A Human Ultrasonic Echolocation Device for Assisting the Visually Impaired

Long, Macy (School: Zane Trace High School)

Visually impaired individuals need a low-cost assistive aid that can provide a new form of mobility and navigation. Currently, the blind rely on canes, guide dogs, and other tools to navigate their environments. However, these tools have their limitations, and they can be cumbersome and inconvenient to use. The basic principle of ultrasonic echolocation involves emitting high-frequency sound waves and listening to the echoes that bounce back from surrounding objects. By analyzing the echoes, animals, such as bats, can build up a detailed map of their environment, which they use to navigate and locate prey. The idea behind a human ultrasonic echolocation device is to use technology to replicate this process using Raspberry Pi. My assistive device emits high-frequency sound waves and uses an ultrasonic distance sensor to detect the echoes that bounce back. These echoes are then processed and converted into vibration signals, which provide haptic feedback to the user. The strength of the vibrations is adjusted based on the distance of objects in the environment directly in front of the sensor, with stronger vibrations indicating the presence of closer objects and weaker vibrations indicating objects that are further away. A series of tests were conducted to evaluate the performance of the device through five sighted blindfolded participants. The five individuals successfully demonstrated the developed system for four primary navigation tasks, including obstacle detection and orientation, to ensure usability and safety among users.

Awards Won: