Leveraging Street Cameras to Support Outdoor Navigation for Blind Pedestrians

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Abstract

In this work, we are exploring the use of **street cameras** to leverage support for outdoor navigation for blind low vision (BLV) pedestrians. BLV people use GPS-based apps such as BlindSquare, but these apps **do not give users real-time, precise information which is crucial for safe navigation**. We hope to address the common challenges that BLV pedestrians face when navigating in urban environments by **developing a street camera-based navigation system using computer vision that provides real-time auditory feedback.**

Research Questions

RQ1. What aspects of outdoor navigation is challenging when using GPS-based assistance?

RQ2. How can a street camera-based system be designed to address these challenges?

RQ3. To what extent do street camera-based navigation systems address these outdoor navigation challenges?

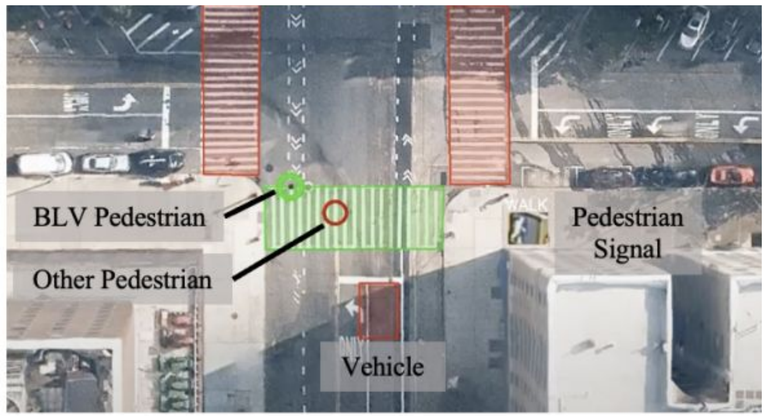
Methods

Formative Study	Computer Vision System	iOS Development
Identify pain points in outdoors navigation for BLVs	Use object detection with street cameras for veering and obstacle avoidance	Develop mobile app to deliver navigation

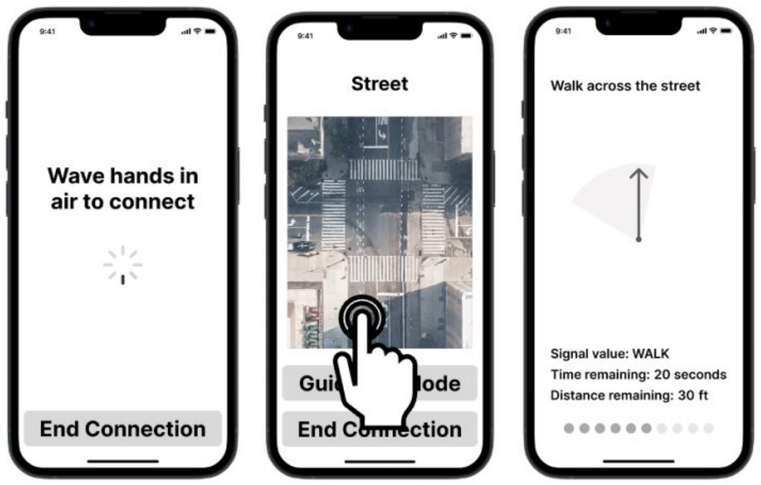
IN PROGRESS

Pilot Study	User Study
Test out system with small group of participants	Structured study with system

a) Street Camera



b) Bird's Eye View Map Representation



c) Companion Smartphone Application

Figure 1 Overall Street Camera Based Mobile App System. *BLV pedestrians use the smartphone app (c) to interact with the street cameras (a-b) in receiving precise and real-time navigation assistance. The system (a) localizes the BLV user by asking them to wave one hand, (c) explore the environment layout, and then guides the user to their destination while avoiding obstacles and veering off street.*

Results

From our formative studies, we found that there are **three main challenging aspects** of outdoor navigation for BLV pedestrians: **1) anticipating environment layouts, 2) avoiding obstacles, 3) crossing street intersections safely.** Therefore, we have designed a system to address these challenges by using street cameras to aid BLV users as they navigate.

1) Implemented map scrubbing feature
2) Street camera obstacle detection
3) Audio/haptic feedback for safety

Conclusion

In conclusion, our research team addressed major challenges that BLVs face when navigating outdoor environments by developing an app using street cameras and computer vision. In upcoming weeks, user studies will be conducted to attain insightful findings on our overall system, by identifying technical issues and necessary improvements to be made. We will compare our system to baseline navigation techniques. **Our aim is to understand the extent to which street cameras can be used to support precise and real-time outdoor navigation.**

Acknowledgements

This work was supported by the Amazon Summer Undergraduate Research Experience and the Computer Enabled Abilities Lab, thank you for this experience.