Orientoma – A wearable orientation system for blind and visually impaired people

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Abstract
This work aims to design and implement a low-cost wearable orientation system able to help blind (or visually impaired) people to walk and orienting autonomously in unknown environments. The basic principle is to create a system able to understand information from the context where the user is and to convey such information using a way that is intelligible for blind people. Such information may come from suitable sensors integrated in the user’s smartphone, which represents the core of the system, and/or from other wearable devices each person is supposed to have, such as a smartwatch.

1. Introduction

Globally, about 45 million people are totally blind, 135 have low vision and 314 experiment visual impairment. By the year 2020, these numbers will double. These people are often affected by the inability for autonomous walking and orientation in open environments. Hence, they may not be able to perform activities that sighted people can, such as walking alone to the nearest supermarket.

Recent advances in technology and better knowledge of human perception permit the design of new assistive interfaces. Research on supportive systems has traditionally focused on two main areas: information transmission and mobility assistance.

Today, cities are equipped with audible traffic lights and pavements with embossed tracks to allow blind people to perform simple actions (e.g., crossing streets). Braille-based maps may allow to identify the current location, and to discover nearby places of interest. However, only few cities offer these services, which are in addition static and cannot be easily updated or extended. Moreover, acting like this, it is impossible to provide real-time information (e.g., obstacles to avoid) nor person-centered services (e.g., where to go to buy one’s favorite ice-cream).

This project stems from the realistic assumption that blind people can afford to buy a cheap smartphone and/or a low-cost wearable device equipped with GPS, Internet and other sensors and able to communicate using audible and/or tactile signals. Main goal is to create a system able to smartly, and safely, drive the person wearing the equipment to a pre-set destination or to points of interest in its surroundings. The system is designed to avoid the problem of sensory overload (too many stimuli can confuse the user), to not interfere with the user’s ability to pick up environmental cues.

Obstacles are detected using miniaturized and low-cost image acquisition devices, and well known navigation techniques; the same devices presently used may send information to the impaired person, reducing the total system cost for the end user.

It also could be integrated with already existing navigation services (fixed infrastructures or mobile apps), and may also encourage municipalities to install new access points, improving, at a reduced additional cost, the services offered and paving the way to a new kind of tourism targeted to blind users.

2. Preliminary development

At the end of our research phase, we have developed a first working system that will be soon validated by visually impaired end-users; a group from blind students from Politecnico di Torino and Politecnico di Milano (Italy) has been actively involved through all the phases of the development.

Core of the system is an Android application that supports vocal commands and has a multilanguage support. This mobile application can read information from all the sensors integrated in the device and can process them in real time to assist the user in his autonomous walking tasks.

The system leverages on the most modern, wearable, and low-power consumptions technologies. In order to estimate precisely the user position we integrate the information provided by GPS and by visual navigation algorithms running on a modern smartphone. The algorithms also allow the user to identify obstacles and navigate correctly in the environment, leveraging on the smartphone camera and on common Computer Vision techniques.

In an indoor environment, to provide for the lack of GPS signal, WiFi, NFC and Bluetooth tags are used to estimate the user position within the environment.

Output is returned to the user via few and precise auditory feedback. We are investigating the possibility to return vibrating feedbacks on smart bands and sensorized shoes.