A Design Toolkit for Visually Impaired People on Travelling Experience

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Abstract. Designers, who are intending to design interactive systems for visually impaired people to enhance their travelling experience, should equipped with relevant knowledge, frameworks and methods to facilitate them to do better design. However, there is no holistic and systemic research focus on the visually impaired people's travelling experience, and many of existing design methods, techniques, and/or tools are not suitable for user research, as these methods and tools rely on sighted information and communication. This paper aims to share a two-dimension design toolkit, which provides some important background knowledge on visually impaired people and some design tools and methods specific for visually impaired people so that designers can quickly start to identify issues and explore opportunities during visually impaired people's travelling experience and develop new products or services to support their everyday lives.

Keywords: Design toolkit · Visually impaired people · Travelling experience

1 Introduction

Living with a visual impairment often means that individual may have many practical and social obstacles for travelling, which influences personal and professional life and can pose them exclusive from the mainstream society [1]. It is widely accepted that the right to fully participate into the community and enjoy the life is the same for people with or without a visual impairment [2]. According to De Potter [3] going out to do some activities can improve visually impaired people's well-being, the perception of self-esteem and self-competence, and preserve them from handicap. Thus, we conducted a study exploring how to assist designers to enhance visually impaired people's travelling experience. Specifically, the word "travelling" is defined as moving outside of those places visually impaired people familiar with.

There is a broad consensus that designers should draw upon a holistic understanding of the user [4]. People with visual impairment live in a different world than other sighted people, thus designers need to make effort in to interact with visually impaired people and understand their preferences, behaviors, and activities. Although there have been

some organizations, institutions and websites specific for blind and partially sighted people to supply some background knowledge about visually impaired people, like The *World Health Organization* (WHO) [5], Fashioneyesta [6] etc., all of these materials and researches are piecemeal. It will be time consuming for designers to absorbing these references. To the best of our knowledge, there is no holistic and systemic research focus on the visually impaired people's travelling experience, and many of existing methods, techniques, and/ or tools are not suitable for user research, as these methods and tools rely on sighted information and communication. Therefore, to bridge this gap, this paper provides a design toolkit to help designers to do holistic research focusing on visually impaired people's travelling experience.

2 Literature Review

The research area of design toolkit for visually impaired people's travelling experience is a multidisciplinary field. It may include design theories, and specific on design process and development of design toolkit. It includes psychology through the study of making sense of experience, travelling system and the impact of visual impairment on these aspects. It also includes computer science, and more precisely human-computer interaction, through the study of interactive prototyping techniques and non-visual interaction.

2.1 Contextual Knowledge about Assistive Technology

Number of information is only presented in visual form, which result in a reduction of autonomy in visually impaired people's daily life. Assistive technology is designed to overcome these limitations and help visually impaired people seek more opportunities from society more independently. In order to promote the further development of assistive technology, an effective and on-going dialogue is required between the end-user communities, which is the visually impaired people, and the various professionals, including designers, engineers, technicians etc. Therefore, to support this dialogue, there is a need for holistic study of assistive technology, including the common definitions, classifications and models. There are a number of different models or frameworks relevant to assistive technology (eg. [7], [8]) Specifically, the CAT model [8], which is a generic framework for classification, synthesis, development, evaluation and matching appropriate users of assistive technology systems, can assist designers to category, synthesize, assess a particular product or system in an effective way. The CAT model can be represented as a tree-like structure model, the top level of which contains four branched including: context, person, activities and assistive technology. However, the components in the activity attribute categorize the various activities into six main components: mobility, communication and information, cognitive activities, daily living, education and employment and recreational activities. It can be found that this categorizing system for activity attribute is not categorized in an efficient way. For example, the activity of shopping, which is classified into the daily living branch by the author, however, it is obvious that the process of shopping expe-

rience also involves mobility, communication or cognitive activities. Therefore, instead of categorizing by these functional activities, categorizing based on the experience of users will be more efficient and in a systematic way [9].

2.2 Making Sense of Travelling Experience

Existing literature tends to suggest that a number of researchers have shown their interest in experience study. The word "experience" here has always been defined as the areas of subjective senses, behaviors, or social scientific discourse [10] [11]. It is Dewey [10] [11], who firstly argued that "experience is the irreducible totality of people acting, sensing, thinking, feeling, and meaning-making in a setting, including their perception and sensation of their own actions." [9] Dewey mainly explained his theory towards experience in Experience and Nature [10] and Art as Experience [11], he proposed that a fulfilling experience includes a number of necessary conditions, including the anticipation about the experience, the continuity during the sense of anticipation, the process of unfolding and reflecting the experience, etc. Besides Dewey, another philosopher Bakhtin [12], who had great devotion to literary, put forward a supplementary theory of the relationship between experience and meaning-making. Bakhtin mainly involved trust, loyalty, commitment or identification etc., which belongs to some personal qualities into the experience consideration.

