Chapter 2
Information Communication Assistive Technologies for Visually Impaired People

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ABSTRACT

The information explosion era provides the foundation for a technological solution to enable the visually impaired to more independent living in the community. This paper first provides a review of assistive technologies for visually impaired people. Current technology allows applications to be efficiently distributed and operated on mobile and handheld devices. Thus, this paper also summarizes recent developments of assistive technologies in mobile interaction. It then presents the Wireless Intelligent Assistive Navigation Management System Using SmartGuide Devices for visually impaired people. The "SmartGuide" of the system is built as a standalone portable handheld device. The system is to assist blind and low vision people to walk around independently especially in dynamic changing environments. It also includes a camera sensor network to enhance monitoring capabilities for an extra level of security and reliability. Finally, the paper presents an improved system with some new designs involving mobile interaction.

INTRODUCTION

Visual impairment can result from damage at any time in the life cycle of human beings. Severe visual impairment leads to a person being totally blind. Less severe cases cause a person to have partial vision loss that cannot be corrected called "low vision". Genetic and developmental anomalies can cause blindness from birth. Visual impairment may also occur during adulthood when many diseases and genetic

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patterns manifest themselves. These groups of people should not be excluded from the community. They should be encouraged to become valuable members of the community. It is often these groups that are left behind in the Information Age. The largest population of visually impaired people are the elderly because vision loss is the normal result of aging. Elderly people, although blind, have years of experience and can be valuable contributors to the community. In current public transportation centers, a tactile strip or paving is placed on the ground for the visually impaired person to follow. There are many limitations with this method. Firstly, it requires the person to already be familiar with the environment which may not always be the case. Secondly, even if the person is familiar with the environment, the person would not know when he or she has arrived at the desired location. The person has to constantly ask people along the way as to whether they have reached the correct place. If there is no one around, the person would be lost. The entire process creates anxiety and stress. Thirdly, in emergency situations such as fire, the paths may not be passable and there are no alternative paths to safely guide them. Therefore, it is important to use Information Communication Technology (ICT) for e-Inclusion in public transportation systems to tap new digital opportunities for the inclusion of visually impaired people. Public transportation systems like airports, bus terminals, LRT stations would be made more accessible to this segment of society. They would be able to travel in unfamiliar locations successfully and have a workable strategy for self-familiarization within complex environments.

Initially, most research and designs on smart walking sticks or smart canes focus on detecting obstacles in the path of visually impaired people (The Nation, 2007; Omar, 2006; Smart Cane, Ankush, 2007). In (The Nation, 2007), a smart cane is proposed to detect objects in front and warn the person through a vibration in the handle. The smart cane used ultrasonic sensors to detect objects at levels from waist to head. The work in (Omar, 2006) used a combination of ultrasonic and infrared sensors to increase the accuracy of the obstacle detection. The smart cane in (Smart Cane, 2005) developed in 2005 by Prof. M. Moghavvemi in University Malaya used 'bat technology' by sending out ultrasound signals so that when the signal hits an object, part of it reflects back and the system can calculate how far the object is from the cane. When the visually impaired person approaches an object less than three and a half meters away, a pre-recorded voice says 'watch out', closer than that and it says 'beware' and when they are about to hit something it says 'danger'. These smart canes are useful for obstacle detection. However, they have no function to inform the visually impaired person of his or her current location. Several researchers have proposed technological solutions using RFID or GPS technology to assist visually impaired people (D'Atri et al., 2007; Chang, et al., 2005; Ran, Helal & Moore, 2004; BrailleNote, n. d.; Cardin, Thalmann & Vexo, 2007). Amongst the assistive systems which have been reported are SESAMONET (D'Atri et al., 2007), iCane (Chang, et al., 2005), Drishti (Ran, Helal & Moore, 2004), BrailleNote (n. d.) GPS and Werable Systems (Cardin, Thalmann & Vexo, 2007). The works in (Kulyukin, 2005) and (Ulrich, 2001) uses robotics technology for visually impaired people. In (Kulyukin, 2005), a RoboCart is used to help visually impaired people navigate a grocery store and carry purchased items.

Around the year 2007, relevant trends in ICT included pervasive sensing networks, wireless sensor networks and ubiquitous computing. The reduction in costs for hardware and software allowed the creation of both novel uses for existing technologies and applications of completely new technologies including assistive technologies. Researchers from the Visual Information Research (VIER) in Nottingham University tried to address problems by research and developing a system called Wireless Intelligent Assistive Navigation Management System Using SmartGuide Devices for Visually Impaired People. Their research works could be considered as the first to utilize wireless sensor network, pervasive computing intelligent processing to develop assistive technologies for visually impaired. Their works could be found

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