Combining 360 videography with interactive assets to create emergency scenarios for design of crisis evacuation instruments

Ray LC[†]
Northeastern University
Boston, MA, USA
rayLC@newschool.edu

Erin Brenneman
Northeastern University
Boston, MA, USA
brenneman.e@husky.neu.edu

Xinyun Chen
Northeastern University
Boston, MA, USA
chen.xinyun1@husky.neu.edu

Miso Kim[†]
Northeastern University
Boston, MA, USA
m.kim@northeastern.edu

INTRODUCTION

Emergency situations like natural disasters, accidents, and mass violence cause undue burden on human well-being and emotional stress. Vulnerable populations with limited mobility, such as older adults and those with special needs, are particularly affected, both because of their relative lack of ability to respond quickly to such crises, and because of their sense of powerlessness in the face of imminent dangers. To remediate these concerns, we propose to empower the elderly and vulnerable individuals to design evacuation procedures and instruments that are tailored to their circumstance. We utilize 360 assets to quickly situate humans in their homes and institutions, instead of unrelated virtual assets, so that they can design effectively in their own environments. Individuals can design and preview evacuations both spatially using navigation in the immersive experience, and materially using a garment into which they can fit their survival necessities. To make the 360 situations interactive, we take 360 photos at various points in the evacuation procedure and connect these points by 360 video transitions led by a workshop team member. The 360 photos correspond to key branch points in the evacuation in which they can preview their own material design by interacting with the environment using their own full-body and garment. This combines the interactivity of virtual reality with the realism of live 360 photo and video, giving vulnerable individuals a sense of familiarity in the immersive environment while allowing them to test the effectiveness of their own garment designs interactively. Such a process prepares the elderly and others for crisis situations while empowering them to design materially and spatially for overcoming these tribulations.

BACKGROUND

Individuals with sensory-motor hindurances, mobility problems, and cognitive issues are most affected by decision making during times of crises like emergency evacuations, endangering their ability to save their lives [Hoffman 2009]. As a stark example, hurricanes Harvey and Irma required the nation's largest emergency evacuations of more than 150 senior homes, presenting a glaring reminder of the lack of systematic evacuation protocol in place for the growing population of the elderly. Evacuation requires accurate planning and execution in a timely manner, which is has often been supplemented by digital technologies like amber alerts and apps. However, elderly

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[†] Correspondence and request for materials should be addressed to RLC and MK (emails: rayLC@newschool.edu, m.kim@northeastern.edu).

and physically compromised individuals are particularly susceptible to problems of navigation during evacuation [Ngo Ehren B. 2001], and their lack of awareness and effective use of mobile technologies during critical crisis situations put them in even more vulnerable positions [Zhang et al. 2020].

One way to remedy these concerns during emergency situations is by training using Virtual Reality (VR) technologies in an artificial game-like context [Feng et al. 2018; Nilsson; Burigat and Chittaro 2016]. While these strategies can help increase awareness of general emergency contexts, they fail to provide the realistic scenarios that seniors actually experience in their own environments. Moreover, there's a lack of fluency and negative attitude with immersive technologies among older adults initially despite the acceptance of these technologies once they try them [Huygelier et al. 2019; Syed-Abdul et al. 2019]. The elderly have a particular affinity for home environments, because they are less capable of adaptation to novel contexts [Filion et al. 1993], suggesting that more realistic scenarios would align with their attitudes and concerns. Moreover, spatial navigation involves learning precise timing and localization, a task that is significantly slower and deficient in the elderly compared to younger adults [Kirasic 1991]. Thus instead of learning about new environments we leverage the elderly's familiarity with their own homes by using realistic 360 videos and photos to train and design for their emergency navigation procedures.
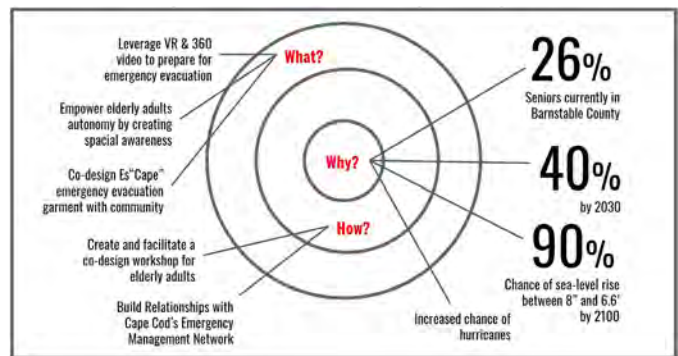
Figure 1: Co-design workshop for using immersive technology to enable older citizens in hurricane-at-risk area of Massachusetts to design emergency evacuation procedures and instruments.

In order to disseminate and empower the participants in an immersive approach to emergency efforts, we will hold co-design workshops to allow older citizens to design a cloak that preserves their dignity as well as life-preserving materials needed for crisis response (Figure 1-2). Working with emergency managers and older

adults in Barnstable County, Massachusetts, we build a community with a focus on helping the elderly design their own garment that ensures protection from the elements and preserves dignity during evacuations, especially at night when individuals are expected to be partially undressed. While majority of emergency management systems provide only passive information, we will use 360 video and photo in a headset to simulate evacuation scenarios, as well as provide an interactive environment where the elderly can see their own garment design in full-body VR and help inform their design.

Figure 2: Example of previously held co-design workshops for emergency preparedness in Northeastern Massachusetts.

TECHNOLOGY

We have prototyped a procedure for combining interactive elements with realistic 360 footage that helps orient the elderly during their evacuation design (Figure 3). We enable interaction with their own garments and other instruments like safety kits in the scene at branch points where the 360 photo serves as a background while the interactive elements are in the foreground. To transition between these scenes, we take 360 videos that move between the exact positions of the 360 photos so that they appear seamlessly integrated into the experience as transition elements, illustrating the fast pace and hectic nature of a real escape.

In playtesting our early prototypes, we found that individuals find the 360 videos to be jarring, while the 360 photo static scenes to be too stationary in the middle of the evacuation. Thus we modify our effort to begin in a completely stationary scene with full-body VR interaction with the garment they designed (detected using Kinect v2), followed by the entrance of a facilitator into the scene in the 360 video transition. We keep the videos short so as not to make the elderly dizzy, but instead of completely stationary 360 photo scenes, we set off a timer of 10 seconds before they are asked to move again using the 360 video transition. This occurs until they are outside the building, when the scene switches back to the hybrid 360 photo with interactive assets view. In the full-body experience while stationary, they can interact with their own bodies, locate where pockets and life-essentials are while seeing the environment in familiar 360 photo.

Using 360 photos for hybrid interactive scenes and 360 videos for fast transitions enables the elderly to experience, and design for, the fast pace of emergency evacuations while maintaining the familiarity of home situations critical to crisis response success.

Figure 3: Emergency evacuation procedure prototyped in 360 video. Place to be evacuated is one of the interactive locations which has static 360 video or 360 photo as background for further interactive components (above). Transitions between interactive locations during evacuation are illustrated by 360 video of a team member leading the way (middle). Scene post evacuation is another static 360 photo as background with future embedded interactive components for design analyses (bottom).

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