User Study on Blind and their Navigation Behavior in Local Trains

Semester IV
Design Research Seminar report

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Declaration

I declare that this written document represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources.

I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission.

I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Approval Sheet

The project titled '**User Study on Blind and their navigation behavior in Local train**' by Kalyani Sanjay Dhone is approved for partial fulfilment of the requirement for the degree of 'Master of Design' in Interaction Design.

Guide : 

Date : 18th Feb, 2015

Content

Abstract

In Mumbai most of the people travels by Local train as it is connected to all the places, but the routes of these trains are complex and difficult to understand.

It is always interesting to know how the blind people must be travelling without any vision and how they navigate from one place to another in city like Mumbai.

The user study is aimed to understand, how blind people travel in local trains. In this user study, we tried to understand - How blind people get information, what are the techniques and methods they use to get this information, what are the problems they are facing currently in traveling, the different resources and assistive systems they use for communicating and navigation. Also, we tried to investigate their behaviour while travelling in Local trains, how they find correct trains and their destinations stations.

The focus user group was children, young people above 18 years and adults. From the gathered data, we tried to find observations and insights which may help in developing system for blinds for navigation in Mumbai local trains.

Introduction

Out of all the population in India, 15 billion people are blinds in India. Out of every three blind one blind person lives in India. There are 2 million blind children in India. Though we have such a major population of blind there are very few resources or helping aids designed for blinds. In Mumbai Local trains are the main means of transportation.

In Mumbai, Local trains are mainly divided into four main routes – Western, Central, Harbour and Thane Vashi. Local trains runs on these routes according to their times and frequencies. In Mumbai there are two types of local trains – Fast and Slow.

Navigation is one of the major problems blind people face every day. In city like Mumbai where public transport is a major means of transportation blind people faces lots of problem while travelling. In Mumbai most of the people lives far away from their home and has to travel in local train from early mornings. In such a crowded environment blind people has to manage their own path of navigation alone.

The user study is aimed to understand the problems faced by blind people while travelling and navigating from one point to another.

In secondary and primary research I tried to find what the current navigation system are and other assistive technologies and facilities are available for blinds.

Scope of the project

The targated users are blind people who travels in train everyday.
The project is intended to understand the navigation behavior of the targeted audiences with the help of user studies.

In this project my goal is to understand how blind people travel in Local trains and what are the factors affects their navigation behavior.

By conducting user studies it was found that - the users are mostly dependent on the people around them while travelling. They tend to rely on people more than technology for finding their routes and destination and there is a need of the system which will help them in finding correct routes without depending on the others.

Design Process followed

Design process followed
Data collection
User studies and literature review were done to understand the blind people navigate and related issues faced by them.
The data obtained from user studies was used to generate observation and insights

BEST Buses in Mumbai

Metro Trains

Auto Rikshaws

Local Trains

Image Source: Google Images

Data Collection

Public Transport in Mumbai

In Mumbai there are many modes of public transports like - Bus, trains, taxis, auto rikshwas etc. Over 88% of Mumbai people uses these public transport services daily for transportation.

Out of all these transportation services trains are the fastest and affordable transport service used by the Local people. These trains are mostly called as 'Local Trains'.

These trains runs on four main routes

Western between Churchgate railway station and Dahanu Road

Central between Chatrapati Shivaji Terminus (CST) and Kasara/Khopoli

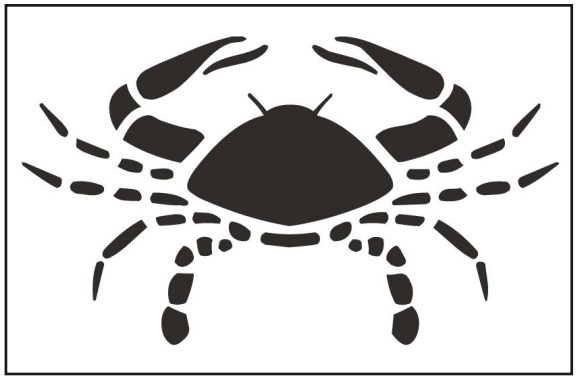
Harbour, running between CST and Panvel/Andheri

Trans-Harbour, running between Thane and Vashi/Panvel

Everyday people from all across the Mumbai travels by trains. It has the world's highest density of 6.3 millions people daily.

