Article

Developing a System Which Supports the Commuters' Experience in Heavy Urban Traffic: Case Study of Delhi, India

IIFT International Business and Management Review Journal
1–14
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DOI: 10.1177/jiift.241273718
ift.spectrumjps.com

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Abstract

The research is performed keeping in view the traffic congestion in urban areas, especially metro cities in India. Getting stuck in jams for hours is a habitual matter. The peak hours are a peril. In just four metro cities in India (New Delhi, Mumbai, Kolkata and Bengaluru), traffic congestion is so high that the fuel that is burnt due to idling of vehicles at traffic jams costs around ₹1.5 lakh crore annually ($18.75 billion). The situation is worst in the nation's capital, New Delhi, with over $8.5 billion. Overall growth in population and economic upliftment, especially in the middle-class section, shaped an upsurge in demand for private transportation. Uber research estimates that the transport demand has increased by more than eight times since 1980 in urban India (Financial Express, 2018). According to findings by the Central Road Research Institute (CRRI) in the nation's capital, New Delhi, every day 39,806 kg of fuel is burnt due to idling of vehicles at traffic jams (Adak, 2014). The article highlights problems faced by commuters, taking into account New Delhi as a case study. It is also largely because Delhi is affected by one of the highest vehicle densities among all the cities in the world (Adak, 2014). The assessment includes continuous observation and interview process of commuters belonging to different socio-economic classes in different areas of the city on (a) mode of transport used by them/preferred by them, (b) decision making towards the preferred mode of transport in the face of uncertainty, that is, traffic and (c) problems faced due to lack of consistent information regarding traffic. The article also discusses redefining the user interface and thereby their experience and forming an efficient and planned social system.

Keywords

Road traffic, traffic congestion, user interface, application system

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Introduction

The location of New Delhi is between the latitudes of 28°-24′-17″ and 28°-53′-00″ North and longitudes of 76°-50′-24″ and 77°-20′-37″ East. The city has a common border with the adjacent states of Uttar Pradesh and Haryana. With 11 districts, it has a total area of 1,483 km^2. The city measures 51.90 km in the utmost length and 48.48 km in the utmost breadth. Urbanisation has almost engulfed the rural area of the region. In the year 1901, the rural population in the region was nearly 50%. It reduced to less than 7% in 2001 census. It is a result of villages being faded away, providing space to skyrisers and commercial spaces. The villages, which were 314 in 1921, reduced to 165 in 2001.

The present population of Delhi is circa 32,941,308 (approximately 32.9 million) (World Population Review, 2023). Rich infrastructure, trade and commerce and better job opportunities attract migrants from other states of India. It has the second-highest population of inter-state migrants in the country, only after the state of Maharashtra (Government of NCT, 2023; Khawoosa, 2019).

There are over 13.4 million vehicles occupying space on the roads of Delhi, creating traffic congestion as a common problem (Goswami, 2022). However, it is impacted by various other factors as well, which are as follows:

- Seasons: Winters offer challenges such as cold waves, fog, smog and extremely low visibility. Summer brings severe heatwaves. Monsoon offers water logging.
- Festivals: The city showcases extensive diversity of religions, languages, customs and cultures coeval in harmony. The diverse socio-cultural groups, with their religious, cultural and social gatherings, have transfigured Delhi into a city of socio-cultural celebrations and festivals. People flood out to either celebrate or shop for their festive essentials (Delhi Disaster Management Authority, 2014).
- Political rallies: Being the political capital of the country, rallies of different nature are frequent in Delhi. Roads are often blocked for the same.

The city has various modes of public transportation system. They are as follows:

- Public bus: The city has nearly 7,500 public transportation buses plying regularly (PTI, 2023). On an average, the daily ridership on public buses is approximately 2.5 million (Mathur, 2022).
- Delhi Metro Rail: In the National Capital Region (NCR), the metro has a total network length of 391 km. There are 12 different routes laid as labyrinth, with 286 stations (Delhi Metro, 2023). The average daily ridership on Delhi Metro is approximately 5 million (Agarwal, 2022).
- Auto-rickshaws: There are over 95,000 auto-rickshaws plying on the roads of Delhi (Goswami, 2021). Approximately 2.5 million people take to auto-rickshaws on a daily basis (ANI, 2020; Goswami, 2021; Mani, 2023).
- Cabs/taxis: There are 112,000 cabs/taxis plying on the roads of Delhi (Mani, 2023). Average daily ridership is approximately 14,000 (Delhi Development Authority, 2020).

