Chapter 13

Using Smartphones for Orientation Training for the Visually Impaired

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ABSTRACT

This chapter discusses the potential of Indoor Positioning and Indoor Navigation (IPIN) systems in teaching and training Orientation and Mobility (O&M) to individuals with visual impairment. In addition, an attempt is made to investigate the implications of such trainings and technology in mathematics education, with regards to the learning of concepts of orientation. For individuals with visual impairment, O&M training is of crucial importance for everyday life and safety. Furthermore, these skills are often connected to problem-solving as well as to the understanding of basic geometrical concepts related to mathematics. In this chapter the developed IPIN system is presented, followed by suggested scenarios of its use in O&M trainings and O&M activities that can be used to introduce and strengthen opportunities for exploring mathematical topics.

INTRODUCTION

During the last decade, the rapid advancement of mobile technologies has been a world changing innovation. Especially the advent of smartphones and their rapid evolution to highly capable miniature computers that can communicate with virtually everything and everywhere, have changed the way we think, learn and do things. Due to this fact, smartphone based Indoor Positioning and Indoor Navigation (IPIN) systems have received a wealth of attention (Torres-Solis, 2010; Gu, 2009) in recent years. The overall goal of indoor positioning is to track the user’s position inside buildings with sub-meter accuracy. Further, indoor navigation provides instructions to the user on how to reach a destination point given a certain starting point. Unlike Global Positioning System (GPS) technologies, which are totally inaccurate

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when located inside buildings due to the fact that satellites are unreachable (Liu, 2007), IPIN systems use different methods and techniques to those used for outdoor positioning that make them much more reliable when indoors. IPIN systems have numerous potential applications that include advertising, first responder, find my car and others, as well as access and social inclusion for the people with visual impairment. A useful application that seems to have not been considered in the past, is the use of an IPIN system for purposes of orientation training for individuals with visual impairment.

**Orientation** is one of the main issues blind people face in their daily routine. **Orientation** (Sauerburger, 2013) refers to the ability to know where you are and where you want to go. As orientation is vital for social inclusion and independent living, people with visual impairment attend several training sessions, in a life-long learning approach, in order to maximize their sensory development and to be able to (ACVREP, 2014):

1. Find destinations with strategies that include following directions and using landmarks and compass directions;
2. Develop problem-solving skills to determine what to do if getting disoriented or lost or needing to change route.

In addition, at school level, orientation is one of the main difficulties that students with visual impairment face, not only in terms of mobility in the school’s physical environment, but also in terms of orientation concepts often included in mathematics, physics and geography curricula.

Even though, at a first glance, orientation and mobility (O&M) might not seem to have a clear connection to mathematics, it actually does have a very tight relation to this discipline. Smith (2006) showed that mathematical concepts, and especially geometrical concepts, can be developed through O&M. As geometry literally means “to measure the earth” (Smith, 2006) and O&M uses several geometric terms including parallel, perpendicular, point, line, rectangle or curve during the teaching process, the relation of O&M to mathematics becomes apparent. For example, individuals with visual impairment must learn to walk in straight lines, and hence they must first develop understanding of the concept of a point (Jacobson, 1993).

An O&M limitation is the fact that only certified O&M specialists can provide such trainings for people with visual impairment (Jacobson, 1993). Because the available number of such certified specialists is small, O&M trainings are quite sparse. Consequently, people with visual impairment are not able to completely comprehend and effectively use orientation guidelines, and hence transfer this knowledge and skill to other learning settings and experiences. Thus, the use of an IPIN system is suggested as an alternative e-learning approach for providing orientation training by utilizing a smartphone. A general-purpose IPIN system is completely suitable to assist in such trainings, as long as it is modified accordingly in a way that both teaches and assesses, and of course in a way that is completely accessible to users with visual impairment.

Smartphone accessibility is achieved by ascertaining that every command of an application can be read to the user and that the user can navigate through all of the application’s menus and controls by using gestures such as flickering (Apple, 2013). An example of an accessible smartphone is the iPhone (3GS or later). The iPhone incorporates a screen reader, VoiceOver, which provides custom gestures, performs text-to-speech, etc. Unfortunately, just the existence of a screen reader is not adequate, as we cannot implicitly achieve accessibility unless we explicitly adhere strictly to the accessibility guidelines of our development platform (e.g. the iOS platform).