STUDY OF CHALLENGES FACED BY VISUALLY IMPAIRED PERSONS IN ACCESSING PUBLIC BUSES
AND
DESIGN AND USER TESTING OF AN AFFORDABLE BUS IDENTIFICATION AND HOMING SYSTEM FOR THE VISUALLY IMPAIRED

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SUMMARY

Independent mobility is a precursor for seeking education and work. Public transport plays an important role in providing a cost-effective solution. A high percentage of the visually impaired reside in developing countries and reliance on public transport is more in such countries, as people cannot afford hiring private transport for daily activities. Despite being crucial for the visually impaired, the current infrastructure of the public transport system poses great difficulty for the visually impaired in accessing public buses. Here we investigate the bus seeking behaviour of the visually impaired and bring out the problems and challenges faced in doing so.

Approach

- To study bus access behaviour in a developing country context and highlight major problems in identifying and boarding buses.
- To study and demonstrate the use of a Bus Identification System and study its efficacy in improving bus access.

System Design

The system consists of three modules: (a) a user module (b) a bus module mounted on the bus connected to a speaker installed near the entrance of the bus, and (c) a programming unit. Once the user hears a bus approaching, she/he can press the 'query' button, which transmits RF waves to nearby bus modules mounted on buses, The bus route number signal is sent back, interpreted by the user module and spoken out digit-by-digit. If there are multiple buses, the user module speaks out all bus route numbers digit-by-digit. The user listens to them and can select a particular bus by pressing the 'select' button when the module speaks out the particular bus route number. Pressing 'select' again each time would generate an auditory cue from the speaker on bus entrance and hence guide the user independently towards the entrance of the bus. The projected cost of the device is **under 35 USD** making it affordable for users in developing countries. Technical design and small scale testing was reported earlier in [1]. The initial prototype and design was discussed in an earlier publication [2].

Experiments

A total of 14 users were enrolled to be part of the experiments where we conducted a questionnaire based qualitative study and direct observation of visually impaired accessing buses. This helped us investigate into current methods and their limitations. In the second phase, the participants were trained to use the Bus Identification System developed by us. Then we directly observed the participants using the system to board buses on New Delhi roads and later conducted a feedback interview to assess the utility of the system.

Conclusions

In this research we systematically explored and documented bus seeking behaviour of the visually impaired. It came out clearly that they rely heavily on sighted assistance for identifying the correct bus and boarding it. All participants clearly stated the unavailability of ready and reliable help from sighted assistance is a major source of

anxiety and day-to-day frustration. It was also discovered that the process of accessing public buses causes visually impaired commuters to become a victim of abuse, misbehaviour and serious upper body injuries. We also prototyped a Bus Identification System, a potential solution, installed it in university buses and demonstrated its effectiveness and potential impact even on busy roads. The users demonstrated high success rate using the device and reported that it made them feel more independent, safe and confident.

In the next phase, we actively seek tie-ups and we are making continuous efforts to engage with public transport authorities in order to make this one great difference in the lives of the visually impaired.

Key Words: Visually impaired; Bus access; mobility; Bus identification; Accessible transport

PURPOSE OF THE STUDY

Visually impaired persons face major difficulties in accessing public buses since they cannot independently identify the bus route number and are unsure of the physical location of the bus entry. Despite seeking help from sighted fellow travellers, they frequently miss their buses, are unable to board the bus and get hurt attempting the same, causing anxiety and frustration.

In past, some researchers have explored the impact of bus transport on the day-to-day life of visually challenged persons. In [3], authors report that the lack of access to public transport greatly demotivates persons with disabilities to travel, forcing them to compromise education, work and self-development opportunities. A study by Golledge et al. [4] identified perpetual dependence on sighted assistance for external travel a leading cause of frustration for a large number of visually challenged people. Crudden et al. [5] identified the lack of transport system as the second greatest barrier (after negative employer attitude) to employment and also a factor for not being able to change or get a job for visually impaired people. However the bus seeking behaviour has not been systematically studied yet. In this paper we address this literature gap and we undertake a study to determine and document bus-seeking behaviour of visually impaired persons particularly in developing countries.