- Cycle rickshaws: There are more than 500,000 cycle rickshaws operating on the roads of Delhi, making approximately 1.5 million trips per day (Goswami, 2021; Mani, 2023; Saini, 2015; Saiyad et al., 2019).
- Ring rail: The railway service connects Delhi with strategic urban and suburban areas of adjoining states, that is, Haryana and Uttar Pradesh, using primarily Electric Multiple Unit (EMU) and Diesel Electric Multiple Unit (DEMU) rakes. Average daily ridership is approximately 7,000 (Delhi Development Authority, 2020).

Selecting the right means of transportation in Delhi depend on various factors including the distance, time constraints, cost, convenience and personal preferences. Here are some considerations that help one to choose rightly and could be selective according to what mode of transportation in Delhi is more suitable to them:

- Distance: For shorter distances, options like walking, cycling, auto-rickshaws, or cycle-rickshaws may be more convenient and cost-effective. Auto-rickshaws and even buses suit mediocre distance. For longer distances, the Delhi Metro, Ring rail as well as buses are a better choice, as they offer faster travel times. Private vehicles and taxis/cabs are good options for all the above-mentioned distances.
- Time constraints: If there are time constraints and one needs to reach the destination quickly, then Delhi Metro is the dependable option.
- Cost: Public transport system such as the Delhi Metro and buses tend to be more affordable and budget-friendly compared to private vehicles or ride-hailing services. Auto-rickshaws and cycle-rickshaws are also relatively inexpensive for shorter distances.
- Convenience, safety and comfort: It is subjective. However, factors such as availability, frequency, accessibility, time of travel, safety assurance, comfort, kind of people travelling together and weather play a major role towards considering the mode of transport.

Ultimately, the choice of transportation in Delhi depends contextually as per the specific circumstances. It is helpful to stay updated on the latest information about routes, fares and any ongoing changes or disruptions in the transportation system. The hourly updates are available on radio, but they are not consistent and dependable. At the same time, one has to wait for the updates.

The focus is to have collective information about the circumstances and thereby establish the problems a common person in Delhi goes through during their daily travel. The goal is to provide a desirable, user-friendly system to beat the traffic for users of all age groups, social and cultural backgrounds at any time of the day (without any wait). The intention is to make the movement of the daily commuters through the city relatively effortless.

Methodology

The interview was conducted as group participatory approach in 15 rounds with 637 women and girls across 11 districts in Delhi.

Identification of the stakeholders was done keeping in view the following:

- A minimum of 40 people/daily commuters from each of the 11 districts of Delhi belong to different age, gender, profession and socio-cultural backgrounds.
- Commuters from all the 12 different routes of Delhi Metro.
- A minimum approximate commuting distance of 6 km was set as a criterion.
- Stakeholders were identified in groups in specific places.

It was the requirement of the research study that the researchers spent a substantial time in the field. The study took over 15 months with intensive observation. Kurt Lewin, in his interpretation, mentioned that there is a limitation of studying complex real social events in a laboratory environment. There is always the complexity of splitting the elements of an integrated system, retaining its genuineness in natural condition (Sofer, 1972).

In holistic view of scientific understanding of living systems, all living organisms have a distinctive commitment to contribute to the harmonious functioning of their ecosystem. This understanding of living systems and subsequently human society is grounded in the perception of relations with numerous paradigms of everyday life, largely falling under intellectual aspects, societal dimensions and environmental aspects. Some of the paradigms of everyday life in human society are welfare and entrepreneurial arrangements, education or awareness, culture and lifestyle and motivation, among many others, which together form integrative tendencies. The progressive system of biosphere and subsequently the functioning of human society as a system may be described as holistic view or systemic understanding (Capra & Luisi, 2014).

