Disaster Scope: The Augmented Reality Floods and Smoke Simulated Experience Smartphone-Application

Tomoki Itamiya, Ph.D. *

Professor, Aichi University of Technology, Gamagori-city, Japan

ABSTRACT

We developed the augmented reality smartphone application Disaster Scope that enables immersive experiences to improve people's crisis awareness of the disaster in peacetime. The application can superimpose the occurrence situation of disasters such as CG floods and debris and fire smoke in the actual scenery, using only a smartphone and paper headset. By using a smartphone equipped with a 3D depth sensor, it is possible to sense the height from the ground and recognize surrounding objects. The real-time occlusion processing enabled using only by a smartphone. The collision detection of the real world's objects and CG debris is also possible. The flood height and flow speed can be changed by each user's setting. As a result, it has become possible to understand more realistically the dangerous of floods and a fire smoke charge. We utilized this system in evacuation drills organized by elementary schools and municipalities. As a result of the survey and verification, it is very useful for improving crisis awareness of young students and citizens.

Keywords: Augmented reality, evacuation drill, smartphone, occlusion, training, floods, tsunami, fire, smoke.

Index Terms: Human-centered computing~Mixed / augmented reality

1 INTRODUCTION

Natural disasters occur frequently in Japan. In the great east Japan earthquake in 2011 March and the heavy rain disaster at western Japan in 2018 July, many people didn't have the crisis consciousness enough to evacuate fast and safely. Numerous studies of flood simulation are performed [1,2], but it is difficult to understand for ordinary people, especially young students. Elementary and junior high schools and local governments hold disaster preparedness seminars using hazard maps and photographs of past disaster areas and educate potential risks in each area. To understand the risk, they need to find a house from the hazard map, read the depth of the flood of your home and school using the legend, imagine the disaster situation based on that the numerical value. These tasks are difficult for a young student. The purpose of this study is to improve young students' sense of crisis in peacetime. We developed the Augmented Reality smartphone application Disaster scope. Users can recognize the danger of floods situation even in low water level under 1 meter. In addition, this application can experience how smoke fills the room when a fire occurs. This app needs only a smartphone and a low price paper headset, Therefore, we can use it easily, and can use multiple at the same time.

* e-mail: itamiya@g.aut.ac.jp

Figure 1: The immersion experience using the Disaster Scope

2 THE SYSTEM

The application Disaster Scope installed on a smartphone, CG flooding or fire smoke is displayed superimposed on the real scenery video shot by the camera of a smartphone. Users can experience immersions by wearing a paper headset on smartphones. Many people can have a special experience because of the preparation is very easy. It is very useful that many people can experience at the same time. Figure 1 shows the immersion experience using the Disaster Scope.

2.1 Hardware

In this system, Zenfone AR (Android 7.0) manufactured by ASUS was used as a smartphone. Smartphone Theater Headset Le Class Single (1 eye type) was used as paper goggles. One piece of a paper headset can be obtained at 10USD.

2.2 Smartphone Application Disaster Scope

This application was developed using the Unity 5.6.2p4 and Google Tango SDK. A smartphone ASUS Zenfone AR has a 3D depth sensor by ToF (Time of Flight) method. It is possible to accurately acquire height position information from the ground of the smartphone and to recognize the three-dimensional shape of the surrounding object. This application consists of two parts.

2.2.1 Tsunami and Floods Situation Experience App

After launching the application, the CG water surface is displayed at an arbitrary height, and the water height can be set every 10 cm. Real-time occlusion processing can be done without delay so that the water surface is not displayed behind the actual objects and above the set water height. It can also express the flooding stream and the drifting thing(debris) accompanying it. And the collision detection of the real world's objects and CG debris is also possible. CG debris bounces off when it strikes the actual wall and people. The flow speed can be set to 3 types (stable, 0.5m/s, 1.5m/s). Rainfall expression is also possible. Figure 2 shows the view of the tsunami situation with floating debris.

