

Challenges and Design Opportunities for Easy, Economical, and Accessible Offline Shoppers with Visual Impairments

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ABSTRACT

Despite numerous solutions offered, offline shopping experience for people with visual impairments (PVI) does not seem to improve much. A lot of PVI have not only visually but also economically challenging. However, existing solutions need additional devices or do not help them shopping economically. Therefore, the goal of this research was to develop a system that helps PVI go offline shopping conveniently and economically. We conducted qualitative surveys and interviews with eight PVI. Based on the identified challenges, we proposed opportunities for easy and economical offline shopping. We hope the findings of this study contribute to a deeper understanding of the offline shopping experiences of PVI.

Author Keywords

Blind; Visual impaired; Accessibility; Interview; Needs assessment; Qualitative; Offline shopping

CCS Concepts

•Human-centered computing → Empirical studies in accessibility;

INTRODUCTION

The Ministry of Health and Welfare's policy team for the disabled in Korea, reports that the number of registered people with visual impairments (PVI) was 252,957 as of 2018 [5]. Since 2011, the number has consistently exceeded 250,000. This is about 0.488 percent of the total population of the Republic of Korea of 51,826,059 in 2018 [4]. Offline shopping might be one of the complicated tasks for PVI. A typical modern supermarket has an average of 45,000 products and a median total store size of 42,800 square feet [1]. Many solutions have been proposed as PVI continue to talk about the disadvantages of online shopping. However, the drawback has not been resolved. Neither have alternatives being offered on how to help the PVI to consume economically, despite their relatively

weak economic power. When the average monthly income of wage earners in the country is 2,430,000 KRW (about 2,005 USD), the average monthly income of the PVI wage earners is 1,964,300 KRW (about 1,620 USD), just 80.84% of the wage earners in the country [13]. Therefore, economical and reasonable shopping is a more important and essential issue for PVI with less income. Therefore, the objective of this study is to answer the following research question: 1) what are the challenges that PVI face when going shopping offline?; 2) what are the design opportunities that a system that helps PVI go offline shopping conveniently and economically? To our knowledge, this is the first interview study that considers economic consumption and personal assistants. Through this study, we classified interview responses into three categories: shopping activities, people, and calculations. Based on the identified challenges, we propose three opportunities to make offline shopping easy, economical, and accessible.

RELATED WORK

Previous studies proposed and evaluated wearable devices for recognizing the images of the products [8, 15]. Kulyukin et. al [8] developed a system, portable devices, and software that does not accompany but with an assistant. If the recognition of the main product image fails, a system that uses P2P cloud computing to give product names directly to unaccompanied personal assistants who share the vision with them. Zientara et. al [15] produced portable devices to help PVI buy independently and created software that applies to them. It targets diverse items geared towards the grocery store and recognizes product labels (logos) with prompts and cameras to help select items. A user test was performed on a person who assumed total blindness. In other studies [6, 7, 11, 12], they developed a system using RFID to enable PVI to identify their location or product. Maïke et. al [12] used RFID to enable PVI to know product information. Furthermore, they developed the mobile platform of the IoT-based system (RFID + Sound) and configured the situation for the PVI and non-disabled and carried out case studies allowing them to perform tasks. Kulyukin et. al designed a shopping cart using a barcode scanner and RFID, to help people with visual impairments buy things on their own without the help of others. In addition, they evaluated 10 people with visual disabilities using the product [7]. Based on this paper, they developed robotic trolleys for the PVI. On the basis of auditory and promotional clues, they inform users of nearby obstacles [6]. López-de-Ipiña et. al [11] made hardware and

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ID	Gender	Period with VI	Frequency of offline shopping	Satisfaction of offline shopping
P1	Male	20	2	5
P2	Female	48	1	4
P3	Female	30	4	4
P4	Female	27	1	4
P5	Female	8	16	3
P6	Female	30	1	N/A
P7	Male	30	< 1	1
P8	Male	30	1	3

Table 1. Interview participants table. VI means visual impairment. N/A means the participant did not report an answer. The frequency of offline shopping means the number of activities of offline shopping per month. The satisfaction of offline shopping was rated from 1(dissatisfied) to 5(satisfied).

software to help PVI buy independently. The RFID sensors are mounted at the end of the PVI's staff, RFID is installed in products and shopping centers and used for navigation. When they approach a product, it recognizes a hexagonal QR code with a smartphone and provides details about the product. A PVI were put to the test. Prior studies [3, 9] developed an app that performs a barcode recognition through smartphone cameras. Kulyukin et. al [9] developed an app that recognizes barcode and informs the user about the information. The app is specialized in the purchase of groceries, providing additional nutritional information and more. Likewise, Kim et. al [3] proposed a smartphone app for scanning clothes during shopping and inform customers. They developed the app collecting design requirements from their target users. The app also recognizes the colors of the clothes through the cameras and guides PVI to choose the clothes through voice service.