In a common question, that is, 'mention three major pain points while commuting', to all the respondents, the answers/reactions were as follows:

- Excessive road traffic thwarts to reach the destination on time.
- Lack of freedom of measures, choices, or decisions under given circumstances.
- Many a times, there are multiple mode of transport used by commuters. Connecting modes of transport are not readily available or rather time-consuming.
- Lack of controllability towards the availability of seats in the bus/metro/ring rail, especially for aged, women and children.
- Not sure about the parking availability of personal vehicles till they reach the space/ metro station.
- Sometimes users' bookings with regards to cabs/taxis/auto-rickshaws tend to fail due to different situations.
- During peak hours, overcrowding is evident in different means of transport.
- Unfriendly seasons: Summers (extreme heat), monsoon (water logging) and winters (low visibility due to fog) collectively comprise approximately 7 months in a year.
- Lack of standardised commuting prices in case of cabs/taxis, auto-rickshaws and rickshaws, especially during odd hours and different weather conditions.

- Infrastructure becomes insufficient to handle the overcrowding. Thereby, the time taken to commute is very high.
- Pollution is unbearable.

The relationship, pattern and connectedness of these various aspects lead to systemic phenomenon. Capra and Luisi, in their study of systems view of life, observed that recognition of networks of social communication led to systemic understanding of social systems (Capra & Luisi, 2014). The 11 paradigms of undesirable problems or drawbacks mentioned above associated with commuting in Delhi are interconnected and classified as follows in Figure 1.

A comprehensive and multi-faceted approach was taken towards developing a framework that addresses the undesirable problems or drawbacks without any skirmish in the present system. Focus group discussion and brainstorming process were conducted to produce ideas. A number of ideas were obtained in two rounds from a number of people divided in two groups of 11 people. The members in the focus group discussion and brainstorming process included daily commuters through bus, daily commuters through metro rail, daily commuters through personal vehicles, daily commuters through multiple modes of public transport, product service and systems design professionals, academicians in the areas of user interface and user experience and information technologists.

The sole agenda for focus group discussion and brainstorming process was to invite number of ideas, perceptions and opinions so that later they may be evaluated and improved upon (Jones, 1970).

Result

Ideas obtained through focus group discussion and brainstorming process are as follows:

- Proper tracking system for smooth transportation.
- Online ticket system for metros and buses.
- Connectivity options, especially in case of multiple modes of transport, should be transparent and readily available.
- There should be some assist system providing options to commuters, contributing towards freedom of measures or choices and thereby controllability under given circumstances.
- Methods should be available to identify overcrowded metros.
- Live weather conditions and traffic conditions, on the spot and consistent updates.
- Online payment facilities.
- Identification of user's daily schedule and auto-save it in an application to provide daily updates accordingly.
- Price should be justified with respect to the distance covered.
- There should be online complaint registering system mentioning the vehicle registration number in case of misbehaviour, last-minute cancellation, unwarranted fare hike under circumstances, et cetera.

