CROWD COMPASS

AN INTERACTION DESIGN EXPLORATION OF A NON-PLACE

INTERACTION DESIGN MASTERS THESIS 2010
MALMO HÖGSKOLA

STUDENT: SUNANDINI BASU
SUPERVISOR: MIKAEL JAKOBSSON
CROWD COMPASS

ABSTRACT
The thesis project is an exploration of interaction design possibilities within the spaces of public transport in urban India and the challenges for design in these large, disorderly contexts. These public transit spaces offer a microcosmic view of the current urban environment of India, where new paradigms of technology adoption are emerging, and provide significant scope for interaction design to learn from and contribute to in diverse ways.

As the theme of public transport and its encompassing spaces are traditionally approached from urban planning and engineering perspectives, this thesis aims to explore the urbanism of transit places from the framework of place-specific computing, which is a perspective on mobile and ubiquitous computing, and a design methodology that is grounded in and emanating from the social and cultural practices of a particular place. To understand and evaluate the environment, the project makes use of elements of participatory design, brainstorming techniques like placestorming, and experience prototyping methodologies, a way for users to interact directly with the prototype, and thus at each stage of the design process explores the role of prototyping to generate reflective discussion.

The thesis proposes Crowd Compass, an information service based on crowd density, that is available freely anywhere but only of value in a certain context to support a specific decision, and expires instantly. The thesis also presents a new paradigm for design in large scale, disorderly contexts: crowd density, a parameter of contextual information for transit; and the concepts of a semi-controlled space for early prototyping, analytic and generative maps for effective analysis, and the significance of design from “the inside”.

KEY WORDS
Context-aware design, place-specific computing, ubiquitous computing, service design, ubiquitous service design, experience prototyping, developing country, India, place, interaction design, crowd density, wayfinding, semi-controlled space, public transport
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>CROWD COMPASS</td>
<td>1</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>2</td>
</tr>
<tr>
<td>CONTENTS</td>
<td>3</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>4</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>5</td>
</tr>
<tr>
<td>THE BUS AS A PLACE</td>
<td>9</td>
</tr>
<tr>
<td>RELATED WORK</td>
<td>14</td>
</tr>
<tr>
<td>WAYS AND MEANS: THE DESIGN PROCESS</td>
<td>16</td>
</tr>
<tr>
<td>A THOUSAND DIFFERING CIRCUMSTANCES</td>
<td>18</td>
</tr>
<tr>
<td>EXPLORATIONS IN MOTION</td>
<td>28</td>
</tr>
<tr>
<td>MAKING SENSE OF INFORMATION</td>
<td>32</td>
</tr>
<tr>
<td>AN ESTIMATION OF ENDLESS POSSIBILITIES</td>
<td>38</td>
</tr>
<tr>
<td>WAYFINDING THROUGH A CROWDED BUS</td>
<td>45</td>
</tr>
<tr>
<td>A SMALL ODDITY TO A GREAT COMMONPLACE</td>
<td>63</td>
</tr>
<tr>
<td>REFLECTIONS AT THE END OF THE RAINBOW</td>
<td>71</td>
</tr>
<tr>
<td>APPENDIX - PROJECT PLAN</td>
<td>78</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>79</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

HELP & SUPPORT
Jörn Messeter, Amanda Bergknut, Per Linde, David Cuartielles

FEEDBACK, FRIENDSHIP & FUN
Rob Nero, Aaron Mullane, Katrina Anderson, Åste Laberg
Matt Goble, Suzanna Kourmouli, Sebi Tauciuc
Tony Olsson, Matt Hennessey

DAILY HUGS
Chris Metcalfe

PARTICIPANTS
Jeet Chaudhuri, Upasana Roy Chowdhury, Kingshuk, Mandovi Mukherjee
Arko Roy Chowdhury, Arjun Gupta, Onkar Basu
Hanna Olsson, Prem Chandran, Malik Rehman, Priya Mani
Anitha Balachandran, Uma Iyer, Priya Kuriyan
Kamolika Dutta, Indira Bisht, Nishtha Pangle
Leena, Uma Shankar, Varghese Cherian
Prashant Singh, Nirat Bhatnagar, Somnath Sengupta
Ganesh Gothwal, Pushpendra Prakash Sagar, Rahul, Manoj

INSPIRATIONAL LUMINARIES
Adam Greenfield
Jon Kolko

IN INDIA
The Family
Rocket Science Animation
Punam Zutshi

&
THANK YOU FOR EVERYTHING
Mikael Jakobsson
Vivekananda Roy Ghatak
INTRODUCTION

"India is a curious place that still preserves the past, religions, and its history. No matter how modern India becomes, it is still very much an old country."
Anita Desai

Modernity and tradition make strange bedfellows, but not so in India. It is a country where the past and the present jostle tirelessly within the social outlook, tempered by an acceptance that the future will bring what it will. This strange cultural mix permeates through the environment of the country, manifest in everyday life in both minute and monumental ways. In this environment came technology as the vanguard of the future.

The universal belief in India is that the future inevitably lies in the cities – which appear as beacons to show the way towards prosperity and development for much of the country. Thus contemporary urban India, bristling with all sorts of optimistic possibilities, is providing a backdrop to a new urbanism that is emerging with the widespread adoption of technology in new paradigms like mobile connectivity. This potent environment thus presents itself as an exciting area to study. And where else would it be possible to obtain a microcosmic view of the current urban Indian milieu if not in the spaces of its public transport? Public transport has been described by Vertesi as the user interface of a city, and in its essentially public places and spaces the interaction with the city unfolds everyday (Brewer and Dourish, 2008).

Clearly I was intrigued by these places of transit and the practices that exist within them; and interested in exploring this slightly removed urbanism, which has so far been studied in the context of the developed world in the discipline of interaction design, as the unpredictable context of urban India offers significant scope for interaction design to learn from and contribute to in diverse ways.

THE SOCIAL MILIEU

Demographics
India is the seventh-largest country and the most populous democracy, with 1.18 billion people. The population density is around 360/km², which means that roughly 360 people live in each 1 km². Though 70% of the population still live in rural areas, most of the urban population live in the 35 cities with over a million populations. The largest cities are Delhi, Mumbai and Calcutta with populations over 10 million. The national male-female ratio is almost equal, and the national literacy rate is around 65%. There are 28 main languages in the country, including English, and 4 major religions.

Society
India is a pluralistic, multi-ethnic and multilingual society that lives as much in its past as its present. Throughout history the country has always absorbed and synthesized foreign elements and influences, and evolved a culture that is quite unique, displayed in every iota of social life, from religion to clothing to the arts.
The Indian society has a strict social hierarchy that is, though not always enforced, manifest in everyday life in numerous ways. While the caste system influences matters of religion and ritual, modern hierarchies of status caused by employment and education are also unconsciously observed. Though a pluralistic society India still demonstrates a high power distance (Hofstede, 2001) as people in general accept the inequalities in social structure as a norm, along with an uncritical acceptance of authority. At the same time, they tend not to follow rules. Following Hofstede’s cultural dimensions, India also demonstrates a very collectivist culture, where there are strong, cohesive, support groups around an individual from birth, with expectations of unquestioning loyalty and protection among its members. This is shown in the large family-run companies that dominate much of Indian business, and in the traditional joint-family structures that is still the norm today.

An industry that has capitalized on this sense of family and bonding is the mobile phone industry, through cheap handsets and inexpensive calling plans specially customized to the Indian family structure. The ease of staying in touch, the growing economy and availability of jobs in certain cities have brought about migrations of young people across the country, which are naturally challenging some of the established norms and practices of the traditional social structure.

There are also strong gender roles within the society, with subconscious compliance of not only what one must do, but also what one can think and feel. Though the status of women has undergone many changes through the history of the country, in modern India they are granted equal status officially but not always socially. Traditionally a woman is considered a possession – an asset or a burden – of the family or the husband. Till date, government documents require a woman’s identity to be endorsed with her father’s name or her husband’s. The unequal status of women is demonstrated in myriad ways – from seat reservations on public transport to discrimination in land and property rights. Despite this, in urban India women are at par with men in terms of literacy and in workforce participation, at least in numbers.

Historically the land of Gandhi and anti-materialist policy, India is now firmly on the path to consumerism. It is now a common aspiration to own a wife, a car and a house, in that order. Therefore the ownership of a personal vehicle is not always for necessity, but also for social status, all over the country, in all cities and villages. This is a deep-seated aspiration that will not easily change, and as a result Indian cities are clogged with traffic, public transport as well as private.

**Field Research Locations**

Most of my research has been carried out in Calcutta and Delhi. Since these cities are big - the urban areas of Delhi and Calcutta are roughly 700 km² and 185 km² respectively, compared to Malmö (71.76 km²) – public transport is an essential part of daily life. A huge number of people use the public transport systems everyday, since less than 2% of the country’s population own personal vehicles (Luce, 2006). Socially the two cities are quite different from each other. Delhi is the capital of the country and absorbs an influx of migrants everyday from neighbouring states, and is therefore socially diverse. Being India’s richest city, not only in terms of expenditure on infrastructure, but also in earning power in comparison to the other cities, so the top half of the inhabitants are wealthy enough to own multiple personal vehicles, while the lower end of the inhabitants depend solely on public transport. As a result the volume of public transport users in Delhi usually comprise of the lower strata of society. Calcutta is a much poorer city than Delhi, administered by a communist local
government for decades, and the earning power of the inhabitants in general is much less. The population is also more homogeneous as there are not as many migrants from other states. Consequently almost all the people, most of whom are at least high school graduates, use the public transport systems, which are therefore very well integrated into the social and cultural infrastructure.

THE PUBLIC TRANSPORT INFRASTRUCTURE

All the metropolitan cities in India – Delhi, Bombay, Calcutta and Chennai - have multiple modes of public transport, the most common one in all the cities being the metropolitan bus transport system. Besides this, Delhi and Calcutta have underground rail systems, called the Metro Rail, and Bombay and Chennai have local train networks, called the Local. Calcutta also has a trams network in the central areas. Taxis, three-wheeled autorickshaws, and cycle-rickshaws are local modes of small-scale public transport that supplement these extensive transport systems.

The most popularly used transport system is the bus transport in both Delhi and Calcutta. Buses are local to the city, and vary from city to city as the transport authority leases out contracts to smaller groups. In Delhi the main fleet are the older DTC (Delhi Transport Corp) buses, and a small number of new hybrid buses, while in Calcutta there are old State buses and Minibuses. The Metro Rail (called Metro) has been running in Calcutta since 1984, while in Delhi it has only been running since 2002. Atypically, Delhi has never had a very good public transport system – so people who can afford to buy their own cars, and a significant amount use two-wheelers like motorcycles, scooters and bicycles to commute everyday, while the rest are forced to use the dismal public transport.

The physical affordances of the typical bus in India are not attractive - they are noisy and they vibrate; they are not temperature-controlled to keep ticket prices low (though in Delhi there are a few air-conditioned buses as part of the public transport network with higher fares); the seats are cramped and the aisles are narrow. The buses are usually full to capacity and over-crowded during rush hours, and people hang from the doors. The buses usually have two doors, and in certain buses they are designated as entrances and exits. A bus can roughly seat around 70-80 people, but almost the same number stand in the aisles during rush hours. Tickets are bought from the bus conductor, who is also the official source of information, in the absence of a public transport information infrastructure.

As we can see, the circumstances of bus transport in urban India offers some interesting and challenging situations for interaction design. The framework of Place-Specific Computing was chosen as it provides a very appropriate perspective on the theme of interaction design for the spaces of public transport in urban India; and the spaces within and around the bus were selected for the area of study.
THESIS RESEARCH QUESTION

Therefore the research question is an exploration of interaction design possibilities within the space of bus transport in urban India to identify challenges and directions for design in such disorderly contexts. The thesis aims to explore these spaces from a perspective of place-specific computing and use participatory methods and experience prototyping techniques to uncover rich cultural insights to inform interaction design solutions for passengers within the research area.

The scope of the project is limited to an academic and conceptual interaction design exploration of the research area and does not attempt to provide a solution that is readily implementable.
"Let us read with method, and propose to ourselves an end to which our studies may point. The use of reading is to aid us in thinking."

Edward Gibbon

As designers, frameworks help us to understand a space, and determine the way we situate ourselves within the domain. While structural frameworks define how we negotiate with space in the physical as well as the digital world, a conceptual framework is a perspective that highlights some features and relations from what would be “an overwhelmingly complex reality” (Kolko, 2009) and provides possibilities for action, with opportunities and constraints. In this project I decided to use Place-Specific Computing (PSC) as a framework for design, which would not only provide an approach for design, but also methodologies, tools and qualities that are highly appropriate for the selected research area. Place-Specific Computing is interesting especially in the context of developing countries like India. Being a country steeped in dominant social norms, it is likely that every 'place' is embellished with their own practices.

PLACE-SPECIFIC COMPUTING

Place-Specific Computing (PSC) is a design methodology that is “inherently grounded in and emanating from the social and cultural practices of a particular place” (Messeter, 2009). It is a perspective on mobile and ubiquitous computing and can be defined as “a separate genre of interaction design, in which place is conceptualized from a starting point that combines perspectives from human geography and recent research in interaction design.”

On Place

PSC also focuses on ‘place’ as a “broadened view on context” (Messeter, 2009), where context is, not only the time, place and location, but also one’s engagement with it, and the interactions that occur within it (MCullough, 2004). Cresswell (2004) defines place as a social construct, where space is invested with social and cultural meaning to become place. Therefore place builds upon context with the social and cultural meanings associated with it. Within space and context, McCullough builds “a typology of situated interactions,” which is essentially a set of patterns of how we inhabit spaces; and using this typology he categorizes our inhabited spaces as the workplace, the dwelling place, a “third place” for conviviality, and “a fourth place”, which are spaces of travel and commuting (2004).

Within the context of travel and commuting, numerous interactions, both social and individual take place – some affected by, and some affecting the spaces themselves. “The spatial structure of the environment embodies cultural patterns of interaction that form our behaviour in the space” (MCullough, 2004). Though public transport is essentially a classless urban service that intends to make all passengers equal, distinct power structures are also manifest in these spaces. Dourish and Brewer (2008) call these subtleties ‘power geometries’ where “people orient towards the space they occupy and navigate in terms of the social organization of everyday life, in which these distinctions play a central role”. Consequently the spaces in and around public transport contain nuances about social and cultural meaning to be read, in order to
understand it from a design perspective. Some of these social and cultural meanings are embodied in the space, and thus become 'practices' associated with that place.

