The Use of Spatial Audio as a Navigation Aid for the Visually Impaired

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Introduction

The Visually Impaired are at a Disadvantage

Current Solutions for the visually impaired to navigate themselves are either guide dogs costing up to $60,000 [1] or white canes, which are unreliable, there does not exist a reliable solution for the visually impaired to navigate themselves in their homes.

Solution: The Use of Sounds to Aid Navigation

Since the visually impaired are known to have increased senses [2], we can use sounds to guide them. This system generates spatial audio, the ability for a subject to discern the directionality of a sound, which would allow the visually impaired to just follow the sound to the destination.

Overview

In order for the system to guide a user with sound, it must have the ability to track the subject's real-time location, and then send the sound to a low-latency IoT speaker system.

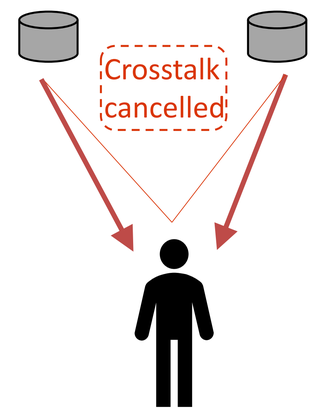
To track the subject's location, we use a Microsoft Kinect camera. This allows us to track the subject's location in a virtual coordinate space.

In order to generate the sounds across a large space, we use wi-fi enabled Raspberry Pi speakers. These IoT speakers can generate low-latency sound across a large system with multiple speakers.

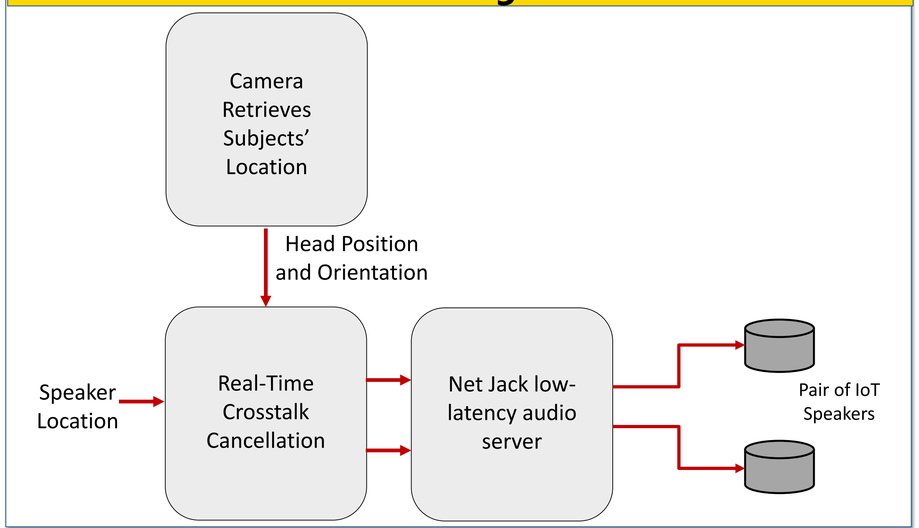
Solution: Crosstalk-Cancellation

In order to guide the subject, the system must be capable of manipulating the directionality of sound to guide a subject.

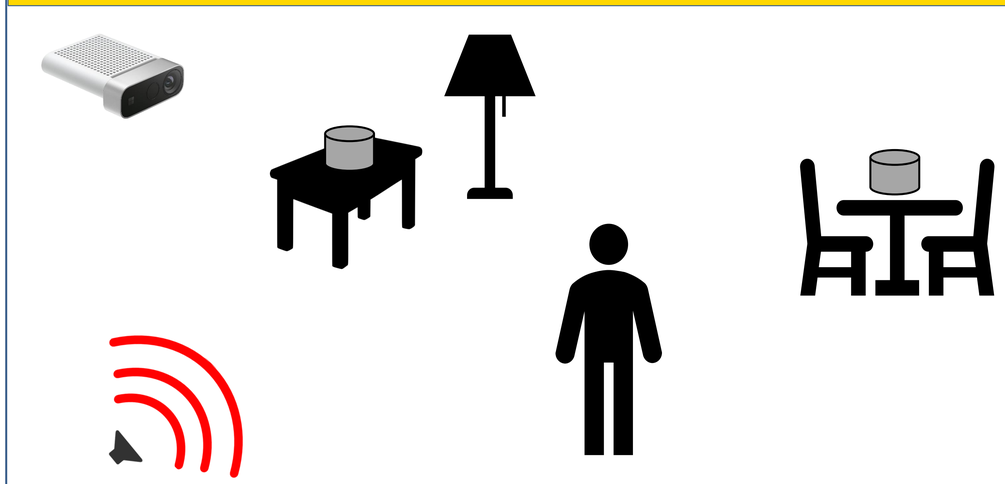
This solution uses an algorithm that cancels crosstalk between speakers with the subject's and speakers' locations, allowing the sound waves to be manipulated, creating the effect of spatial audio.



Block Diagram



Real World Scenario



Future Exploration

- Voice recognition for commands
- Object recognition to help locate missing items
- Mapping of area to navigate subjects to specific destinations

References

[1] Sullivan, Paul. "Precious Eyes." *The New York Times*, The New York Times, 7 Nov. 2013, www.nytimes.com/2013/11/08/giving/precious-eyes.html

[2] Burton, Harold, et al. "Adaptive changes in early and late blind: a fMRI study of Braille reading." *Journal of neurophysiology* 87.1 (2002): 589-607.

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