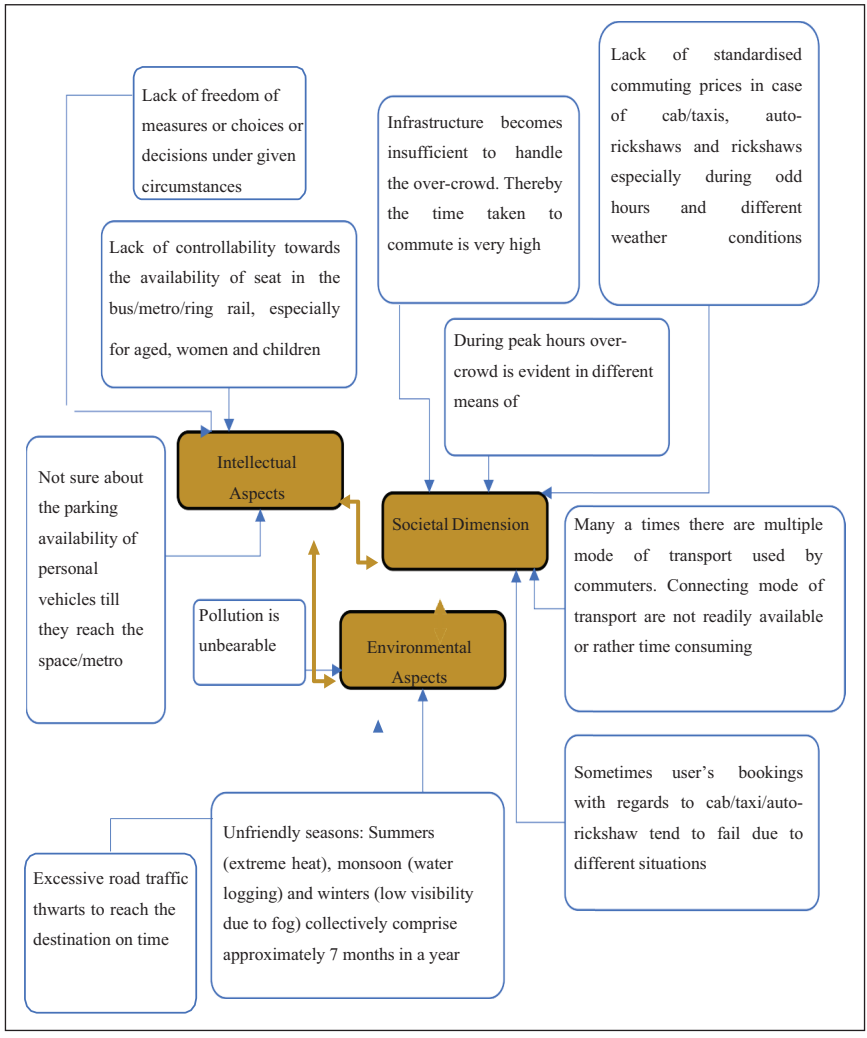

Figure 1. Paradigm of Undesirable Problems or Drawbacks Associated with Intellectual Aspects, Societal Dimension and Environmental Aspects and their Connection with Each Other.

- A system which is consistent and comes with affordance for majority of commuters belonging to different age groups, genders, et cetera.

During the process of substantiation of the above ideas with the members, a number of ideas were emphasised upon. They need to be re-assessed and consolidated. It is done keeping in view forming the ideas into systems with various arrangements of multiple elements. Re-assessment of the ideas was done with the application of transformation techniques or removal of mental blocks. Transformation technique can be applied to corroborate ideas or search (Jones, 1970). The transformation technique that is used is as follows:

- Placing each of the ideas and linking it as a solution to the problems with the help of attribute listing (Crawford, 1954).
- Relating the ideas with each (viewing their dependence on each other) other and the problems that are to be addressed with the help of attribute listing (Crawford, 1954).
- Rearranging, combining and juxtaposing the 14 brainstormed ideas (mentioned previously in sub-chapter 3.3, Conceptualising ideas) into four (Jones, 1970; Osborn, 1963).

The conceptualised idea that can be established into interrelated systems is an application operational on any smart phone. It is based on a fact, that is, the number of smartphone users in India will be 1 billion by 2026 as predicted by Deloitte's 2022 Global Technology, Media and Entertainment, Telecom (TMT) (Press Trust of India, 2023). The top five cities in India raised over 55% of smartphone sales, with Delhi generating the maximum demand (*The Hindu*, 2018). Against a population of approximately 3.2 crore (32 million) in Delhi, there are over 4.5 crore (45 million) mobile phone connections, and it is increasing fast (PTI, 2012). Figure 2 depicts the conceptualised idea as a system with various system elements.

The application tends to address all the paradigms of undesirable problems or drawbacks associated with intellectual aspects, societal dimension and environmental aspects. The objective was to come up with a holistic solution to all the commuting problems in Delhi.

Some high-fidelity screen images of the application are mentioned below, depicting the interface and the user experience it offers.