**On Practice**

Passengers participate in the creation, and the use of practice within the spaces of public transport without thinking, e.g. they use different strategies for getting a seat for at least part of their journey in crowded buses and trains. These are tacit strategies and skills indirectly shared by strangers who frequent the same place everyday. The idea of "place" plays a significant role in determining behaviour; one of the design implications is that place reflects the emergence of practice (Dourish, 2001). Dourish also points out that practices emerge from the actions of its users, which signifies that true places emerge only through habitual occupation, and also that "place can’t be designed, only designed for" (2001).

The practices inherent in a place also shape, and are affected by, the interactions they offer for design. Dourish (2001) distinguishes between these interactions as "interactive phenomena that are derived from the nature of the space…and those that are based on the understanding of the place that is occupied". E.g. A person new to travelling by public transport knows that he has to buy a ticket to ride on the bus, but he may pick up strategies to get a seat after a few weeks of travelling on public transport by observing and participating in its social and cultural constructs.

**Qualities of the Framework**

By using PSC we build upon the qualities of the framework in the design process. Instead of beginning from a people-centred perspective, PSC alters the paradigm by letting the range of users be determined by the place. This seems appropriate since the range of passengers using public transport anywhere would encompass a wide spectrum of demographics.

The 'here and now' approach of PSC to ubiquitous computing is also suitable in the context of travelling where information is relevant just for the moment, and expires immediately.

**Situated Contexts**

From an understanding of place and practice, I derived "situated contexts" – based on Dourish’s views on the relationship between social action and the setting in which it occurs (2001). He refers to the planning paradigm of early AI that was used for the design of software, and the publication of Suchman’s book that challenged this view. The planning model was based on the assumption that our interaction with the world was stable and objective, and failed to consider how we act socially in the world; while Suchman presented a cognitivist model which suggested that our interpretations of the world, and hence our interactions, are formed in response to social contexts, and therefore “situated”. Looking at the space from this perspective, I was able to derive interactions that I called "situated contexts" that would typically occur in public transport settings.

**Place-Making**

Being a part of urban public space, public transport is therefore the setting for our social interactions in public contexts. Ito et all (2009: 67) write that people are constantly in a process of negotiating with public spaces, “selecting different identities to interface with the local infrastructure, anonymous others and services”. Dourish and Brewer’s (2008) perspective on such negotiations is that they are the “fundamental ways in which we encounter spaces”, and they represent “social negotiations
embedded in taken-for-granted technical forms”. Of the three forms of place-making that Ito et al identify from their research, cocooning is the most relevant one for this project.

Cocooning is a “personalized media environment that is attached to the person and not the physical space”; it helps the user to avoid engagement with the local and others who are present in the space by creating a “private territory” within public urban space. Mobile phones, media devices, books, newspapers and magazines are mainly used for cocooning purposes. “Cocoons are micro-places built through private, individually controlled infrastructures, temporarily appropriating public space for personal use. They involve a complex set of negotiations – the presence of others in the vicinity, and also work to shut them out.” Cocooning is mainly used for “filling or killing in-between time” when people are in transit, inhabiting or moving through places that they are not interesting in fully engaging with. “Cocoons transform dead time in incidental locations into time that is personally productive or enriching.” It was noticed too, that people make efforts to maintain the boundary of their cocoons, e.g. readers sit in such a way that their material is not readable to others, while headphones shelter others from personal audio. In case there is leakage, e.g. a mobile phone conversation that is audible to others, it creates social tension and “fails to adhere to the norm of cocooning of personal media.”

**IS THE BUS REALLY A PLACE?**

**Non-places**

The proliferation of cocooning devices in public transport would almost suggest that people do not want to engage with these spaces. Despite being a *place*, the anonymous, transitory, public nature of the space of a bus also does not encourage engagement. Cresswell (2004) refers to the work of Marc Augé, who wrote that non-places, are “spaces of circulation (freeways, airways), consumption (department stores, supermarkets), and communication (telephones, faxes, television, cable networks)...they are spaces where people coexist or cohabit without living together” and also observes that “non-places, which are detached from the environment and can be anywhere, are being created as the sense of place is decreasing due to mass communication, increased mobility and homogeneous globalization”. Non-places are temporary and are places of mobility and travel, and not associated with any particular history. Thus it can be said that the bus is a non-place. Non-places are replacing places as an ongoing process of our increasingly mobile lifestyle, and at the same time, due to the same causes, there is an increasing sense of ‘placelessness’. However the two concepts are totally different. Placelessness is the active erosion of place, as more and more of our lives are taking place in places that can be anywhere, e.g. a McDonalds or a Starbucks are the same all over the world and “completely detached from the local environment” (Cresswell, 2004). Though these places add to the sense of placelessness on a global sense, they are still places, not non-places, on a local scale.

Non-places are marked by their transience and the dominance of mobility (Cresswell, 2004). They are essentially spaces for travellers. They are spaces that are temporary and confined, which people inhabit while they are in transit – places that they are not interesting in fully engaging with (Ito et all, 2009). Non-places are buses, trains, and the spaces that surround them like stations and bus stops.
PLACE AND UBQUITOUS COMPUTING

PSC is a perspective on ubiquitous computing, and some of the qualities of ubiquitous computing are also relevant to this project. In the book Everyware, Greenfield proposes the term “everyware” for locations/things that make up the ecosystem of ubiquitous computing, where ordinary objects become “sites for sensing” (2006:9). He states the paradigm of everyware, which is a distributed phenomenon, “a social activity shaped by and shaping our relationship with people around us.” Among the qualities, challenges and questions concerning ubiquitous computing that he presents, the notion of multiplicity, and the qualities of periphery and imperceptibility are particularly relevant to the research topic.

Multiplicity is a quality not only pertaining to ubiquitous computing but also to public spaces. In ubiquitous computing it pertains to overlapping zones of influence, multiple systems, multiple inputs – and it is difficult for designers of these systems to anticipate how these different elements will work in practice. System software for ubiquitous computing, as put forward by Kindberg and Fox – should be an environment that will contain “infrastructure components, which are more or less fixed, and spontaneous components based on devices that arrive and leave routinely” (Greenfield, 2006). It goes without saying that this is a situation where many factors are highly dynamic and unpredictable. Almost like the chaotic environment of public transport in urban India.

Design for the Periphery

With good reason, effective ubiquitous computing should be governed by principles of reduction of cognitive load. Mark Weiser said, "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" (1991). Ubiquitous computing systems should therefore be designed so that they “inform without overburdening” and allow the user to move back and forth between the focus of interest and the periphery – “that which we are attuned to without attending to explicitly” (Weiser, 1995).

SPACE AND MOBILITY

Public transport is one of the ways in which people navigate the city. Dourish and Brewer (2008) suggest that the cultural experiences of a place may influence the ways in which it can be traversed, and the ways in which we navigate it give rise to the structure we find in it. Mobility is therefore the foundation for the way we understand a space, and “space is understood differently as patterns of movement change.” They elaborate that transportation systems may provide orientation as the “user interface” of a city, and as a representation of mobility, brings elements of social geography to a city (Dourish and Brewer, 2008).

The spaces of public transport may also be tests of established social structures. In a talk at a Mobile City Conference, Cresswell talks about the politics of mobility, from the beginning of public transport in cities, which made it possible for everyone to travel (2009). Before public transport, people who had their own vehicles were the “kinetic elite”; while walking was for the poor, the young, the criminal, and the ignorant. Public transport flattened the existing social structure, at least within its confines, by allowing all sorts of people to travel together at the same cost.
UNDERSTANDING THE PLACE

PSC proved to be an appropriate framework in understanding the bus as a place and the nature of it. I concentrated on trying to understand the place in terms of the typologies of situated interactions, patterns of use, and the social and cultural practices. I wanted to observe how the culture and norms of the society manifest themselves in this classless place, and how public transport might be another setting for the digital divide to be played out. I assumed that the bus might be read as a public space and approached it from that angle.

The transitory nature of the space of the bus and the diversity of people travelling by buses everyday in an Indian city also makes PSC a suitable approach for design.

Place-making activities like cocooning which are prolific in public transport seem to suggest that people do not necessarily want to engage with the space of the bus. The element of place-making in non-places, the maintenance of anonymity – people do not like to interact beyond the necessary with others in the same space – suggest that design for the space should not force people to interact or draw undue attention to the user.

The quality of peripheral use for any design artefact in the space is worth keeping in mind. As the main focus of activity for the user is on the journey, so the default state of the design artefact must not seek to engage the user’s full attention, but rather try to reduce the stress of travelling in public transport everyday.
RELATED WORK

“Our best thoughts come from others.”
Ralph Waldo Emerson

To begin I looked at related work within the area of public transport primarily for developing countries. Most of the work was from engineering disciplines, in the area of public transport infrastructure. Even so I was able to get some understanding of the real context.

STUDIES ON PUBLIC TRANSPORT INFRASTRUCTURE

The most important study done in public transport for developing countries is the Bus Rapid Transit system in Curitiba, Brazil, which is noted for its efficiency and low cost (Mau, 2004). The system started out with a simple express route and made small improvements over time. Since Bus Rapid Transport (BRT) systems in ten cities in India are being modelled on it, it was useful to know how the future infrastructure might be and how that might impact practices in the space. Some of the infrastructure changes can already be seen in Indian cities and some are in the process of being implemented, e.g. the new buses are faster and more comfortable, the buses and the bus stops are accessible and elderly-friendly, fares are planned to be collected before boarding the bus and paper tickets are to be supplemented by RFID cards.

Kadri (2010) writes about the newly developed BRT in Ahmedabad, India. It highlights the importance of involving a qualified team and using a design process – factors that are usually overlooked in India – in order to get solutions that fulfil the needs. The team of urban planners identified different socio-economic needs, integrated the BRT with existing transport infrastructures and shady bicycle lanes for safe and sustainable bicycle use. They created low cost prototypes of bus shelters and invited public feedback. They focused on creating a holistic design solution for all stakeholders, working in tandem with the municipality and the NGOs. It was interesting to see that the municipality did not leave any stones unturned for the new BRT – they encouraged physical resilience and solidarity among bus drivers as well, with months of training, including yoga. This was an eye-opener for me, as the workforce is commonly considered replaceable and not “valued” so much in India.

Tiwari (2001) highlights the socio-economic disparities within the population of an Indian city and argues for the need, and also discusses the challenges, for an inclusive public transport infrastructure. Pucher et all (2004) also put forward the current issues in urban public transport and propose areas of restructure.

STUDIES WITHIN THE SPACE

There have been relatively few studies done within the spaces of the bus or the subway. Ashok et al (2007) proposes a tool to increase efficiency inside the bus through a wearable digital device for the bus conductor, to help him tally ticket sales and collect data. The team carried out an initial survey in buses in Chennai, and tested prototypes with participants. TunA (Bassoli et all, 2004) is a mobile music sharing application that can be used to share music locally through handheld devices. They used methods like observation of a target user group, surveys and questionnaire,
semi-structured interviews, talk-aloud interface evaluation, field studies and post-
study interviews. BlueBus is a study that aims to provide Bluetooth based mobile data
services to passengers in a bus (Choong et al., 2007). McNamara et al. (2008) also
attempt to do the same, but uses historical co-location to find the best content sources
among other passengers. These studies are both from the discipline of computer
science.

Possibly the study that influenced me the most was Aesthetic Journeys (Brewer et al.,
2008). The study explores the relationship between urban public spaces, technology
and mobility. It suggests a shift from the idea of "travelling" to "travelling well", the
"journey" rather than the parts that make up the transit, so that one might turn a
"potentially unpleasant experience into a pleasurable one". The methods used in the
study were participant observation, photo documentation of the spaces, people and
behaviours, object shadowing, interviews and a discussion around the photos with
artists and designers who use public transport. The study provided key insights into
how people travel – “Go with the flow” where people tend to give up their own
agency and trust the system; while "Insider choices" allows passengers to make use of
a special skill to navigate the complicated system, based on insider knowledge, “a
series of little victories” over the system. The study also explores the “ecology of
objects” while travelling – they find that hands are usually always full, and how a
group of objects might work together at different points, e.g. objects that create an
“emergent sociality,” like newspapers that are shared, and objects that allow one to
manipulate common social norms of behaviour, like stepping over the yellow safety
line on platforms.

The Daknet system (Adams, 2008) is an innovative way of providing (asynchronous)
internet access to villages in low-infrastructure areas of Orissa, India. The internet can
be accessed through kiosks in the village, but the kiosks only connect when local
buses – which are fitted with wireless transmitters – passes through the village on their
regular routes. The bus has a transmitter and a receiver that uploads and downloads
data from the kiosk and transfers it to the internet when it reaches the main depot in
the state capital. This is an interesting example of how local public transport can be
used indirectly to bridge the digital divide.

PUBLIC TRANSPORT AS PUBLIC ART

I also looked at the work of Mick Douglas, a Melbourne artist who uses the tramways
and bicycles as sites for public art (2005). Douglas used these low impact modes of
transport to engage in dialogues about art and the environment. He also worked on a
collaborative art project with the Melbourne and Calcutta tramways, involving tram
riders as well as the tram drivers and conductors in both the cities as artists and
audience.

Another distinctive project was the Bokbus designed by Swedish design studio
Muungano for Kiruna, in which the interior of the bus is transformed into a library, a
cinema and a place to access the Internet and play computer games (n.d.). It is a place
where new digital media is presented alongside traditional printed media, as well as a
place for socializing; and the graphics of the bus are especially colourful, designed for
the dark winter months.
WAYS AND MEANS: THE DESIGN PROCESS

"Verbalizing design is another act of design."
Kenya Hara

The design process focused strongly on empirical studies with consequent analyses and evaluation. Using a framework not only provided the starting points, but essential methods for gathering information, exploration and evaluation.

The design process began with the project framing. This was especially important, as the research area was vast. Once the conceptual framework was in place, a perspective could be established for the research area. For gathering information, the framework of PSC suggests ethnographical methods like field studies, participant observation, shadowing, interviews, sonic moodboards and participant walkthroughs. The next phase concentrated on quick explorations and evaluations. The method of placestorming was ideal for the purpose. Both the learning and exploring phases of design provided significant rich feedback, and I created mental models and affinity diagrams to analyze all the information. Some of these visualizations proved to be highly useful as generative tools in the concept generation stage, and were used along with insight mapping and provocations to come up with concepts. The PSC framework also offered some of the qualities and directions that shaped this process, as well as some of the criteria for selecting the final concept. The methods of experience prototyping and participatory design were used to evaluate the initial iteration of the concept, and finally, an experience model was created for the eventual form of the design.

