Abstract

According to an estimate, there are 36 Million people with blindness globally, of which an estimated 5 Million people live in India. Among the persons with disability in India, nearly 1 in 5 has visual disability and nearly half of the population with blindness in India are uneducated. Lack of accessible infrastructure restricts their travel that in turn affects the education and employment prospects ultimately hampering the quality of life and often results in social exclusion and economic burden.

Assistive Technologies (ATs) for aiding independent travel have huge potential and can play a pivotal role in significantly improving the quality of life for persons with visual disabilities. Despite of significant research and development efforts to realize assistive devices, more than 90% of visually disabled population in India and in many parts of the world do not have access to appropriate AT solutions.

One of the reasons of limited success in adoption of assistive technologies is that many of these have come from developed countries and are designed keeping structured environments which exist in those countries. They often do not work in unstructured environments that exist in countries such as India. Affordability and access to these devices for people in India is another major reason for lack of their success. Another reason for abandonment of these devices is tendency to design and develop such aids on technical aspects with very limited or no focus on human dimension.

The present research is a first comprehensive attempt to study independent travel needs of persons with blindness in unstructured environments and is carried with an objective to identify assistive technology requirements to address these unmet needs. In the first part of the thesis, two major studies have been undertaken to understand present status of mobility and navigation characteristics of people with blindness as well as to capture their future requirements for independent mobility. The first part of the study focused on understanding the travel patterns of persons with blindness, challenges faced during travel and the strategies undertaken by them to overcome such challenges. The second part of the study concentrated on understanding their current use of assistive technology products and solutions, their preferences and their expectations from the future AT products and solutions.

White cane is the most commonly used mobility aid in developing countries. However, a normal white cane can detect obstacles from ground to knee height and fails to detect obstacles from knee to head height. Negotiating obstacles from knee to head height may not be a major requirement for visually challenged people residing in structured environments but it certainly is a primary requirement for people residing in countries such as India. One of the mobility devices, which have been designed
keeping these requirements of visually challenged people, is SmartCane. It is an electronic travel aid designed for negotiating obstacles and for path finding, which is also affordable. SmartCane is one of the first affordable devices that have some penetration in developing countries such as India. Two studies involving 30 users and 150 users were conducted to evaluate the efficacy of SmartCane device. Efficacy of this device in meeting user needs, expectations and aspirations has been studied as a part of the present research. The results show that SmartCane has been largely successful in meeting all user requirements.

Outdoor mobility not only demands negotiating obstacles along travel paths but also overcoming navigation challenges. Navigations applications such a Google maps etc. are used by sighted people but the same is not designed keeping all the navigation requirements of people with blindness. In this case, people require different landmarks than those used by sighted people and different interfaces than the ones that rely heavily on vision. Keeping this in mind a Navigation System for Persons with Blindness (NAVI) has been proposed.

In the subsequent part of the thesis, NAVI system has been built and implemented. User interface of NAVI is made completely accessible with TalkBack. Comparative study of NAVI with Google maps in terms of performance and overall user satisfaction is conducted. Results revealed that average time to complete the journey with Google maps was 20% more as compared to NAVI. Task success rate with NAVI was 78% and with Google maps, it was only 54%.

This research work carried out as a part of this thesis show that SmartCane effectively ensures detection and avoidance of obstacles and NAVI enables independent navigation to the desired destination. Their combination can address the travel related challenges for people with blindness residing in unstructured environments.