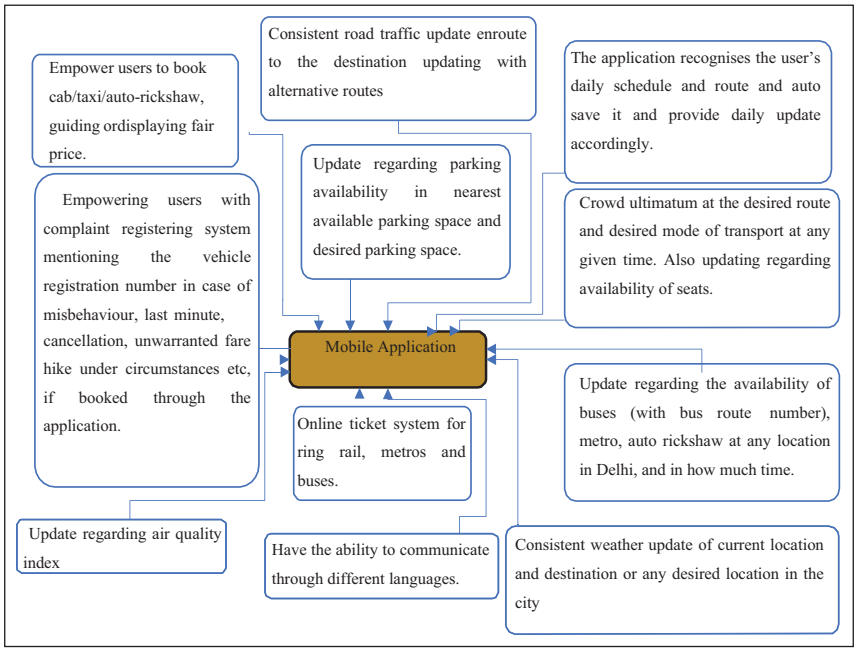

Figure 2. The Conceptualised Idea as a System with Various System Elements.

Figure 3. Splash Screen.

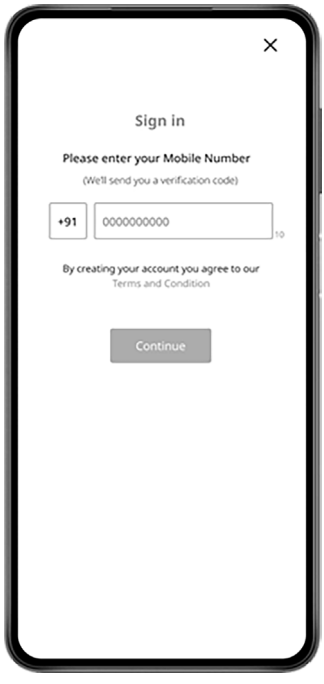

Figure 4. Signing In, Splash Screen.

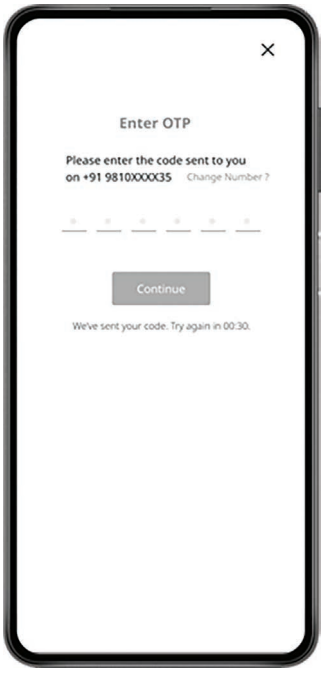

Figure 5. One-Time Password (OTP) Splash Screen.

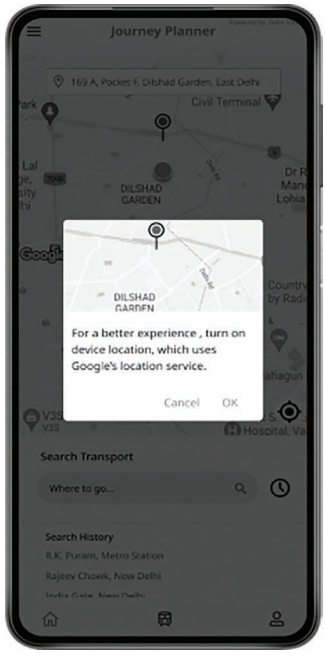

Figure 6. Location Permission Screen.

