Obstacle Detection for Visually Impaired and Blind

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For most visually impaired and blind people (VIB), the main barrier to improve their quality of life is the inability to navigate across a large variety of environments with a considerable quantity of obstacles. INSPEX [1] is an H2020 EU project that develops a portable multi-sensor system for obstacle detection, integrating a combination of distance measurement sensors such as ultrasonic, LiDAR, and RF UWB radars, intended to be used in multiple industries including high-end autonomous cars, smart-canes for VIB, safer human navigation in reduced visibility conditions, and drone navigation.

The first prototype of the smart-cane has been developed as a Medical Device Class I. The system adds a miniaturized Mobile Detection Device (MDD) to a typical white cane for VIB people. An augmented reality audio interface in extra-auricular earphones and the head attitude, tracked with an Attitude and Heading Reference System (AHRS) in a headset, provide 3D spatial sound feedback of an obstacle's real direction and range. Context aware messages guide the user within a wider smart environment such as smart traffic lights, navigation beacons and ID tags (Figure 1). The smartphone is the gateway between the smart-cane and the headset, enabling also the localization by means of mapping apps (embedded GPS or other means).

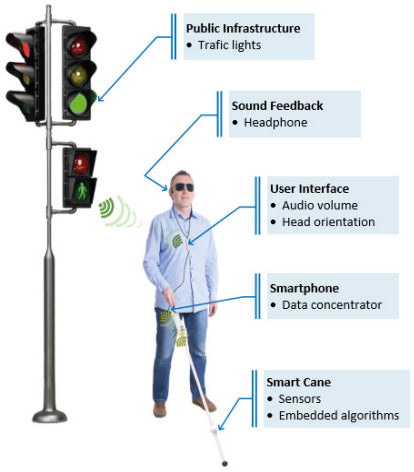

Figure 1: Full navigation system for the VIB.

The project follows the V-model design approach, and the documentation for a Medical Device Class I follows the prototype development. Figure 2 shows the concept of the final smart-cane.

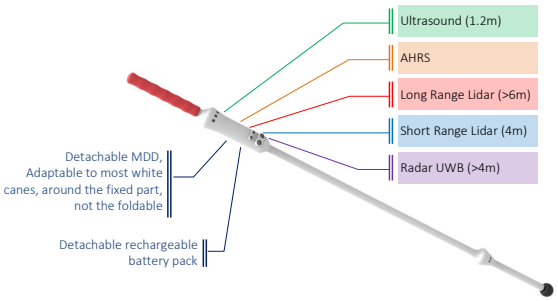

Figure 2: Projection of the final prototype to be implemented.

The detachable MDD is designed to be easily attached around the fixed part of the most used types of white cane. The MDD embeds four distance measurement sensors of different technologies, which cover different ranges and environmental conditions (short- and long-range LiDAR, ultrasound sensor and UWB radar). The MDD also embeds a detachable rechargeable battery and a simple user interface. Figure 3 shows the processing from sensor acquisition to 3D data generation to be further converted into audio messages.

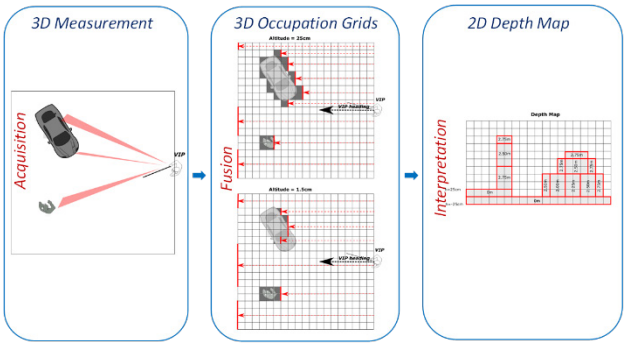

Figure 3: From sensor acquisition to 3D data generation.

To illustrate the system capabilities, Figure 4 shows the test setup representation for a detection test with the first prototype. The cane is placed on a swiping module and a pole is positioned from 4 m to 0.5 m by steps of 50 cm. For each pole position, sensor data is acquired over a full rotation of the platform. The distance information of the cane is shown in the bottom-right of Figure 4 where the obstacle is clearly visible on the profile.

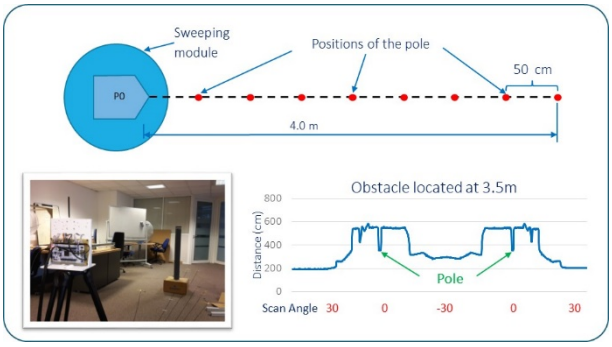

Figure 4: Test setup and results.

The first test results for obstacle detection in the shape of a smart cane are very promising: small objects such as poles are visible and feedback can be given to the VIB. A second demonstrator is being integrated for final system verification tests.

The project partners are: Commissariat à l'énergie atomique et aux énergies alternatives (FR), University of Manchester (UK), Cork Institute of Technology (IE), STMicroelectronics SRL (IT), University College Cork (IE), Université de Namur (BE), GoSense (FR) and SENSL Technologies Limited (IR). The project has been funded by the H2020 research program as well as the Swiss Secretariat for Education, Research and Innovation (SERI) and for which we would like to thank them for their support.

[1] INSPEX project official website (http://www.inspex-ssi.eu/)