Assistive Wearable Technologies for the Visually Impaired

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Wearable technologies are expanding into applications to assist users in performing critical yet potentially dangerous tasks. By requiring limited or reduced user input alongside collecting valuable information from both environmental sensors and online resources, these technologies can significantly benefit the visually impaired by aiding in navigation, the recognition of objects, and avoidance of dangers in the users' environment.

Introduction

Wearable technology is a rapidly growing market that has the potential to impact how individuals function in their daily lives. Devices like "smart watches" and Google Glass have become extremely popular for their innovative features, portability, and ease of use. Currently, fitness and health monitoring applications constitute a large portion of wearable device products (Langston, 2014). As technological development continues, wearable technologies can perform very critical jobs that relate to an individual's safety and well-being.

Assistive wearable technology could be applied to disabilities such as visual impairment. Visually impaired individuals require assistance for navigation, finding and recognizing objects, and interacting with devices like computers and smart phones. Many other disabilities make tasks like communicating, avoiding danger, and traveling difficult. Wearable technologies allow users to receive reliable assistance for extended periods of time, thereby reducing dependence on other people.

Analysis of Related Technologies

The Yellow Team has explored a number of promising technologies for the application of visual impairment assistance. However, we had decided against some methods like ultrasonic sensing and image processing. These methods do have the potential and usefulness for certain tasks (Mali, 2015). However, they possess limitations that impacted their current growth or applicability. Ultrasonic sensing is limited in terms of the sensor placement and cost. Image processing is limited in the high complexity of its design and implementation. As a result, other technologies were chosen for further research.

The two of the most promising technologies for wearable applications are RFID (Radio Frequency Identification)/Bluetooth and EM-Sense Touch recognition (Figure 1). These technologies provide broad and reliable ways for the user to gather information about their environment.

RFID/Bluetooth

RFID tags and Bluetooth beacons are technologies that would allow visually impaired users to navigate environments safely. RFID technology is able to pass data to nearby devices, through radio frequency electromagnetic fields (Agila, 2013). Bluetooth passes data using wireless radio signals. RFID tags can be installed along the paths of indoor and outdoor environments. A wearable device, such as a walking cane, collects the data and presents it to the user with navigation directions, and other information about their travel path and location. Another example is a system using beacons to pass information, via Bluetooth, in order to guide travelers through the London subways (Stinson, 2015). A smart watch could seamlessly gather and present the subway data collected from the user's mobile device.

The benefits of these technologies are that they do not rely on GPS (Global Positioning System) for navigation. GPS may lose its connection to devices depending on the weather and location of the satellites. For indoor environments, the GPS signal is usually very weak.

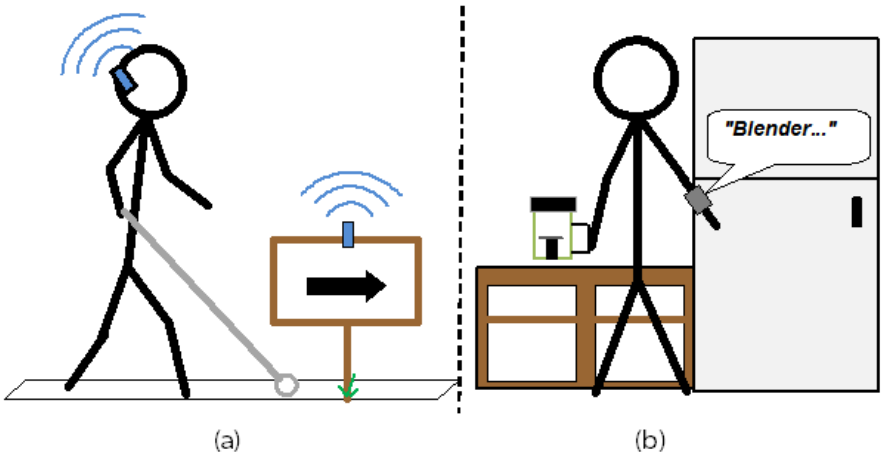

Figure 1. Assistive Technology Methods: a.) Navigation with Bluetooth. b.) Object Recognition with EM-Sense

Overall, RFID tags and Bluetooth beacons are technologies that can provide the visually impaired with reliable, non-GPS-dependent, navigation assistance through a wearable device (Figure 1a).

EM Noise Touch Recognition

The analysis of electromagnetic noise allows wearable devices to recognize an electrical or electromechanical object when a user touches a specific object. One study used a smart watch, attached to a user's wrist, to read the electromagnetic noise from the objects that the user had touched using *EM-Sense* (Harrison, Sample, Xiao, Yang, 2015). During this experiment, the devices were able to recognize power tools, door handles, home/office appliances, and vehicles. The devices could also gather specific information about objects such as their types, locations, and real-time information. They were then able to run certain programs, based on the previous object recognition, automatically when users touch the specific objects.

Electromagnetic noise therefore is very useful for those with visual impairment. A possible application could allow blind individuals to know the room name by simply touching the handle of the door. Blind people could also touch a kitchen/home appliance and be given instructions on how to safely use that specific appliance (Figure 1b). They could receive appliance information such as status or current conditions.

Another benefit of this technology is that it does not require installation of hardware like RFID tags and beacons, thus reducing costs. This would allow users to recognize any object with previously-analyzed EM noise. As a result, using *EM-Sense* would provide an efficient way for visually impaired individuals to interact with and recognize objects.

Conclusion

In conclusion, the implementation of assistive wearable technology would make a significant impact assisting those with visual-impairment. This technology would assist with navigation, object recognition, and safety. The growing market and adaptation of wearable devices would make the transition to assistive technology seamless, impactful, and profitable for businesses (Langston, 2014). Technologies like EM-Sensing, RFID tags, and Bluetooth Beacons allow these assistive wearable devices to be effective, reliable, and easy to use. These methods seem likely to drive the growth of such devices due to their potential applications. They significantly help users by providing them with information they cannot gain due to their disability. These systems are comparatively more robust since they do not rely on traditional methods like GPS. In the near future, assistive wearable technologies will become more common, improving the quality of life of those with disabilities, such as visual impairment.

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