A few research efforts have attempted to develop technological solutions to assist persons with blindness to access buses. The Talking Signs identification system [6] consists of infrared (IR) transmitters on the bus. Since an IR beam is highly directional, this method does not work well as the user cannot point the receiver accurately towards the transmitter. Step-Hear [7], an RF-based system comprises of a transmitter on the bus and a small activator in the hand of the user. At close range, they beep and pressing a button would trigger a pre-recorded message like a bus-route number. However the system does not handle the case of multiple activators (users) and transmitters (buses) within close range. In the PAVIP Public Traffic system [8], RFID tags are placed on bus stops and give an indication when the required bus arrives.

However, this costly and unaffordable system does not solve the problem of boarding the bus and also does not give the user the choice to select between multiple buses.

These systems are restrictive and although installation of such systems have been attempted in some cities, their widespread adoption never happened in developed countries as well. In the developing countries situations like the lack of proper bus stops and infrastructure and the huge number of commuters supported by public transport, exist. These systems have not been engineered keeping the developing countries' scenario in mind and hence are totally unsuitable to be used in the countries where majority of the visually impaired population lives. Furthermore the cost of these devices is also a major barrier for their widespread deployment and acceptance.

Hence in this research we undertake the development of a novel system, which can operate even under developing country road conditions, and reliably help the visually impaired seek buses and in this study, test this system on-road to assess the impact and utility of using this system.

The specific objectives are- (i) to study and report the current methods and limitations in the bus access behaviour of the visually impaired in the developing countries context, to assess the resulting user anxiety, impact on personal, professional and social well-being, (ii) to passively observe the visually impaired where they attempt to board buses, as do so every day and the second time using the Bus Identification System, we corroborate our findings with visual evidence and also assess how well is the system able to solve the problems encountered seeking buses.

MATERIALS AND METHODS

1. Understanding current bus seeking behaviour

In this section we present an overview of the personal interview study and direct observation of visually impaired persons accessing buses, which is used to examine the current bus seeking behaviour and its limitations.

(a) User Group Enrolment

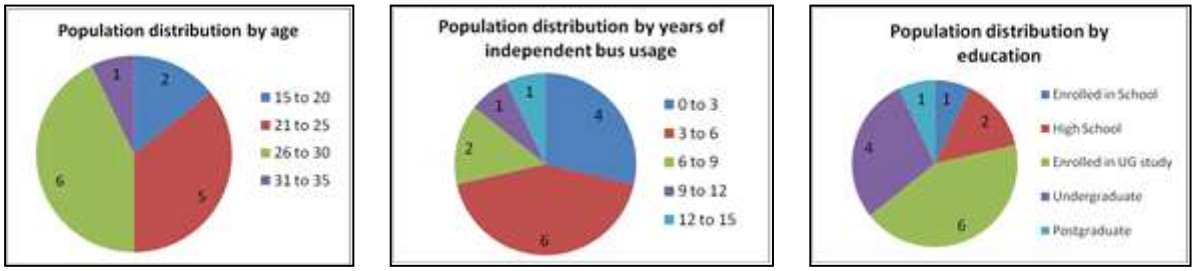

Figure 1: Participants' background – their distribution by age, years of bus usage and education - 14 persons in all (8 men and 6 women)

Fourteen visually challenged bus commuters (8men, 6 women in the age group 15-35 years of age) were enrolled in the study from four welfare and rehabilitation associations

in New Delhi, see Figure 1. Within the group, there was one low vision participant and the rest possessed total visual impairment. All subjects preferred to use the white cane while outdoors, specifically at bus stops. More males could take part in the study due to organizations being reluctant to send female volunteers for questionnaires and on-road trials.