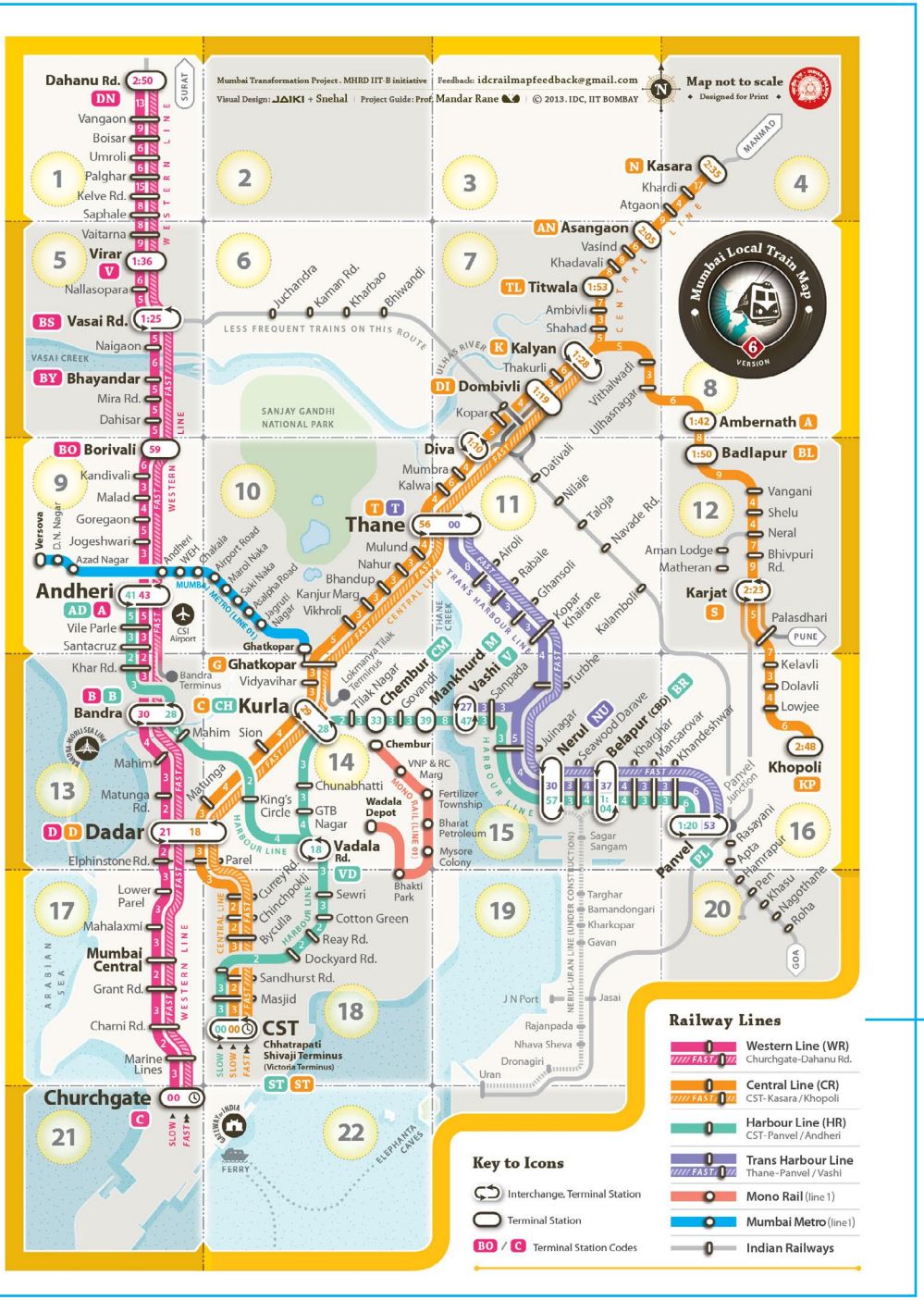
All these trains provides First class, General bogie (Second Class) for passangers. It also provides Ladies bogie specially for Women and Physically handicapped and cancer patients. [2]

The bogies for Physically handicapped people are indicated by symbol of wheelchair and cancer. Also, yellow stripes so that passanger can easily identify it.



Symbols used for Physically handicapped and Cancer patient on door

Image Source : Google Images



Different railway lines in Mumbai rail map.

Image Source : http://www.mrane.com/images/railmap/IDC%20Mumbai%20Railmap%20V6%20english.jpg

a	⠁
b	⠃
c	⠉
d	⠙
e	⠑
f	⠋
g	⠛

h	⠓
i	⠊
j	⠚
k	⠅
l	⠇
m	⠍
n	⠝

o	⠕
p	⠏
q	⠟
r	⠗
s	⠎
t	⠞
u	⠥

v	⠧
w	⠺
x	⠭
y	⠽
z	⠵

1	⠼⠁
2	⠼⠃
3	⠼⠉
4	⠼⠙
5	⠼⠑
6	⠼⠋
7	⠼⠛
8	⠼⠓

9	⠼⠊
0	⠼⠚
10	⠼⠁⠚
1,000	⠼⠁⠂⠚⠚⠚
100 000	⠼⠁⠂⠚⠚⠀⠚⠚⠚
3.14	⠼⠉⠲⠁⠙
½	⠼⠁⠌⠃

Basic braille letters and numbers

Braille

Braille – Braille is a tactile writing system used for writing for blinds and visually impaired. Braille is comprised of the six dot blocks called as cells. Each cell contains the tiny dots which can be touched and feel by blinds. These dots are arranged in such a way that they for a different arrangement for different characters and letters. The braille code which are used for writing regular books, magazines documents are called "Literacy Braille". [1][3]

In English braille there are three levels of encoding of braille –
Braille has three grades – Grade 1, Grade 2, and Grade 3

Grade 1 containing all alphabets and numbers (0-9)

Grade 1 is a (nearly) one-to-one transcription of printed English, and is restricted to basic literacy.

about	
above	
according	
across	
after	
afternoon	
afterward	
again	
against	
almost	
already	
also	
although	
altogether	
always	
ance	
and	
ar	
as	
bb	
be	

because	
before	
behind	
below	
beneath	
beside	
between	
beyond	
blind	
braille	
but	
can	
cannot	
cc	
ch	
character	
child	
children	
con	
conceive	
conceiving	
could	

Examples of contraction Braille

Grade 2

Grade 2 braille is also called as English braille. It is composed of 250 or so letters (phonograms), numerals, punctuation marks, formatting marks, contractions, and abbreviations (logograms).