Although previous studies proposed and evaluated tools and devices to support PVI [2, 3, 6, 7, 8, 9, 11, 12, 15], there still remain limitations of their proposed solutions. First, a device or system proposed in prior work [6, 7, 8, 11, 12] requires additional devices (e.g., a shopping cart using a barcode scanner and RFID, robotic trolleys). They are necessary to install and manufacture additional devices such as RFID. This increases the cost burden and reduces the likelihood of an actual application. Second, prior studies [3, 9] did not widen the scope of the product. For example, existing systems [3, 9] were not feasible to be applied to all items as they are limited to certain items such as clothing and groceries. Last, researchers did not evaluate tools they developed with PVI [2, 8, 15]. As no evaluation was done with PVI, it is not known whether it would be feasible for PVI to interact with. Fernandez et. al developed an application but did not conduct interviews with PVI. Also, Kulyukin et. al and Zientara et. al [8, 15] tested people who were not PVI, assuming they were all blind.

METHODS

Participants

Initially, we conducted surveys and qualitative interviews with PVI. We focused on PVI's shopping experiences to understand PVI's needs and challenges in offline shopping. The inclusion criteria were individuals who: (1) are 18 and older, (2) are

able to understand spoken Korean, (3) are blind or visually impaired, (4) have offline shopping experiences in the last three months, and (5) have a smart device, such as a smartphone and tablet, for more than one year. However, we excluded any participants who had any other disabilities except for visual impairments. We used the following topics when conducting semi-structured interviews with participants:

- Challenges with shopping activities, e.g., *can you tell me the details of how the process of finding, selecting things is done? how do you confirm that the product is the one you want? do you use your smartphone in this situation? can you do the process easily?*
- Challenges with the assistant, e.g., *do you usually shop offline alone? who are you going with? personnel assistant? what does your assistant help you with?*
- Challenges with financial issues, e.g., *can you estimate the total amount of the goods before payment? what do you think are the criteria for rational and economical consumption? what makes it difficult to spend rationally and economically?*

Procedure

All interviews were conducted directly at the Siloam Wellness Center for the PVI located in Seoul, Korea. The interview was conducted during July 2019. The participants received full information about the study's content and rights. At the beginning of the interviews, verbal consent was given by each participant for recording the interview and using unidentified data. Each interview lasted 30–45 min. We asked open-ended questions that we devised ourselves to hear a variety of stories. All interviews were audio-recorded and transcribed. We removed all personally identifying information and assigned a unique identifier to each participant. The recordings were destructed when the data analysis was completed. Participation in this study was voluntary. For analyzing the qualitative data from the interviews, we collected statements from transcripts that described experiences of participants on offline shopping. After reviewing the transcripts, we highlighted excerpts iteratively. A team of researchers conducted an affinity diagramming session to identify key insights, themes, and patterns that occurred in the interview data repeatedly. We have identified important topics about how PVI engage with the step-by-step offline shopping process. We then classified their experience into challenges with shopping activities, people, financial issues.

RESULTS

Eight PVI (5 females) participated in our interview study (see Table 1). The average time they have visual impairments is 28.5 years (std 11.49). Four PVI purchased offline about once a month. Three people shop offline more than once a month, and P4 does it about four times a week. However, P7 of the participants went offline shopping less than once a month. People usually shopped at large shopping malls. P1, P3 and P6 of the participants said they usually shop at large retailers (e.g., Costco, E-mart), while P5 and P8 answered they shop at department stores. On the other hand, two said they shop at retail stores such as convenience stores and no one answered that they shop in places (e.g., traditional markets).

Participants awarded an average of 3.43 out of 5 points (std 1.27) to the satisfaction survey of offline shopping. When asked about the frequency of use of the smartphone and the smartphone apps, seven participants responded that they did not use the smartphone at all, and only P5 said that they used the smartphone to use notepad to buy and calculator.

Interview Results

Challenges with Shopping Activities

One of the key findings is that PVI have difficulty in performing shopping activities. All PVI pointed out that purchasing process is an inconvenience and it is difficult to obtain enough information. First, they said that it was difficult to obtain information about the products. This makes it difficult to choose the items that best suit their needs, and also makes shopping that is completely different. P1 stated, *"The problem is that lack of information on products. In the case of fresh food, the expiration date is important, but it is hard to know."* They just buy products that a familiar advertisement with listening to or that anything cheap. Because that is only information about the product they can get. Second, we noticed that it took a long time for PVI to go offline shopping. For instance, it took much more time to choose the same as for the non-disabled since they have to listen to each and every one of the elements that they have to look at or touch. P1 said, *"I have to ask them all. It takes a long time. It is not easy for us."* Third, we found that there is a restriction of movement. They have many difficulties while going to the shopping place, and also moving inside the shopping mall. P3 mentioned, *"I usually use the social assistance call to get to the mall, but it is inconvenient because it has to wait. Also, when moving within a market, it is difficult to use a cane if there are many people, and there is a risk of dropping things when passing."* When PVI moved, they usually grabbed the arm of a personal assistant. Ironically, this help also restricts the activities of the PVI. P2 mentioned, *"If I go shopping with the guide, I have to hold his arm. If I buy heavy products like detergents, we both feel uncomfortable."*