(b) Qualitative interviews to understand current bus seeking behaviour

Semi-structured questionnaire-based interviews enquired about the present dependence on public buses and interaction with fellow commuters at the bus stop. Interviews lasted 30 minutes and centred on extent of use, preferred time of day, need for help from a sighted guide for bus boarding and any pre-planning required. Further they were asked about how they seek assistance from fellow sighted travellers at the bus stop to help them identify and board buses. They were asked to recount instances when they are successful in obtaining help as well as when they were refused help, misguided, harassed or ridiculed. They were also asked if there were occasions when they were hurt or injured while attempting to board the bus. The final set of questions aimed to assess the psychosocial effects of the bus seeking experience which involved rating (on a scale of 1-5) the overall anxiety, frustration and lowering of self-esteem while asking for help from unknown commuters with the aim of boarding the correct bus.

Figure 2: Left: Field researcher explaining device usage to participant; Middle: User training with system installed on stationary bus; Right: Participant operating the device at real bus stop with one researcher observing and another video recording without the knowledge of the user

(c) Observation of user interaction on real bus stops while boarding buses

This phase involved directly observing the participants board their specific bus at on real bus stops in New Delhi. After completing the interviews (discussed in the previous sub-section) the participants were facilitated towards the bus stop from where they could board the bus taking them to their place of work or residence. Two field researchers carefully observed, documented and videotaped from a fair distance the individual's behaviour and interaction during the process. In order to prevent a subjective bias, the participant was not told about the presence of the field researchers (see Figure 3(c)). Further, the researchers did not participate in conversation or gain direct attention while the participant was conversing with sighted individuals, in order to allow the sighted fellow travellers to interact naturally with the visually impaired. However, researchers were directed to intervene in dangerous situations, for instance, if the participant fell on the sidewalk or came in the way of passing vehicles.

Five bus stops each were identified along two routes in New Delhi, as in Figure 3. The first was a low-traffic route within the IIT Delhi, interspersed with five bus stops located at least 50m apart each. Four bus stops lacked a proper standing structure and were adjacent to a key landmark. Trials were conducted during *off-peak* hours (10-11am) when traffic is low and people are generally not available to assist a person at a bus stop. The second route was selected along Aurobindo Marg, a road with heavy traffic movement. Five bus stops were selected (separated by at least 60m each). Trials were conducted during peak-hours (1-2pm), when there is considerable rush with many commuters waiting at the bus stop.

Figure 3: From the left: (a) Low-traffic path in IIT Delhi campus (b) High-traffic path along Aurobindo Marg, a busy road in New Delhi (c) A bus stop without structure in the IIT campus (d) A bus stop with a shed on a high traffic route

2. Bus Identification and Homing System: Design and User Trials

In this section we present an overview of the bus identification and homing system developed for assisting visually challenged persons to identify and locate buses independently. This is followed by a description of system deployment, training and user trials on real bus routes identified in the earlier section, followed by a discussion of the post-trial user feedback interviews.

(a) Functional Overview of the System

The system comprises of three modules: (i) *User Module*: A handheld device carried by the user, (ii) *Bus Module*: A module placed in each bus, and (iii) *Programming Unit*: A module placed at bus depot to program bus route numbers in the bus modules. There are two stages of operation: (i) *Query stage* and (ii) *Selection and Tracking* stage.

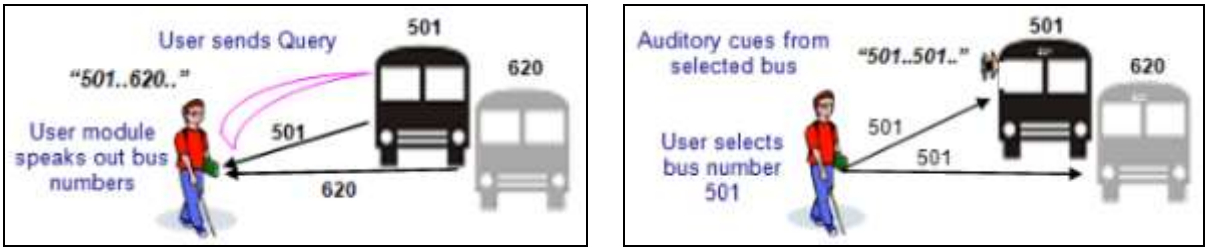

Figure 4: Left: User queries for route numbers and User module reads out the received numbers; Right: User selects bus to trigger an auditory cue from its entry

