The Evaluation of Experience-based Tsunami Drills Using a Mixed Reality

Koki Kadoya1\*, Yuya Yamato1, Koichi Hayashida2, Masaho Yoshida1, Tomonari Murata3

1 Department of Civil Engineering, National Institute of Technology, Fukui College, Fukui, Japan

2 Technical Support Center, National Institute of Technology, Fukui College, Fukui, Japan

3 Department of Electronics and Information Engineering, National Institute of Technology, Fukui College, Fukui, Japan

\* Corresponding author. Tel: +81-778-62-8306; E-mail:  [s53609kk@fukui-nct.ac.jp](mailto:zilidai@shu.edu.cn%20)

**Objective**

The purpose of this research is to understand changes in awareness of disaster prevention through hands-on tsunami evacuation prevention training in a virtual reality using a head-mounted display (HMD). The novelty and originality of this research is that it uses an immersive system to develop tsunami evacuation prevention drills that enables the participants to imagine what a disaster would look like, and that this research aims to improve the disaster prevention awareness by conducting hands-on disaster prevention training.

**Development of simulations and changes in disaster awareness**

The system was developed using Microsoft's HoloLens 2 HMD. HoloLens 2 is a technology that extends the virtual reality into the real world, allowing the background to be seen through the lens. The simulation can be replayed on HoloLens 2 because of The Mixed Reality Toolkit in Unity can adapt the simulation to a mixed reality. The simulations can be replayed with HoloLens 2, which allows us to introduce novelty to conventional disaster drills by using HMDs. In the building collapse simulation, buildings were selected and collapsed, and road closure was reproduced. The local residents who participated in the study expressed changes in their awareness of disaster preparedness, such as the need to change evacuation routes, the importance of disaster drills, and the need to be prepared on a daily basis. In addition, the participants were wanted to share their experiences in this study with those who could not participate in the previous disaster drills, which did not include tsunami attacks or building collapses. It is thought that the use of an unprecedented mixed reality attracted the interest of residents and made them want to experience it again.

**Evaluation of disaster drills using mixed reality**

According to the results of questionnaire, 89.3% of respondents answered that they thought evacuation drills based on a tsunami scenario were useful. The reason for this is that the evacuation drills were based on a tsunami in virtual reality, which they had never experienced before. In addition, by using the virtual reality to enter a real town, the participants were able to understand how their own town might be attacked.

The results of this study showed that experiential tsunami evacuation drills in a virtual reality using HMDs are effective.

Acknowledgments

This work was supported by the nippon foundation.