Balance of Considerations between Technological and Social Factors: A Case Study on Smartrack™ for the Visually Impaired

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Abstract. Rebuilding inclusive facilities in old districts in metropolitan cities with high population density encounters a number of problems. It is necessary to find a solution to renew the city with minimal interruption of people's everyday life. Through a case study of Hong Kong, the paper addresses the conditions of the public facilities provided for the visually impaired persons (VIPs) in Hong Kong. VIPs' needs and concerns while using the facilities were investigated. Based on the findings, a new tactile guide path using smart technology, named Smartrack™, is designed. It is argued that supplementary actions have to be taken to help people with special needs to understand the issues of public privacy when smart technology is being brought to them. Inclusive researchers, designers, as well as educators, should collaboratively attain a balance among different considerations between technological and social factors.

Keywords: Smartrack · Visually impaired · Public design · Guiding path · Privacy

1 Introduction

People with special needs and disabilities encounter several problems in their daily life affecting their living quality. Although governments and non-government organizations (NGOs) are implementing different measures to help this group of people to adapt to the society, it is still difficult for most of the disabled persons to live like others without any accessibility issues in the city. Especially in metropolitan cities with high population density such as Hong Kong, the facilities are quite limited because of the land problem. Older districts, where the elderly dwell, should get the priority to be redesigned, and the facilities there should also be upgraded and improved for the needed. However, they are also the most difficult area to be rebuilt because the residents refused to move out, and the elderly's everyday life would be largely disturbed because of the construction work. Either the government would move all residents away from the districts and relocate them in newly developed towns away from the city center, or the residents would have to live near to the construction site. Many arguments and conflicts would occur when the districts are about to rebuild and renew. Given this dilemma, it is necessary to develop facilities and renew the city with minimal interruption of people's everyday life.

In Hong Kong, one of the facilities that are in need to be rebuilt in the public areas is those designed for the visually impaired persons (VIPs) [1]. The needs of the VIPs and the inclusion of their daily activities to the society are often neglected [2]. In the previous studies, one of the most important observations was that VIPs would not use the tactile guide path on pedestrian streets [3]. They depend on their own to find their ways and other public facilities. It is necessary to redesign the facility so that the resources are not wasted and remained unused.

Through a case study of Hong Kong, as the needs of VIPs are seldom addressed [4], the study first explores the needs of Hong Kong's VIPs when navigating in a city and approaching pubic services. Based on the findings, a new smart tactile guide path for the VIPs is designed using smart technologies. The tactile guide path, named Smartrack™, is used as the major technological device to help the VIPs to find their ways in daily life. As smart technology is used, personal privacy should also be considered. The paper thus discusses the balance and tension between privacy in public spaces and smart public services experienced by the needed people. It is hoped that the study will be able to help VIPs to optimize their daily life and also educate VIPs and the related associations about public privacy when using smart technology.

2 Method

2.1 Case study

Hong Kong has established policies and regulations addressing the issues of city inclusiveness in these few decades. Barrier-free design, which is also known as inclusive design and universal design, has already accepted by society. In this study, three old districts in Hong Kong were investigated, i.e., Sham Shui Po, Kwun Tong, and Kowloon City. They are the fourth, first and fifth densest districts in Hong Kong. During the study, the population densities of these three districts were 43,381, 57,530 and 41,802 people/km^2 [5]. Densely populated districts were chosen because the facilities were relatively old, and this was able to reveal more information about the VIPs' difficulties and needs in living in Hong Kong. Figure 1 shows the location of these three old districts.

The research and design team of the Public Design Lab at the Hong Kong Polytechnic University has been researching the needs of VIPs in different aspects of their lives. The study was conducted based on the trust between the research and design team and the VIPs. As VIPs were a marginalized and neglected group in society, they might not be open to talk to or make contact with other people. The trust developed was essential to gain reliable information from the VIPs.

Fig. 1. Location of the three old districts in this study.

2.2 Procedures

A non-government organization (NGO) in Hong Kong was approached to recruit VIPs to participate in the study. Sixteen VIPs (8 female and 8 male) living in the three old districts were recommended by the NGO. They had different levels of visual impairment, and most of them needed to use a cane to help them to navigate in the city. Their residential information was collected, and based on this piece of information, fifteen parks in these three old districts were chosen for investigation. These parks were close to or in the residential areas that the 16 VIPs lived in. The team's researchers and designers visited the parks, and the inclusive facilities were investigated. Photos were taken to record the provision of the facilities during observations.