Based on the Dewey and Bakhtin's theory on experience, Wright, McCarthy and Meekison [9] developed an experience framework, which aims to figure out the different elements constitutes experience with technology and how they mutually constitute each other. According to their framework, there are six processes of sense making: anticipating, connecting, interpreting, reflecting, and appropriating.

This framework describes the processes people use when making sense of experience in a systemic view, which encourages people to think technology as experience. However, for the travelling experience of visually impaired people, it is also important to consider how to draw visually impaired people's attention and attract them to go outside, since it's much more difficult for them to gather visual travelling information from newspapers, magazines, or social medias than sighted people.

3 The Component of Design Toolkit

Through my practical project during my master period and the literature reviews above, we have developed a range of knowledge, tools and tips to enable designers and visually impaired people to become more actively involved in the research process. Therefore, we propose a design toolkit for visually impaired people's travelling experience, as a way to synthesize and share all of the resources we have designed and gathered over the years. The design toolkit will assist designers to conduct projects in support of visually impaired people's travelling experience. It will promote research that:

- Starts with comprehensive contextual review of target group then helps designers produce issues and strategies before first encounter visually impaired people
- Uses scenario-based and experience-based approach to assist designers seek more opportunities

- Based on an iterative user-centred design process

This toolkit proposes to have two dimensions: the first dimension follows an iterative design process that leads designers to implement research or design projects for visually impaired people; the second dimension is structured into nine sections with each section focusing on a key aspect in practice of designing for visually impaired people, that including background knowledge, design principles, design scenarios, travelling experience phases, person attribute, context attribute, technology attribute, prototyping techniques, and evaluation methods. Each section consists of various relative knowledge, tools and tips that should support the design process.

When designers intend to conduct a design project for visually impaired people in terms of enhancing their travelling experience, they can follow the design process in the first dimension, while choosing the relevant approached in the second dimension in each design stage. In other words, in each design stage, designers need to conduct their projects by using one or more approaches from the toolkit, and the specific usage can be seen in the table 1. For example, in the understand stage, designers need the background knowledge approach and design principle approach, while in the study stage, design principles approach, design scenarios approach, and travelling experience phases approach need to be involved.

Table 1. Design toolkit for visually impaired people's travelling experience

	Understand	Study	Design	Build	Evaluation
Background Knowledge	√				
Design Principles	√	√	√	√	√
Design Scenarios		√			
Travelling experience phases		√			
Person attribute			√		
Context attribute			√		
Technology attribute			√		
Prototyping techniques				√	
Evaluation methods					√

3.1 Design Process

The design process in this toolkit is mainly based on the Harper's (2008) user-centred design process, which is an iterative process comprised by understand stage, study stage, design stage, build stage, and evaluation stage. The details of each stage can be seen below:

Understand stage: making choice, choosing the particular focus group, and pursuing its relevant fundamental knowledge, like different kinds of domains of activity, cultures and environments.

Study stage: involving a grounded understanding of how individuals and social groups seek and accomplish those specific aspirations.

Design stage: a creative or design phase and involves figuring out what the design purposes should be, after considering the individual's characteristics, culture and context, and the different kinds of new technology will be situated.

Build stage: building something by using some prototyping techniques involving from low-tech methods to more high-tech methods for long-term field testing.

Evaluation stage: evaluating what has been built in the previous stage by some proper evaluation methods.

3.2 Background Knowledge

The background knowledge approach will include some fundamental and important information about visually impaired people's characteristics, needs, and daily behaviors etc. It will assist designers to have a general understanding for visually impaired people before they first encountering them. The background knowledge may from some **official website for some organizations**, like The *World Health Organization* [5], *The Hong Kong society for the blind* [13] and *RNIB* [14]; **website-based toolkits**, like the *inclusive design toolkit* [15]; **social media materials**, like Fashion-eyesta [6] and BreakingBlind [16]; and **other materials**, like academic paper, blog articles, accessibility design standard in terms of product design, architecture design, environment design etc., all of which will help designers to gather more contextual knowledge for visually impaired people.

3.3 Design Principles

"Design Principles are the guardrails of your solution—quick, memorable recipes that will help keep further iterations consistent." [17] In this approach, there will be some design principles specific for designing for visually impaired people, all of which were generated through our practical research with visually impaired people. They are normally short and memorable, but contain the most important factors that designers need to follow when conducting a design project for people with visual impairment.