Figure 7. Language Screen.

Figure 8. Journey Planner, Home Screen with Traffic Updates.

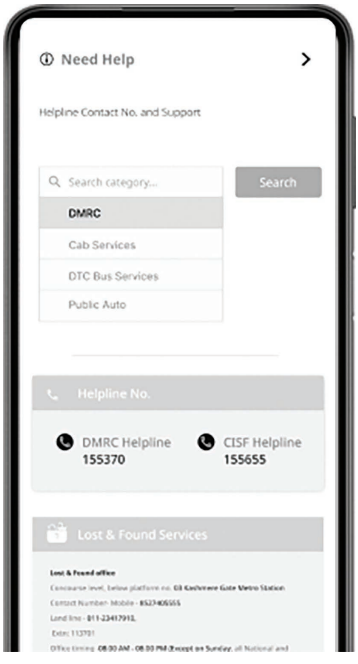

Figure 9. Complaint Registering Screen.

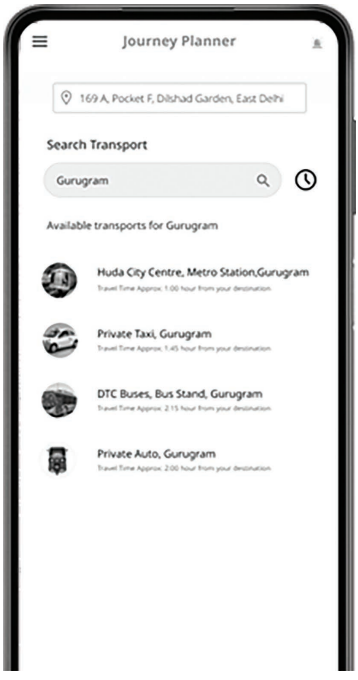

Figure 10. Journey.

Figure 11. Cab.

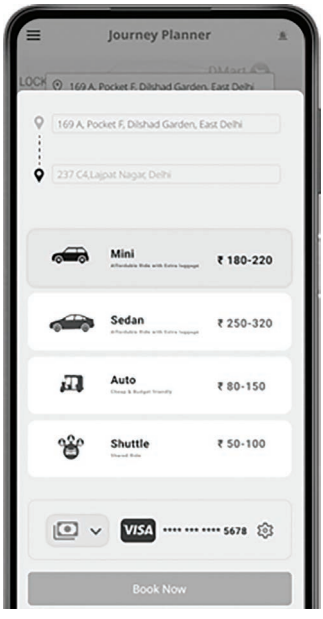

Figure 12. Cab.

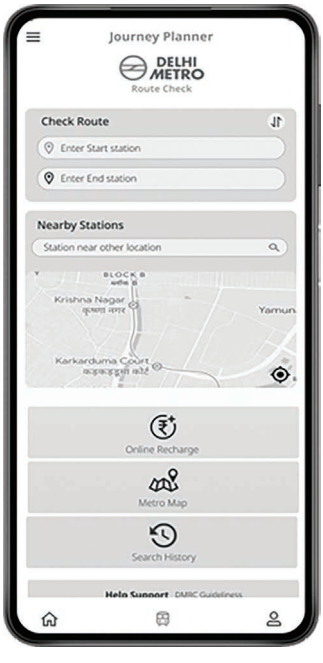

Figure 13. Metro.

Figure 14. Metro.

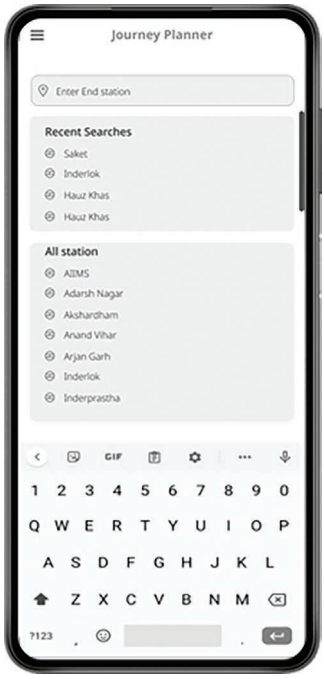

Figure 15. Metro.