After visiting the parks, VIPs were invited to go to the park that is near to their home. They started walking to the park from their home with researchers and designers. Their different processes of wayfinding of the VIPs were recorded. Semi-structured interviews were conducted to understand their needs. Questions like 'How familiar are you with the park we visited?', 'What kind of difficulties have you encountered in finding the way to parks and navigating in the city?', 'Is technology able to assist your daily life?', and 'How you understand public privacy?' were asked. The interviews were recorded, and notes were taken during the interviews.

3 Findings and discussions

3.1 Facilities in the parks

Limited facilities designed for the VIPs were found in the parks included in this study. The most common facility was the tactile guide path. Some parks also had a tactile map located at the entrance of the park. According to the Universal Accessibility guidelines, in order to ensure the VIPs to find the tactile map, the Architectural Services Department suggested that detectable clues such as tactile paths should be pro-

vided to lead users to the tactile map [6]. In the field observation, it was believed that the users should be able to find the tactile map following the tactile path. However, the color of some tactile guide path has a low contrast to that of the ground, and the VIPs might not unable to notice the path from a distance easily. Figure 2 shows an example of a tactile path turning at a right angle with low contrast to the ground.

Fig. 2. An example of a tactile path turning at a right angle with low contrast to the ground.

Tactile map was not a common facility that some smaller parks or sitting-out areas do not have the map, and it was not mandatory to install tactile maps in public spaces. Therefore, different designs of tactile maps could be found in the visited parks. Figures 3 shows two different designs. One at the left-hand side is to combine the textual and tactile information, and the other one is to illustrate the two information separately. The design of the tactile map was not standardized. It can be argued that the variation of the design did not facilitate VIPs to use the maps in different parks.

Fig. 3. Two different tactile map designs found in the parks.

3.2 Difficulties encountered when using the tactile path

The VIPs who participated in the study were able to find the park near their home. However, they reported that this was because they were familiar with the areas near to their home, and they knew very well where the park was and the road condition on the

way to the park. Most of the VIPs did not use the tactile guide paths on the streets or in the park. In the interviews, they expressed that the current tactile guide paths were not user-friendly. It often brought people to turn at an acute angle like a robot. Besides, the VIPs also expressed that if they followed the tactile guide paths to move around, they would have to walk for an extra-long distance before reaching the facility or the destination, whereas the direct distance between the starting point and the destination is much shorter. Even they did not care about the long-distance walk and follow the tactile guide paths, it was not guaranteed that they could reach the facility they need. Many tactile guide paths led the VIPs in the wrong direction.

Therefore, the VIPs who participated in the study responded that most of the VIPs in Hong Kong did not use the tactile guide paths, and they tended to believe in their only memories and experiences when navigating in the city. They would only go to the places where they were familiar with, or they would need volunteers from the NGO to bring them to familiarize the route and the place before going there alone. They tended not to explore new places, as there were many unknown road conditions and dangers.

3.3 New tactile path for the VIPs: Smartrack™

The findings from the observations and interviews show that the design of the tactile path does not cater for the VIPs' needs. The VIPs participated in the study had a very limited social space in life without others' help. Considering Hong Kong's busy traffic on pedestrian roads, it is not practical if the construction work for building facilities for the VIPs would create major disruption. The design of the new tactile guide path for the VIPs should be succinct yet functional, i.e., meeting the needs of the VIPs.

In view of the issue, the research and design team has invented and designed a revolutionary tactile path, named Smartrack™, for guiding VIPs to walk on pavements safely (Fig. 4). The new design applies radio-frequency identification (RFID) technology and various tangible tactile forms. VIPs are expected to receive information related to the path through the vibration pulse from a specially designed cane and also the tactile sensation underfoot and at the tip of the newly designed cane.

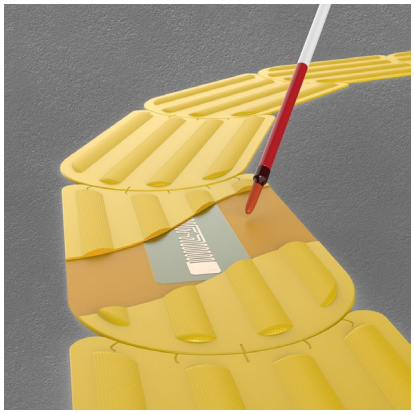

Fig. 4. Design of Smartrack™.

With a thin RFID tag attached inside individual tactile path tiles, the sensor at the tip of the newly designed cane can recognize the tactile path within a range. Different kinds of vibration pulses will be generated at the cane handle to inform users to walk, turn or stop. Besides, at the top of the newly designed cane, there is a button to switch on or turn of the location mode. The location mode helps VIPs locate public facilities by using the Smartrack™ App in smartphones. Smartrack™ forms a network in the city, and direct VIPs to public facilities freely and inclusively.

