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Authors
Mirzaei, Fatemeh
Manduchi, Roberto
Kurniawan, Sri

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Public Transit Accessibility: Blind Passengers Speak Out

F. Mirzaei, R. Manduchi, and S. Kurniawan

University of California, Santa Cruz, USA
fmirzaei@ucsc.edu, manduchi@soe.ucsc.edu, and skurnia@ucsc.edu

Abstract. Riding public transit can be confusing for everyone, especially in an unfamiliar environment. One needs to figure out which transportation lines to take to reach a destination, when and where to catch a bus or a train, when to exit, and how to negotiate transfers. For those with sensorial or cognitive disabilities, these problems become even more daunting. Several technological approaches have been proposed to facilitate use of public transit for everyone. For any assistive technology to be successful, though, it is imperative that it is developed from the ground up with a clear understanding of the intended users' needs and requirements, and possibly with a direct participation of these users throughout the project lifecycle. In this study, we conduct a focus group with blind participants, designed to highlight the main issues, problems, and limitations with the current transit system in our local area as well as the perception of the participants our proposed RouteMe2 technology [1]. We found two core categories of issues faced by blind travelers: (1) spatial/location awareness, and (2) temporal/ time awareness. Configurability and accessibility were the most desired features requested for a new transit information app.

Keywords: Assistive Technology, Public Transit, Focus Group.

1 Introduction

For many people, especially for those living in suburban or rural areas, driving is the preferred means of transportation. Those who cannot drive (due to a physical, sensorial, or cognitive disability, or to old age) have a number of options. They can use taxi cabs, ride hailing (such as Uber or Lyft), public transit (bus, subways, light or heavy rail), paratransit (a door to door service that is complementary to fixed-route systems), or volunteer ride services. Among these choices, public transit often represents the best compromise between cost and efficiency. Unfortunately, use of public transit is challenging for many potential passengers. In this contribution, we focus on the problems associated with information access. Riding public transit can be confusing for everyone, especially in an unfamiliar environment (e.g. when visiting a new city).

One needs to figure out which transportation lines to take to reach a destination, when and where to catch a bus or a train, when to exit, and how to negotiate transfers. For those with sensorial or cognitive disabilities, these problems become even more daunting. In many cases, some of these potential travelers feel intimidated, and prefer to resort to more expensive or less convenient options.

Several technological approaches have been proposed to facilitate use of public transit for everyone. Some of these systems are designed so as to provide users with location- and event-based information, such as helping with identification of an arriving bus, or notifying the user when it is time to exit the vehicle. For example, RouteMe2 [1], an NSF-funded project at UC Santa Cruz, encompasses location-based services (enabled by an infrastructure of iBeacons) and cloud services, which are in charge of tracking the user's progress in a trip, generating notifications, and coordinating with real-time information provided by the transit agencies. Some of the functionalities of RouteMe2 include: helping with finding the exact location of a desired bus stop or train platform; informing the traveler when the desired bus has arrived at the stop; and notifying an authorized third party if something occurred that requires special attention (i.e., if the traveler has taken a wrong train, and is unresponsive to system-generated notifications).

For any assistive technology to be successful, though, it is imperative that it is developed from the ground up with a clear understanding of the intended users' needs and requirements, and possibly with a direct participation of these users throughout the project lifecycle. For this reason, we decided to conduct a focus group with blind participants, designed to highlight the main issues, problems, and limitations with the current transit system in our local area (the Monterey Bay region in California), as well as the perception of the participants our proposed RouteMe2 technology. We believe that the outcomes of this focus group, as described in this paper, may be of interest to any researcher or practitioner who is looking to build new assistive technology in the field of public transit.

2 Related Work

Previous studies have shown that people with visual impairment experience difficulties at determining the route and schedule information, purchasing fare, finding the correct bus-stop location, getting on the correct bus, and getting off at the right stop [23, 4, 5, 6, 7] focused on identifying a correct bus to board when waiting at a bus stop, while the systems described in [8910] provided alerts for an upcoming stop while riding the bus. [11] proposed gathering spatial and temporal information from different patterns of mobility and travel time using smart card and GSM data. They aimed at building a public transportation system that could adapt to different travel patterns for different situations. [12] proposed a high resolution spatio-temporal, Geographic Information System (GIS) based public transit network model to measure different models of travel time, such as waiting time at bus stop and transfer times between routes. A variety of solutions have been proposed to help people with blindness and with limited vision, including providing non-visual information about the location of bus stops. For example, [4] developed GoBraille, a system that uses crowdsourcing to gather detailed information about the location of stops (a similar system is StopInfo [13]).

This prior work shows that there is a need for people with limited or no vision to be constantly aware of where they are in reference to their travel goal, as well as to obtain the information that is necessary to utilize public transit effectively. However, these prior studies do not offer in-depth knowledge and detail to the level that is necessary to make correct design decisions on the best tool for accessible public transit. Motivated by this observation, we decided to conduct the focus group described in the next section, which allowed us to observe group dynamics of several participants in our target population.

