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VR Wildfire Prevention: Teaching Campfire Safety in a Gamified Immersive Environment

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ABSTRACT

Due to an increase in the prevalence and intensity of wildfires worldwide [Liu et al. 2010], it is becoming more important to understand campfire safety in order to prevent human-caused wildfires. In the United States, the most common fire safety advice comes in the form of commercials and posters as a part of the Smokey the Bear campaign [Smo 2017]. Presenting this information through a virtual reality game provides a controlled and engaging environment to practice and learn how to safely control a campfire. This immersive experience guides the user through every step of creating and extinguishing a campfire based on information from the Smokey the Bear campaign. VR Wildfire Prevention aims to engage and educate people in campfire safety by providing a controlled environment to practice the relevant techniques while incentivizing proper behavior through gamification. Players of the game report that the game is an enjoyable experience.

CCS CONCEPTS

• **Human-centered computing → Activity centered design**;

KEYWORDS

serious game, immersion, virtual reality, safety training

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1 INTRODUCTION

A trend of longer and more frequent wildfires has been building since the mid-1980s and the consequences of global warming threaten to only continue and heighten it. In 2016, the state of California alone suffered from 4,808 human-caused wildfires that burned a total of 282,482 acres of land [Tim 2016]. In south-eastern Australia, a positive correlation was found between human population density and wildfires [Collins et al. 2015]. Growing populations indicate more wildfires, and with more wildfires comes more damage, property loss, and higher costs for fire suppression. Although some risks and causes of wildfires are uncontrollable, proper education and safety training can prevent one of the major causes of human-started wildfires: improperly managed campfires.

Providing campfire safety training has been the task of many organizations for several decades. However, the didactics through which this information is given to the public is not engaging enough, resulting in low knowledge retention [Chittaro and Buttussi 2015]. We propose addressing the issue of engagement and knowledge retention through the gamification of campfire safety guidelines as a serious virtual reality game. Previous studies show that virtual reality games can be used to teach safety protocols and increase the user's confidence to handle a simulated situation if it were to arise in real life [Orr et al. 2009]. Our VR Wildfire Prevention game enables users to practice safe campfire starting, maintenance, and extinguishing techniques in a controlled environment. We believe that the game is more engaging than current fire safety training methods and will increase the chances that the information is retained and used with real campfires.

1.1 Related Work

Games with fire safety training goals have been developed for fire evacuation training for mine workers [Orr et al. 2009], office workers [Ha et al. 2016], and for young children [Strickland et al. 2007]. The vast majority of games that are focused on general fire safety are desktop games aimed at a young audience, such as those found at Fire Safe Kids from CMG Inc [FSK 2010]. Currently, to the best of our knowledge, there is no game that serves the same purpose as VR Wildfire Prevention. The VR Wildfire Prevention game is aimed at an older, but general, audience and attempts to educate about fire safety techniques as well as build confidence in the creation and handling of safe campfires.

2 GAME DESIGN

VR Wildfire Prevention is a virtual reality game in which the player performs a series of tasks regarding safe building and maintaining a campfire. The player has free reign to make mistakes, and is notified

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Figure 1: Gameplay screenshots outlining the major events in VR Wildfire Prevention: Game start, location selection, material collection, fire-pit building, fire creation, and fire extinguishing.

at the end of the game whether their actions presented some risk in starting a wildfire.

VR Wildfire Prevention is built for the HTC Vive, a room-size VR system, allowing the player to explore a virtual campfire side, and perform the training through a series of simulated physical activities.

2.1 Gameplay

The game begins in the middle of a forest and the player is directed to a campsite. Once at the campsite, the player must manipulate the environment to build, maintain, and extinguish their campfire.

In order to set up a fire safely, the player must start by selecting an appropriate place for the campfire; somewhere far enough from trees and other flammable materials. Next, the player should dig a hole in the ground and surround it with stones. Then, the player can build a fire from branches and logs scattered around the campsite. Finally, the fire must be put out with the bucket of water.

While the above activities should be performed in the order described, the game makes it possible to make mistakes. For example, the player may forget to dig a fire pit, or surround the fire pit with stones, or the stones may be put around the fire after it was built.

The player may enable audio cues that provide instructions as well as encourage the use of proper techniques. A tablet also exists in-game that has instructions written for reference after the audio cues have passed, or for hearing impaired players. Played without the audio cues and a tablet, the game is more engaging, as it challenges the players to complete a task without giving them explicit instructions and forces players to think of potential consequences of each action taken. Played with the audio cues or written instructions, the game becomes a more traditional instructional system.

A score is kept internally and is not revealed to the player until the end of the game; a positive score indicates that the campfire was well controlled and had a low risk of starting a wildfire, and a negative score indicates that there was a high risk that their actions would start a wildfire.

3 PLAYER'S FEEDBACK

The game was presented a the Festival of Games, California State University Monterey Bay's game design competition, winning Best Game Design, Best Game Development, and Best Game Graphics awards. The feedback from the players has been positive, with players commenting positively on the immersiveness, engagement, and the user experience. In the future, we plan to formally evaluate the game's plausibility and its comparative effectiveness as a campfire safety training tool. The game is available for download, including the Unity source code in C#, at http://csumb.itch.io.

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