The system used for reproducing most textbooks and publications is known as Grade 2 braille. In this system cells are used individually or in combination with others to form a variety of contractions or whole words.
For example, in Grade 1 braille the phrase you like him requires twelve cell spaces. It would look like this:

You like him

If the same sentence has to be written in Grade 2 then the same phrase would take only six cell because letters *y* and *i* are also used for the whole words you and like respectively.
The word him is formed by combining the letters hand *m*. It would look like this:

You like him

Grade 2 uses 189 different letter contractions and 76 short-form words. These "short cuts" are used to reduce the volume of paper needed for reproducing books. Normally printing Grade 2 braille is preferred because it saves time and paper. [1][2][4]

Grade 3, is not a single system, but any of various personal shorthand. It is almost never found in publications.

In different countries different braille scripts are used. In India Bharati braille or Bhartiya braille is used for different languages in India. Bharti braille uses the standard 6 dots format for writing the numbers and letters. Most of the letters are assigned same code consistently crossed the different regional scripts of India. Hindi, Bengali, Urdu and English are rendered mostly the same in braille. [5]

ISO	a	ā	i	ī	u	ū	e	ē	ai	o	ō	au
Braille	● ○ ○ ○ ○ ○	○ ● ○ ● ● ○	○ ● ● ○ ○ ○	○ ○ ○ ● ● ○	● ○ ○ ○ ● ●	● ○ ● ● ○ ●	○ ○ ● ○ ○ ●	● ○ ○ ● ○ ○	○ ● ○ ○ ● ○	● ● ○ ○ ● ●	● ○ ○ ● ● ○	○ ● ● ○ ○ ●
Gurmukhi	ਅ	ਆ	ਇ	ਈ	ਉ	ਊ		ਏ	ਐ	(ਖ਼ x)[5]	ਓ	ਔ
Urdu		ا		ی		و		ے	ے	(ے x)[5]	و	و
Devanagari[6]	अ	आ	इ	ई	उ	ऊ	ऐ	ए	ऐ	औ	ओ	औ
Gujarati	અ	આ	ઇ	ઈ	ઉ	ઊ		એ	ઐ		ઓ	ઔ
Bengali	অ	আ	ই	ঈ	উ	ঊ	(য় y)[7]	এ	ঐ		ও	ঔ
Oriya	ଅ	ଆ	ଇ	ଈ	ଉ	ଊ	(ୟ ẏ)[7]	ଏ	ଐ		ଓ	ଔ
Telugu	అ	ఆ	ఇ	ఈ	ఉ	ఊ	ఎ	ఏ	ఐ	ఒ	ఓ	ఔ
Kannada	ಅ	ಆ	ಇ	ಈ	ಉ	ಊ	ಎ	ಏ	ಐ	ಒ	ಓ	ಔ
Malayalam	അ	ആ	ഇ	ഈ	ഉ	ഊ	എ	ഏ	ഐ	ഒ	ഓ	ഔ
Tamil	அ	ஆ	இ	ஈ	உ	ஊ	எ	ஏ	ஐ	ஒ	ஓ	ஔ

Bharati Braille

Image Source : http://en.wikipedia.org/wiki/Bharati_Braille

I becon for location finding

BlindSquare remote control

Image Source : http://www.blindmaps.org/prototypes

Current existing solutions

Blind Maps - BlindSquare

BlindSquare is a navigation system designed by the students of the Copenhagen Institute of Interaction Design. This system allows the blind person to navigate on road with the help of the white cane a connected device which acts as an interface to the urban environment and to the user's smartphone.
In this device a white cane acts as a navigation tool for blind people. The device is attached to a white cane and gives audio and haptic feedback.

I-Beacons are used to give accurate feedback near intersections and important juctions.

BlindSquare remote control is used to give area specific information to the user when required. The system also gives the real time information about the trams, trains, buses just by clicking one button on white cane's grip. [6]

Talk Back Application

Big Font Application

Image Source : Google Images

Big Fonts – Big font is application for smart phones. With the help of this application user can change the font size of the display on the phone. Most of the partially blind user use this feature in their phone to see the text and other textual content.

Talk Back – TalkBack is a service that helps blinds and visually impaired people to interact with their phone. It uses text to speech technology to read the messages and text. It allows the user who can't see to choose different options and perform actions according to the audio feedback. [7]

User studies

As a part of user studies, I conducted four interviews in National Association of Blind, Worli

Interview 1

The first interview was conducted with the lady who is working in Printing press in Association. She is 48 years old, completely blind. She is working there from last 15 to 16 years. She lives in Vasai Naigaon in Mumbai. Every day she has to travel by Rikshaw, Bus and Local trains to come to office. In the morning either someone from family accompanies her or she leaves alone from the house till the rickshaw stand. As she is travelling from last 15 years, its quiet easy to find her way without any difficulty. After reaching the rickshaw stand she goes to Naigaon local train station to catch her train. As she is living in that area from long time she is quiet familiar with all rickshawalas. So while going to station if she finds any difficulty in finding her way to train, rickshawalas help her. When she was new there, she used to ask someone to help her out in finding platform and her bogie. To make boarding easier for visually impaired people, the beepers are installed at fixed spots on each platform where the handicapped bogie arrives. By listening to beeper she finds the position of her bogie without any difficulty. If she gets confused in finding her way, she asks people nearby or sometimes people themselves ask her whether she needs any help.