The design process was strongly focused on thinking by doing. Most of the methods used involved an active engagement with the tools of design – props, mock-ups, prototypes and visualizations; and the essential involvement of participants in some of the stages. I wanted to use elements of participatory design (Ehn and Kyng, 1991), as it would provide a close, yet broad perspective on understanding passenger needs, the local culture, and an evaluation from their context. At the same time the act of co-creation with the participants might reduce inhibitions and provide more nuanced insights in a short time.
The project plan was quite significant, as it involved some amount of fieldwork and prototype building in India, while most of the conceptual work and design took place in Sweden. The field studies, the participatory design workshop and the interview were carried out in December 2009 and January 2010 in Delhi and Calcutta, over a duration of two weeks, while the contextual explorations took place in Malmö and Copenhagen in February 2010, over three weeks. The final evaluation with participants was conducted in Delhi in April 2010, over three weeks, where the first two weeks were spent in building the experience prototype.
A THOUSAND DIFFERING CIRCUMSTANCES

"Accuracy of observation is the equivalent of accuracy of thinking."
Wallace Stevens

This phase of the design process was concerned with learning about the area of research, through field studies in Delhi and Calcutta. Within the limited time that I was in India I conducted a few field studies on buses, an interview with a regular user of public transport and a participatory design session with daily users. These activities were further supplemented by a cross-cultural comparison and a culture probe.

EMPIRICAL STUDIES

THE FIELD STUDIES

The goal of the field studies was primarily to gather information about the spaces within the bus, the practices, and the customs and behaviours that unfold in the space. I set out to get a sense of place, and document the experiences through photos and audio.

The studies were essentially bus rides that I took from different parts of the city, focussing on the busier junctions of public transport. Though I was interested in the rush hour crowds, I could only manage to get on two of those buses, both in Delhi, but get off at the next stop, as it was quite difficult to move any limbs in the crowd. The duration of the other journeys were between fifteen minutes to half an hour, and usually outside of the rush hours so I could observe and document. I also tried to get on to as many different kinds of buses as possible, in both cities, to see if the physical setting influenced people’s behaviour in any way. In all I took about seven/eight bus rides in India for the studies.

Using fly-on-the-wall observations (borrowed from cinema, a method of unobtrusive observation) and techniques of defamiliarization (adapted from modern art where it forces audiences to see things in an unfamiliar way) allowed me to experience the context from a passenger’s perspective.

The initial impression was of noise and chaos – the buses rattle and vibrate, the bus conductors or their helpers bang on the walls of the buses with their ring-studded fingers (worn expressly for the purpose) calling out the destinations, and the cacophonous bus horns, blown in distinctive ways to demand attention from every other entity sharing the road.

Despite the clamour, there are no bus stops, or any kind of bus stop signage visible in many parts of Calcutta, and one either had to look for groups of people who look like they’re waiting for buses, or ask other pedestrians where the stop was. Most of the time they would say, “Go a little further,” and point vaguely down the road. It was only later, from an interview with a daily passenger that I learnt that buses stop anywhere, and one only has to raise an arm and shout for the bus to stop for them. In Delhi the situation was better, but there was still a lack of comprehensive information at most bus stops.
When buses arrive it is difficult to make sense of the route number, because either the routes are not displayed anywhere or the lettering on the bus is too small to read. This is possibly why conductors and their helpers have perfected the art of calling out the subsequent bus stops in a long verbal string, to entice possible passengers; but don’t usually announce the name of the current stop as it reaches. And more often than not,
people who are unfamiliar with the local dialect and cannot decipher the conductor’s accent correctly get on the wrong bus by mistake. This happened three times in one of the trips that I took for the field studies!

Entries and exits are not standard as different kinds of buses have different rules, but usually one is the entry and the other the exit in Delhi, while in Calcutta either door can function as an entry or an exit. This hampers getting on or off the bus as people tend to crowd around the exit. Bus tickets are made out of recycled paper, stamped with the date and time, and sometimes zones are marked too. They are discarded after one use, and a cause of litter.

Once on the bus it’s usually difficult to find a place to sit or stand during rush hours. The common practice is to get on the bus, find a place and then buy the ticket. Typically the conductor will come to you. While standing it's difficult to keep balance as the buses lurch and brake quite suddenly. On crowded buses it's also difficult to find a place to hold on to, and falling against people around is quite common. People pack into the space densely, in extremely close physical proximity, as personal space for a passenger on a crowded bus is non-existent. Passengers who travel everyday have different strategies for getting to sit for at least part of their journey. They know by experience in which parts of the bus they will have better chances for getting seats. Others make arrangements with those already sitting to “reserve” their seats when they get off.

Outside of rush hours, though, it's possible to find a seat, and people in both cities usually help by pointing out empty seats. Towards the front of the bus seats are reserved for women, elderly and handicapped people, but often men sit on the reserved seats and refuse to get up even if there are women or old people standing nearby. In the Minibuses in Calcutta, adolescent and college girls usually stand in the niche next to the door, which is a tacit practice maintained by the passengers and the conductor. This niche is a little sheltered from the flow of people, and hence has become a place for girls to stand. Often men standing there will give up the place to girls who have just got on. The older buses are not accessible for disabled people, though seats are reserved for them.

Officially, information infrastructure for bus transport in most Indian cities does not exist, but there is an unorganized information system that is tacit and word-of-mouth. Hence power politics have evolved around information channels. People who travel everyday have “insider information”, i.e. they know the ins and outs of the system and also the relative merits of different strategies while travelling by bus everyday. While the conductor is usually the main source of information on the bus, people are also usually helpful with providing local information, even without asking, but not always. In the absence of an official information channel simple activities like buying a ticket or getting off at a stop can get difficult for a non-frequent user of public transport.

While travelling people are usually dozing, talking on the phone, talking to companions, and looking out of the window. Some of the observed interactions that take place during a journey were with a companion (for company), a person not physically present (through phone), a stranger co-passenger (by proximity), the conductor (for necessity), the conductor with potential passengers (announcing), and with the driver (usually non-verbal, through previously established code). Often people who are sitting offer to hold the heavy bags of school students. During the cricket season however people interact much more through the exchanging of scores and match-related news. However not all interactions are friendly - “eve-teasing” is
the name given to the groping women and girls face in crowded public places in north India, and quite common in buses in Delhi. Women try to counter this by standing near the reserved seats, so the crowd is composed mostly of women around there.

Figure 3 Photos from field studies
The process of defamiliarization allowed me to compare cultural differences between
the buses I used in Malmö, which has a mature transport infrastructure, and the ones
in India. Apart from points mentioned earlier, there are different buses catering to the
different strata of society in Calcutta and Delhi, and the volume and scale of usage are
enormous. The lack of information infrastructure has given rise to power politics,
while Malmö has a transparent and helpful information infrastructure. Another
interesting point was physical proximity among passengers – a reflection of the
Swedish sense of personal space compared to the Indian attitude of “adjustment” –
and also the respect for a co-passenger’s personal space, which is non-existent in
India. In Malmö older people usually tend to sit towards the front and younger
people at the back, though in India these kinds of demarcations are very subtle, and
difficult to distinguish, except that women travelling alone tend to stand near the seats
reserved for women, and young men at the back. In India interactions with strangers
are usually necessary, while in Malmö it is easily avoidable. As the environment in
India is very noisy, people also tend to talk louder – and this is quite apparent in
public transport – but in Malmö no one raises their voices and to be noisy in the bus is
considered a violation of the social norms.
While the lack of a sturdy public transport infrastructure in parts of Delhi and Calcutta affect the nature of the place of the bus and the practices within and around it in many ways, in parts of Delhi the new transport infrastructure is being rolled out. The new infrastructure helped to envision the context of a realistic infrastructural and cultural future. However, despite improvements in the infrastructure, some of the existing practices will not easily disappear, like hanging on to the footboard, gathering near the exit, gaps in the information access infrastructure, the role of the conductor and his helper, the existence of the paper bus ticket along with RFID cards and the nature and presence of crowds and crowd behaviour.

Understandings From the Field Studies
It was most interesting to see how the theoretical concepts were illustrated within the research context - the creation of the place of the bus through the daily use of the people, the practices that shape this creation, buying a ticket, finding a seat, cocooning; and how the passengers in the bus participate in the creation of meaning - like the niche for girls to stand in Minibuses or pointing out a free seat to a standing passenger.

I also identified some cultural factors that might influence design, e.g. the diversity of buses in a single city, the fact that buses can be stopped anywhere, the tacit information infrastructure, and the Indian sense of adjustment.

PARTICIPATORY DESIGN WORKSHOP
Keeping in mind that the range of users was broad, a participatory design workshop was conducted in Calcutta to get a broad overview of the space, identify needs and directions for design, and gather insights of the experience of a journey. Traditionally a methodology of bringing together different stakeholder perspectives in workplace scenarios, participatory design contains elements that were favourable for the project. The aim was to use it at the initial phase to gain a shared perspective, and also elicit individual viewpoints through the act of co-creation. As participatory practices work effectively with homogenous groups – and especially in a culture of high power distance – I chose to focus on students and professionals who travel by bus everyday to help me get the broadest understanding of the space.

The workshop was two hours long. There were 8 participants - 3 law students, 3 engineering students, 1 professional, and 1 high school student. Apart from the high school student, they were in the age range of 19-24 years. There were three girls and five boys, and while half of them knew each other, the rest were strangers to each
other. All the participants travelled on public transport i.e. the bus and the Metro twice a day at least. The durations of their journeys were 20-40 min. Two of the law students mentioned that they had moved relatively closer to their institute, as they would otherwise have to spend two-three hours on commuting everyday. Though not articulated, the students travel by public transport because they have limited finances, and the boys seemed to assume that when they start working they would be able to afford a personal conveyance.

The discussion centred around comparisons of the existing modes of public transport in the city; the time spent in travelling and how it is spent; interaction with strangers, privacy issues; and their opinions on how the status quo can be improved. In the second half of the session the participants were split into two groups and asked to visualize their vision of the future of public transport in the city.

The workshop proved successful in the sense that the students were very forthcoming and articulate with their opinions. While most of the main points are discussed in Chapter 7, briefly, the workshop allowed me to understand the perceptions and perspectives these participants had about the public transport infrastructure they use for a significant amount of time everyday.

INTERVIEW

The participatory design workshop and the field studies brought up some interesting points with regard to a daily journey that I wanted to delve deeper into. I also realized that the workshop itself at this stage of the process encouraged a broader perspective among the participants rather than a deeper, focused frame of mind. Therefore I
followed it up with an interview with a 24-year old professional Onkar who uses public transport everyday. As I had a few points in mind that I wanted to pursue, I used the unstructured interview method (Blomberg et all, 2003:964).

Onkar, who lives in Calcutta, is an articulated accountant and travels by bus or the Metro to work and back everyday. His journey usually takes 40 minutes one way. Though he can use the family car, he finds it expensive to pay for fuel and parking if he uses it everyday, and therefore relies on public transport for his daily commute.

Onkar’s main mode of transport is the bus, sometimes the Metro if it falls on the route. He usually takes the bus to work every morning and returns home by Metro in the evening. As he travels during the rush hours, the buses and the Metro are both crowded. He chooses a bus route based on the amount of walking he would have to do, and the amount of the crowd on the bus. To take a bus, he usually makes a judgement from the bus stop about the crowd and his chances of getting a seat. “My journey is around 40 min, so I want to sit.”

He detests crowded buses, even though he travels by them everyday, because it’s uncomfortable and stressful. “It is really crowded and there is no place to stand. There’s a lot of struggle and people pulling and pushing as they get on and off. It's too much in summer, you sweat a lot, and reach the office tired and exhausted.” He also finds it stressful as the buses stop everywhere to pick up people, the traffic moves slowly and the discomfort stretches out interminably. “The main problem with the bus is that it’s overcrowded. If it weren’t crowded it would automatically be better.”

Onkar has learnt to gauge his chances of getting a seat on a crowded bus based on experience. Once on the bus he has his own strategies of getting a seat – “I usually never get a seat as soon as I get up, but within a few stops…I go to the back of the bus, where the probability of getting a seat is more, as the last row is wider. Usually the back of the bus is less crowded, as most people stay towards the front.”

On the way home he usually takes the Metro – which is faster, more comfortable and not as crowded, and the crowd is “better” (of similar social class). On a journey he usually listens to music on an mp3 player or reads a book. Other people read the newspaper and do Sudoku. "If you know how to entertain yourself and have a place to sit you have no problems.”

Onkar doesn’t like to interact with others on the bus: “I don’t interact with strangers - not at all with the bus driver.” He sometimes asks the conductor for information if he’s not sure of the route, and buys his ticket from him. As there is usually there’s a crowd near the door, in both buses and the metro, he has to ask people to move when he wants to get off. Even though he personally doesn’t like to interact in the bus, he mentions other passengers: “There is another sort of people who randomly converse with strangers about common topics like stock market tips and communism…they are usually people who have been travelling on these routes for some time. The accountant in my office married a woman he met on a bus.” He says that while everyone is on the lookout for companionship to pass the time, “Interacting to entertain yourself – I’m not partial to doing it in a bus.”

Like most public transport users in India, Onkar feels the need for an accessible information infrastructure. He doesn’t use certain buses, as they don’t have the routes marked on them. He feels that in Calcutta you have to have an understanding of the city before you attempt to use the bus transport. “A newcomer can get confused. To
travel in a bus you have to have a general idea of the places since there is no information. Therefore you have to communicate with the conductor who might give you this information. It's necessary communication that you'd rather not have.” He points out that the Metro has a much better information infrastructure.

Onkar says in the future he would use the Metro over the bus. He would park his car at the metro station and take the train, as the metro is good for long distances. He thinks carpooling is a good option because you know the people, but if he had the choice he would work from home.

When asked what he wished he could have in the bus, Onkar said, “Something that can make movement inside the bus easier. And holding on to things easier. The constant juggling for space and adjusting makes people very tired.” If he could make bus travel better, he said he just wants it to be comfortable. He says there is no problem with connectivity, he can take multiple modes of public transport from any one place, but “the problem is more of infrastructure. The goals of the bus transport people (conductors and drivers) and the passengers are misaligned. I want buses to be faster, more convenient and more comfortable. I have no problems with mass transit except that it be enjoyable.”

**PROBE**

I also sent out a simple probe to the participants of the workshops, asking them about the things they carry. The information received followed true to existing data on mobile kits (keys, cash and phone) with a few exceptions like an umbrella (Chipchase et all, 2005). It also confirmed the fact that hands are hardly ever empty while travelling by public transport; and that people tend to pick up things on the way, like coffee or newspapers, which they then discard later.

