**Audio-based Navigation Glasses**

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**Motivation**

Close your eyes - what would you miss out on?

Many day-to-day situations rely on sightedness, including the road signs for guiding pedestrians alongside traffic. Existing technology cannot fully empower the blind and vision-impaired within these situations, relying on outdated centralized mapping information or physical contact to inform one of their surroundings. To address these issues, our solution will utilize recent advancements in computer vision to recognize objects in the wearer’s vicinity, reacting in real time to the changing world to increase one’s awareness of their surroundings.

**Characteristics**

- **Flexible**: in a variety of situations, recognize common symbols and signs: stop, pedestrian crossing, no entry, railroad crossing
- **Practical**: accurately detect objects and obstacles within one second without requiring network connectivity
- **Portable**: lightweight for wearing on long walks, and battery-operated with automatic low-power mode
- **Unobtrusive**: enable user to hear surroundings while audio cues are played via bone conduction, compact and adaptable to any social environment

**Product Overview**

- **Power**
  - 3+ hours battery life
  - Power/control button:
    - Tap: Speak sign (if on), turn on system (if off)
    - Hold 2 sec: pause/resume camera sign recognition
    - Hold 8 sec: shutdown

- **Sensors**
  - Inertial Measurement Unit detects head motion, automatically entering and leaving low power mode
  - LiDAR sensor measures distance, pausing detection when too close to objects (e.g. a poster or screen)

- **Object Recognition**
  - JeVois camera detects pedestrian signs using SURF keypoint matching
  - Matches are filtered to reduce noise using the following constraints:
    - Number of detections per second
    - How quickly sign position changes
  - Each constraint has a range between acceptance and rejection, keeping signs from switching in and out of detection

- **Audio Output**
  - Bone conduction for private listening
  - Positional audio cues for the following categories:
    - Continue
    - Continue with caution
    - Do not walk

**Performance Metrics**

- Recognizes chosen pedestrian signs from 5 – 13 ft within a second at around 82% accuracy (indoors & outdoors)
- Left to right positional audio feedback for signs
- Battery operated with 3+ hours run time

**Future Improvements**

- Detect and warn of approaching obstacles
- Replace hardware button with head gestures for control

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**Conclusion**

Our Audio-based Navigation Glasses provide the visually-impaired and blind with an offline, privacy-preserving way to stay informed of their surroundings, harnessing a camera and sensors to detect nearby objects, relaying the most relevant information about signs via positional audio cues.

**Ethics statement**: Our team respected all known copyright and licensing requirements in the design of our device, including using only open-source or legitimately-obtained proprietary software.