3 Focus Group

3.1 Participants

Our focus group involved seven participants (three females) from the Vista Center for the Blind and the Visually Impaired of Santa Cruz, California. All participants were iPhone users and were familiar with the VoiceOver screen reader. Five participants were totally blind, while two had some residual vision. Three participants stated that they used public transit several times a week; two used it occasionally, while two stopped using public transit, although they had experience with it in the past. Four participants stated that they signed up for paratransit or volunteer driving services. Two participants used dog guides. Participants were compensated $60 for participating in the focus group.

3.2 Methodology

The focus group was organized in two 45 minutes sessions with a 10 minutes break between the two sessions. In the first session, participants were asked to discuss their experience with using public transit. Specifically, participants were asked about their opinion of the transit system in the Santa Cruz area; the difficulties experienced using transit; and the factors (impediments and challenges) that discouraged them to use transit. In the second session, a moderator gave an outline of the goals of the RouteMe2 project, then asked participants for feedback about the project, about their preferences, and about what, in their opinion, would make an application such this usable in terms of functionality and user interface.

Audio recording of the focus group was then transcribed for analysis. This data was analyzed using the *grounded theory* method. First introduced by [14], grounded theory is an inductive research methodology used extensively within the social sciences for inspection of qualitative data. Unlike deductive approaches that assume some prior theoretical framework, in grounded theory concepts and theories are built through methodic collection and analysis of data. We used Nvivo, a qualitative data analysis software designed to help researchers organize, analyze, and find insights in unstructured or qualitative data.

3.3 Results

A number of themes emerged from the grounded theory analysis of the first session. Essentially, we found two core categories of issues faced by blind travelers: (1) spatial/location awareness, and (2) temporal/ time awareness.

Location awareness deals with being aware of one's geographical position in reference to the public transport throughout the entire trip. Most participants reported situations with loss of location awareness due to multiple reasons, such as knowing whether or not they are in the right vehicle, whether they are waiting for a bus at the right stop, whether the bus vehicle they are waiting for is close or far, and whether they stand next to the entrance door of the bus vehicle or train car. Some of the main themes that emerged during the first session are listed in the following. Some participants complained that routes (including the list of stops) and schedules are not clearly communicated. Finding the exact location of bus stops and train platforms was one of the main challenges for the five participants who were completely blind. This includes understanding which side of the street the bus stop is located at, and whether one needs to cross the street to reach it. Finding the correct train platform is also challenging. In addition, knowledge of the layout of a stop is important when one needs to negotiate a transfer. Participants mentioned that in these situations they often rely on sighted travelers, when available. Locating doors of buses or trains with multiple cars was mentioned as a challenging task, especially for the local subway system (BART). Maintaining awareness of one's surroundings is particularly important. Participants shared experiences of walking in the wrong direction after leaving a train or a bus, as they had no clear idea of the surrounding area. Catching the right bus or train and knowing they are in the right one was an issue mentioned multiple times in the discussion. Excessive ambient noise, and wrong or incomplete announcement from the vehicle's speakers, may causes loss of state awareness in these situations.

Time awareness is about obtaining exact and detailed temporal information. For example, participants commented that bus schedules are often not as detailed as desired, and that sudden changes of schedule are a source of difficulties. In addition, participants lamented the inability to obtain better estimates of upcoming busses or trains. The need for access to real time bus schedules was a topic that clearly emerged from the discussion. This is particularly important in the case of transfers and connections. Another theme that emerged from the analysis was the lack of awareness of the distance of an upcoming bus. Being able to predict when the bus is about to arrive would give one some time to get prepared to board. Planning ahead of a time for trips to new places often represented a serious challenge. Some participants stated that, to be on the safe side, they double up the estimated total travel time in these cases. Sometimes, due to the very long estimated travel time, they end up using private transportation, or even canceling their trip.

In the second session, participants focused on the desired functionality and user interface of a new transit information app to be developed. Participants concurred in the importance of configurability and accessibility features. The three most requested accessibility features were: VoiceOver control; a simple user interface; and requiring a small number of queries (commands) from the user. An example of desired configurability is the ability to change a route in the middle of the trip. Participants expressed the desire that the app would notify them upon arrival at the correct bus stop; note that this was one of the main issues discussed in Session 1. Another desideratum was the ability of the system to announce all bus stops. This is a functionality that is often (but not always) present in existing busses, but announcements from the speakers are sometimes difficult to hear. Several participants favored implementing alert mechanisms by means of phone vibration in several situations, such as upon arrival at a bus stop, upon bus arrival, and when upcoming stops are announced. On-demand calculation and reporting of all possible routes at any time was another requested desirable feature, with some participants stating that this feature would help them organize their trip more efficiently and save time. Finally, participants were generally in favor of the idea that the same smartphone app could be used to access transit information and for fare payment. Indeed, several participants mentioned situations in which they had difficulties finding where to validate a paper ticket at a transit center.

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