Avoiding block other senses. Since visually impaired people are only able to use their sense of sight to a limited extent possible not at all, and will be largely reliant on hearing, touching and olfaction, they need to receive and analyze large amount of travelling information during their travelling experience. For example, along the path to a certain destination, visually impaired people need to find object references and land-

marks so that they can build their mental map. In addition to the tactile route information, it is also significant for visually impaired people to notice the sound changing of the environment. Not only the sound of nature, but echoes made by visually impaired people can also contribute to indoor navigation. Some visually impaired people can make clicking sounds with their tongues and listen to the returning echoes from which that acquire information about the changing of the space's size. Therefore, electronic navigation systems should be considered as supplementary equipment that could produces a small quantity but significant navigation information while not disturbing other information perceived from the environment.

No overwhelming information. Many of the existing devices have problems in the way that the information is presented to users. "They do not present relevant information in a way users can actually be oriented and sometimes overwhelm users with a huge amount of information." [18] "This turn out to be an excessive, confusing and unnecessary amount of information which only confused blind users." [19]. Therefore, the evaluation of the product should be according to the contribution it produces, not the amount of information it generates. [20]

Avoiding becomes a stigma. Most of the existing specialized products for visually impaired person are easy to recognize like a white cane or a guide dog, which will immediately become stigmatized. However, people do not want to stand out too much especially visually impaired people in mainstream society. They do not want to draw other people's attention to their visual impairment. Therefore, when designing for visually impaired people, designers should not only address the devices' function, cost, and usability, but also considering their aesthetics and social acceptance.

Translating the missing visual cues efficiently. The needs of people with visual impairment are vary depending on how the eye condition affects their vision. Therefore, accessible technology needs to be flexible in design so that they can offset the missing visual cues according to users' needs efficiently. For instance, some visually impaired people can read enlarged text on the screen, while some other users need synthesized speech software or braille software output the content of webpages, and some other low vision users may need highly contrasting color aids.

3.4 Design Scenarios

Using design scenarios approach can enable designers to rapid communicate with users about their usage possibilities [21] [22]. Some existing studies showed that regarding to the travelling experience, customers, including both mainstreams and disabled people, will have particular information needs for different scenarios [23].

Within the tourism field, according to the Leiper's tourism framework, the scenarios of travelling can be separated in three kinds: Leisure travel, business travel and other travel (eg. health or study).

Besides the tourism field, some other characteristics of travelling experience (e.g., whether it is goal-oriented or goalless-oriented) should also be considered. Because visually impaired people are hard to sense visual oriented information during their travelling experience, planning the path ahead and rehearsal it is vital important for their navigation. Therefore, goal oriented travelling is the experience that can be planed ahead and compared easier for visually impaired people while goalless oriented travelling is much more difficult for them. Since it need visually impaired people to make

sense of the current information from the environment and make the navigation decision immediately.

3.5 Travelling Experience Phases

This approach expects designers to figure out what the design goals should be. In this stage, we provide a structured approach to help designers to identity and explore issues and opportunities during visually impaired people's travelling experience. Combining with Wright, McCarthy and Meekison's [9] research, we proposed that there are seven phases in travelling experience of visually impaired people: attraction, anticipating, connecting, interpreting, reflecting, and appropriating.

3.6 Person Attribute

When designing a specific assistive technology, the people who are going to use is one of the most important factors refer to the success of the design. According to Hersh and Johnson [8], the people attribute can be considered in three aspects: characteristics, social aspects and attitudes.

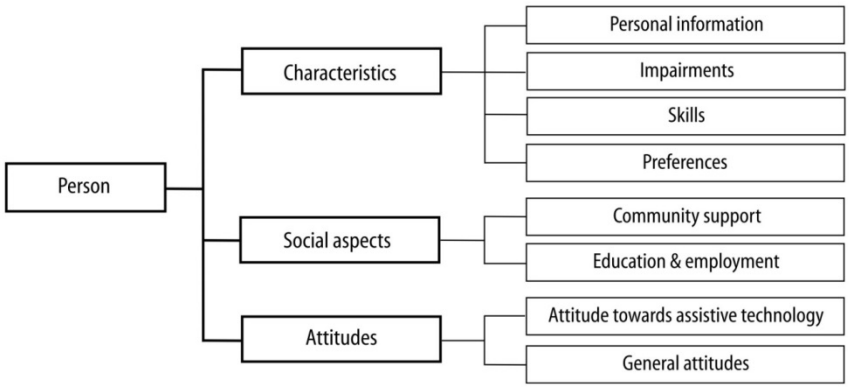

Fig. 1. Model for person attribute [8].

3.7 Context Attribute

The existing context that the user belongs to is also very important but unchangeable in terms of assistive technology design. According to Hersh and Johnson [8], the context attribute includes the following three factors: cultural& social context, national context, and local settings.