Once the user hears a bus approaching, they can press the *Query* button, which transmits an RF signal in the vicinity. When the user module is set in the *Auto query* mode, this happens without user needing to press *Query*. This RF signal is received by bus modules mounted on buses, which are nearby and hence approaching the bus stop, and a RF signal is sent back with the number of the bus. This signal is interpreted by the user module and spoken out digit-by-digit. If there are multiple buses, the user module speaks out all bus route numbers digit-by-digit. In the second stage, the user listens to them and can select a particular bus by pressing the *Select* button when the module speaks out the particular bus route number. Now the particular bus, say bus route number 501 is selected; pressing *Select* again each time would generate an auditory cue from the speaker on bus entrance and hence guide the user independently towards the entrance of the bus.

The system involves a novel communication and synchronization protocol that allows reliable and fast communication between multiple user and bus modules but can still be implemented on low-cost mass produced RF hardware. The projected cost of the user and bus modules is under 35 USD.

(b) System Installation and User Training

The system is designed in such a way that the bus module can be hinged into the window of any bus. This system was installed in IIT Delhi buses for the purpose of this study. As can be seen in Figure 5(right) the speaker of the bus module is placed right beside the entrance of the bus. The auditory cue from the speaker guides the user towards the entrance and helps him board the bus safely and independently. In Figure 5(right) the user is holding the user module in his hand through which he queries and makes selections to initiate sound output from the bus. Figure 5(left and middle) show the user and bus module.

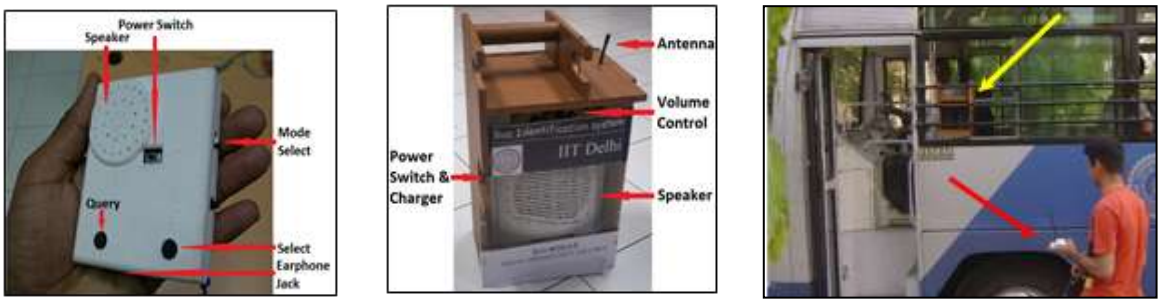

Figure 5: Left: User module; Middle: Bus module; Right: The bus speaker installed near entrance and a visually impaired person holding the user module

The user training was done in three parts. In the first part, the users were provided self-learning manuals, which provided users all the essential information about the functioning and orientation of the two modules of the system. The second part of the training consisted of making the user learn about the components and functioning of the user module. The last phase of the training involved training the users in making selections and following auditory cues to board a stationary bus.

(c) Trial and Post-usage user interview

In this phase the participants boarded specific buses on real bus stops in New Delhi, also marked by numbers on the paths in Figure 2. University buses equipped with our system were used to conduct on-road trials. The users were given a bus route number (the same as the university bus route number) and instructed to board the bus when it arrives. This activity was repeated multiple times and field researchers carefully observed, recorded and videotaped the individual's behaviour. As the bus arrived, the field researchers made note of the following metrics - (i) Distance of the user from the bus when he starts walking towards the bus, (ii) The time taken by the user to independently board the bus, (iii) The number of selections (auditory cues) initiated by the user to reach the entrance of the bus, (iv) Success ratio of boarding the right bus. For this study, a successful attempt was defined as the independent boarding of the correct bus by the user in 3 minutes or less.