After boarding the train she goes to Dadar station. She figures out the right station by the announcements at stations going on in train. If sometimes she misses the announcement or there is no announcement machine in the train she notices the sound of train when it crosses the Bandra Khadi and can predict Dadar station is coming nearby. She never counts stops of the local train as many time train stops in between so she cannot rely on it. As she is a regular passenger of local train and same route she knows which side of the gate to get down from the train. Otherwise she asks any neighbor passenger which direction to get down. After getting down from the train, she goes to nearby bus stand and takes the bus which takes her to her office. Normally she asks conductor about bus no or she asks nearby people before boarding the bus. After reaching her stop, she takes around 2 to 3 mins walk towards office and reaches her destination. She has a Nokia smartphone which has a software 'Talk Back' specially developed for blind people which can be used to listen to the each action they do on phone. She uses her phone for messaging and calling. She used to use internet on phone long back but now she doesn't have GPRS in her phone she doesn't use internet on phone. She used to have one navigation system using which she could understand which station she has reached but no detail information of the station was provided. If she wants to go to any new place, normally she takes someone with herself else she ask detailed route of place to travel there.

Interview 2

The second interview was with the girl who works in Vodafone call center. She is partially blind. She can see the objects as blur which are very close to her. She lives in Badalapur and has just completed her studies and working in Vodafone from last 5 to 6 months. She travels to CST everyday by local train. Every morning she takes a walk to railway station as her house is nearby. As she is now familiar with the route and she can easily find her way else she ask people nearby to help her in finding her way. She finds her bogie number or position by listening to the beeper installed on platforms. After getting into train she recognizes the station by announcements going on in train. As she is familiar with the route, she has by hearted all stations and can easily calculate the time to reach her destination. So through announcement she can easily understand when to get ready to get down from the train. As sometimes she takes slow train and sometimes she takes fast train, she prefers to ask people which side of the gate to get down. After getting down at CST she prefers to take rickshaw to reach her office. She doesn't have any smartphone to navigate. She uses a simple Nokia phone which she uses for calling purpose.

As she is partially blind she can recognizes the symbols with high contrast like symbol of the bridge near station or toilet symbols on doors. If she wants to travel on new route she always ask her friends who has been to that route or she takes anyone from family or friend along with her. While travelling also she asks people nearby if she gets confused between stations or her route.

Interview 3

The third interview was conducted with the 25 years guy who is partially blind and working in call center in Vodafone from last 2 years. He lives in Worli and travels by local from many years. As he lives in South Mumbai from long time he is familiar with almost all routes. Every day he travels to his office via local train. He comes by walk to railway station or someone drops him to the station. As he is familiar with Worli station he knows how to go to platform else he ask someone around to help him find his way. With the help of beepers installed on platform he can easily recognize his bogie. He normally travels alone or with friends. He uses touch smartphone with android OS where 'Talk Back' software is installed in his cell phone which gives audio feedback for each actions on phone. As he is partially blind he can read the big fonts. To read text in his phone, he has installed a software 'Big Fonts', which helps the user to enable the bigger font in his/her mobile. He uses his phone to navigate when he wants to go to any picnic spots near Mumbai. To search location he uses google maps. But in his phone google maps doesn't support Talk Back service, hence he cannot use his phone all time for navigation.

To find the local trains on different route he uses M-Indicator software with the help of big fonts. He can read the letters with big fonts and black and white contrast. His eyesight is dependent on the surrounding light. In evening it is problematic to read text or see images for him. So in evening while travelling only beepers helps him in locating his bogie position. He cannot recognize any signage while travelling in evening or night. He doesn't use any map for navigation.

While travelling if he gets confuse between directions of the platform he prefers to ask nearby people for help. Whenever he gets break from his work he plays game on his phone whichever possible (where he can see elements clearly)

Interview 4

The fourth interview was conducted with a girl who is 25 years old. She is completely blind. She lives Ulhasnagar. She uses rickshaw and local train to reach her office. Before starting working in Worli, Vodafone office she used to study in Ulhasnagar. So there was no need to travel much. Nowadays she leaves home around 6'O clock with her mom who takes her to rickshaw stand. After getting a rickshaw she gets down at Ulhasnagar station and finds her way to her platform. As she is familiar with station she finds her way to platform easily. She now aware of the fact that bogie for handicapped people comes near the bridge, moreover the beeper also helps her to find it without anyone's assistance.

After getting into train she listens to announcements for getting down on her station carefully. Even if sometimes she misses the announcement she asks other people on train to help her in getting down. She has by hearted all station so that it gets easy for her to count the stations. She can find which station will come after or before she gets down. When she was new to travelling in local she always used to ask her friend or family before travelling. She uses Nokia E5 smartphone where she has 'Talk Back' software which gives her audio feedback for each action. She uses What 'Sapp messenger for messaging her friends. She doesn't use any navigation system in her phone like Google maps. Whenever she wants to go to new place she takes any of her friends with her or gets detailed information about that place where she has to go alone.