3.4 Issues of public privacy

The new design helps the VIPs to navigate in the city with confidence. However, while they enjoy the convenience provided by the design and the services, they, the users, also have to know about the privacy issues. However, most of the VIPs are not aware of the issues and unable to protect their privacy.

Many social activities happen in public spaces that are designed for public gathering and communication. These activities are not private, and also the space where the activities are held, are open for all [7, 8]. However, when each individual is considered in a public event, the issue of privacy emerges, especially in the technological era. For example, the advancement of location service with Wi-Fi and GPS in smartphones has disclosed an individual's activities at different locations to the mobile carriers, despite better mobile services provided to the smartphone users. Location privacy, according to Cremonini, Braghin, and Ardagna, is 'the right of individuals to decide how, when, and for which purposes their location information could be released to other parties' [9]. Lack of location privacy protection may lead to different kinds of attacks such as physical harassment and unsolicited advertising. Other technologies also collect personal information in public spaces while the city is advancing its services and facilities to be a smart city. While many voices from the general public express that the use of personal information should be used cautiously, people with special needs or disabilities are one of the community groups who's public privacy is less concerned. It may be due to the limited public information received by the group and the poorly established channels for the group to express opinions. While using the newly designed Smartrack™, the VIPs' privacy may be disclosed without being informed.

Considerations on the privacy of people with disabilities when providing public service should be given when smart technologies are involved. Education related to the knowledge of public privacy is essential to protect this group of people. A balance of consideration between technological and social factors should be achieved so that people can have different preferences and choices in daily life. This is the kind of equity and inclusiveness that every smart product should be claimed for the benefits of people with special needs.

4 Conclusions

The study adopted a case study approach to investigate the public facilities provided for the VIPs in Hong Kong. Sixteen VIPs were invited to take part in the study.

Through field observations and interviews, VIPs' needs and concerns while using the facilities were investigated. Based on these findings, a new tactile guide path is designed, and it is named Smartrack™. Smartrack™ is able to allow the VIPs to navigate in the city confidently and conveniently, and it helps them to find their ways to the public facilities easily.

However, most of the VIPs are unaware of public privacy issues. It is argued that although through *smart* products and services are able to optimize the life quality of the people with special needs, their *privacy* may be disclosed and the users are unable to be notified. Supplementary actions have to be taken to educate them to understand the issues. Inclusive researchers, designers, as well as government officials and educators, should collaboratively attain a balance among different considerations between technological and social factors.

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References

1. Siu K.W.M.: Accessible Park Environments and Facilities for the Visually Impaired. Facilities 31(13/14), 590--609 (2012)
2. Marmeleira, J., Laranjo, L., Marques, O., Pereira, C.: Physical Activity Patterns in Adults Who are Blind as Accessed by Accelerometry. Adapted Physical Activity Quarterly 31, 283--296 (2014)
3. Siu, K.W.M., Xiao, J.X., Wong, Y.L.: Inclusive Design of Open Spaces for Visually Impaired Persons: A Comparative Study of Beijing and Hong Kong. In: Di Bucchianico, G. (ed.) Advances in Design for Inclusion: Proceedings of the AHFE 2018 International Conference on Design for Inclusion, pp. 171—179. Springer, Orlando, Florida (2019)
4. Faruk M, Ormerod M, Newton R, MacLennan H, Abbas MY. Tactile paving a necessary intervention, but does it suit everyone? In: Bust D (ed.) Proceedings of the International Conference on Contemporary Ergonomics, pp. 303--308. Taylor & Francis, Nottingham, UK (2008)
5. Census and Statistics Department: Hong Kong 2016 Population Census. Census and Statistics Department, Hong Kong (2016)
6. Universal Accessibility for External Areas, Open Spaces & Green Spaces, https://www.archsd.gov.hk/archsd/html/ua2/3_6_4.html
7. Aubock M, Cejka A.: Open Space: The City. Verein Planbox, Wien (1996)
8. Siu K.W.M.: Open for all: Open Spaces and New Urban Lifestyles. The International Journal of the Humanities 7(12),25--8 (2010)
9. Cremonini, M., Braghin, C., Ardagna, C.A.: Privacy on the Internet. In: Vacca, J. (ed.) Computer and Information Security Handbook (2nd ed.), pp. 739-753. Morgan Kaufmann Publishers/Elsevier, Waltham MA.