After the on-road trials, semi-structured questionnaire-based interviews were conducted with all participants to assess the utility of the system and take feedback on the device features, ease of use etc. Individuals were asked about the utility of the system in identifying and boarding buses. They were asked if this system made them more confident, reduced anxiety and can potentially have a positive impact on their study/work/life or not. Additionally, users also gave feedback on the device shape, form, ease of use, learning manuals and training protocol and suggested improvements.

RESULTS

1. Current bus seeking behaviour

The questionnaire analysis and the observation yielded overwhelming evidence that visually impaired people face major difficulties in accessing buses and need to seek and heavily rely on sighted assistance, which is often unreliable. During the study, users told that that seeking help often leads to misbehaviour, abuse and misguidance and causes a large impact on personal and professional interactions. Figure 6 below summarizes the problems cited by the users and their outcomes are described under different categories and appear as sub-sections below.

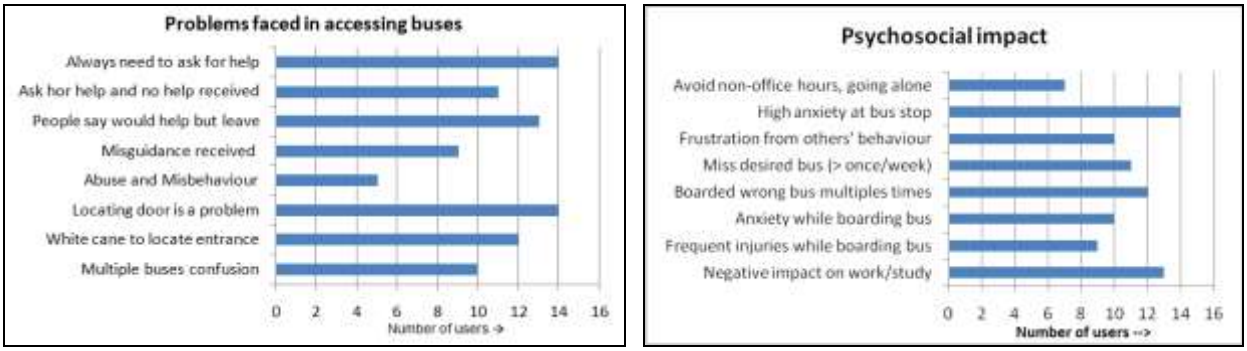

Figure 6: Cumulative participant responses regarding day-to-day challenges faced and the impact of the process of identifying and boarding buses. (Total of 14 users)

(a) Seeking help from sighted travellers on the bus stop

All participants categorically stated that they miss their desired buses very often and find difficult to find reliable help to assist them in boarding. They mentioned that sometimes try to ask bus conductors or drivers but this help is very unreliable and it often leads to long delays or misguidance. Some of the key problems cited by the users are that people do not offer to help and even if they do, they leave when their own bus arrives without informing the visually challenged person, who is left waiting and expecting the person to be still present. Ravi, a visually impaired commuter for 15 years, says, *"So many times we keep saying... excuse-me asking for help but they keep ignoring us. If no cares, what is the point of asking? Many times, if somebody does agree to help, but their bus comes, they leave without informing and we are just left behind standing behind" ("kitni baar excuse-me bolte raho who log sunte nahi hain, jab tak koi answer karega nahi to bolne ka kya fayda, bahut baar unki bus aajati hai aur wo chale jaate* hai aur hum reh jaate hain.*"*).

Figure 7: Problems faced by the visually impaired video recorded by observing field researchers Left: Asking assistance to identify the correct bus. Middle: A visually impaired person repeatedly asks for help (for 10 min) but no one is around and then ventures toward the bus in desperation. Right: A visually impaired commuter left stranded mid-way on the road own their way to the bus stop and they come dangerously close to passing vehicles.

