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PRODUCTS
MILLENNIUM

Evacuating Public Buildings Using Sound

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1 INTRODUCTION

Trying to escape from a burning building must be one of the most terrifying situations we could ever face. Although the fire itself is deadly, most casualties die from smoke inhalation which firstly blinds those trapped in its path, making it impossible to see the emergency exits, before being choked and suffocated.

Behavioural studies have repeatedly shown that people tend to evacuate a building by the route that it was entered, and in many cases the repercussions of such actions have been severe. Many people fail to spot nearby, and in some cases walk past visible fire exits, resulting in overcrowding of circulation routes that are used for normal, everyday movement, slowing down the evacuation process. As a direct consequence, some occupants are exposed to deadly smoke and flames.

Since we cannot rely on having unobscured vision in a fire situation, the effectiveness of aids such as emergency lighting and signage must be questioned. Indeed, what if you are among the 1.75 million people in the UK who are visually impaired?

Relying upon visual means just isn't good enough so it is imperative that another sense is activated, the use of sound being the obvious solution. At Leeds University, such a wayfinding aid has been developed, with extensive field trials showing it to offer fast,

efficient evacuation for sighted, visual and learning impaired users.

2 LOCALIZING SOUNDS

So, why not use your current fire alarm or speech alert mechanism as a wayfinding aid, placing them over exit doors? Basically, to localize a sound, it must contain as much of the audible frequency range as possible (20 Hz to 20 kHz). However, fire and speech-based alarms operate over a very narrow band of frequencies (typically 800 Hz to 3 kHz) therefore do not provide enough information to have their location determined.

3 TESTING THE BEACONS

To test the egress beacons, a complex route was devised in a deserted junior school owned by Leeds University. Subjects used included sighted, visually impaired and children.

Having filled the school with artificial smoke, all beacons, including the building's existing fire alarm were activated and each subject entered into the smoke.

Only 4 egress beacons placed at strategic points marked the entire route. At one point a small flight of stairs led upwards to a mid-level in the building, and a beacon was designed which, as well as having rapidly pulsing broadband noise, included an upwardly sweeping 'melodic'

complex which denoted to the subject "go up the stairs". At another point, there was the main staircase that descended to the final exit. Similarly, a 'down-sweep' was designed, giving the impression of "going down" the stairs. As beacons progressed from the starting point to the final exit, their pulse rate increased, a concept relying on human intuition with regards to faster events signaling nearing a final goal.

4 RESULTS

From the experiments, it was clear that the beacons proved themselves to be a crucial aid for all users under such visually impaired conditions. By providing directional information, they removed the need for having prior experience with the building, reducing evacuation time by more than two-thirds in many cases. Additionally, all subjects reported that the implementation of melodic complexes informed them not only of the presence of a staircase but also of the intended direction of travel.

The egress beacons have further advantages, notably by alerting users to exits that are out of their direct line of sight and, being language independent (using only broadband noise), they provide exit marking for all nationalities. However, they are not a replacement for current alert mechanisms and have been

designed so as to be easily interfaced with conventional fire control panels, providing the additional benefit of locating exits.

5 CONCLUSIONS

Although provision for emergency egress is improving, it is our duty to provide as many egress options as possible to all occupants of a building. Only by combining both visual and auditory wayfinding aids will optimal safety be achieved.