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

Anish Narsipur, Computer Systems Engineering  
Mentors: Dr. Robert LiKamWa, Frank Liu PhD. Student  
School of Computing, Informatics, and Decision Systems Engineering  

## 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

- Camera Retrieves Subjects’ Location  
- Head Position and Orientation  
- Real-Time Crosstalk Cancellation  
- Net Jack low-latency audio server  
- Pair of IoT Speakers  
- Real-World Current

**Camera**  
- Retrieves Subjects’ Location  
- Head Position and Orientation  
- Real-Time Crosstalk Cancellation  
- Net Jack low-latency audio server  
- Pair of IoT Speakers

## Real World Scenario

- **Speaker Location**  
- **Crosstalk Cancellation**  
- **Net Jack low-latency audio server**  
- **Pair of IoT Speakers**  
- **Real-Time Crosstalk Cancellation**  
- **Net Jack low-latency audio server**  
- **Pair of IoT Speakers**  
- **Real-World Scenario**  
- **Crosstalk Cancellation**

## Future Exploration

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

## References