

Participant Evaluation of Headworn Camera vs. Smartphone Camera While Performing Guided Navigation Task

James Weiland^{1,4}, Yiran Zhou^{1,2}, Hannah Boike¹, Ava Fischer¹, Tanya Marrocco-Redmond⁴, Saad Alrazzi³, Ava Chang³, Eli Lebowitz¹, Clayton Bone¹, Sherry Day⁴

¹Biomedical Engineering, ²Robotics, ³Computer Engineering, ⁴Ophthalmology & Visual Sciences, University of Michigan, Ann Arbor, MI

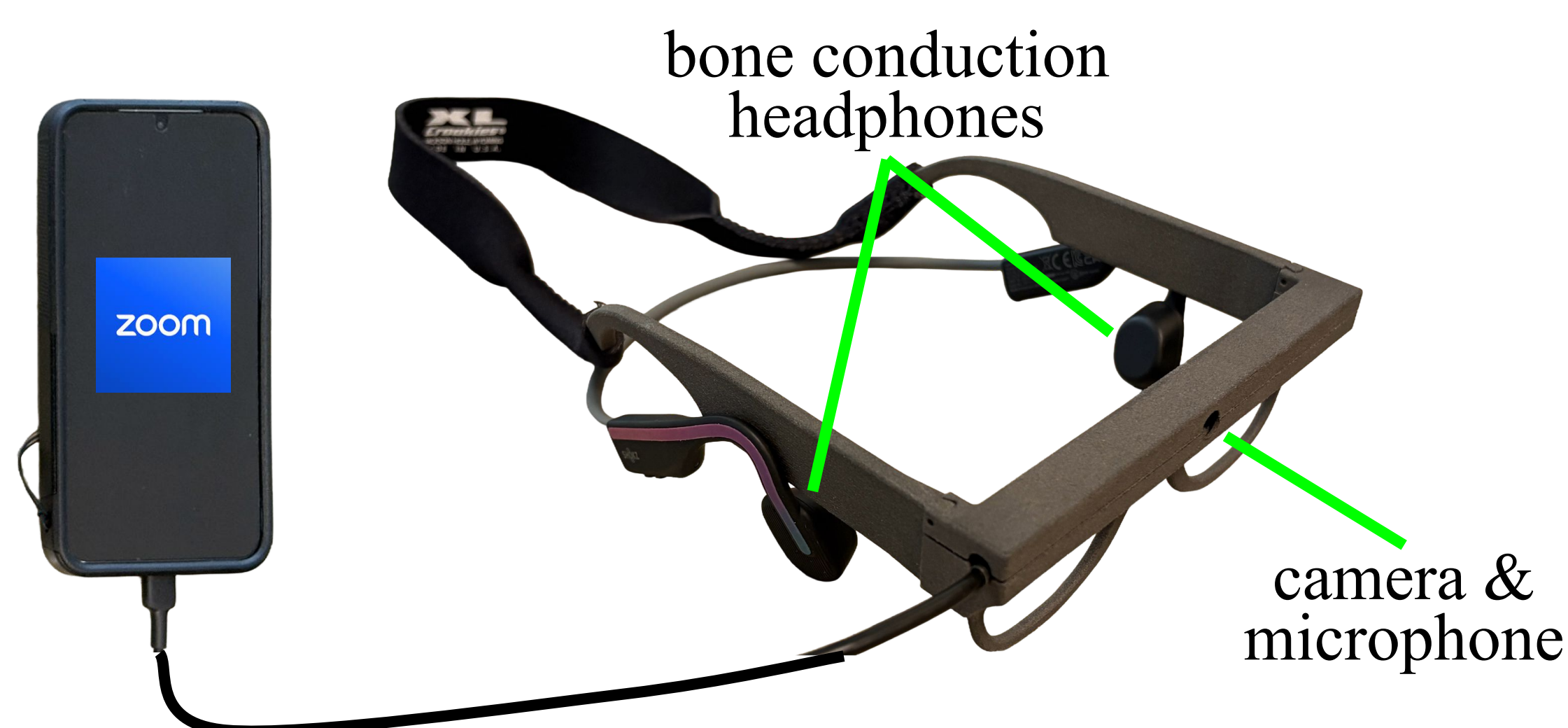
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Introduction

Mobile apps provide significant benefit to people with visual impairment. Navigation, scene identification, and remote connection to sighted guide are examples. A negative aspect of mobile apps on smartphones is the requirement to hold the phone in one hand for camera use. We developed a simple wearable camera that enabled hands-free operation of guided navigation task. We compared user navigation performance in two conditions: using a camera on glasses connected to a smartphone vs. using a handheld smartphone.

