Constructing Interactive Virtual Scenarios for Investigating Human Behaviors in Pre-movement Time of High-building Fire

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ABSTRACT

Many fires in high-buildings have indicated that behaviors of occupants in period of pre-movement are important for survival. Pre-movement time and the behaviors in the pre-movement time are currently referred as most important factors that influence on the time of start to evacuate. The objective of this study is to identify occupants' behaviors in the pre-evacuation time and the period of the pre-evacuation in the event of high-building in the fire. This study proposes three kinds of factors based on the literature and characteristics of the domestic residential building and fire alarm, which are fire characteristics, building characteristics, human characteristics. Based on these factors, the earlier stage of the whole study constructs interaction scenarios of building interior in fire. Based on the interactive scenes, this study will investigate occupants' performance in the period of pre-movement time.

Keywords: Interaction virtual scenarios; human behaviors; high-building fire

INTRODUCTION

The research indicated that there are only 29% occupants leaving their houses while fire-alarm system giving signal firstly (Proulx and Reid 2006). Other persons continue to do their things, or respond it until their surroundings evacuate, or contact their family members or friends to identify their next activity (Fahy and Proulx 2001, Sandberg 1997). Some investigations showed that pre-movement time exhausted even more than 20 minutes in the reality (Proulx and Reid 2006, Fahy and Proulx1997, Averill, Mileti, Peacock, Kuligowski, Groner, Proulx, Reneke and Nelson2005). Therefore, the occupants' behaviors in the period of pre-movement are important for survival. Pre-movement time and pre-movement behavior are currently referred as most important factors during evacuation. Because the evacuation process is dynamic with chaos and memory bias in an emergency would appear, investigating the survivors after fire is very difficult. In the past twenty years, advancements in computer technology have given rise to high fidelity simulation, which make it possible to model the evacuation scenarios.

The aim of this project is to explore occupants' behaviors in the pre-evacuation time in the event of high-building in the fire. And the factors that influence pre-evacuation time of occupants during an actual fire evacuation also would be identified. This paper is part of the study, which is to construct interaction scenarios of building interior in fire.

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METHODOLOGY

This study is to construct interaction scenarios of room interior in the event of high-building in the fire. So, at first, factors influencing human behaviors in the room while occupants hearing signals like fire would be studied in the base of literatures. Then, static scenes of the room would be constructed. After that, according to possible occupants' behaviors in the room while hearing the signals like fire, this study would set up interactive props. Consequently, participants under the interactive scenarios would perform many kinds of behaviors.

Virtual Scenes

The human decision-making process is not isolated, but subject to various internal and external factors. Based on related works (Kobes, Helsloot, De Vries and Post 2010, Kobes, Post, Helsloot and Vries2008, Deloitte 2006, O'Connor 2005, Proulx 2001), this study proposes three kinds of factors influencing the human behaviors during the pre-movement in the event of fire. The factors are: fire characteristics, building characteristics and human characteristics. The first factor related fire includes fire location in the building and ways of fire perceived. The second factor is physically environment which occupants' behaviors are carried out. Because the processes of occupants' behaviors are completed in the room, the floor position and layout of the floor are considered for the building characteristics. The third factor is human nature including physiological characters (age, gender and disability), psychological characters (fire experience, training, education and personality), family composition, and occupants' initial situation in the event of fire. Because the research focuses on residential building, the virtual environment is designed into two-bedroom apartment. The two-bedroom apartment includes a sitting room, two-bedroom, a kitchen, and a restroom. The apartment is located in the 20-story building. The layout of the apartment is shown in figure 1.

Fig. 1 Top view of the whole interior scenes and front view of living room

Note：The fire smoke can be observed from the sitting room after a few minutes.

Interactivity of the scenarios for user performance

When the occupants perceive signals in case of fire, before evacuation a few kinds of possible behaviors in this period would happen. The behaviors includes searching information required for decision-making, collecting items of personal importance, rescuing relatives and friends and extinguishing fire and so on (Kuligowski and Hoskins 2010). In order to investigating these behaviors which could happen, this study constructs interactive interior scenarios through virtual software. The interior provides many related interactive props required in proceed of behaviors being conducted as shown in figure 2.