She avoids travelling by bus on public holidays as very few people travels on those days which makes it difficult to find help around as there is no other way to find out bus no. on bus stands.

Interview 5

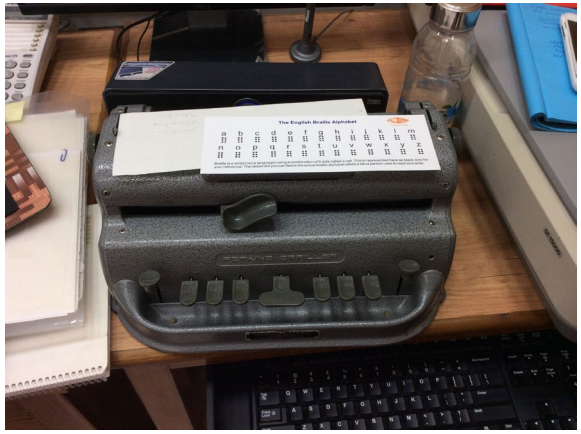
This interview was conducted with a student of XRCVC. He is 18 years old student, lives in Panvel. He is partially blind and can see read and write with normal lights. In evening he faces little difficulty in reading. He can easily read the letters in high contrast. He is travelling in local from last two years. He knows all his routes of travelling and doesn't face any difficulty in navigation. He has by hearted all the stations so he knows which side the platform will come. If sometimes he gets confuse then he prefers to ask nearby people. While going to new place, he ask for the route to his friends or family. He has a smart phone and uses M-Indicator to search for the timings of the local and routes. He has never travelled ahead of Vashi. He travels in first class to come to the college from home. On platform to see the indicator, he uses camera to zoom. He has not use any maps for navigation. Uses Google maps for navigation.

Interview 6

The 6th interview was conducted with student of XRCVC. He is 18 years old and lives in Panvel. He is travelling from two years in local trains. He is partially blind and gets difficulty in reading in dimmed light.

Every day he takes a walk to the station as he lives nearby. Otherwise his dad drops him to the station. He knows where his bogie comes and stand there for his train. He can recognize his bogie by yellow stripes painted on bogie. In addition to that, he can recognize his bogie position by beeper sound. As he cannot see the far away objects, he goes to the indicator to see the train timings and train code. He knows his route very well, so doesn't face any problem while going on same route. But if he has to go on new route he takes someone along with him. He doesn't have smart phone so doesn't use Google maps or M-Indicator for navigation. He travels in handicapped bogie and doesn't use any map for navigation

Braille Slade used for writing braille



Braille printer

Visit to XRCVC

As a part of my studies I visited XRCVC centre in Mumbai CST

Data collected while discussition with staff and students

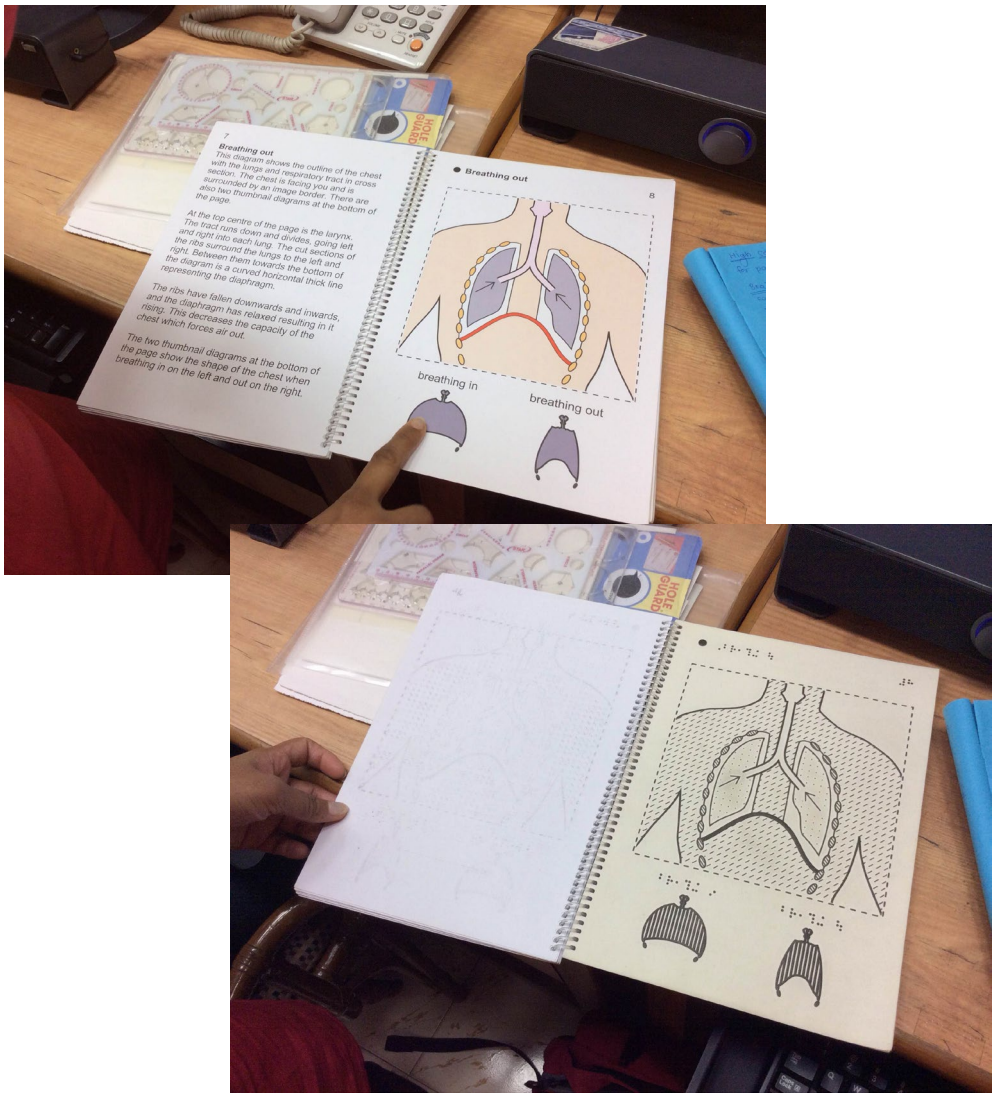
While discussing with the staff and student it was found that,
If the person is partially blind High contrast and big font is needed to read the text.

