論文の内容の要旨

論文題目： Smartphone-based Mobility Aid System Architecture for the Visually Impaired
（スマートフォンを用いた視覚障碍者向け移動支援システムアーキテクチャに関する研究）

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People who are blind and visually impaired face many challenges in achieving independent mobility and travel. Despite considerable research efforts into building effective mobility aids, no single solution has yet been widely accepted by the blind community, mainly because the existing systems cannot satisfy all of blind people's needs; they usually require additional dedicated hardware that is expensive and cumbersome, are difficult to learn and use, or are not aesthetically appealing. Meanwhile, the advent and rapid adoption of smartphones that are equipped with a rich set of sensors such as GPS, accelerometers, and digital compasses has opened up new opportunities for improving blind people's travel experiences in an unobtrusive, inexpensive, practical, and effective way.

This dissertation proposes a mobility aid system architecture for the blind that can be used to create easy-to-use and readily usable assistive technology solutions that are delivered via mainstream mobile devices such as smartphones without requiring that users carry additional special hardware. The architecture supports a set of major tasks involved in blind people's travel activities such as *navigation & orientation* both outdoors and indoors and *environmental access* to points-of-interest (POI), public transit, buildings, signage, and electronic kiosks. This architecture has been derived based on the experiences of iterative prototyping with blind users for smartphone-based applications that aid targeted mobility tasks. The proposed architecture consists of three layers: The user interface, functionality, and infrastructure. In particular, the user interface layer includes a set of interface design techniques that are intuitively usable by blind users for touch-based mobile devices.

To verify the effectiveness of the proposed architecture, I developed three prototypes: SaSYS, TalkingTransit, and StaNavi, which provide mobility aids for POI search, public transit use, and indoor navigation, respectively. Experimental evaluations involving a number of blind people show that each system was generally well accepted by its intended users. User studies for both SaSYS and TalkingTransit were conducted in the laboratory, each with 11 blind participants, where the prototype was compared to an existing approach. A field test was conducted for StaNavi, in which eight blind participants inside Tokyo Station were asked to independently navigate to a given destination. This was the first thoroughly conducted indoor navigation study with blind people under real-world conditions.

This architecture's applicability was then demonstrated by reflecting on the three prototypes' development processes and system designs. In addition, the potential of this architecture to create further mobility aids was also demonstrated by conducting a rapid prototyping of TalkingBuilding that aids building use and by discussing the development of applications that aid outdoor navigation and provide access to signage and electronic kiosks. This shows that the proposed architecture can be applicable to all target mobility scenarios in this dissertation.