When asked how visually impaired commuters identified bus route numbers, all participants replied that they are forced to depend on sighted persons. Swati, a female college student says, *"There is no choice other than asking for help and sometimes people help and sometimes they don't"* ("*Help lena hi padta hai. Kabhi karte hai help kabhi nahi karte*"). Mr. Naresh mentions, *"In case nobody is there, we knock at bus with our (white) canes to ask the route number– some good natured drivers stop for us; the rest just drive away"("Stick maar kar puchna padta hai kaunsi bus route number hai, ache driver rok lete hai otherwise bhaga le jaate hai* "). All participants said that identifying and locating buses through these means is highly unreliable and dangerous and often leads to serious injuries. In Figure 7(left) the user is asking for help and in Figure 7(middle) there is no one at the bus stop to help.

(b) Boarding the desired bus

Bus boarding is the most crucial and dangerous step in bus access behaviour of the visually impaired. During the questionnaire and trials, it was found that the first preference to identify the door of the bus to board properly is to ask people for help or follow the crowd towards the entrance. As Jatin says, *"If three-four buses come, a lot of chaos happens and then it becomes very difficult to board the right bus."* As Swati mentions, *"We know the bus has arrived by the sound, we still need to ask but nobody takes us towards the bus. Even the bus conductor does not call out to us."(Awaaz se pata chalta hai, puchna padta hai, bus ke paas nahi lekar jaate, conductor kabhi awaaz nahi lagata).*

In case of no help, most commuters reported that they themselves attempt to find the entrance using the white cane by striking it against the bus and trailing the side face of the bus in order to locate the door. As shown in Figure 8(a) and (c), users are trying to board the bus by trailing the bus body with their hand stretched to touch the bus and are walking towards the tyre of the bus. All users recounted incidents when they get injured in this process. In Figure 8(d), there is so much crowd at the bus stop that boarding the bus even with help becomes a big challenge. Some said they are not able to see the cuts in the buses and while trailing the bus, get hurt and also miss the bus. "Your bus is here" is a misnomer and non-discriminating and thus cannot help the visually impaired in locating their desired bus.

Figure 8: Problems faced by the visually impaired in finding and boarding the bus. From the left: (a) Approaching a bus via sound and getting dangerously close to it (b) Being pulled into the bus by a sighted person hurriedly as the bus is about to leave (c) Approaching a bus with outstretched hand and moving towards the tyre (d) Standing at a crowded bus stop, not knowing where to go

(c) Injury, abuse and misbehaviour

Aftab, an 18-year old school student said, *"While boarding, I fell down and the wheel went over a part of my leg."* When asked whether they have been injured, all 14 participants recounted multiple instances and Bharti, a regular bus commuter elaborates, *"We get hurt a lot, often we are unable to determine the location and extent of the bus door and something like a bag gets stuck and sometimes there are so many people getting down"* ("*Bahut chot lagi hai, kahin baar sides pata nahi chalta and bag phas jaata hai, kahin baar bahut log utar rahe hote hai*").

Three of six women interviewed cleary recounted incidents of harassment while seeking help at the bus stops. Shaheen, a female student says, *"I am hesitant to ask (adolescent) boys for help. On one occasion, a young man took advantage and took me somewhere else (rather than towards the bus) ("Haan boys se hoti hai..Ek baar hua tha ek ladka kahin aur legaya").* *Bharti, another female commuter said, "People frequently misbehave and talk rudely. Even bus conductors/helpers talk very rudely and misguide us from our route."*

Many commuters reported a high amount of frustration with the fellow commuters' attitude towards helping them access buses. In 31-year-old Naresh's words, *"We don't get to know the bus route number, people stand there and yet they do not speak up or help. I retorted that they must be mute that they are not able to help us" (number pata nahi chalta, bande khade hote hai but bol nahi rahe hai, maine bhi bola tum log gunge ho tum kya help karoge).* In another commuter's experience, *"We get to know when the bus comes but nobody from the bus, not even the staff helps us out. I get a lot angry whenever I get late while trying to take a bus." (Bus aane par pata chal jaata hai but bus wale help nahi karte, haan bus lete waqt bahut gussa aata hai jab main late ho jaati hoon)*.

