Good Health*

Dual Good Health is a company in the UK with the aim to training more people on "how to save lives", with virtual reality by immersing them in a realistic and practical

simulation. The first aid tutorial is conducted in steps that provides real-time feedback in a variety of scenarios via an in-game narrator. Each task must be completed to progress to the next. They are using the HTC Vive Headset and Motion Hand Controllers and giving the users task to do which follow the DRSABC action plan.

Fig: The user is giving victim CPR

B. *St John Ambulance*

St John Ambulance in Australia used virtual reality to make first aid training within everyone's reach by developing fun and immersive educational simulations that instills users with the confidence to effectively respond in an emergency. Their system takes place in a realistic computer generated environment. Similar, to the previous system and our system, the system trains the user to follow the DRSABCD action plan of first response, in which, each letter is a specific task with different actions and knowledge required.

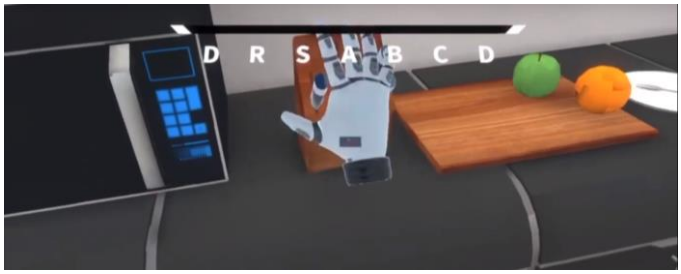

Fig: Place knife away from victim (Danger)

By gamification of the simulation, the user is not aware of the training program anymore, and boosts the engagement in simulation training [18].

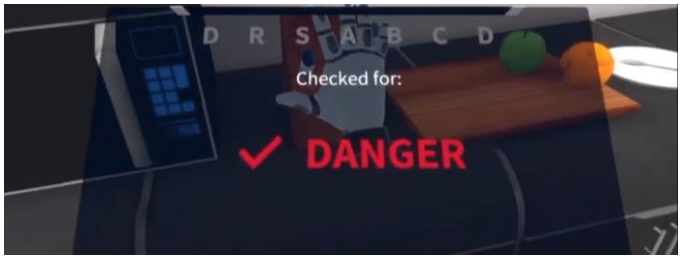

Fig: Completed Danger task

The above two VR simulations use high-end VR headsets like HTC Vive and Oculus Rift that have a 6DOF and allow users to move and interact in the space using both their body and hands [11].

IV. PROPOSED METHODOLOGY

A. *Hardware Specifications and Challenges*

The Oculus Go has a Snapdragon 821 processor with the Adreno 530 Graphics Card. Unlike the HTC Vive and other VR Headset, both the headset and the controller of the Oculus Go have a 3DOF system. Therefore, the experience had to be sit and watch with a point and shoot mechanic.The Unreal Engine offers us the ability to make games and simulations for the Oculus Go but in practice and testing, with the hardware specifications from 2015, with the rendering pipeline doing millions of computation to render meshes, lighting, animations, colors and game logic it is technical challenge to get a smooth experience of virtual reality [1].

B. *VR First Aid Questionnaire*

With the aim to test the user's knowledge on road safety, first aid knowledge, important emergency helpline numbers, Basic Life Support Guidelines and how to approach victims in emergency situations. We choose this mechanics because of the limitations of movement offered by the hardware.We wanted to experiment this mechanics with the use of 3D models to create the actors involved in a crash site, audio, 3D objects floating in space, a helpful narrator, with custom animations.The narrator takes you through the questionnaire through audio clips playing for each question number in the Game Mode. The respective answers are shown for the current question number. This system also shows the user at which stage of the DRSABC action plan is the user in reference to the question.Correct answers guide the user through elaboration on the answers and incorrect answers guide the user on what should have been done. Answering the questions is followed with illustrative visualizations and narrator animation to engage the user and aid him/her in better understanding the answer.

Fig: In – game screenshot: Color coded answers, DRSABC guidance, Audio and Visual Feedback

C. *Picture Based Point and Click Narrative Experience (PBPCNE) in VR*

Initially, we tried to replicate the live action scenario by developing Branching Narrative Live Action Story Experience, with Choice and Time based System like Bandersnatch from Netflix.The Choice Based Branching Story System with its intricacies of creating a branching narrative and other filming aspects of it, like acting, directing, cinematography, script writing and video editing, suddenly looked like an unviable solution for creating other emergency and medical VR training programs. Hence, it was discarded.Therefore, a new system was proposed to simplify the entire process. We created a situation where a person has fallen unconscious on the bathroom floor and there is blood on the floor, and Sambaran(you) are the first responder. The user then plays

through the narrative story of being the first responder.We shot multiple images from the script we prepared and used the Unreal Engine UI editor, to use static images of the scenes, and place buttons over the points of interest, in a given scene, to go to the next scene. Here, in the picture below, he first identifies an obstacles in his way to the victim and chooses to remove the obstacle.We gave it a narrative style dialogue themed user interface by taking inspiration from Japanese visual novels.

Fig: Remove obstacles button (action) in the scene is placed closed to the lying obstacles

V. DISCUSSION

Our VR Questionnaire System served as an important lesson in highlighting the differences between development for traditional interactive experiences and virtual reality experiences. After several attempts, we were finally able to bring our VR experience into a well optimized state by continuously refining and fine tuning our development practices. Iterative testing of the prototypes we built revealed the limitations of the hardware provided, and the measures that we had to take in order to overcome the shortcomings, like reducing the polygon count in our meshes and using a lower level of Light Importance Volume for lighting our level. It was noted that the prolonged inactivity in the VR Questionnaire broke the immersiveness and users specifically requested for a “repeat question” button and to add some movement in the scene.We also learnt how to effectively code a branching choice based system using the appropriate data structures, create visually impressive materials for our meshes by playing around with image properties, develop a working animation state machine for the entire system and develop a user friendly VR interface.The Point and Click Narrative Experience was an important lesson in how to create visual storytelling simulations. Rendering static backgrounds with interactive option overlays acts as a base which can be built upon by adding more things like 3D objects, particle effects and animations, to create an impressive 2.5D environments. We also learnt how to effectively use static images for storytelling purposes, which cuts down on resource expenditure significantly when compared to building full-motion video content. This blending of interactivity with 3D objects over 2D backgrounds will go a long way in making viable but immersive user experiences.

VI. CONCLUSION

The VR Questionnaire and VR Picture Based Point and Click Narrative Experience (PBPCNE) prototypes were developed by recognizing the hardware limitations in present low-cost VR headsets. We have followed the best practices not only for a smooth experience but also considered possible health hazards like motion sickness, physical and mental fatigue when wearing virtual reality headsets. Therefore, the concept of training programs can be built easily and improved upon using other Game Engines.Out of these two prototypes, the PBPCNE proves to be a more viable solution by reducing the time needed to build emergency training programs to less than 6 hours whereas the VR questionnaire took a few weeks,. It also simplifies the process by conveying the necessary information about the scene through the use of only UI elements and UI animations, therefore reducing the human resources required for the development of these training simulations.

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