Braille is a script which is used by blinds. Though it is a script specially done for blinds, all blinds cannot read it. To read and write in braille, first they need to learn braille and special training has to be given for it. Braille is a script (not language) using combination of 6 dots called a cell.

Braille has three grades – Grade 1, Grade 2, and Grade 3

Normally blinds learn first grade braille for reading and writing. Depending on the intelligence blinds can learn this.

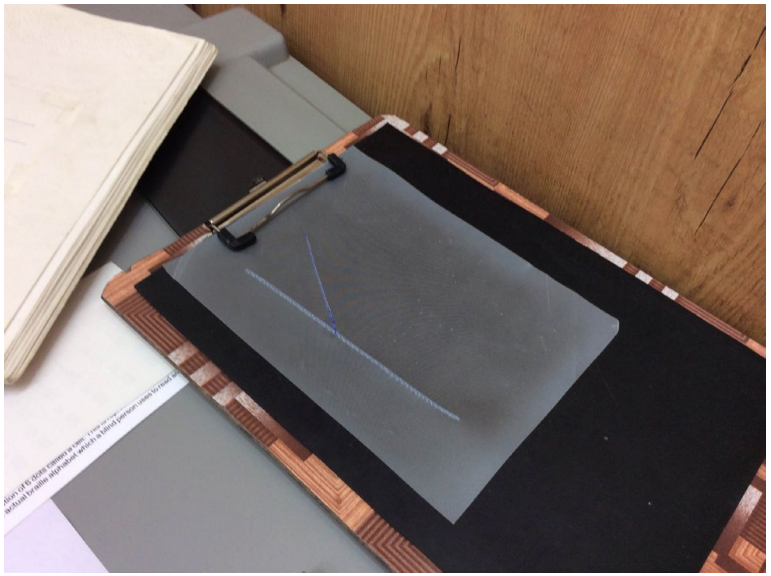
Normally printing Grade 2 braille is preferred because it saves time and paper.

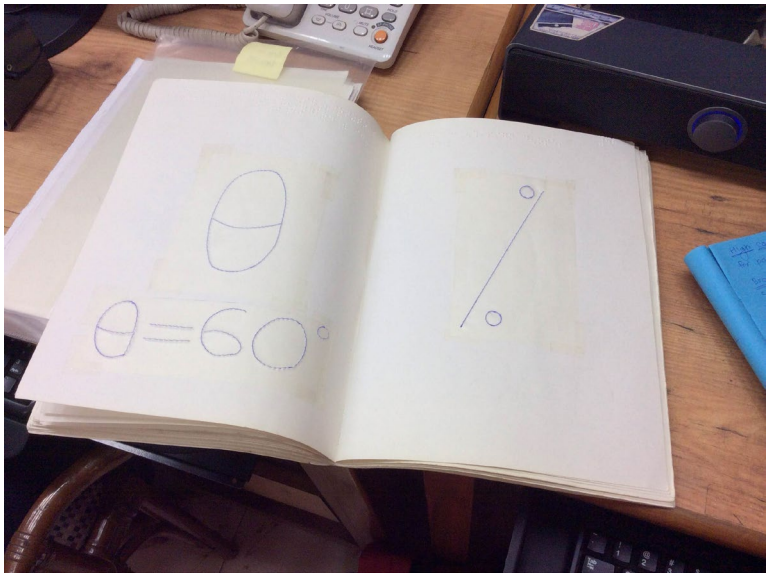


Textures used in diagrams

Textures

Apart from braille, different textures have been used for diagrams and maps. For explaining any diagram, different types of textures are used in single diagram so that blind person can touch the texture and understand the different components of the diagram. For example In a diagram explaining the chest and respiratory track of the human body three different types of textures are used to explain and differentiate components of the respiratory system.