(d) Impact on professional life

All participants told that they confine their bus travel to office hours as it is difficult to find help otherwise. In a user's words, *"We can find help in the morning as many people travel towards their offices. In the afternoon, it becomes a huge problem as we are alone then." ("Help mil jaati hai morning mein otherwise afternoon mein problem hoti hai. Morning mein log office jaate hai to help miljaati hai. Akele ho jaate hai baad mein* "). More than 12 out of 14 visually impaired commuters in the study use public buses daily for commuting. Of these, 5 out of 8 men and all 6 women said that they experience high anxiety while boarding buses. The rest three men said that they do not feel anxious now as bus boarding and its problems have become a part of their daily routine.

All participants reported missing their buses at least 1-2 times every week which impacts confidence and professional interactions. The primary impact of this is that they turn up late and end up being reprimanded and embarrassed at their place of work/study. Naresh said, *"I was almost fired for coming late to the office on multiple occasions because of missing buses."*

All 8 students in the user group said that they get scolded and are deemed insincere because they are not able to reach class on time. 20-year-old Kanika spoilt an examination because she could not find her desired bus in time. She says, *"I had an examination for Social Studies but I could not get any bus of the route number 192. Found another bus very late and reached late for the examination" ("paper tha SST ka but bus nahi mili. 192 nahi mil rahi thi, mudrika mili, uske baad hum waha pahuche.)"*

Nilesh says, *"Yes. (Being late) affects us. In class we often get scolded and if somebody calls at a specific time, it becomes a problem." ("haan padta hia class mein aayenge to daant to padti hai, time se kisi ne bulaya hai to problem hota hai")*. Another student adds, *"If we reach late, we feel very bad. We also miss our class" ("late se pahuchte hai to bura lagta hai.class bhi nikal jaati hai.")*.

2. User trials with the bus identification system

The user bus access behaviour was studied first in the baseline case and then with the current prototype of the Bus Identification System. All participants successfully boarded the buses independently without seeking any sighted assistance. Two examples are shown in Figure 9 and 10. The system was tested on both the road paths and the results of the testing are summarized in this section.

(a) Effectiveness in independently locating and boarding the correct bus

System Parameter	Distance (in m)	Time taken (in sec)	Average number of selections	Success rate
University campus route (Low traffic route)	6.86±4.87 (Min:1, Max:15)	30.9±11 (Min:20, Max:48)	5.14±2.11 (Min:2, Max:8)	100%
AIIMS-IIT Delhi route (High traffic route)	6.67±2.8 (Min:3, Max:12)	60.78±43.43 (Min:20, Max:180)	5.33±2.42 (Min:1, Max:12)	96.3%
Stationary Bus (inside university campus)	6.05±2.65 (Min:2, Max:10)	29.1±8.64 (Min:15, Max:45)	5.63±2.58 (Min:2, Max:11)	100%

Table 1 - Bus Identification System - Trial statistics (averaged over 2 iterations for each user for each route) (Each figure set represents Mean ± SD for all users)

Table 1 summarizes our findings from the trial conducted once with a stationary bus, inside university campus and finally on a very busy road. Users use 5 auditory cues on an average to reach and board the bus. Also, in the high traffic area, the time taken increases and also varies a lot because of traffic and crowd factors. The average distance of the user from the bus entrance is 6m and time taken to cover this distance varies from half a minute to a minute using the system. Figure 11 (left) shows how the users could successfully access buses without encountering aforementioned problems.

It was observed that despite high traffic noise, all users displayed good sensitivity to sound localization and were quite attuned to following the direction of the sound. All users followed a direct line towards the entrance of the bus tapping the cane on the ground and directly boarding the bus. Trailing for a significant distance or touching of the body of the bus were both not observed with the system being used. The low vision participant also confirmed that the system was useful. He found the system very useful for identifying bus route number and quickly could locate the door of the bus.

However it was observed that sometimes a user got confused between the query and the select button and hence could not board the bus in time using the device. Also the construction of the bus stops was so uneven that the user took more time to navigate safely through the bus stop than directly reaching out to the bus.

