# Designing a Smartphone-Based Assistance System for Blind People to Recognize Intersections and Obstacles in Indoor Corridors

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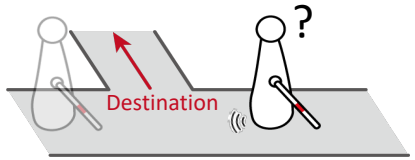
## Motivation

**Blind People face difficulties when navigating in indoor corridors.**

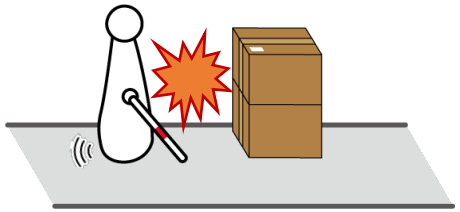
### Problem 1: Walking Past

Blind people may not notice the existence of intersection even if they are in it, and they may walk past it unnoticed.




### Problem 2: Collision

Indoor corridor may contain obstacles and blind people need to be aware of them to avoid accidents.



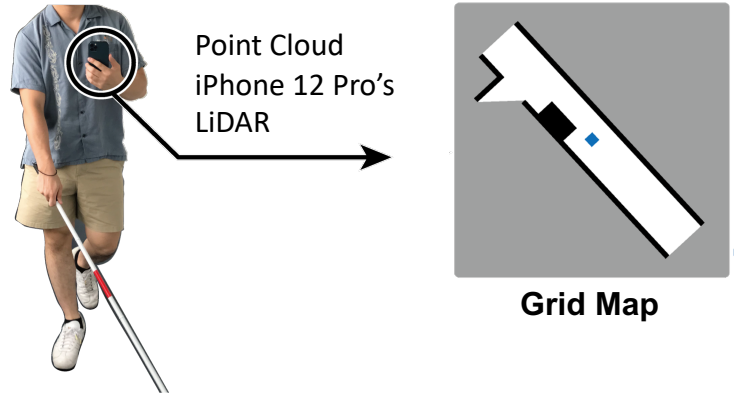
## Related Work

Garcia *etal.* proposed to use an RGB image taken by quadcopter to detect intersections [1]. As photos taken by blind people may contain motion blur [2] their method may not have robust detection results when applied to blind people.

To avoid obstacles, previous research used wearable devices [3] and robots [4]. On the other hand, we use smartphones, which are already widely used by blind people [5].

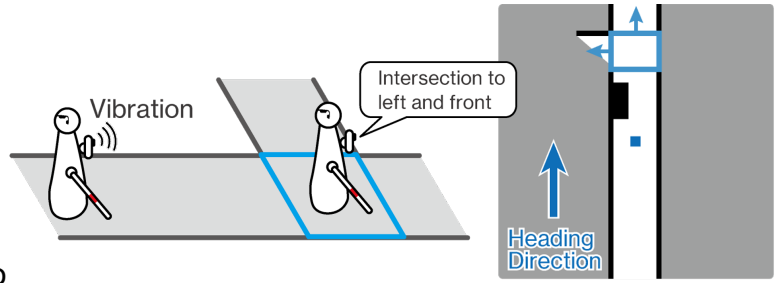
## System Design

We designed a smartphone-based walking assistance system for blind people to recognize intersections and obstacles in indoor corridors. The system will first construct a grid map of the surrounding environment using Lidar sensor of iPhone 12 Pro.



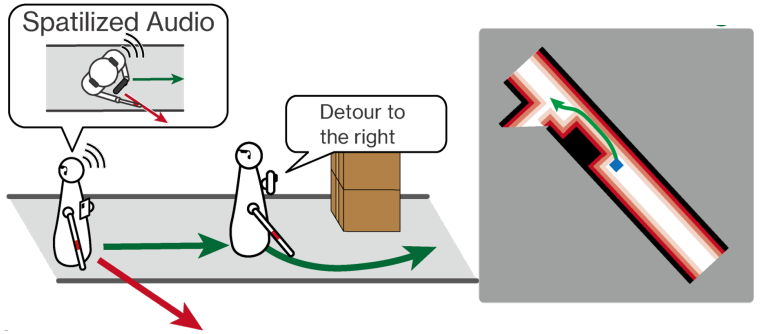

## Intersection Detection

The system will detect an intersection using the image of grid map to avoid motion blur of RGB images. The system will first preprocess the image of the grid map, having the heading direction of the user up. Then the position and shape of an intersection will be detected through YOLOv3 detector [6]. The system will vibrate to notify the existence of an intersection and convey which way the intersection leads to by audio feedback.




## Obstacle Avoidance

The system will first assign cost value to each cell and then perform path planning algorithm. The system will provide spatialized audio feedback when the user is veering from the path. Also, the system will tell the user to make a detour when an obstacle is ahead.

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**Reference [1]** Garcia, A *etal.* A Convolutional Neural Network Vision System Approach to Indoor Autonomous Quadrotor Navigation. ICUAS'19. **[2]** Sanketi, P *etal.* Anti-blur feedback for visually impaired users of smartphone cameras. ASSETS '10. **[3]** Lee, Y *etal.* Wearable RGBD Indoor Navigation System for the Blind. ECCV'14. **[4]** Guerreiro, J *etal.* CaBot: Designing and Evaluating an Autonomous Navigation Robot for Blind People. ASSETS'19. **[5]** Morris, J *etal.* Blind and Deaf Consumer Preferences for Android and iOS Smartphones. Inclusive Designing'14.**[6]** Redmon, J. YOLOv3: An Incremental Improvement, https://arxiv.org/abs/1804.02767