![Figure 4 Things carried](image)

**KEY UNDERSTANDINGS FROM EMPIRICAL STUDIES**

**PERCEPTIONS OF THE BUS AS A PLACE**

The main insight that I gained from this phase of design was that people do not perceive the space inside a bus as a “place”. None of the participants at the participatory design workshop thought of the bus as a place, or even a space. Instead it was considered more as “a connection between real places” and they were also hesitant about new and active interactions within the space. So I understood that they perceive the bus as a “non-place”. In the workshop the bus was viewed by the
participants from the larger perspective of infrastructure, and not as a utility of everyday use. Consequently they had difficulty evoking the actual experience of the journey, since they had never thought of it till the workshop; instead they spoke a lot about how commuting in general fits into their daily lives.

While Onkar was able to identify the different spaces within the bus that he uses, e.g. the seats at the back, the entrance and the exit, it was obvious that he did not want to engage with the space – using a book or a music player to cocoon himself – or with the others in the same space. Most of the participants at the workshop were also opposed to interacting socially in the bus / Metro, and mentioned cocooning strategies like reading and listening to music.

THE IMPORTANCE OF CROWDS

I also found that apart from the discomfort due to the physical proximity of strangers, crowds are also an essential decision-making factor for most of the participants and also Onkar, not only to choose between different modes of transport or different routes of buses at a particular point, but also the time of the journey. Crowds seemed to be an essential factor of travelling by public transport, as most of participants only referred to “the crowded bus” and not “the bus” throughout the discussion. It was also interesting to note that Onkar made an estimation of the crowd, and also navigated through it with his own strategies for getting a seat.

SITUATED CONTEXTS

From the field studies, I derived what I called “situated contexts”, based on the relationship between social action and the setting in which it occurs. They are habitual scenarios of interactions that would typically occur in public transport settings in India, and I could use these to provide the contexts for exploring initial ideas in the space. Some of the situated contexts were: It’s so crowded you can’t breathe, the person next to you is standing too close, the person next to you is talking loudly on the phone, you can’t find anything to hold on to, you need to get your change back from the conductor but your stop has arrived, and so on. The situated contexts proved to be particularly helpful to provide context in more than one design phase.

USING ELEMENTS OF PARTICIPATORY DESIGN

Instead of using a focus group, which could have provided similar results, I used elements of participatory design, chiefly for the act of co-creation that it involves. As the workshop was mainly a discussion, the acts of co-creation and making models vocalized what the participants’ true perceptions are, and not what they said. It also allowed participants to overcome inhibitions and feel more at ease with each other, and therefore enriched communication.
EXPLORATIONS IN MOTION

“There is nothing like looking, if you want to find something. You certainly usually find something, if you look, but it is not always quite the something you were after.”

J.R.R. Tolkien

The initial information-gathering phase of design generated a lot of ideas within the space of the bus. In the next phase of design I carried out some explorations of those ideas through contextual experiments. The objective was to externalize some of the initial ideas and narrow them down against the context. Four experiments were conducted in buses in Malmö and Copenhagen.

CONTEXTUAL EXPLORATIONS USING PLACESTORMING

Method
Placestorming, a context-driven and play-based brainstorming method (Anderson and McGonigal, 2004), was used for these explorations. Placestorming is a playful method that makes people use their own imagination while using props to recreate a personal experience, and employs elements of street games, role-playing and improvisation. The advantage of the method was that the context itself could trigger ideas and the physical affordance of the bus and its social environment could “engage, refocus or hinder” concepts and provide valuable insights. Along with this, real-world issues in the context would also be identified. I also decided to use a ‘prop’ or a proxy device, to help the participants imagine more easily, so that I could try out different form options, and also use the form of the ‘prop’ itself to stimulate a variety of ideas.

As the exercise is ideally conducted with teams consisting of designers and participants, I built upon the participatory nature of the project by involving another person who was unrelated to the project as a participant. As it would be easier to engage in depth with one participant, I decided to do the experiments with one person at a time. Though the participant is provided with one prop throughout the whole experiment, I encouraged more exploration of the prop, letting the participant change its nature and properties with each task, and enabling it to be combined with other complementary tools provided.

Props
While choosing the props, I debated about using everyday objects like the method specified, or a ‘vanilla’ object that had no previous connotation for the participant. The form of the props could not only be explorations of the form of the design artefact, but also its physical affordance would influence the participant during the brainstorming. The prop for the first experiment was a scarf – as I initially thought along the lines of making a wearable, and also since unstitched cloth forms a part of everyday attire for both men and women in India - which had the possibility of being moulded to any form. The other props were a small cardboard disc the size of a coin and little round stickers to attach on fingertips. Along with the cardboard disc some wire, string, pins, etc. were provided; while the stickers were placeholders for an ‘invisible’ interface, to be controlled by fingertips marked with stickers. I wanted to
explore and test the extent of tangibility that an interaction might need to have, in order to provide affordance and ease of use.

**Participants**
Rather than using demographic criteria, I chose to have participants with imagination, who would approach and interpret the exercises in their own subjective ways. The basic criteria was that they should be frequent users of buses, so that they would be already be familiar with the space of the bus and have their own contextual “ritual”.

The four participants (Hanna, Priya, Malik and Prem) were aged between 20-30, and two were male and two were female. Priya lived in Copenhagen, while the others lived in Malmö. While three of the participants used the bus and train services extensively in the winter and bicycled in the summer, Prem relied exclusively on buses the whole year. Prem and Priya were from the discipline of design, Hanna was a student of literature and Malik a software developer for Sony Ericsson. I did not consciously match the props with the participants, except in the last experiment, where I thought the profession (Priya is a textile designer and was given the scarf) might elicit some specific insights during the journey.

**Plan of Action**
The activity was structured around the situated contexts. I would begin by introducing the prop to the participant, and explain the contexts. Then we would board the bus and begin doing the exercise. They would be shown a particular context, displayed on a card, and they would have to brainstorm on that situation with the prop. After about five or six contexts, we would have a small discussion to end the activity.

Though this was the basic plan, I changed it slightly each time. In the first experiment, I was concerned about putting the participant at her ease, and asked her to choose three out of the six contexts herself, before we got on the bus. Since it didn’t make a significant difference to her thoughts, I left it out for the other experiments. In the second experiment, the discussion at the end took place on the next day, and the participant was able to be very reflective in retrospect, and I felt it added to his ideas, as well as provide some context for the participant himself. The third experiment was carried out in a train between Malmö and Lund, and since I felt that the activity was quite unproductive, I turned it into an interview instead. It also struck me at this point that there was some ‘performance anxiety’ that the participants faced, due to which they did not feel completely at ease while doing the experiment, and as this affected the outcomes, I changed the protocol to make it more like a game where the participant and the designer would both brainstorm together. We took turns to pick a card, and then brainstormed with it using the prop. Not only did this provide some equality between the participant and the designer, we were also able to generate more ideas during the journey.

**Outcome and Reflections**
Some interesting ideas were generated over the four experiments. For example, since it’s difficult to keep balance in a moving bus when there is nothing nearby to hold on to, Hanna came up with the “weighted scarf” that when wrapped around the body would exert pressure in the opposite direction of motion, and keep the body stable. Another version of the same concept was a mat that could be placed on the floor of the bus and hold the feet in place with magnets. In another experiment, the scarf wrapped around the wearer would wind itself up along with the duration of the
journey, until it was completely wound up around the wearer by the time the destination was reached. In another experiment, Prem pretended that the cardboard disc was a combination of a tiny microphone and speaker and attached to his shirt collar, so he could make and receive phone calls discreetly. In fact one of the concepts generated in this phase was taken forward to create the Cocoon Dupatta, which is mentioned in Chapter 8.

Despite this, none of the experiments produced exactly what I was looking for. A number of factors could upset the outcome. Initially I felt that either the ‘play’ element of the exercise was not strong enough, or that the prop did not resonate with the participant, or the participant were too immersed in reality to engage in the ‘shared fantasy’ that the experiment demanded, or they felt the pressure to perform. But in retrospect I realised that the participants only did what they were comfortable doing within the context of the bus or the train, following the norms that were imposed by the social and the physical environment, which were of course different from the social and physical environment of the Indian context. This was a reminder of the significance of the cultural context.

Also, I initially saw the experiments from a divergent perspective of generating ideas, but their value really lay in being convergent, through the imposition of the physical
and social norms of the environment, and narrowing the focus to the most important
points. The most important insights that I got at this stage was that once people find a
comfort zone in the bus/train, they stay there until the end of the journey. They
engage only with the area of their personal space, and rarely reach out beyond its
limits as was confirmed by the ideas and explorations that centred around the
participants’ persons. Their hands are usually busy holding or carrying. The
experiments also confirmed earlier findings about the bus as a “non-place” when I
saw how much my participants were reluctant to engage with the space, even though
they were trying to push the limits as much as possible during the exercise.

In terms of methodology, I benefitted from trying out improvements within the
experiment plan, and realised some other essential situations – like people travelling
together using one prop between them or two co-passengers using the same prop in
the same space – which I was able to incorporate in a later design phase. Though
documentation does not usually play an active role in this kind of design activities, in
some of the experiments it turned out to be quite helpful, as a tool for reflection in
retrospect, and also enhanced the participatory approach as both the participant and
I took turns to document.

Combined with the insights from both the empirical studies and the explorations, this
phase of the design process provided a prioritizing perspective on the information
gathered which was helpful for the analysis phase that followed.

![Figure 5 Some of the ideas generated](image-url)
**MAKING SENSE OF INFORMATION**

“Good design is a lot like clear thinking made visual.”

*Edward Tufte*

Both the information-gathering and the explorations phase provided ample amounts of rich data. In order to make sense out of it all, I tried to create as many charts and diagrams as possible, as I found that the most effective way of externalizing all the information was to make it visual. In essence this process is to identify the most interesting and useful information and find patterns and connections among them.

**DIVERGENCE**

![Figure 6: Thesis directions](image-url)

This chart shows the thought process from beginning at one point and diverging into a few initial directions. It encompasses all the information from the empirical studies mapped against the different directions. The findings from the empirical studies are in yellow, and then ideas and qualities towards the right. The chart not only helped to define the directions, but also to situate the ideas that came up against those directions, and to make a note of the specific insights and qualities that I wanted to have. A visual form like this was useful as a reminder for the information and also as a foundation for the exploratory experiments that followed.
ANALYTIC MAPS

Next I created a set of analytic maps, visualizations that would help me assimilate the information and help to analyze it.

Here the experience of a journey was explored through visual forms. I tried to deconstruct a journey into its components and came up with a flowchart comprising of a set of decision-making points.

I used broad scenarios to categorize the journey. Each scenario was then further broken down into granular events. The scenarios were - waiting for a bus, choosing a bus, getting on, buying a ticket, finding a place to sit, the journey, the activity, the exit. Finding a place to sit, for instance, was further broken down into these actions and decisions – (1) Scan the bus (2) Is someone getting up (3) If they are, do other people want the seat (4) If they are not, keep standing; and so on. While this was a clinical version of the actual task flow, it doesn’t completely take into account the true social behaviour that takes place in the context.

Next I mapped the situated contexts (the contexts are highlighted in yellow) against the journey timeline. To design for a particular event it might help to situate it in the exact context it might occur. This was helpful to some extent, as it defined the boundaries of possible interactions.
Both the visualizations helped to make linear sense of the daily bus commute in urban India, and also allowed me to focus on particular scenarios. However, when I wanted to use these as tools for design, I found that they excluded all the nuances of the social and physical environment that make the journey an experience in a practiced space. A chart that was of little value for was an affinity diagram of what the participants of my empirical studies carried everyday.

**GENERATIVE MAPS**

Next I tried to create maps of information that would be more useful as tools for brainstorming. I called these Generative Maps, as they would help to produce concepts. I laid out the insights and the information I had collected so far. These were the things that people had mentioned, or insights that I had during the field research and the explorations. It was interesting to note that most of the useful information from the exploratory experiments ended up in the generative maps.

I grouped the information under the following heads: The Space and I (how one interacts with the space); The Body (personal to an individual); Others and I (interaction with others); visualized uses of a future design and the qualities it must have. This chart proved to be rather useful for the concept development process. It served as a reminder of the points to consider for each concept.

It was also helpful to similarly map out the cultural and contextual information I had gathered.
Here I distinguished between Behaviour, Practice and Infrastructure-related information – in this way I could clearly exclude infrastructural issues and concentrate on the practices that exist in the space. This map helped to distinguish clearly the infrastructure information as opposed to social and cultural information that I could use. It also helped to remind me of the specific strategies and practices that exist in the public transport in urban India.

Along with the generative maps, visualizations of abstract constructs also helped to understand the space. While conceptualizing I used the two previous charts in tandem as well as this kind of visualizations of some specific constructs.

Apart from being useful in themselves, the process of creating these visualizations and charts allowed me to constantly filter through all the data, and in this way assimilate it. This process of sensemaking and synthesis of information are “creative activities that actively generate intellectual value, and are unique to the discipline of design (Kolko, 2009).”

I also tried to identify significant insights from the various research, to get a deeper understanding of the perception of the place. I thought that this might define the boundaries of social behaviour in the space, and hence provide directions for design.
CONVERGING: RE-FRAMING THE RESEARCH QUESTION

Finally the approach chosen was a design that would facilitate negotiation in various areas with the social and physical environment within the space. The use of facilitation in this space could be for wayfinding, information-seeking, communication, entertainment, protection and camouflage, to name a few. Within
these, I chose to focus on communication with co-passengers, expression of public opinion in a public space, and navigation in crowded public spaces.

While most of these situations are handled verbally some of the time, they might invite more response if the communication is non-verbal. A common problem in India is that the language is unfamiliar; also sensitive situations can be handled well through the infusion of a little humour. The design would focus on a convivial tool that would try to let each person create their own meaning through its use and enable them to appropriate it to their own context.

**BRAINSTORMING & CONCEPT GENERATION**

For brainstorming on concepts, provocations and insight-mapping (combining insights with social and physical environment) were used to come up with ideas. The concepts can be mapped on the framing like this:

This was again a generative process, to see where most of the final concepts tended to be located. The concepts can also be mapped against design genres – I chose to have a scale of critical design to industrial design on one axis. While one approach for the design could be an exploration of the practices and interactions of the place, another approach was to look at it in terms of how relevant would that design be in the context of use – this was an analytic process that helped me to situate the concept within different research angles.
AN ESTIMATION OF ENDLESS POSSIBILITIES

“If at first the idea is not absurd, then there is no hope for it.”

Albert Einstein

For development I narrowed down six concepts that had the most possibilities for design exploration. As mentioned in the last chapter, they focused on communication and navigation within the space of the bus.

THE CONCEPTS

1. THE COCOON DUPATTA
Facilitates Private Communication in Public Spaces

This was one of the concepts that were generated during the contextual explorations on the bus. A dupatta (pronounced doo-puh-taa) is a multipurpose traditional scarf that is worn by women of all ages, statuses and religions in India. Inspired by the way this piece of headgear is conventionally worn, and the concept of cocooning oneself in non-places, the Cocoon Dupatta allows wearers enhanced privacy to talk on the phone in public spaces. Noise-cancelling earphones are integrated into the scarf near the ears, and a highly sensitive microphone is near the mouth. Essentially it is the combination of the form of a dupatta with the functionality of a wireless headset.