Figure 2: The view of the tsunami situation with floating debris

If the water height is higher than the height of the smartphone, the underwater expression is displayed. The view becomes brown and cloudy, and the user can see the bottom of the water surface when looking up overhead. By the AR depth meter display and occlusion representation, it is easy to understand the height even above the overhead water height. Figure 3 shows the example view of the underwater expression.

Figure 3: The view of the underwater (water height 1.5 m)

2.2.2 Fire Smoke Situation Experience App

In the fire smoke situation experience application, a situation occurs where the fire occurs and the smoke fills the room indoors. When wearing a paper headset and launching this application, the CG smoke is displayed superimposed on the image of the real scenery. Since the height position of the smartphone from the floor can be precisely sensed from a 3D depth sensor information, in the state of standing up, the smoke is very dense and the surrounding visibility is very poor, but when taking a crouching low posture, even in the state that smoke becomes thinner and the real scenery becomes easier to see. Therefore, the user can feel the situation that there is little smoke near the floor. The boundary between smoke and air is clearly visible. Users can fully understand the necessity to escape in a low posture to avoid smoke when a fire situation. It is also necessary for firefighter trainees to learn the boundary. The ignition point can be set to any position from this application activation position. The appearance range of smoke can be set to a shape conforming to the internal structure of the actual building. The representation of smoke of this application is based on the video taken by the author about the appearance of smoke generation, indoor filling and diffusion in the actual firefighters' training room of Kyoto Multifunctional Fire Fighting Center. The expression of smoke was created under the guidance of firefighters. Figure 4 shows the view of the fire smoke situation. The height of the bottom of the smoke is 0.7 m.

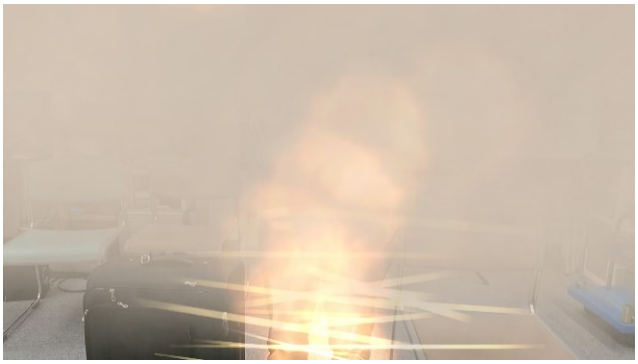

Figure 4: The view of the fire smoke situation (height 0.7 m)

3 Evaluation

We conducted the questionnaire survey on 807 people aged 7 to 70 who experienced in evacuation drills at elementary and junior high schools and disaster prevention events sponsored by municipal governments and subjective evaluations were conducted. Figure 5 shows the results of whether she/he thought about preparing for a disaster through two AR experiences.

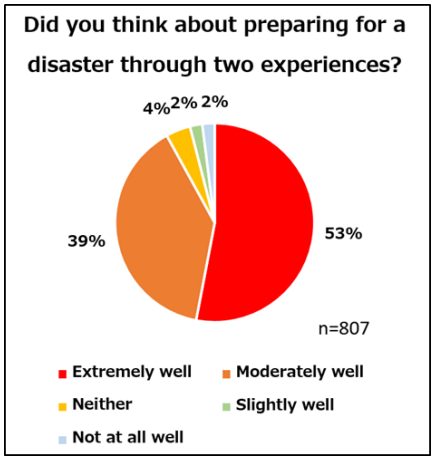

Figure 5: The results of the questionnaire survey

4 Conclusion

As a result of the questionnaire survey, it was suggested that using this application is useful for improving crisis awareness among young students and citizens. Although the range that can be sensed by the Zenfone AR's 3D depth sensor was about 5 meters, occlusion processing of an object that is more than 3 meters away was impossible under direct sunlight in some cases. Black clothes that are easy to absorb infrared rays may not be able to perform occlusion processing properly in some cases. This application runs only with Zenfone AR, so its versatility is low. It is desirable to disseminate a low-cost software mechanism that enables 3D spatial recognition only by a smartphone camera.

References

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