Symbols on Parchment paper

To explain the different diagrams Parchment paper is used. This paper is put on the rubble sheet and with the hand pressure diffrent diagrams can be drawn on it. Different symbols and diagrams can be easily explained to students with this method

The disadvantage of this paper is - it can easily get crushed because of which the diagrams drawn on it looses its accuracy. Also the diagrams with minute details can not be explained on this paper

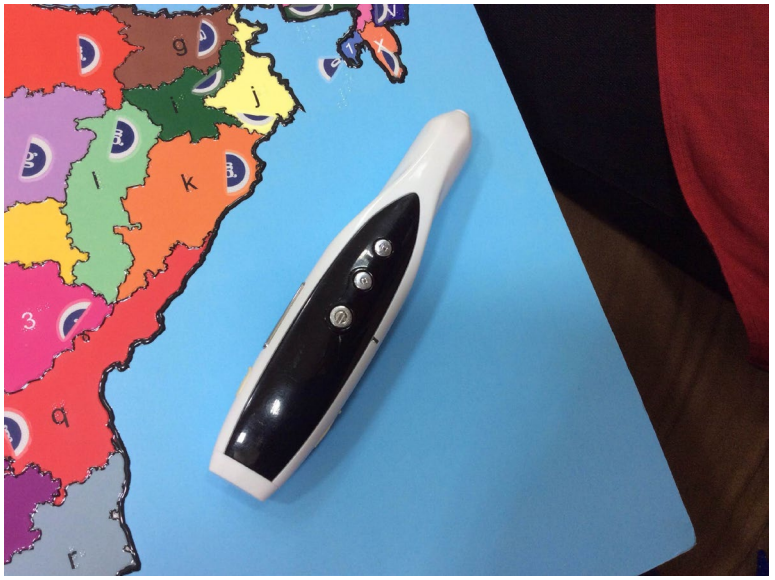
For advance printing polymer dots are used for textures and better feel. Different sensors are also used to give audio feedback to blinds. Blinds can recognize the symbols as it is. But previous training has to be given to them.

Calendar printed for blinds by Reliance

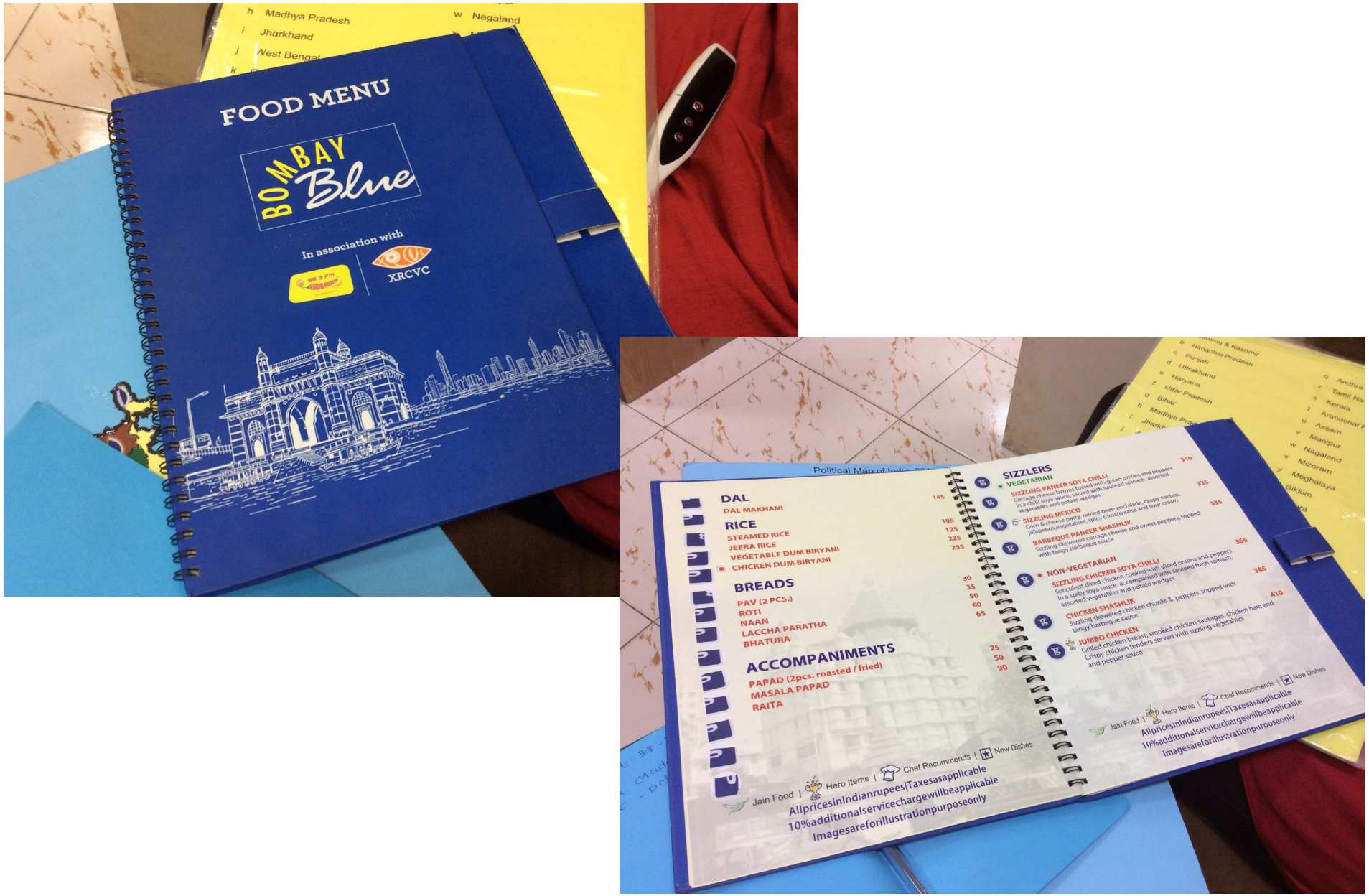
Map of India with sensors and Legend key

With advance technology people have printed maps with audio feedback. In this maps, braille letters are printed to indicate different components on the map. Legend is also provided with the map so that user can understand which letter or symbol is used for what. In addition to this sensors are which gives audio feedback are also pasted on the map. As soon as the device which recognizes the sensor put near it, it gives the audio feedback and gives the information related to that component. The audio can be changed according to the components given and erased and edited as required.