The concept is exclusively for women, building on the essential need for privacy and the kind of social interaction that takes place when one is travelling. It provides some relief to the wearer from the invasive male gaze, and an augmented outlet of temporary escape from an aggressively public non-place.

The Cocoon Dupatta allows the wearer to talk on the phone without drawing attention to herself. The wearer would also not need to physically handle the phone – since hands are usually occupied while travelling – as it can be accessed through the dupatta by voice-based or gesture-controlled interaction. The dupatta situates itself within the domain of wearable computing.

The wearer therefore gets relative privacy to talk on the phone in public places, without disturbing others or being eavesdropped on. Sometimes people don’t like to use their personal “cocooning” devices in a public space, either for fear of theft or
because it can imply disrespect to others in the space. The Cocoon Dupatta could also be a discreet way to isolate oneself to listen to music or the radio, as people tend to do while travelling.

The concept can be developed in both hi-tech and lo-tech ways. The hi-tech version uses embedded electronics and smart fabrics that can connect to the wearer’s own phone. The interface could be either voice-based, since the device is highly personal, or gesture-based as it is on the body, or more specifically the head; and the wearer can have their phone in a pocket or in a bag and connect through wireless technology. The lo-tech version can be a separate electronic attachment for fastening on to any kind of dupatta – as one usually has many dupattas and matches them with separate garments – and then operate in the same way.

In this concept I tried to bridge the gap between traditional and digital cultures by incorporating technology into an already existing piece of clothing and thereby giving new meaning to it, as well as empowering women of a more traditional bent of mind who would not be comfortable wearing a wireless headset. The concept thus offered, as scope of design, an exploration of wearable computing, not only of the genre of interaction design but also from the perspective of the wearable as a reflection of the culture, and the combination of traditional cultural materials with smart materials and technology for contemporary use. Being specifically for women it would also raise questions about the digital divide and women, and design for women from developing countries.

2. THE EYE-BOOK
Facilitates Anonymous Communication with Strangers

The Eye-book is a device that allows readers to show their displeasure in a discreet and humorous way, and yet remain anonymous at the same time. Based on the fact that many people read while travelling on public transport, and inspired from the wings of moths - which have eye-motifs on them to scare off predators – the eye-book allows the user to “frown” at co-passengers and yet maintain anonymity, a necessary requisite of interaction with strangers in public spaces. The book essentially displays giant eyes on its outer cover to give the impression of frowning at people who might have incurred the displeasure of the reader. The outcome of the interaction might make the co-passenger reflect on their behaviour.

![Figure 17 Scenario of Use](image)

The Eye-book is basically a cover that can be fitted on any book. On the inside of the cover there is a camera that takes a photo of the reader’s eyes, and displays them on the outer cover. The outer cover is the screen, with magnifying lenses to also exaggerate the image of the eyes. The concept is interesting because it can look different for each person reading the book, and can also be used in different contexts. Thus it is a facilitation device that not only allows humorous communication
between strangers, but also enables some reflection on behaviour in public space. In this regard the eye-book can be situated in the genre of critical design, as an intervention in public space.

The scope of the concept is therefore as an intervention for exploration of the space. While this is the quality of the concept, it can also be its weakness – critical design is subjective and would be effective when the audience is homogeneous to some extent, which is rare in the context of urban India. This is a concept that may work in a comparatively homogenous city like Calcutta, a laid-back city where people are likely to carry books while travelling, and also appreciate the humour; but it would completely fail in Delhi with its multiple social strata, a coarse taste in humour and a generally faster pace of life. The concept itself is quite subtle, which may not even be noticeable in the overwhelming environment of the typical Indian city. Also the concept was essentially humorous - which is also quite subjective - and may not be effective in communicating the correct message, if at all.

3. RADIO-SHARE
Facilitates Anonymous Communication with Strangers

The inspiration of Radio-SHare arose from the form of the Bouroullec Brothers’ Ivy (2004), and based on the insight that during cricket season in India people go out of their way to find out scores and listen to the live commentaries.

The concept is a system for many people to listen to the match commentary from one device, but through a network of interlocking earphones that will plug onto each other like the Ivy, with only one earphone connecting to the source radio. It’s like a silent rave for cricket, within a moving public vehicle. It could be used within a public transport scenario where people arrive, attached their headphone to listen to the match for a while and then depart. They can be part of the shared experience without carrying their own radio or even be in the proximity of the main (fixed or portable) radio.

The uniqueness of Radio-SHare is that it enhances the shared experience of listening to the cricket commentary with strangers – a practice that was common in the days before the mobile phone. The cricket commentary not only holds a special place in people’s hearts in India, but also plays on the emotional aspect of bonding with strangers over the game, an essential element of cricket in India. While everyone already owns mobile phones with built-in radio, the sharing of a common radio will evoke memories of earlier but fondly cherished times, and for a while try to recreate that nostalgia within the daily journey. The appeal of the concept is therefore purely emotional and can be very easily embraced by users. A subtle quality is that others in the space would not be disturbed as everyone is plugging in with earphones – but this subtlety might get lost in the chaotic noisy environment of urban India.
In principle the technology could be simple. Each earphone extension will have an output as well as input jack. The next extension can be plugged into the output jack of the previous extension and so on. Possibly two or three source radios could support an entire bus of listeners, if required.

Radio-Share situates itself broadly within the concepts of ubiquitous computing, not from the perspective of technology, but through its behaviour – which is closely related to the Volatility Principle where the infrastructure elements are more or less fixed, and spontaneous devices come and go, so that “the set of participating users, hardware and software is highly dynamic and unpredictable” (Greenfield, 2006). Therefore the scope for design of the concept could be from this angle as well as from an emergent use perspective. While it is an interesting concept, the weakness of Radio-Share is that it does not offer enough scope for design exploration in the discipline of interaction design.

4. MISTER-INSIDER
Facilitates Anonymous Communication with Strangers

Mister Insider is an information service that relies on crowd sourcing and insider information, and the insight that in a non-place, interactions between people should try to preserve the essential anonymity of being in the space. The concept is based on the fact that there are always some people in the bus or the train who know the system thoroughly, whether an information infrastructure exists or not, from their own experience of using public transport.

The essence of the concept is that any passenger on a bus or train can throw a question out to the public – other passengers in the same physical space i.e. the crowd – and someone, a Mister Insider will answer the question and send it back to the asker. The user of the Mister Insider service gains relevant local information from an expert in the same vicinity without having to directly interact with anyone. Simultaneously it also builds on the universal latent desire among passengers in urban India to help people without actual interaction.

While it can be done using existing mobile technology and devices a truly seamless and integrated system that is easy to use while commuting for both the asker and the 'Mister Insider' has yet to be worked out.

Mister Insider locates itself firmly within mobile computing, but while it is highly relevant as a concept in a country where gaps in the non-existent information
infrastructure creates power plays, similar services already exist and therefore the concept does not offer much of an opportunity for design exploration.

5. THE ANGRY SEAT
Facilitates Negotiation with Public Spaces

The Angry Seat is inspired by the playfulness of childhood, and attempts to provoke reflection about social behaviour in a public space. It is therefore an exploration of the perception of the place, and situates itself within the genre of critical design.

The Angry Seat shows its displeasure to people who talk loudly in its vicinity through humour and provocation. When it detects a human voice above a certain decibel, it immediately records a part of it and plays it back in a “Mickey Mouse” voice continuously until the volume of the loud voice decreases to an acceptable limit. While this provides entertainment to onlookers, it also effectively and provocatively communicates to the passenger concerned that they are not following the social norms of the place.

The technology is simple; it uses a voice recorder, some pre-formatted sound scrambling software, and speakers. The weakness of the concept is the same as the Eye-book, its effectiveness lies in its power of provocation and reflection, and that may not be successful in a typical Indian city.
SELECTING THE FINAL CONCEPT

Finally the concept that was taken forward was one called the Crowd Map – which is explained in the next chapter in detail. While it was stronger than all the other concepts in terms of scope of design, exploration possibilities and opportunity for learning, the other concept that was a strong contender was the Cocoon Dupatta.

It was difficult to choose between the two, as I was interested in exploring the genre wearable computing as well as the Crowd Map. So I sent out a sketch of the concept to some female friends in India, who used public transport, explaining the concept and its value, and inviting their feedback.

![Concept drawing for email discussion](image)

This is the drawing I sent out. I tried to get the respondents to identify with the girl in the picture by visualizing a scenario of use and detailed out elements of the Cocoon Dupatta.

Out of the four responses I got, two of the women liked the concept – they are in general very open to new technology - but they could not see themselves using it. The other two thought that it was impractical for use in public transport as it’s difficult to manage. The main issue that was on the uppermost of all their minds was that what kind of woman would realistically use the Cocoon Dupatta? This was the mistake I made with the drawing above. Trying to “sell” the concept to my young, trendy, tech-savvy women friends, I made the girl in the drawing look as close to them as possible, while the original drawing (as shown in the concept description) showed an older woman of a more traditional mindset.

I had always perceived the Cocoon Dupatta to be used by a woman who was averse to using a headset, and had difficulty with the complexities of the mobile phone. She would probably be slightly older, wear traditional clothing (hence the Dupatta), use
the most basic phone, and only make and receive calls and maybe send a text message or two. The Cocoon Dupatta therefore seemed suitable to manage this limited set of functions with some simple gestural or voice-based interaction. Therefore I agreed with my respondents – a young tech-savvy girl would probably use a headset if she wanted, and not drape a dupatta in this traditional way.

They also raised some other valid questions – as a dupatta is an accessory that is changed everyday, to go with the main apparel that a woman wears, one would either need to have many Cocoon Dupattas or be able to detach the technology and attach it to the dupatta of the day. Could any other accessory fulfil the same functions? Another detail to consider was the kind of draping – how many different kinds could the Cocoon Dupatta support?

While the questions were interesting, and the concept could be taken forward, it finally did not appeal to me as much as the Crowd Map.
WAYFINDING THROUGH A CROWDED BUS

“The only important thing about design is how it relates to people.”
Victor Papanek

THE FINAL CONCEPT

THE CROWD MAP

Crowd Map is a way to help people navigate in crowded public places. The application picks up the positions of people in a crowd in a particular space, and creates a heat map with it, that shows areas of more and less people i.e. the crowd density in the space. The map is displayed on a portable device carried by the user. As the user moves through the space, the map updates constantly to show his position relative to the crowd as well as changes within the crowd.

Crowd map situates itself as a wayfinding device. Wayfinding, in essence, is the way we orient ourselves to the environment, picking up cues to navigate within the space. In architecture wayfinding includes “signage and other graphic communication, clues inherent in the building's spatial grammar, logical space planning, audible communication, tactile elements, and provision for special-needs users” (Passini, 1992). The crowd map tries to apply the concept of wayfinding within a temporary, confined public space, with regard to the people present in the space.

The rationale behind the crowd map is that people form mental models of spaces while trying to navigate through them, which combine cues from the environment (Bowles, 2009). While the space within a bus is confined and temporary, it would still help to know areas of crowd density to reduce some of the stress of the journey.

QUALITIES OF THE CROWD MAP

The Crowd Map application only works with a critical mass of people, as there is no need for a way-finding device if there are too few people in the space. This is the strongest rationale to design this product for the crowded cities of India. The map is dynamic, since it picks up positions of the crowd, and also orients itself to the user's position in the space. This is a main reason why the application should be portable. It reduces cognitive load on users by displaying information that is 'here and now'. This is all the more important knowing the dynamic nature of crowd behaviour. The map
enhances the user's sense of wayfinding by giving information that would be a challenge for him to get at the specific time. E.g. if his view is blocked by crowds; the space in question is tiered, like a double-decker bus.

The map is essential to the concept. While it might be possible to create a similar application with a tactile / audio interface, without a visual interface it would be a challenge to communicate the information quickly.

The portable nature of the device could also be explored through wearable computing since people usually don’t have their hands free while they're commuting. One option is to combine the application with the RFID bus/travel card, which is already part of the ‘here and now’; or make use of wearables that would accommodate the device.

While the application is best used as a portable device, it can also be used as well while fixed to one location. At a junction where more than one bus are likely to arrive at a time, or on a railway platform where users can choose which coach to enter.

It can be placed inside the coach/bus near the entrance where the user buys his ticket / swipes his card to display free seats. The bus driver can use the map to see how full the bus is. It can also be displayed on the outside of the bus for the use of people about to get in along with functioning as dynamic bus graphics.
Therefore there would be trade-offs in the qualities of the interaction when choosing to make the crowd map fixed or portable. With the fixed application, the interaction then becomes less personal and more large-scale.

The Crowd Map can be modified for use indoors to create smart spaces. The existing network can be leveraged and the application can be used to gather information about the use of spaces within the building. The Crowd Map may be applied to open grounds as well, where it can make use of additional infrastructure like GPS to provide information on multiple levels, e.g. noise levels, exits and entrances, etc. Apart from this the visual interface could be replace by a dynamic tactile interface for navigational assistance for blind people.

The Crowd Map was chosen as the concept to take forward as it provides enough scope for design exploration. It could be situated in the area of portable navigation systems as well as part of the public transport infrastructure when used in combination with the RFID card or as a fixed display, and can be explore through the perspective of service design as well.

PORTABLE NAVIGATION SYSTEMS

A large number of studies have been carried out in the area of portable navigation systems, and a few good examples like Google Maps are also available for use. However most of these navigation systems are primarily for outdoor purposes; and also uses GPS technology, which being a line-of-sight technology does not work indoors or in areas of heavy building density. Here are some studies that highlight some interesting qualities.

Baus et all conducted a survey of map-based navigation systems dating from 1996-2004 and point out some qualities that map-based navigation systems should have: Positioning and situational factors (2005: 193). Positioning is the term given to the feature of determining the user’s current location, and displaying it on the interface. Most of the systems surveyed in the study use GPS or infrared beacons connected to a database or sensors to measure the user’s location; except DeepMap, which uses a sophisticated model based on position history, situational knowledge and visibility. Situational factors is a useful feature, utilized by devices to track potential changes in the user’s interest, and display the level of detail suitable for the moment. Museum guides HIPS and GUIDE make use of situational factors. The study also points out challenges for such dynamic design – the portable device must have technical resources (such as bandwidth, storage capacity, display size, and computational power) available in the mobile scenario, along with the fact that “the user’s cognitive resources are also likely to be under strain in a mobile scenario, e.g. when the user is performing a secondary task.” They also point out some hygiene factors like the ability to adapt to changes in the physical and virtual environment, and in situations where there is no relevant information “the system should gracefully degrade instead of
abruptly failing.” Some of the devices surveyed also supported multimodal use like speech, gestures and stylus inputs, apart from text/verbal input and pointing.