Methods

Test system - A commercially available camera module was embedded in custom 3D printed glasses frame. A USB-C cable connected the camera to an Android Smartphone. Wireless bone conduction headphones provided an audio channel.



After enrollment, visual acuity and contrast sensitivity was obtained (if possible). Participants were trained how to respond to remote guide instructions.

Participants walked 2 indoor routes (3 turns each) and 2 outdoor routes (same number of street crossings and similar length) with remote guidance. Study team walked with the participants. The zoom call was recorded and a separate video recording captured the participant walking. One indoor and one outdoor route was done with each of the two system configurations: Mobile phone only (**Phone**) and mobile phone plus glasses (**Glasses**). In the Phone configuration, participants held the phone against their chest.

The participants were guided via a Zoom call. The study team member on the zoom call could see the point of view from the camera (Phone or Glasses configuration) and guided the participant while the participant walked indoor and outdoor paths.

A post-test interview asked specific and open-ended questions. Post-test video analysis quantified walking speed and number of interventions.

Results

| | Participant 1 (Cane) | Participant 2 (Guide Dog) | Participant 3 (Cane) | Participant 4 (none) | Participant 5 (none) |
|----------------------------------|----------------------|---------------------------|----------------------|----------------------|----------------------|
| Glasses Indoor PPWS | 1.12 (B) | 1.13 (A) | 1.48 (A) | 1.19 (A) | 1.24 (B) |
| Phone Indoor PPWS | 1.24 (A) | 1.44 (B) | 1.31 (B) | 1.03 (B) | 1.32 (A) |
| Indoor order (Route A/ Route B) | Phone/ Glasses | Glasses/ Phone | Glasses/ Phone | Glasses/ Phone | Phone/ Glasses |
| Route A> Route B? | Yes | No | Yes | Yes | Yes |
| Glasses>Phone | No | No | Yes | Yes | No |
| Glasses Indoor Interventions | 1 | 0 | 1 | 0 | 0 |
| Phone Indoor Interventions | 1 | 0 | 0 | 0 | 0 |
| Glasses Outdoor PPWS | 0.69 (A) | 0.68 (B) | 0.65 (B) | 0.93 (B) | 0.7 (A) |
| Phone Outdoor PPWS | 0.69 (B) | 0.73 (A) | 0.61 (A) | 0.80 (A) | 0.65 (B) |
| Outdoor order (Route A/ Route B) | Glasses/ Phone | Phone/ Glasses | Phone/ Glasses | Phone/ Glasses | Glasses/ Phone |
| Route A> Route B? | No | Yes | No | No | Yes |
| Glasses>Phone | No | No | Yes | Yes | Yes |
| Glasses Outdoor Interventions | 6 | 0 | 1 | 0 | 0 |
| Phone Outdoor Interventions | 6 | 0 | 4 | 0 | 0 |

Post Test Survey Questions

| | | | | | |
|---|----------|----------|----------|----------|----------|
| The glasses will help me travel with confidence. | Agree | Agree | Agree | Agree | Agree |
| The glasses need to be improved before I would use them to travel. | Agree | Agree | Disagree | Agree | Agree |
| The glasses can be a substitute for my current mobility aid (cane or guide dog or human guide). | Disagree | Disagree | Disagree | Disagree | Disagree |
| I would feel self-conscious using the glasses. | Disagree | Disagree | Disagree | Agree | Disagree |
| The glasses can augment my current mobility aid (cane or guide dog or human guide). | Agree | Agree | Agree | Agree | Disagree |

Results

No differences were noted in percentage preferred walking speed (PPWS) based on configuration or test order. The configurations resulted in a similar number of interventions (where a study team member intervened to prevent a collision). PPWS was greater than 1 during indoor routes, suggesting that the participants felt safe walking at a faster than usual pace using both configurations. In contrast, PPWS was consistently below 1 (median 0.69) during outdoor tests, suggesting a more cautious approach.

Participants agreed that a future version of the glasses would be helpful for traveling and navigation and agreed that such a system could augment but not replace current navigation aids (see table). From the open ended questions, the headworn camera was appreciated, but the wire connecting the phone and glasses was viewed negatively. Here are some participant comments to open ended questions (**bold** text added for clarity):

*“It's [**the glasses**] more natural of movement that I have. To look for traffic and things. It wasn't turning my body [**as with the phone**], it was just more natural”*

“a heads up that you're coming up to like an intersection slow down or like a driveway that was super awesome that was very helpful “

“with the audible capability, it will help me navigate as a blind person along with me using my orientation and mobility skills. “

These tests support commercially available smartglasses (e.g. Meta AI Glasses) as a valuable technology to increase adoption and effectiveness of smartphone based navigation apps.

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