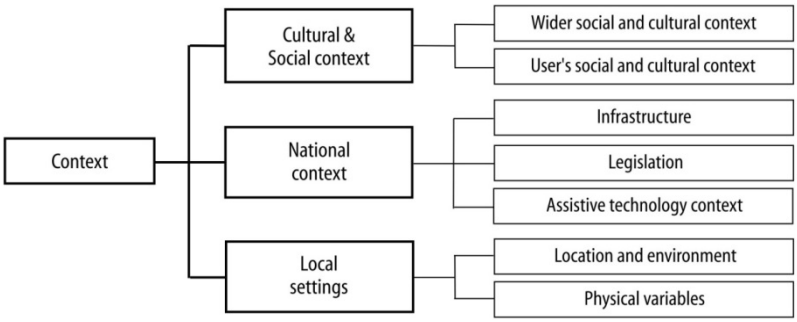

Fig. 2. Model for context attribute [8].

3.8 Technology Attribute

According to Hersh and Johnson (2010), there are four aspects in technology attribute: activity specification, design issues, system technology issues, and end user issues.

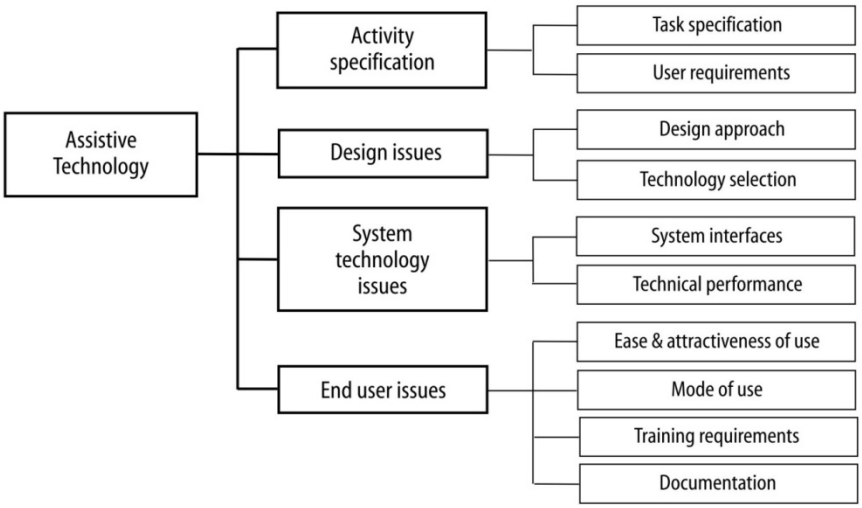

Fig. 3. Model for technology attribute [8].

3.9 Prototyping Techniques

Making prototypes including both low- fidelity prototypes and high-fidelity prototypes can help designers select or propose new ideas, get feedback from users or customers choose among design alternatives, and articulate reasons for their final choices [24]. It will raise specific challenges when including visually impaired users in the design process since they may have very specialized and little known requirements [25]. Mock-ups prototype method and Wizard of Oz method which mainly relay on touching and hearing feedback are suitable for design project for visually impaired people.

3.10 Evaluation methods

The emphasis of interaction design is considering those who are going to use or benefit from the design during the design process. Design practices should consider people's emotional needs rather than only their capability to use design, and should seek to involve them actively in a co-design process. When evaluating a system in Human-Computer Interaction, usability, which is defined as "the extent to which a system [...] can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [26], is an important measure. There are three factors for evaluating the usability: efficiency, effectiveness and satisfaction.

Efficiency is defined as the resources expended in relation to the accuracy and completeness with users achieves goals [26]. A common measure of efficiency is time on task, but efficiency may also relate to other resources [27].

Effectiveness is defined as the accuracy and completeness with users achieve specified goals [26]. It is commonly measured as error rate, completion rate, frequency of assist to the participant from the tester or frequency of accessing help or documentation [27].

Satisfaction is defined as the freedom of discomfort and positive attitudes towards the use of the product [26]. It is common to assess satisfaction with a Likert-scale questionnaire [27]. It is generally to make questionnaires accessible through technology like "Google Forms". However, even though visually impaired people can access the questionnaires through a screen reader by using the Google Forms, it still existing the risk of pressing the wrong button, therefore it will be much easier to present these questionnaires as interviews. The USE questionnaire is one kinds of good measurement to be used to evaluate user attitude towards a specific product [28].

4 Conclusion

There is a broad consensus that when conducting a design project, designers should draw upon a holistic understanding of the user. However, most of the designers are not experienced to interacted with visually impaired people and have no background knowledge about their preferences, behavior, and activities. This design toolkit was developed on the basis of literature and our own design experience for visually impaired people. The aim of this paper is to share this design toolkit for visually impaired people's travelling experience with the design research community, so that others can use it as a starting point for their design project. We encourage others to use and improve our design toolkit, and formulate new ones.

Furthermore, further exploratory research and evaluation research will be conducted to develop this toolkit. In the long term, we hope this toolkit will be developed to be an dynamic web-based resource, that more people can contribute to it.

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