Designing a Low-Cost Wayfinder for the Visually Impaired Using Bluetooth Angle-of-Arrival Feature

Cai, Brandon (School: Parkland High School)

In this project, a fully functional location-tag based point-to-point wayfinder system was created to help the visually impaired navigate large public facilities like airports and shopping centers. This homemade wayfinder uses the Angle of Arrival (AoA) feature from the 2019 Bluetooth 5.1 spec but deviates from the intended setup for AoA in traditional Indoor Positioning Systems (IPS). The new simplified solution introduced in this project only uses one antenna array on the user device, entirely eliminating the use of a mesh network as in IPS. Using a self-developed algorithm in Python, this wayfinder successfully detected both direction and distance to a target marked by a low-cost Bluetooth antenna. The target direction sensing capability calculates angle from the phase difference measured by two adjacent antennas on the user's antenna array following the newly introduced AoA concept. The target distance estimation is derived from the traditional Bluetooth Received Signal Strength Indicator (RSSI) feature. This wayfinder demonstrated directional angle accuracy of less than 10 degrees within the 15-meter range. The Python program written for this project shows the user an intuitive radar-like display. As future improvement, the 15-meter range can be extended to over 84 meters by amplifying the 3.16mW transmission power to 100mW, and a voice notification system will be built for more serious visually impaired users. As a successful proof of concept, this new AoA based design opens the door to a low cost solution for the visually impaired without the high cost associated with the complex whole premise mesh IPS.