Development of the Java-based Evacuation Simulator equipped with plural wireless sensor network devices for fostering a deja vu

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1 Introduction

According to the recent report of Tokyo Fire Department published in 2011, the number of fire disasters was 5,088 and the number of deaths was 105. Although numbers are on a declining trend, the fire disaster is still a daily threat in Tokyo, and is almost impossible to prevent fire disaster perfectly [1]. Since ordinary evacuation training system has disadvantage in reality (lack of smoke, night-time, obstacles, etc.), the frequency and time length of the training. Thus it is insufficient for realistic training so that trainees can remember the way of survival when they meet with fire disaster scene.

In order to make up for such ordinary evacuation training, we developed a first-step model [2] of evacuation simulator utilizing the Java3D technology [3]. For the intuitive operation of the evacuation simulator, we adopted the wireless network sensor device (SunSPOT) and combined it with the Java3D program by using network data transfer.

In this paper, we expanded the use of the SunSPOT not only for directing device, but for reflecting trainee's crouch down position and for linking the real room lightness and the virtual room lightness. We believe this simulation approach would be utilized in the study of group psychology behaviour in disaster. We believe this realistic evacuation simulation approach would be utilized in memorising the trainees the success of evacuation, so that they remember the way of evacuation when they meet with a real fire disaster scene.

2 Expansion of the function of Java3D-based Evacuation Simulator

Fig. 1 illustrates the structure of the Java3D API program of the evacuation simulator that we developed. Left side sub-tree shows the structure of the building model, while right side tree shows the viewer system structure controlled with wireless network sensor devices. When the trainee recline the sensor device for move, the sensor behaviour object detects the angle variation during specific time, then set necessary viewpoint transfer to the top "TransformGroup" object.

In this paper, we added the function of considering the trainee's crouch position. We used another SunSPOT to know the trainee's crouch down position

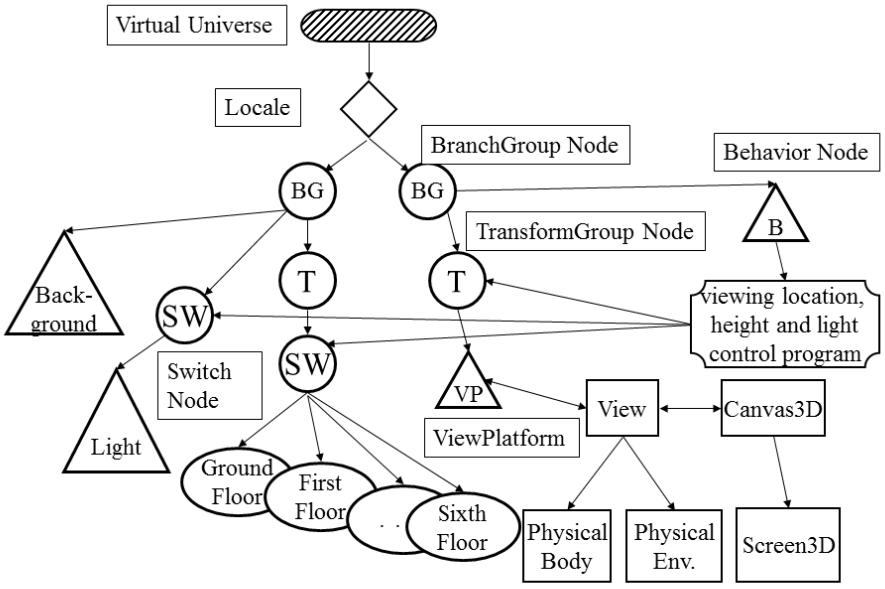

Fig. 1 Scenegraph of the Java3D-based Evacuation Simulator

by detecting the tilt angle of the SunSPOT which is equipped with trainee's thigh (fig.2). The reason of considering the crouch down position is that the position is considered as effective to keep clear sight and to protect oneself from harmful smoke, CO_2 CO, etc.

Fig.2 Wireless Network Sensor Device Attached to the Trainee's Thigh

We also added utilized the light sensor information of the SunSPOT to synchronize the trainee's room brightness and the simulated room brightness. These data link relations are illustrated in fig.3. Since the SunSPOT runs on the Java Micro Edition Virtual Machine, it cannot call the method of the Java3D-based program. So we used the UDP communication to combine the SunSPOT and the Java3D-based Evacuation Simulator.

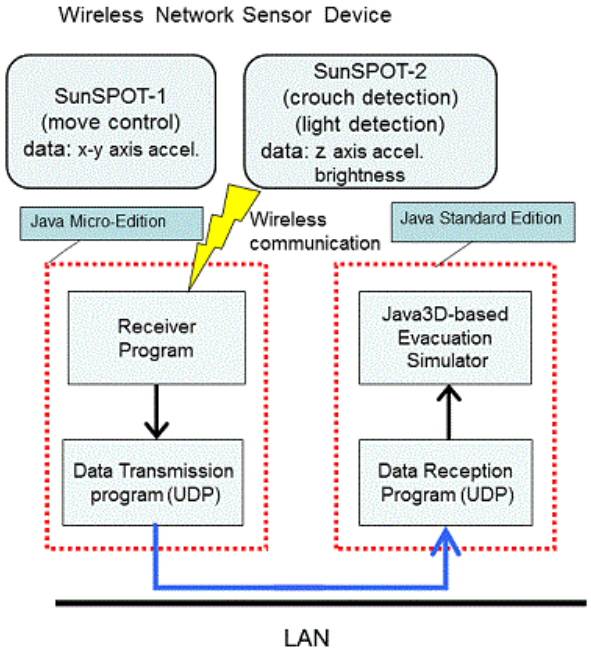

Fig. 3 Network Link between Java3D Program and Wireless Network Sensor Devices

3 Preliminary result of the effect of plural wireless network sensor adoption

In order to create realistic "fire disaster scene", we firstly examined the usability of this new configuration system. Through the several staff tests, the crouch down sensor and room light sensor worked fine (fig.4), but it became clear that the usage of the movement controller for walk-through should be modified because some of the trainees felt this control operation as non-natural. The current operation for indicating the moving direction is to tilt the SunSPOT to a direction going to move. This non-natural control disadvantage showed up because the other control (crouch down, etc.) utilized very natural action. Hence, we are now considering the improvement in this matter for the next version. The other element for realistic fire disaster scene "smoke-filled situation" was successfully introduced to the system as shown in fig.5.

Fig. 4 Evacuation Simulator Screen at Crouching Down Position

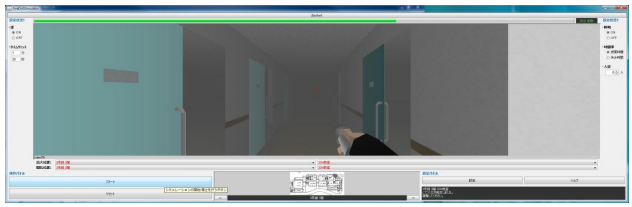

Fig. 5 Evacuation Simulator Screen at Smoky Situation

4 Conclusion

This paper has described the Java3D-based evacuation simulator, which is expected effective in educating successful evacuation training which is complementary to the real evacuation training. By adopting the plural wireless network sensor devices, we believe that natural, intuitive and effective scene representation became possible. This simulation approach can be used in the study of group psychology behaviour in disaster. We also hope this system is utilized in the education of self-starter evacuees to protect lives from disasters.

References

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