GAUDI is a pervasive navigation system that allows nomadic users to share control of semi-public displays for navigation purposes (Kray et al, 2006). A prototype was tested in a university environment where the digital nameplates on each door were temporarily allowed to display navigational cues to a nomadic user. It is one of the few indoor applications of navigation systems and is unique in its genre by appropriating existing display points into its design, and so creates a temporary and relevant object ecosystem for navigation.

Tram-Matena, a context-aware, mobile information system supporting the use of public transport, is a very relevant study for this project (Kjeldskov et al, 2003). The study was carried out in Melbourne, with business executives who don’t usually use the trams when they attend business meetings in the city. The researchers found that using trams could be more effective if, by providing relevant information at the right time and place, the uncertainty associated with public transport use could be reduced. The problems they decided to address were: Uncertainty about combining routes, the precise time of arrival at a destination, finding the nearest stop and having to walk to and fro from the stop to the destination. The information that Tram-Matena provides is (a) an estimation of travel time before the journey related to where to go and what to catch; (b) on the tram it provides primary information like where and when to get off, what to do next. It integrates easily with the user’s schedule, as it relates the travel information to appointments, provides route planning based on current location, alerts the user when it is time to depart, provides access to information about travel time, walking distance and number of required route changes, with minimum complexity, by being additional to the PDA-based calendars used by the user group. While this is a simple, effective and efficient system, the Tram-Matena is successful also because the user group is small and homogenous.

Exit Strategy NYC is an iPhone app for New Yorkers that shows users where they need to stand on the train, so that they can reach the right subway exit for their destination in the least amount of time (Wegener and Wegener, 2009). The app contains locations of exits, transfers and elevators, and the timings of the exits as well. The app has just three steps and does not require an internet connection. Since its launch last year users have coined new terms for emerging uses like “platform strategy,” “one-positioning,” and “pre-walking”. It is also available on Blackberry, Android and Kindle.

While Tram-Matena and Exit Strategy NYC highlight the need to reduce uncertainty while travelling by public transport, the other studies on portable navigational devices highlight some of the qualities that the crowd map device must have – situational factors that will show how the environment is changing constantly, a common occurrence with crowds in transit; positioning to help the user understand where he is in the graphical representation and orient himself accordingly; a gestural input like pointing the device.
EVALUATION OF THE CONCEPT

THE EXPERIENCE PROTOTYPE WORKSHOP

The experience prototype workshop aimed to test the role of the crowd map prototype with users of public transport in India, and also use participatory design techniques to have a discussion and brainstorming based on the experience. The prototype was also going to be evaluated on terms of implementation or “what it works like”.

The method of evaluation chosen, experience prototyping, is a method for stakeholders to gain a firsthand understanding of the design through interaction with prototypes (Buchenau and Suri, 2000).

Since executing the experiment in a real environment would be too difficult, and especially in India, a simulated environment was to be created in a closed room, with seats and a floor mat that will be able to “sense” if they are sat on, and will communicate to the Crowd Map prototype outside the room. People about to enter the room can take a decision about entering or sitting based on the map. They will therefore be able to experience a future scenario for the concept.

I decided to do this experiment in Delhi, as I had not had good results with the experiments in the buses in Malmö and Copenhagen, as the context is so different. The experiment took two weeks of planning and preparation but finally a rich environment was created for participants to interact with and give feedback.

THE PROTOTYPE

A very low fidelity version of the crowd map was created, using a cardboard box and LEDs. A display on the box would indicate which seat inside the room was full. The box was connected to an Arduino board programmed to switch the LEDs on and off when someone sat on a seat.

The seats were built on the simple principle of a button. The seat cushion was built from two cardboard pieces covered with silver foil and a layer of foam between them, and connected with copper wire. When it was sat on, the two pieces of cardboard would connect and conduct electricity through the wires to the Arduino, and the corresponding light would go on. A wireless transmission was planned using XBee shields between the box and the Arduino, but couldn’t be built due to lack of time, and therefore the fixed quality of the crowd map was tested in the experiment. The reason for using Arduino was that a multiplexor could be used for the sixteen
buttons to make a manageable circuit, but in the end I used two Arduino boards instead. Apart from the seats, I also used the same principle of the button to make the floor mat, connected to the Arduino in the same way.

Figure 25 Simulation plan

Figure 26 The making of the prototype
PARTICIPANTS

From an earlier experiment with role-play, I knew that it was imperative to have participants who were able to immerse themselves in the role-play. It was also important to have participants who travel by public transport for valuable first-hand feedback, as well as some others who could drive the discussions. Therefore I invited a mix of people – professional animators who are comfortable with characters and role-play, people who travel by public transport daily, and others who were interested and articulate. There were 15 participants and 2 moderators, apart from me. The participants, 7 women and 8 men, were between the ages of 24-33, and all lived in Delhi. Half of the participants do not travel by public transport anymore since they drive. The rest use autorickshaws, buses and Metro. Almost all the people have lived in other cities with better public transport infrastructure and they were able to draw on those experiences as well.

THE SPACES

There were two spaces in this experiment. The main space was the Bus Stop. It was indicated by a bus sign as seen in the picture below. The box – a lo-fi prototype of the crowd map concept - was placed at one end of this space, next to the entrance of the inside room or the 'bus'

The second space was the room inside, where I tried to create a simulation of a real bus. On the left side, there windows were marked on the white sheet, while on the right side the front seats were reserved for women, written in Hindi as in a typical DTC bus, as seen on the left of the picture (above, right).
In the background a soundtrack composed of recordings of street sounds from Delhi’s most crowded area played constantly in both the spaces. This helped to enhance the ambience of crowded Delhi bus stops and buses.

THE SCENES

The workshop was structured around role-play and discussions. The role-play was divided into three scenes, while the final discussion involved brainstorming in groups and lastly, a presentation.

For the enactment of the scenes, the participants were first divided into two groups. In the first scene, one group stayed outside while the second group went inside the bus. The goal of the first two scenes was to see how the crowd map application fits into the daily activity of getting on a bus. This was played out in the first two scenes so that all the participants would have a chance to interact with the prototype and the spaces, and also for them to feel more comfortable doing the activities. For the second scene, the groups were reversed and for the third scene, randomly picked. At the end of each scene there was a short discussion.

Activity at the Bus Stop

Each person at the bus stop was given a card with a character and a destination on it.

When the moderator called the destination, it meant that the bus that went to that particular place had arrived at the stop. The participant would then be able to choose to ‘get on the bus’, based on the card, or by looking at the
box, or by some other improvised situation. Once inside, participants had to find a place to stand/sit until the scene ends. They were told to stay in character, which should be recognizable by others, until the end of the scene. The characters were a school student with heavy bag, Old woman with many bags, Loud impatient office-goer, Two college girls travelling together, Eve-teaser (a man who molest women; likely in public transport in north India), Salesman selling cheap toys, Couple from the village (who would want to sit together), American tourist and 'Kolagiri' or coconut seller (common in the summer in Delhi). There were three destinations, chosen since they were the biggest hubs for public transport in the city – Connaught Place, ITO and Medical.

**Activity Inside the Bus**

There was a moderator inside the bus as well. Her task was to randomly give out some task cards. The tasks were: you want a window seat, The person next to you is smelly so you want to sit somewhere else, You want to get off, You want to sit in the front of the bus, You have to keep talking loudly on your phone throughout the journey. These tasks were drawn from the situated contexts explored earlier. The aim of the tasks was to keep the participants inside moving, so their movement is reflected on the box outside; as well as create an ambience of a typical bus journey in a minimal way.

**Scene 3**

In the third scene everything remained the same, except some of the participants at the bus stop were given small blank cards and asked to pretend that they were able to access the crowd map display on them. The goal of the scene was to see if the handheld format could make a difference to the experience of the application.

**BRIEFING THE PARTICIPANTS**

This was the first time most of the participants had attended a workshop like this. Therefore it was crucial to communicate the exercise in such a way that the feedback would be productive and relevant. The brief to the participants communicated the framing for the concept; the workshop and experiments I had done prior to this one (so that they understand it's part of the process); and also that the design they had gathered to experience was a very lo-fi conceptual prototype which would be advanced through their participation in the workshop. Finally to make the participants feel at ease, it was very important to tell them what was expected of them at the workshop, what they would have to do, and why they were selected.

**OUTCOME**

**The Scenes**

Once briefed, the participants seemed really eager and excited to begin. There was a lot of anticipation, especially about what might happen inside the 'bus'. The groups
were formed and the moderators began briefing the groups on the activities in the respective spaces.

Figure 30 Role-playing at the bus stop

After the first scene I realised that the space of the bus stop was quite spread out, and consequently the box was not noticed. So for the second scene we decided to bring the participants closer to the box, nearer to the door of the bus.

By the second scene all the participants were quite engaged and involved with the characters they were playing. Despite moving them closer to the box, it was again not noticed. Later in the discussion some of the participants mentioned they had noticed it, but did not know what it was for.

Some of the participants were getting quite absorbed in the role-play and improvising on one another’s roles, as I ideally wanted them to do, like this ‘salesman selling cheap toys’ who’s buying coconut from the coconut seller. (Coconut sellers selling pieces of raw coconut as a snack are common in Delhi in the summer.) Inside the bus the participants were being very loud and boisterous. Some of them were diligently doing the tasks, though not everybody was willing to keep moving from seat to seat as I had wanted them to do.

Figure 31 Buying coconut
In the photo above one participant (left) is busily talking loudly on the phone as instructed; while another participant (in the right bottom corner) held her nose as the person next to her was smelly, instead of trying to move to another seat. This was another demonstration that people do not like to move from comfort zones on buses. At the end of the first scene, we gathered in the next room for a short discussion.

Since the participants had missed looking at the prototype in both the scenes, I finally decided to explain the concept and the importance of the box to them. The discussion took place after the second scene inside the bus, as I felt that being in the bus might help to keep the participants in the right frame of mind. Even though I felt at the time that the concept didn’t live up to the participants’ expectations, there was still a lot of energy in the room. Everyone was completely engaged in the discussion that followed.
After lunch the role-play was resumed. This time a few of the participants at the bus stop were given blank cards and asked to imagine that the crowd map information was displayed on them. After this scene, the participants were divided into teams and they had to brainstorm on the following questions: How do you want to get this information? How do you think it should look? How would you change the concept? What other possible uses can you see of the concept? The workshop closed with everyone presenting their perspectives.

**EVALUATION 2: FEEDBACK FROM INTERVIEWEE**

Just to check the relevance of the concept with earlier participants, I also evaluated the concept with Onkar whom I had interviewed early in the design process. I showed him the video of the crowd map and explained the concept to him. I asked him how he saw this information fit into his daily life. He had some very rational comments, which I’ve included in the discussion.
DISCUSSION ON THE CROWD MAP

A number of interesting points were brought up in the discussions:
The scale of application of the concept:

• The concept is relevant if applied to larger areas, where the presence of people might help to make a decision about the place, and for spaces outside of the visual range. A number of participants said it would be more useful in extended spaces like the Metro – on the platform as well as inside the train. “In the Metro, people usually get on the train and don’t move from a particular space, even though it’s crowded, because they don’t know if they will find space elsewhere. If there was some information about adjacent areas, people could move to those spaces, and it would be a more efficient use of the capacity.”

• Most of the participants agreed that it doesn’t seem to be useful inside a bus. “I’ve already pushed through the crowd and gotten in, so I don’t think this application will be of help here.”

• The participants agreed that it was most useful for transit areas, like railway stations, airports and parking lots.

• A couple of the regular passengers saw the current iteration of the crowd map being used by them in situations when the journey is long (30 min or longer); when they’re carrying luggage and would want to know if there’s space to keep it; or when they’re travelling with a child.

However, most of the participants, and specially the ones who use public transport everyday, felt that it would be highly useful at a bus stop when combined with other information.

• The crowd map could be shown for the next few buses at a stop, so passengers can take a decision on which bus to take. While this is useful to know, it was pointed out that it also makes sense to know the intents of other passengers i.e. how many people at the bus stop might take the same bus. “If I know there are 3 seats and 5 people from this stop getting on, I might not want to take that bus.” Also, there are different types of buses that come to a particular stop. “People who take the AC buses don t even consider the DTC buses.” It was suggested that it might be possible for waiting passengers to ‘check in’ their destinations at a stop even before the bus arrives, through an extension of the transport system, for other passengers to make a decision.

• The information could be supplemented by local tacit knowledge as well. “A bus arriving at Adchini might be really crowded, but if I know that most of the people will get off at Khirkee Extension which is the next stop, then I might still take that bus.”
Though most of the regular passengers felt the information would be most useful when accessed at the bus stop, some of them thought it should be available through a mobile service as well, for two reasons:

- The decision to take a particular bus is sometimes taken away from the bus stop, specially when a passenger has the choice of taking buses from different bus stops, or other modes of transport like the Metro or an autorickshaw;
- Buses in Indian cities stop anywhere for people to get on and off, so it would be helpful to have that information with you at the time.

Passengers also commented on the precise moments of getting and using this information - “A few minutes before the train arrives, so that I can go to that particular part of the platform.” One participant who tried out the handheld scenario during the role-play said that she really wanted to use it, but when the bus arrived, she was so engrossed in getting on, that she forgot about the crowd map. “I was looking at the bus, and I forgot to look at the device.”

The current display of the Crowd Map was the most common issue that was brought up in the discussions.

- Participants were misled into thinking that the information provided by the crowd map was precise rather than an approximation, as the lights on the box gave the impression of ‘units’ rather than an ‘area’. Participants commented that it reminded them of seat selection software for planes and at the cinema. So a more exact display will work in places like these, but not in the case of public transport in an Indian context, as there is an ingrained attitude of adjustment, of squeezing between people in a crowded bus or train – as illustrated by an idiom from the streets that translates as ‘you need to have space in your heart’.
- Participants agreed that the information needs to be displayed as ‘capacity’, and came up with varied visualizations of that.

- The dynamic quality of the map was also important, participants pointed out. As people get on and off the bus, the display should keep updating its status. One participant suggested using the downloading bar from Internet browsers, as most people - including people from small towns - are familiar with it due to slow connections.
Some of the criteria that the display should have, to be inclusive for users of public transport, are that illiterate people should easily understand it, and the display have a sharp learning curve, so it can be figured out by using it a few times. Though there were some misgivings about information overload, regular passengers agreed on the peripheral quality of the concept - which is in the background until it is required and is of use for a very short, momentary spell. A participant brought up the fact of using simple technology so that it can be easily repaired.

