Haptic MR Pre-Training System for Firefighter Safety in Zero Visibility

Learning haptic feedback through VR

TactSleeve
Alerts users to the **distance** and **direction** of obstacles

Haptic ankle belt
Detects **hazardous areas** and helps users move through them

Applying haptic feedback in real-world
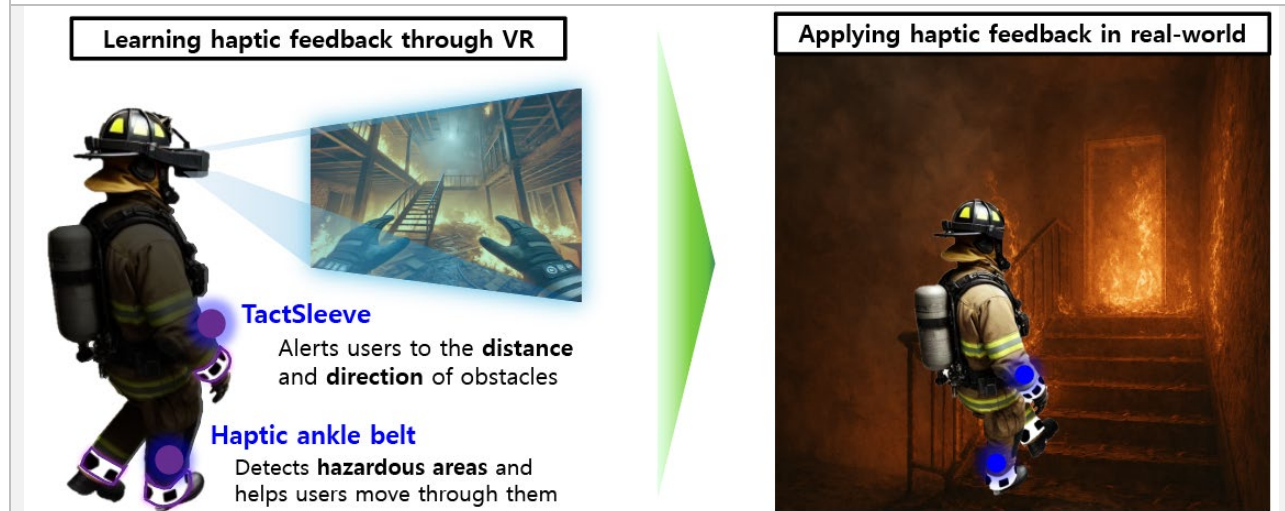
Summary: We present a haptic pre-training system in mixed reality designed to enhance firefighter safety in zero-visibility environments. The system delivers directional tactile cues via wrist- and ankle-mounted actuators to convey the presence of environmental hazards such as drop-offs, stairs, and obstacles. Prior to deployment, firefighters undergo immersive pre-training in a simulated MR environment to build intuitive associations between haptic patterns and spatial risks. This approach improves risk perception and response without relying on visual or auditory input. The proposed system is also extensible to other high-risk professions operating under visibility constraints, including military applications and assistive solutions for the visually impaired.