

Training an agent to find the best virtual reality route in Texas considering road construction, weather, and traffic

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Abstract—With the advancement of modern technologies, Virtual Reality plays an essential role for training rescuers, particularly for disaster savers employing simulation training. By wholly immersed in the virtual environment, rescuers are capable of practicing the required skills without being threatened of their lives before experiencing the realworld situation. This project presented a work-in-progress Virtual Reality application to help trainees get used to various disaster circumstances. A scenario of a city was created with an ambulance rescuer and several rescuees in the scene. The intelligent ambulance rescuer was introduced as a rescuer/guider to automatically search and find the optimal paths for saving all rescuees. The problem of finding best route is formulated into finite grid world, deterministic Markov Decision Process (MPDs) problem, when finding the optimal policy is together with finding the best routes. Factors of construction, weather and traffic are taken into account in the real-time to estimate the rewards (or penalties) in the policy selection. In this context, two approaches, namely Dynamic Programming and Temporal Difference are taken into consideration. In the first half of the project, we are model different and possible routes between two points of interest. The weather and construction conditions are updated by directly update from Internet sources (OpenStreetMap)

Keywords—*Reinforcement learning, best route planning, dynamic programming, temporal difference*

I. INTRODUCTION

According to the Department of Homeland Security, the United States had severely suffered from natural disasters and catastrophes within a twenty-year period (from 1995 to 2015) which cost 16.1 billion dollars insured losses. Floods and storms accounted for the majority of common disasters (71 percent of all incidents). More recently, Hurricane Harvey (2017), Hurricane Irma (2017), Hurricane Maria (2017) continued threatening people's lives in this country. These catastrophes do not occur only in the US but also in other parts of the world [2] such as in Sierra Leone (flooding and landslides in 2017), Colombia (mudslide in 2017), Bangladesh (monsoon flooding in 2017), Mexico (earthquake in 2017) and the like. Thus, the demand for quick responses to these unexpected events has increased than ever before. One such important response is to rescue people within a sufficient time and cost.

Virtual Reality (VR) is an emerging trend in the preparedness of natural disasters because of its cost-effectiveness, efficiency, comprehensiveness, safety, scalability, and customization. Being immersed in a controlled environment, trainees can take advanced tactical training, repetitively practice with chaos until they master the required

skills without threatening their well-being. Also, critical thinking will also be enhanced through a series of mental challenges such as finding the most sensible solutions or optimal alternatives to a circumstance. Thus when they face a real-life strike, their actions will be automatically triggered. Another important aspect of VR is that VR allows a user to navigate through the subconscious mind in which it is sometimes difficult to process a huge amount of information.

To take the advantages of VR, several case studies and applications have been conducted and developed in both government and education sectors [1, 2, 3]. Although VR is still in the early stage of development due to unavailability of standardized VR software package, the outcomes of these training offer a unique realistic quality and gain a high level of acceptance. Each of these training focuses on different aspects of disaster management (i.e., fire, health-care, mass casualty, navigation to a single point). The need to have a training application to optimally rescue multiple people is not fully addressed, which in turn can help rescuers to act quickly in real-life situations [4, 5, 6, 7].

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