Participants also pointed out how such information can be put to use if employed by the bus conductor, who could use this information for crowd management, to ensure optimum usage of space capacity, and to carry out differential pricing schemes for window seats; and also authorities like government agencies and urban planners could use this information for developing better transit systems.

Most of the participants thought that the concept was more applicable in the areas of large retail spaces like malls and supermarkets, for use by consumers for navigation as well as the administrative bodies for identifying bottlenecks, ad-optimization based on footfalls, market research, and optimization of infrastructural resources. Another space that would greatly benefit was urban parking spaces.

The concept itself raised questions about

- What should actually be measured – static groups of people or flows of moving people? Can users accessing this information tailor it to their needs by specifying the input criteria e.g. how many people are waiting for that specific bus, etc?
- How many people might use such a service if it’s not publicly available? Should such services be limited to those that can pay for it?
- What will happen if everyone has access to all this information? It can be used to game the system, as well as pose security risks, although insignificant, from terrorists.
- Does it increase complexity for a simple decision? Does the concept promise more than it delivers since the information is not terribly useful? Can the same resources be put to better use?
REFLECTIONS AND ANALYSIS

None the less, it was in this experiment that I learnt the most. At the time of the experiment the concept had been worked out as much as possible, and the experience prototype workshop gave it fresh directions. The strength of the workshop was it was a fascinating way to learn.

While the physical prototyping on this scale (16 foam buttons and 16 LEDs) first hand was an eye-opener, the scale of the workshop also transformed the place, the people, and the significance of the prototype. I discovered that scale changes the perception of space. While I was planning the experiment, and even trying out the flow of movement with a few people, the space seemed big enough, the prototype had just the right amount of prominence. But when there was eighteen people in that same space, the space seemed crowded, which was a desired effect, but the prototype got lost in the confusion. In retrospect I finally understand that in this is how a real context of use might be, and that scale is one of the most important factors to consider when designing for public spaces and public use.

Another factor that impacted the experiment was the perceived importance of the two spaces the bus and the bus stop - while the bus looked inviting, the bus stop only had a brown sign and a white box, almost placed as an afterthought. Consequently participants felt that the bus stop was not important, and that the bus itself was ‘magic’. While working on the spaces, I had rationalised that in India most bus stops are not clearly demarcated, swallowed up by the usual urban paraphernalia of roadside tea stalls or makeshift temples, so I didn’t spend any energy on it. In retrospect I feel I could have drawn attention to the space through some information and signage for better feedback. I also hadn’t realised that the presence of eighteen people and the location of the box would impact the concept so greatly.

Figure 37 An affinity diagram of the points raised
In fact the concept did not live up to the expectations of the participants - the prototype actually misled them into thinking it was fixed to a location, precise in its measurement and to be used by the bus driver/conductor. Only after my explanations did the concept become adequately clear, and the participants began to visualise it as I intended. While it was interactive, the display should have been closer to my visualization. This was the main misleading factor for the design.

Despite these faults, a lot of insights were gained. There were perspectives that I had earlier not thought about, regarding other kinds of related information that might make the concept more relevant; what sort of decisions might people take with this information and at what points would that occur; the justifications to make the concept portable and mobile, but also fixed in certain locations; and its usage by other stakeholders. Some of the regular passengers were able to recognize scenarios of use for themselves and also understand the peripheral quality, while non-passengers applied the concept to their lifestyles, as in the car parks at malls! In analysing the information gathered I’ve also weighted inputs from participants by what I know of them and their lifestyles, and that has helped me to prioritise issues.

Apart from the mistakes, there were some successes too. I was really satisfied with my choice of participants for the experiment. All the 17 participants contributed in some way or the other. The animators were key to the carrying out the role-play. Their confident acting encouraged the others to get into the spirit of the exercise. The regular passengers were therefore able to relax and draw upon their everyday experiences for performing as well as in visualising the use of the concept in their daily lives. Discussions were driven by the moderators along with some of the other participants who had been expressly called for their perspective on public transport. Participatory methods usually require representing most of the stakeholders involved but this workshop would not have been successful if the participants had been selected from the stakeholder groups.

I was also doubtful about trying to combine a participatory workshop with an experience prototype. While this might be a perfect method when doing a workshop with a design team, it can be difficult when using participants who are non-designers. Serendipitously more than half the participants were designers, so they did not have to make those leaps of understanding, and some were even curious about my methodologies. While using elements of bodystorming and role-play in the first half of the experiment gave some rich insights and made significant impact on the whole workshop, during the experiment I realised that I should have tried out something similar earlier in the design process too, as part of the earlier participatory session, as observing participants interacting with prototypes provides a deeper understanding of the context of use. The combination of these techniques also gave a broader understanding of the concept, which I hadn’t really expected, instead of more detailed feedback on the prototype. The low fidelity of the prototype and the large number of users are also reasons why most of the feedback received was not very detailed. A more focussed evaluation could have been possible by limiting the participants’ attention to selected contexts of use.

I also intended that the workshop be fun for the participants. From previous experience I knew that the participants must be relaxed in order to get into the spirit of the activity and the role-play and improvisation, and that a loose structure might work here; but since there were already some unknown factors, and a large number of participants, I created a very structured and time-bound protocol. It was difficult to
pare it down and yet keep the essential elements. The moderators and I discussed this and our individual tasks during the workshop and on the brief to the participants to reach a final version. Later I was surprised to find that we managed to follow it almost exactly, and even finished on time.

I learnt too that in the absence of a design team, it is effective to delegate logistics to others, and that when the scale is larger than usual reinforcements need to be called in. I was lucky to have a friend who arrived the night before with knowledge and skill about materials and spaces and proceeded to quickly execute the fabrication. Other friends volunteered to take care of food and refreshments, and to document the whole event.

The experiment on the whole was not only challenging for what it aimed to achieve, but also in what it demanded of me. I did gain some wisdom but it wasn’t easy. It was difficult as well to manage so many people and yet get them into the right frame of mind to provide me the rich insights I wanted. It was also not easy to manage the group dynamics in order to make discussions fruitful. Most of all it was not easy to be receptive to criticism from so many people together, and not be defensive.
The discussion from the experience prototype workshop gave me two important insights: (a) that public transport users have different needs in different contexts, which means in this case, different information at different times; and (b) the information provided by the crowd map need not be fixed to a device or a place, i.e. it should be accessible from everywhere. This is true to the ubiquitous computing concept of ambient informatics, which is a state in which information is freely available at a point in space and time until someone requires it, generally to support a specific decision (Greenfield, 2006).

I decided to explore the different points in space and time, i.e. the contexts through the journey map created earlier. Charting the crowd map function along the map, there are distinct points were a person might make decisions about using public transport. The journey map was therefore extended to explore the different contexts present within a journey and how the crowd map could be made more relevant in those different contexts.

Figure 38 Decision-making points
ALONG THE JOURNEY TIMELINE

At the beginning of a journey, it can help a user decide between different modes of public transport, between different route numbers of buses, and also different buses on the same route to reach a destination, by showing the approximate capacity of a bus. E.g. if a user was close to both a bus stop and a Metro station from a certain location, to help him make a choice between them he would need to know when the bus and the metro were arriving, and how full the bus/buses would be. This information could be accessed from a mobile phone or a portable device, since it should be available wherever a bus might stop i.e. anywhere along it's route. At this stage it would be irrelevant to know how full the Metro would be, since there are a number of coaches, and people typically make a choice about coaches when they are on the platform.
At the bus stop, a public display can show the capacity of approaching buses, along with already existing information, to allow users to make decisions about which bus they might take. It is important to know, that the capacity of a bus at all times is a composite status indicating (a) empty seats/spaces (b) people about to get off within a few minutes and (c) spaces that are not going to be empty in a given amount of time.

Inside the bus, it is helpful for passengers to know the likelihood of getting a seat, so that they can choose where to stand, etc. Therefore statuses of seats could be shown (a) physically (b) through a common display (c) through a mobile application (d) by a dynamic display on RFID card.

On the Metro, the experience would be almost similar. It is not relevant for users to get information about the capacity of each coach of a train before they reach the station, as there are many coaches and the information would be changing very quickly. On the platform however the user should be able to access information about the capacity of individual coaches in order to make an informed decision. It is important that this information is available a few minutes before the train arrives so that one can be at the chosen place on the platform. Within the coaches too, it will be helpful to know about empty spaces in adjacent coaches so people can spread out through the train, and therefore the space is used more efficiently. While getting off the Metro too, a user can get the bus information on his phone.

The information provided by the crowd map therefore needs to be of two types – (a) the capacity of a confined area seen from an external viewpoint, and (b) a status of seats/spaces within the confined area, which will be tied to physical locations within the space. Within the space, the user should be able to view this information from his current position, which should therefore be accessible on a personal device with both the features of positioning and situational factors, more like the initial iteration of the concept.
THE CROWD COMPASS SERVICE

While the first iteration of the crowd map was a product – a tangible object existing in both time and space – the findings from the workshop clearly show there is more value for users if the Crowd Map is a service - a process that exists in time, and can be experienced, created or participated in (Morville, 2010).

The concept therefore becomes an ambient informatics service, the Crowd Compass that is available in certain contexts. While the information is available anywhere, the value of it is only within the relevant time and place, and expires instantly. Thus it illustrates the PSC quality of “here and now”.

The service ecosystem visualization below tries to show the relationship between the different touchpoints of the service; the frontstage and the backstage. The service ecosystem includes sub-systems across multiple locations, devices and channels. For example, the application running on a mobile phone would be a sub-system in itself, as would be the public information display at a bus stop, or the displays within the Metro Rail network. For a seamless experience, the service ecosystem needs to be well integrated and consistent across all these platforms.
Figure 48 Service Ecosystem with the touch-points

Figure 49 Service Frontstage
THE CROWD COMPASS AS UBQUITOUS COMPUTING

Of course much of the service is only possible with ubiquitous computing technology, where standard public transport buses become “sites for sensing” the presence of people, and combining that with other information. This is an example where computing moves out of our traditional forms of access, the desktop/ laptop or the mobile phone, and becomes embedded within spaces of habitual use, and in doing so, it also impacts the very social fabric of our lives. When people can use the Crowd Compass service to avoid crowds in public transport, or even to reduce the stress of a daily commute, how might that impact their travel behaviour? Can it subtly change their perception of the spaces within the bus/metro over time? How might that manifest itself into emergent behaviour? How might it impact social activity within the spaces of transit? What if everyone gets the same information? But these are questions that we cannot predict at this stage, and maybe a matter of future study.

Another attribute of ubiquitous computing is that it can be engaged unknowingly and inadvertently, and people would not even know that they are interacting with information technology. In the case of the Crowd Compass, this is an advantage, since knowing or not knowing about the service will not impact their use of it, as it makes a difference only as part of a larger system and in a very subtle way.

Though the service seems to be technologically challenging, it might not be so difficult in actuality. Not only are microprocessors getting cheaper and faster (according to Moore’s law), but also technologies that would make this service possible already exist. NTTDocomo’s CarpetLAN prototype is an interesting wireless-like broadband networking and positioning system, which uses the floor surface and the human body as an Ethernet cable and weak electric fields as the transmission media (Fukumoto and Shinagawa, 2005). As the CarpetLAN offers no way to differentiate between individuals, it could be an interesting technology for public use where presence of people, but not their identity, is important. Another possible technology is image processing with infrared cameras that are already being used to detect traffic patterns.

Presence of people is therefore possible to track, but the status of seats/space could be a little more complicated, but still possible, through destination-specific RFID cards.
that already exist for the Metro Rail. Other possibilities could be electronic ticketing devices used by the conductor that would update the status based on a passenger’s destination at the time of buying the ticket.

**DISCUSSION ON THE CROWD COMPASS SERVICE**

The Crowd Compass service will be particularly helpful for people to navigate during their daily commutes. These journeys, especially the one to work every morning, are more or less at fixed times with precise starting points and destinations everyday. Thus on the mobile phone application, for example, as it’s a personal device, this information could be pre-recorded by the user, so at the decision-making point, the service does not bother him/her with obvious information, but presents what is relevant at the point.

In the context of India however not everyone may be able to have a smart phone that seems the most suitable to run this application. But the information will still be valid without the graphical interface, even if only used through text message, e.g. “233 (Medical) 1345 60% 45% For next bus reply Y” would indicate that the bus route number 233 going to Medical (from this particular, or the nearest, stop) at 1:45 pm is 60% full with people not getting off in the next 15 min, and 45% people getting off in the next 15 min, with a 5% overload. The user can even choose to find out about the next bus by sending Y to the service. Of course this is value-added messaging (VAS in India), which though cheap is not free; and everyone may not be comfortable with English (the language of text messaging in India at the time of writing). Hence people can also access this information at bus stops where it can be easily integrated with existing display, for all the buses on the route, through the visual display.

The value of the concept therefore lies in the fact that it tries to make the most efficient and optimum use of already existing capacity. While the bus transport can be made marginally comfortable by optimum utilization of space, the Crowd Compass service will really benefit the Metro with its extended spaces of transit. Not only by optimising space in the Metro, but the crowd map service will also help in integrating the Metro with the bus transport by providing contextual information for both modes of transport when required.

To passengers the Crowd Compass service can be essential in navigating through the crowded places of transit. While it is difficult to completely avoid crowds in an Indian city, people can now have the power to make an informed decision to make their way in relative comfort and less uncertainty. The convenience of the concept is also that a user can choose to use it or not. It would also be interesting that if people do use it, what kind of emergent behaviour might evolve, and how that might impact the information available.

While the Crowd Compass service is the solution proposed from an interaction design perspective into the problem of crowded buses in urban India, it approaches the problem from a passenger’s perspective and proposes a solution that optimizes existing space and capacity, and provides relative comfort. The problem of crowded buses itself is complex and not easily solved by simply adding more buses to the network. The streets of Indian cities are already clogged with traffic, and in 2030 India is expected to have 200 million vehicles on the road (Luce, 2006). Apart from urban issues like parking and transport infrastructure, problems of environmental degradation also need to be considered for a holistic solution to the problem.
The final design eventually situates itself close to ubiquitous computing with its distant utopian technological future, but it might seem like an impractical solution for a country with non-existent or rickety technological infrastructure, where things are in a perpetual state of chaos. But India is also a country that is highly unpredictable in its adoption of technology, and there is always a way to get around insufficient infrastructure.

