VIS⁴ION: A Smart Wearable for Navigation Support for the Visually Impaired

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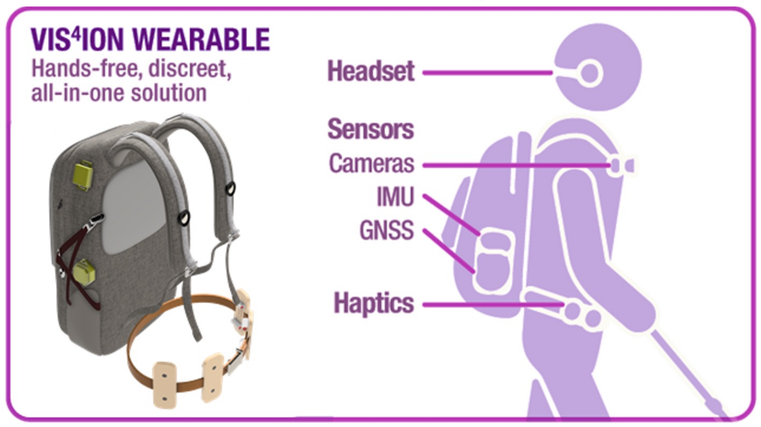
(a) Project Challenge

There are 285 million people with blindness and low vision (pBLV) worldwide that face numerous challenges in daily life. One critical pain point involves difficulties with navigation, hindering education, access to healthcare, and employment. This project seeks to take a significant leap in addressing the barriers pBLV face through a recently developed powerful platform: VIS⁴ION (Visually Impaired Smart Service System for Spatial Intelligence and Onboard Navigation).

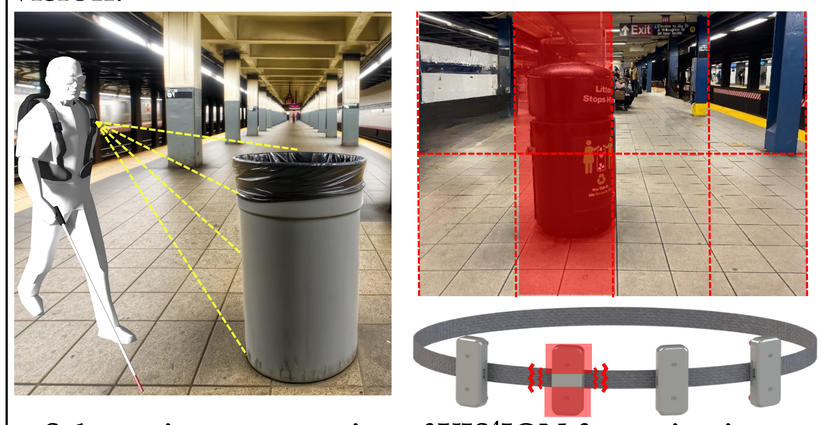
(b) Intellectual Merit

The VIS⁴ION is a discreet backpack equipped with mini sensors including cameras, microphones, GNSS receivers, and IMUs. It provides real-time guidance through audio and tactile feedback via a bone conduction headset and a haptic waist strap.



Schematic of VIS⁴ION Wearable

VIS⁴ION's capabilities include, but are not limited to, enhanced obstacle negotiation and ego-motion estimation aided by computer vision.



Schematic representation of VIS⁴ION for navigating around obstacles in a subway station

The 'Virtual Whisker' is a microservice within VIS⁴ION, aimed at improving users' ability to navigate around obstacles. It detects nearby obstacles and converts their positional information into vibrational signals on a haptic feedback belt, thereby assisting users in safely navigating their environment.

The other microservice on the VIS⁴ION is the "Collision Risk". This microservice decomposes motion in the camera frame into the user's ego motion and the motion of other objects.

Visualization of the Collision Risk microservice

By utilizing object tracking and ego motion estimation, this microservice categorizes objects as either low or high collision risk. It selectively alerts the user only to the high collision risk objects that are directly relevant for safe navigation.

(c) Major Outcomes

We have built and demonstrated initial versions of the wearable system for all key functions for navigation needs.

(d) Broader Impact

This project seeks to improve urban navigation for the visually impaired through the enhanced VIS4ION platform, promoting safer, independent transit use, boosting employment, and lowering healthcare costs, while also encouraging community participation by allowing visually impaired users to contribute spatial data.

(e) Future Goals

Large user trials in diverse scenarios for support at the workplace, within the hospital, through the street, and during subway/bus commuting. Trials will be conducted at the enterprise-level to support employees with BLV as well as in business cases.