Study of Challenges Faced by Visually Impaired Persons in Accessing Public Buses and Design and User Testing of an Affordable Bus Identification Homing System for the Visually Impaired

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Study of challenges faced by visually challenged population in using Public transport system

Importance of Public Transport System

- 1) Public transport is the only viable mobility option for the most of the visually challenged in our country.
- 2) 87% of the visually challenged individuals live in developing countries where no other viable option exists.
- 3) Reliable access to public transport is a precursor for seeking
 - education
 - employment
 - social integration

Problem faced by the visually challenged in accessing public buses

- 1) In the bus transport system the route number is *only* displayed on the number plate
 - \Rightarrow A visually challenged person has to rely on sighted assistance
- 2) Difficulty during non-office hours and at less-frequently used bus stops
 - ⇒ Further inconvenience when no one is around
- 3) Even after identification the user is unsure about the physical location of the bus
 - \Rightarrow Needs sighted assistance in navigating towards the bus





Problem faced by the visually challenged in accessing public buses

- 4) In developing countries, buses commonly arrive together and line up arbitrarily along crowded bus stops.
 - ⇒ Systems developed for highly structured transport conditions fail.
- 5) A majority of bus stops consist of a single shed or a place next to a building with no power supply.
 - \Rightarrow An announcement device at the bus stop is not always feasible.
- 6) Does a speaker on the bus announcing its number work?
 - ⇒ No. This creates too much noise pollution even at bus stops where it is not required. The user cannot trigger auditory cues trying to reach the bus.





Measures adopted by the Visually Challenged to Access Public Buses

Behaviour	Problems
Arrange for a sighted person to accompany for the trip.	Creates dependence. Lowers self-esteem.
Find a sighted person at a bus stop and ask for help.	Person may leave without informing and the blind person keeps waiting.
Listen carefully for the bus conductor.	Very unreliable. Conductor may not call out or call just once.
Follow the direction of the engine sound.	May reach the wrong bus. Very dangerous. The user can come in front of the vehicle.
Follow the direction where maximum noise is emanating.	Very unreliable. May board the wrong bus if multiple buses are present.

Details of Study Carried Out

- Studied 14 persons (8 men and 6 women) in the age group of 15-35 for problems faced by them in accessing public transport.
- The purpose of study is to examine the current bus seeking behaviour and its limitations.
- The study also included psychological impact of problems faced.
- The study was carried out by both observation and personal interviews of individuals participating in the study.
- Observation included video recording of personnel in natural environments.
- Interviews tried to assess extent of use, preferred time of day, need for help from a sighted guide for bus boarding and any pre-planning required etc.

Findings



Findings

Psychosocial impact

Avoid non-office hours, going alone High anxiety at bus stop Frustration from others' behaviour Miss desired bus (> once/week) Boarded wrong bus multiples times Anxiety while boarding bus Frequent injuries while boarding bus Negative impact on work/study



Conclusions

An unfriendly and inaccessible public bus system causes blind persons to:

- Miss 3-4 buses on a daily basis losing precious time and work opportunities.
- Board the wrong bus and reach an unintended location.
- Undergo stress and anxiety each time they are boarding a bus.
- Undergo physical injury in trying to board a bus
- An urgent solution is needed to ameliorate this problem.

Design and User Testing of an Affordable Bus Identification Homing System for the Visually Impaired

Solution

- To design and implement an affordable user-enabled system to obtain the route number of buses approaching a bus stop.
- To assist the user in reaching the bus entry of the desired buses through active auditory cues.
- The system operation must be controlled entirely by the user with no dependence on sighted assistance and require minimal modifications to existing infrastructure.
- To install the system on university buses and conduct experiments with potential users under normal traffic conditions and collect user feedback.

Bus Identification & Homing System



Bus Identification & Homing System

SELECTION STAGE

Voice output from the bus of interest gives *directional-cue* to board the bus



User Module

Features

- Comfortable size for hand-held operation.
- Self contained RF-antenna and speaker.
- Easily locatable and usable Query and Select buttons.
- Powered by rechargeable Li-ion batteries.
- Optional provision for a monoearphone.
- Braille markings to locate buttons.



Hand-held User Module

Bus Module

Features

- Self contained RF and Voice Output Module.
- The unit hinges easily on the window railing.
- Voice output easily heard 15m away despite ambient noise.
- Indication to the driver.
- Protection against rain.
- Connects easily to bus battery with in built voltage regulation.





System Installation on IIT Delhi Buses





User boarding the bus with the system without any sighted assistance. (Left)

Bus module kept near the driver's controls (Right) ¹⁷

Installation on the University of Delhi Bus



A visually challenged university student boarding the bus independently by triggering auditory cues from his user module. Arrows indicate user and the bus modules.

Experimentation at a real bus stop



Limited Trials with IIT Buses

Proposed Design and Development Methodology

- User-centric design methodology
 - Potential users were involved in every stage from inception, specification formulation, testing and trials.
 - Every design feature was user ratified.
- Focus User Group
 - 25 visually challenged bus commuters, aged 24-52, varying degree and onset on blindness
 - Provide detailed inputs to design team for development and quick feedback on prototypes.
- Iterative system development
 - Emphasis on reliability, usability and cost
 - Thorough testing and theoretical analysis

Conclusions

- Proof of concept studies have shown potential of the proposed system and an useful enabler to address mobility and transport problem of visually challenged.
- The system is affordable and can be integrated into existing infrastructure with minimal changes.
- The system is of potential use to low vision people as well as elderly.
- The proposed system will undergo further trials in coming months.
- A patent has been filed on the proposed system to protect intellectual property.

Thanks for Your Attention