Though it must be kept in mind that the Crowd Map service is still conceptual at this stage and a long way from becoming even a prototype, but if it is eventually put to use, the information it provides will be considered as essential as traffic signal counters, and will not take any extra effort from people to understand and engage with, in a peripheral way. The Crowd Compass service therefore aims to be an example of what Naoto Fukusawa called “design dissolving in behaviour”.
REFLECTIONS AT THE END OF THE RAINBOW

“Do not go where the path may lead, go instead where there is no path and leave a trail.”
Ralph Waldo Emerson

Altogether the project was an intense learning experience in many ways. I knew that situating the thesis within the context of a chaotic space like urban India itself would be a challenge, and prepared as much as I could to design in the space. While public transport in general was an area that has been much researched by the social sciences and engineering disciplines, there were relatively few studies in the field of interaction design that dealt with the places of and around public transport, and almost none at all in developing country contexts. As a result, using the framework as the foundation, not only did I have to combine existing methods and tools, but also extend them further, to get the desirable results and interactions. And out of these combinations some new thoughts emerged.

1. A SEMI-CONTROLLED SPACE

Since PSC was the chosen framework, it was only to be expected that the concept of place would play a central role in the project. However as the project progressed, I found that not only was it the essence of the conceptual framework, but also a main factor to determine exploration and evaluation strategies. Each phase of the process contributed to my understanding of the “place” which changed significantly over time. At the beginning, the place of study was the interior of the bus. Over time, the place of study increased to include the context of an Indian city, and finally it was not only the bus and the Indian city, but also a combination of an individual’s experience, both past and present, that was really essential to the design process.

During the contextual explorations phase, the buses in Malmö and Copenhagen as the context did not meet my expectations for the study not because of any other reason, but that they were not buses in India. The experience prototype evaluation was therefore planned in India. Though the best setting for the experience prototype would have been in a real bus or bus stop, being logistically challenged a simulation of the environment was created instead; which also proved to be successful in recreating the space mentally and physically for the workshop participants. While a simulation could have been created in Malmö itself and the prototype evaluated with slightly less
inconvenience, essentially it was the embodied experience of travelling in public transport in an Indian city that was desired.

The simulation of the space provided the embodied experience to quite some extent, and also allowed me to control the environment to get the best setting for the prototype evaluation. The real environment would have resulted in too much noise - other factors would have crept in that I do not consider relevant for the purpose of this study – and also would not have allowed me to select my participants, which was essential as I mentioned earlier. Compared to the “controlled space” of a lab environment with test participants, and the “real context” of an actual bus in an Indian city with random but real users, the setting that I used for experience prototyping could therefore be called a “semi-controlled” environment with carefully selected real users of urban Indian public transport. When these participants interact – following broad instructions – in the recreated environment, they not only respond to the environment and to each other but also bring up their past history and cultural background in the area of research to contribute to the shared experience. This is another reason why the environment is semi-controlled. The semi-controlled environment would therefore ideally need, or be, the design artefact itself – with a level of fidelity suitable for the phase of design – as well as participants who are not only actual target users for the design artefact, but also possessors of the creativity and the imagination required to engage in the role-play and bridge the perception between the real and the semi-controlled environment.

While this kind of semi-controlled space is ideal for early stages of design, there should still be a goal, i.e. some concepts or a form of the prototype, to evaluate, rather than initial brainstorming which is best done in real contexts. This method of using a semi-controlled environment can work in the evaluation of studies where the context (location, time, space) plays a significant role, as well as people, practices and cultures, i.e. the place.

2. DESIGN FROM INSIDE

One of the earliest and most important breakthroughs in this project was my realization that people do not think of the bus as a “place.” None of the participants at the participatory design session or the exploratory experiments actually articulated this thought, and it took me quite some time to arrive at this insight. From the beginning of the project, I had approached the space of the bus as a place for design, tried to explore possibilities within it, and therefore I was already biased with a designer’s point of view; and for a substantial time in the early stages of the design process, I was not able to separate my perspective from the participants’. In fact, I found it terribly frustrating that the participants were not able to share my viewpoint. It was only in the analysis phase that I realized the difference between my perception of the space and that of a regular passenger’s, and was able to gain this particular insight of a non-place. Until till then I was occupied with making sense of the immense complexities of the research area, identifying the needs in the space and trying to find possibilities for exploration; and did not specifically give much importance to the passengers’ perceptions of the space.

Often when we as interaction designers approach large-scale research areas – like this one – we are overwhelmed by their immensity and complexity. Too often the physical infrastructure blinds us, and diverts attention away from the human element. It is also so easy to forget about the people when approaching a research area from the
perspective of place – too easy to slip into the perspective of space, and discount people altogether.

PSC points towards an understanding of the physical and social infrastructure of a place and essentially takes focus away from the people to the place, but does not discount the value of the people in the place. So methods of information-gathering should not only look for information at a mass level and the identification of user needs, but also seek for in-depth understandings of user perception on the subject at hand. This is especially important while using the framework of PSC as true places emerge only through habitual occupation – it is the people that make the place, and it is their perception of what the place is, that is so essential for interaction design for place.

The design process should therefore expand to focus on identifying perceptions as well as needs from the information gathering process. Once identified, these perceptions could be the design insights that are then used to create the design principles for the project. For example, the fact that people do not think of the bus as a place indicates that they do not want to engage with it – hence interactions in that space should actually be anonymous, and thus follow the social norms of the public behaviour in the space; and not impose active social behaviour on the passengers.

The importance of user perception to the design process is universal and can be applied to any design discipline where understanding stakeholder needs is important. There is a sight distinction here within stakeholders – stakeholders with control over the design requirements and stakeholders who are affected by the design, but do not necessarily have any power over the design. It is the perceptions of the second group of stakeholders that is important to ascertain in the design process, and related to Krippendorff’s second order understanding where there designer needs to shift perspective to understand the stakeholders’ way of thinking (2006). While participatory design is the best method to understand user perceptions by co-creation, it should also be an essential element in other design methods.

Thus the process of design could be called design from “the inside”, from within the existing behaviour of the people, i.e. the practice. Interaction design from the inside would not only ensure that the new design is easily accepted, but also embraced wholeheartedly into the lifestyle and thus becomes an effortlessly sustained adaptation.
3. CROWD DENSITY: A NEW PARAMETER OF CONTEXTUAL INFORMATION FOR TRANSIT

Two of the main factors that can reduce stress and uncertainty while travelling by public transport are distance and time – it is always useful to know how far the destination is, and how long will it take to reach. In countries like Sweden these two factors are enough to make the journey quite peaceful. Not so in India, where a number of factors out of a passenger’s control can make the daily journey an ordeal.

In this project I proposed that crowd density is another parameter of contextual information for travelling on public transport. During the project a repeated theme from participants centred around crowds in public transport, and how they take decisions and strategize against it to alleviate some of their discomfort. All this extra effort results in stress, which is why most of my participants had negative associations of travelling by buses and Metro.

Since India is a densely populated country, and the cities face a significant amount of influx of migrants everyday, it is not likely that crowds are going to lessen in the future. Therefore a solution that can help people avoid discomfort due to crowds on their own terms would be highly relevant in their lifestyles.

If combined with parameters of distance and time, crowd density could really make daily journeys by public transport a better experience. Not only for passengers of public transport, who will then be empowered with valuable contextual knowledge on demand; but also for easier adoption of public transport into the lifestyles of people that would normally use their personal vehicles. So a cumulative result of these factors would mean that there could be a possibility of fewer personal vehicles with one occupant on the road – that is common now – and more widespread usage of public transport.

Though similar concepts do exist in the design disciplines of architecture and urban planning, it is usually considered from a physical perspective and not as a social concept. Interaction Design in the genre of public spaces and utilities for Asian contexts (which are densely populated) should not only consider crowd density as another factor that impacts social behaviour, and hence design, at many levels; but also as an essential parameter of contextual information.

4. ANALYTIC AND GENERATIVE MAPS

While the discipline of science has been thoroughly comprehensive about the sensemaking processes followed within it, design has never been comfortable explaining how exactly designers deal with information to make it usable for their processes. In fact though it is an essential part of the design process, somehow in the discipline of design sensemaking has always been an understated activity in academics as well as in practice (Kolko, 2009). The truth is, designers themselves have never really tried to understand their process of sensemaking, being contented with the widespread opinion that it is inherently mystical.

To understand the information gathered in this project, I devised my own processes of sensemaking. Designers typically visualise and externalize the data gathered during the initial phases, and that’s what I did, in many different ways. During this activity, it
was the act of visualizing the information, as well as the visualization itself that were key to the process of understanding the information.

However during the brainstorming phase, I found that all the visualizations that I had made do not have the same quality – while some had been extremely effective in understanding the information gathered, others were particularly helpful in generating concepts while brainstorming. It was not that the information in all these maps were mutually exclusive, but while one set of maps merely visualized the information and found connections between them, the other kind of maps used those connections to derive insights and create design principles or qualities for design. The sense-making activity was therefore distinguished into understanding and pattern creation, which would be analysis, and the set of maps was termed Analytic Maps; and deriving insights and the creation of design principles to help in brainstorming, which would be generative, and therefore termed Generative Maps.

These distinctions within the sensemaking process actually serves to remove the mystery associated with the process of analysis in design. It not only helps in articulating the thought process, for the practice of design – where the demystification of the thought process helps in stakeholder buy-in by reducing a certain amount of uncertainty – but also for communication within the design team. The distinction further separates the two stages of the sensemaking process, so designers can concentrate on the individual stages in a logical manner.

The Analytic and Generative maps are thus offered as guidelines for analysis in any design process, but most effective for large-scale projects where the information can be overwhelming and difficult to assimilate.

5. DESIGN ACTIVITY AS INSPIRATION FOR PROACTIVE BEHAVIOUR

Design artefacts are often solutions to problems, instruments of expression, communication, and empowerment for users, but the tools of design rarely reach out of the design studio to deeply influence the lives of users. Though participatory design is such a process that aims to involve users so that they might become co-creators and thus be empowered, it has been usually used with stakeholders who already have some ownership of the issue at hand.

Though India as a country has its share of proactive, ambitious people, lack of resources and civic and community support can foster cynicism and apathy even in the best of them. Enterprising productions more often than not are countered by resigned outlooks manifest as scepticism and ridicule, and as a result social innovation requires extremely strong dedication to counter these demoralizing effects.

In this project I did not attempt to do any kind of social innovation, instead my motivation was to provide some relief to the harassed passengers of urban bus transport services. However in both the workshops as the participants – who began by being slightly but not openly cynical about the theme – got more involved in the process their attitudes changed a little. The shared experience of constructive thought towards a service that touches them all made them open to realizing possibilities, big and small, knowing that they do not have the power to realistically execute these
possibilities. The design activity of the participatory design workshop thus provided a common platform for fostering a proactive attitude in general.

When participatory design sessions are held with a homogeneous group of users on a commonly experienced theme without having any control over it, the design activity could inspire the participants towards collectivist proactive behaviour. In the workshops participants were able to explore possibilities around the theme and be co-creators by means of participatory design. This helped them to voice their opinions and also constructively channelize energies for the present theme as well as get inspired to be proactive in general. The design activity – possibly because the research area was a public service – therefore can become a tool of social innovation itself, if done on larger scales on a regular basis. Design in this context therefore becomes a tool for changing attitudes and encouraging proactive behaviour for social change.

**CONCLUSION**

The thesis project has been an intensive exploration of the nature of the spaces of bus travel in urban India, through the use of many different methods and tools. The study has uncovered some valuable insights and cultural understandings for interaction design of public services and places of travel in developing country contexts. The identification of the crowd density factor, the perceptions of the passengers of the bus, the implications of the cultural context are significant understandings for design in the domain. The project is also an exploration into using the philosophy of participatory design in a developing country context, and physical prototyping to gain rich feedback.

The design process was extensive and allowed me to go deep at each phase of the project. Tools like visualizations, sketching, and prototyping allowed me to externalize thoughts and at the same time understand my own analytic process. At each step there was substantial learning – some from mistakes – that helped me to progress to the next one. Conversations with my supervisor and feedback sessions with classmates also helped me to articulate thoughts, activities not to be discounted in any way.

Overall though I did make some mistakes, I also managed to recover from them with enough knowledge and a great deal of reflection. For example the exploratory experiments in the bus were not successful at all, but it was possible to salvage some ideas and understandings from them. And not only that, in the process of staying involved with the project through this activity helped me to understand and analyse the subject at hand more thoroughly.

A recurring theme in the early stages of the design process was my questioning of the research theme. The massive scale and the infrastructural issues was a constant distraction and made me question my motivations many a time. Design in this area in India is strongly industrial, and it took me a lot of effort to move away from not only the design philosophy – but also from viewpoints raised in the experience prototype workshop that the concept should try to solve a “real” problem. To people travelling by bus in the heat of the country everyday it is a real problem, but Indians by nature always learn to adjust, and the approach to solutions has always been through the infrastructure and not through the place. In that sense using place-specific design has been incredibly useful in enabling a fresh perspective on this area.
In conclusion, the project was significant in its exploration of the concept of place, and applying it to all phases of the design process to get a deep understanding of place in a highly cultural context; and also to understand the cultural perceptions that surround the place. The Crowd Compass, a design concept built on these understandings, if implemented, will gradually establish its relevance and be assimilated in the most unobtrusive way; and thus dissolve, like other influences on the amalgamation that is India, in the basic cultural behaviour.
## Appendix - Project Plan

<table>
<thead>
<tr>
<th>WEEKS/TASK</th>
<th>0 Dec 2009-Jan 2010</th>
<th>1 18/01-24/01</th>
<th>2 25/01-31/01</th>
<th>3 01/02-07/02</th>
<th>4 08/02-14/02</th>
<th>5 15/02-21/02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary Field Research in India</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary research</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explorations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experiments in context</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brainstorming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concept Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prototyping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test in India</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WEEKS/TASK</th>
<th>6 22/02-28/02</th>
<th>7 01/03-07/03</th>
<th>8 08/03-14/03</th>
<th>9 15/03-21/03</th>
<th>10 22/03-28/03</th>
<th>11 29/03-04/04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prototyping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test in India</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WEEKS/TASK</th>
<th>12 05/04-11/04</th>
<th>13 12/04-18/04</th>
<th>14 19/04-25/04</th>
<th>15 26/04-02/05</th>
<th>16 03/05-09/05</th>
<th>17 10/05-16/05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prototyping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test in India</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final design concept</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhibition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WEEKS/TASK</th>
<th>18 17/05-23/05</th>
<th>19 24/05-30/05</th>
<th>20 31/05-04/06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documentation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhibition</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES


FIG. 1: DESIGN PROCESS
Fig. 2: Thesis Directions
FIG. 40: AFFINITY DIAGRAM FROM THE WORKSHOP

[Diagram showing a crowd map with various elements such as accessibility, decision-making points, needs, etc.]