Disadvantage of the system – The disadvantage of this system is polymer printing is too expensive and as there are very few devices designed for blinds, the cost of single device is not affordable for user.



Device which recognizes the sensors on map and gives auio feedback



Food Menu designed for blinds by Bombay Blue

How Blind children see the world

In user studies, it was interesting to see how blind children see their world.

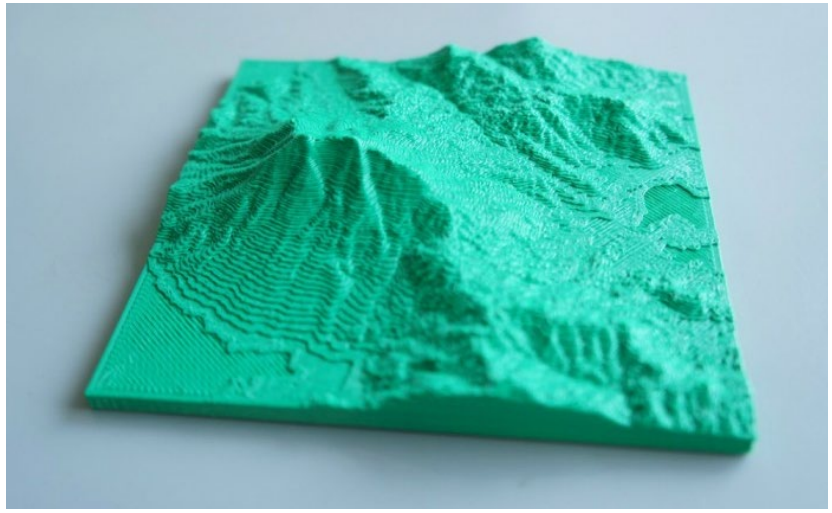
In schools normally blind children come with their parents they never travel alone. When they come to school they live away from their parents. So when they come they take some time to settle down. Teachers in school always help them to settle down. Children has built the bond with teachers and they treat teachers as their parents.

In blind schools all teachers are well trained. They always try to motivate children to learn more things. They will tell children to experience things around them. Before planning the lesson they will practice the lesson so that they can understand the difficulties they can face while teaching. Sometimes teachers blindfold themselves and try to understand the difficulties through blind children's perspective.

While teaching they will hold children's hand and make them feel objects around them. While teaching geography they will use 3D maps to make them understand the conceptual model of the map.

Braille classes

The children are 3-4 years old in the Braille class – partially or total blind.



3D maps for blind people
Image source: http://www.psfk.com

While teaching they make use of Montessori aids

Parents do not try to make children help in touching and experiencing the things, like they eat omelet but doesn't know how egg feels like which leads to loss in children

While teaching teachers tell most of the stuff orally, as their sensory organs are quite strong.
Math and science are difficult/optional, but a students do lean if they get motivated

While learning, teachers will try to make and develop the all capabilities child has. If a child is partially blind, do not ignore the little sight and they use braille only.

Make use of whatever sight is there optimally – It develops, else it is wasted.

Teaching through textures

Use tandul, gehu, vatana, etc.
Learn to differentiate in a thali
Start with just two at a time

Final test is to differentiate between chai Patti and sugar (difficult) because of their fine and similar texture

Educational kit for learning geometry. Useful for students from Std. 3rd to Std. 10th

Image Source: https://www.youtube.com/watch?v=L76rEU78KrE

Designed books different textures of cloths (cut different pieces of cloth)
Book of various leaves (but has to be made anew each time as the leaves perish and texture changes)
Teaching through books and kits
Geometry kit is available and they can do it.

Mr. Bhausaheb Shinde, from Saraswat High School, has designed a Geometry and trigonometry kit. Awarded in Singapore. Has made a model and book to learn this.

Trigonometry through origami folding, etc.

Limitation

The blind have limitations (of the 5 senses usually 80% is visual experience)

Need to give them relevant experiences as much as possible
"Bring the thing to them, or take them to the thing"

Make models , show model first, vs. later – prefers later

Model vs. real – as far as possible, given an opportunity, show the real object. E.g. Tree model vs. real one.

Educational trips/picnic needed e.g. Railway: Sighted need not study about track, rails, station, etc. as they can see

Concept of flying birds: The museum has stuffed birds. They touch and feel real birds

Conclusion

From the secondary and primary studies, it is been found that, though blind people can not see, they have good understanding about directions and routes. Since there is map available to them with can give them overall view about all routes and trains, there mental model about overall system is not clear.

As there are very few technology gadgets available in market for blind, it is very difficult for them to afford.

So, there is huge need of a system which should be cheap, affordable, easy to use and which can help the blind people while navigating from one place to other

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