Challenges with Assistants

We found that multiple challenges were associated with their assistants. First, PVI say that it is difficult to offline shopping without an assistant. PVI can only get detailed information about the product in the way that the assistant tells them, and only because they depend on the assistant in the market to move around. Second, under the disability support policy, PVI are eligible for support in activities by personal assistants. However, there are drawbacks with regard to personal assistants, and first, they have a fixed time for the PVI to take advantage of them, so they can not be used for as long as they want. Therefore, they cannot request all the information they want because they have to rush to buy and cannot consider enough products. Last, if the personal assistants are not friendly or meticulous, their shopping experience will remain an unpleasant experience. P2 mentioned, *"There is a fixed amount of time for personal assistants. Depending on the personal assistant's personality, shopping is difficult because some personal assistant is annoying and not careful."*

Challenges with Financial Issues

We found multiple obstacles to PVI related to financial issues. First, PVI spoke forcefully of the drawbacks associated

with the calculation. In particular, if there is an error in the calculation, PVI cannot find the error because they cannot see the receipt. This applies equally when they request the delivery service to their home after buying offline. P7 stated, *"Sometimes the calculating is wrong. If there is a big difference between to original price, I cannot just overlook it. Even when I order delivery at a supermarket, sometimes I get things that I don't buy or things that I buy disappear."* Second, they cannot guess if the total amount of the products is in the budget during offline shopping. Because they cannot know the total amount of the products in between, and the only way to know the exact amount is verifying the amount settled after the calculation. P2 stated, *"If personal assistants tell me what the total amount is after the shopping, that is all I know."* Third, we found that it is difficult for PVI to obtain information about discounted products. Although the most common method to deliver discount information is through flyers, participants were able to only obtain information through advertising messages, comments made by their relatives or market announcements. P1 mentioned, *"In fact, because blind people have a weak economy... That is the trouble. And because of the lack of access to information about products, it is hard to spend wisely."* This hinders economic spending.

DESIGN OPPORTUNITIES

Based on identified challenges, we suggest three design opportunities to improve offline shopping experiences of people with visual impairments. Basically, the use of all applications is available for PVI who use voice guidance and tactile feedback. Also, we assumed they were buying with their assistant. Because at the time of purchase, most of them have accompanying people, such as a personal assistant, and assistant is supported by the government. In addition, if some problems are solved, the assistant can be highly efficient in the movement or selection of objects for PVI. First, for challenges with shopping activities, we suggest that designers allow PVI to make a list of items to purchase before buying and to establish a budget. To avoid the use of additional devices, it is essential to just use the barcode reader function of the smartphone and to read the barcode of the product to provide PVI with information, such as product name, price, brand, product evaluation, discount, etc. This might allow PVI to buy in a planned and economic way, and reduce the time it might take to go shopping. Second, for challenges with assistants, we recommend that designers share their planning lists and budgets with personal assistants in advance. This may help PVI communicate with a personnel assistant and allow them to go offline shopping more efficiently within an allowed time slot. Also, by presenting a parallel list of planned items and items in the cart during the shopping, a personal assistant could purchase every single product that PVI are interested in. Last, for challenges with financial issues, we suggest that designers create a smartphone app that enables PVI to add items to the list for purchase by scanning a barcode on each product. The key features of the potential app may include: 1) calculating items on the list for a total amount automatically; 2) providing PVI user with voice assistant about the list of the items to be purchased and the total amount; 3) creating a combined barcode that allows the cashier to enter the items in

the list into cashier machine at once. At this time, a cashier can scan the barcode sent to verify that the item matches the list and make the payment. Thus, PVI could be aware of the total amount of goods at all times before the calculation and the risk of calculation errors was reduced.

CONCLUSIONS

Overall, the goal of this research was to develop a system that helps PVI shop offline conveniently and economically. The key contribution of this study is that it expanded knowledge about the challenges and opportunities for easy, economical, and accessible offline shopping experiences of PVI. We conducted surveys and interviews with eight PVI to discover the challenges and opportunities of offline shopping for PVI. The analysis of the responses from PVI revealed that it is difficult for PVI to obtain information about free goods and discounts. Also, we found that PVI have burdens when reviewing and confirming the total number of items as well as the price of the items to be purchased. PVI rarely shop alone, and sometimes they have difficulties in their relationships with their assistants. Therefore, we suggest that their assistant should be considered important to improve PVI's offline shopping experience. Thus, we suggest design opportunities that may potentially contribute to solving uncomfortable and non-economic shopping experiences of PVI. One of the limitations of this study is that since our study only focused on the Korean, this might reflect the characteristics of the Korean society. Since PVI is 9.9% of the total population with disabilities [14], it is likely to be more people with other disabilities. Therefore, the other limitation is that we did not consider other types of disabilities, such as hearing/motor impairments, and cognitive disabilities. As for future work, we aim to create a smartphone application that enables PVI to economical, easy, and accessible offline shopping, which might be similar to the application proposed in a recent work (e.g., SEEjang [10]) economical, easy, and accessible for PVI. Also, potential studies may involve a long-term field study where we evaluate the effectiveness of the developed applications that address the needs of PVI.

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