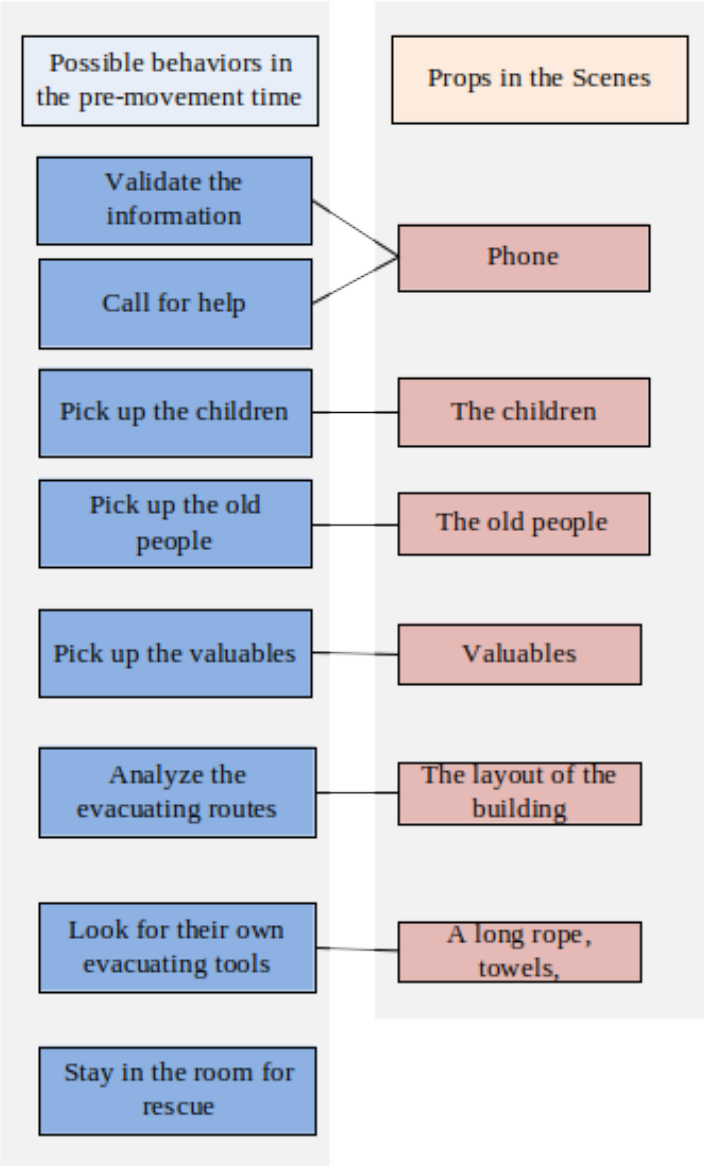

Fig. 2 Probable behaviors in the pre-movement and corresponding props

In addition, to achieve the behaviors in the pre-movement in the event of real fire through virtual scene, two aspects should be considered. One is normal situation designed for participants before the fire happens. Only in this way, the period of pre-movement could appear when the fire happens. The other one is to inspire participants in the virtual scenarios nervous, anxiety. In that way, the behaviors would be close to the real ones. The process of the experiment designed for a participant is shown in figure 3. This study only records the actions that the participants take before evacuating from the room while hearing the signals like fire.

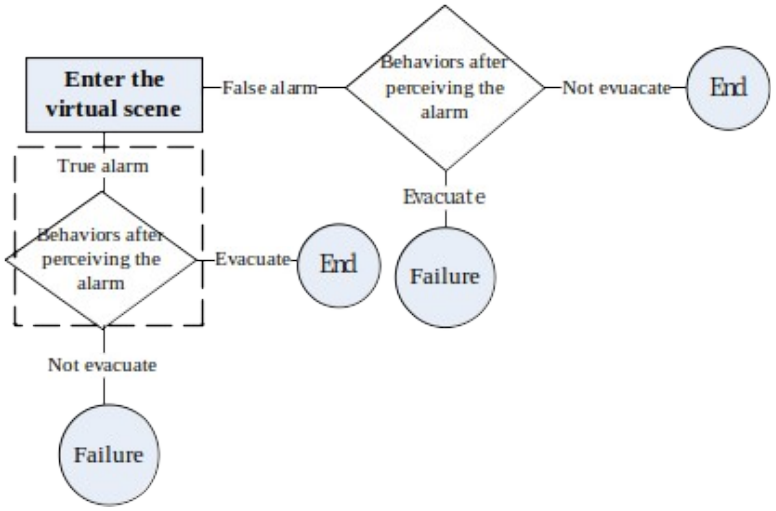

Fig. 3 Users' tasks in the virtual scenes

CONCLUSIONS

This paper is the part of earlier stage of the whole research project. In order to investigate human behaviors in pre-movement time in high-building fire, this study construct interactive virtual scenarios. According to the characteristics of the domestic residential building and fire alarm, this study proposes that three kinds of factors influence human behaviors in a fire. The factors including characteristics of the building, fire information, and characteristics of the people are considered in the course of constructing the interactive scenarios. Based on the interactive scenes, this study will investigate occupants' performance in the period of pre-movement time.

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