Figure 9: System trial. From the left: (a) Query Stage (b) Selection (c) Moving towards the bus (d) Successful and independent boarding of the bus

Figure 10: System trial with auto-query mode. From the left: (a) Automatic query stage (b) User getting up to board the bus (c) User moving towards bus and selection mode (d) Boarding of bus

(b) Utility and psychosocial impact of using the Bus Identification System

During the questionnaire, all 14 users overwhelming stated that they feel the immediate need of a device which will help them identify and board buses and added themselves that it would make them independent and would boost their confidence hugely. All users said that using the system increased their confidence in identifying and boarding buses. Figure 11(right) shows the opinion of the users about the system.

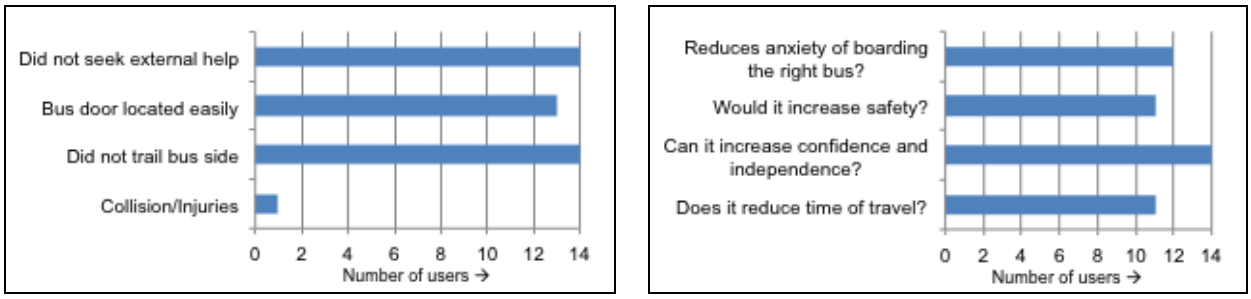

Figure 11 - Bus Identification System Trials (left) Trial statistics (right) User opinion

Naveen, a visually impaired bus commuter for 12 years says, *"We get nervous standing at the bus stop. That will be reduced. If it also contains information on where the bus stopped, it would boost lot of confidence*." (Aisa *device hona chahiye…kaafi saari problem ko sort out kar dega. That device would boost lot of confidence. Nervousness hota hai bus stand par wo kam hoga…. location kaha stop hua hai…usmein hona chahiye…to aur jyada confidence level bad jayega).*

Nidhi says,*"That this device won't deceive them unlike others." ("Haan iss device se mujhe dhoka nahi milega").* Kanika says, *"The device increases confidence and safety. This device would help reduce our problems. Till now we had to depend on others but not anymore. This device makes us independent. (Confident banata hai device. Safety bhi badegi, itni problem nahi hogi jitni hoti hai. Abhi tak to doosro par depend nahi hona padta, ab nahi hona padta, independent banata hai).*

Notes on this study:
(a) Prior consent was taken beforehand for participation in the study and obtaining any images or videos during any phase of the study. (b) When referring to participants in the text, their names have been changed. (c) All questionnaires were conducted in the local language - Hindi. (d) Female participants were interviewed by female field researchers to prevent any cross-gender bias. (e) The electrical safety of all devices was checked before giving them away to the users.

CONCLUSIONS

In this research we systematically explored and documented bus-seeking behaviour of the visually impaired. The participants overwhelmingly stated that they rely heavily on sighted assistance for identifying the correct bus and boarding it. All participants told that the unavailability of ready and reliable help from sighted assistance is a major source of anxiety and day-to-day frustration. It was also discovered that the process of accessing public buses causes visually impaired commuters to become a victim of abuse, misbehaviour and serious upper body injuries. As part of this study, we also prototyped a Bus Identification System, a potential solution, installed it in university buses and tested the same on busy roads and inside university campuses. The participants who used the device demonstrated high success rate and reported that it made them feel more independent, safe and confident.

In the next phase of our project, we actively seek tie-ups and we are making continuous efforts to engage with public transport authorities in order to make this one great difference in the lives of the visually impaired.

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