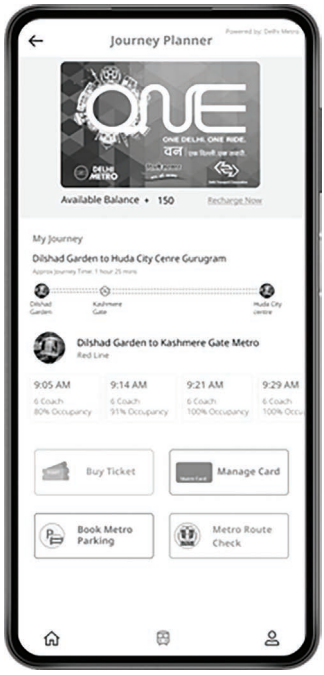

Figure 16. Metro.

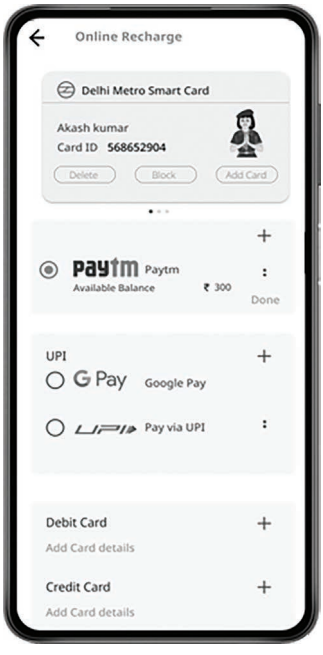

Figure 17. Metro.

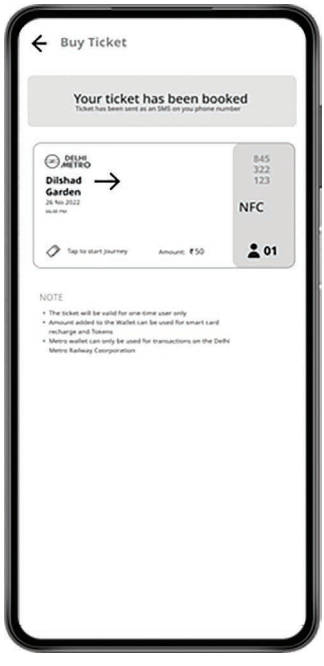

Figure 18. Metro.

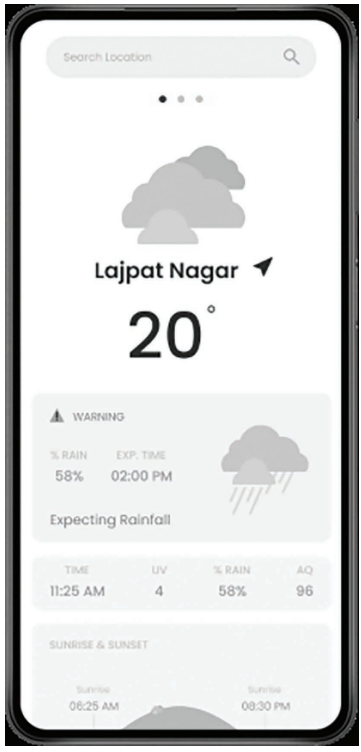

Figure 19. Weather Guide.

Figures 3–10 describe the application's signing-in process, language options and the journey planner. The application may offer more than 30 language options. Figures 11 and 12 describe the cab booking process.

Figures 13–18 describe the guide for metro train travel within the city, including the rush monitor in selected stations and online ticketing system. Same guide will be available for other mode of public transport as well, for example, ring rail and bus.

Figure 19 is a complete guide to weather updates and air quality index in specific locations in the city.

Conclusion

The entire study was to analyse the problem faced by the population of Delhi while travelling in traffic congestion. The challenges they face while managing their travel because there is uncertainty while commuting. Commuting is not very friendly and rich in experience.

The proposed system offers security, controllability and ease to over 32 million population in Delhi. It is going to be an absolute city commuting guide in all circumstances. It is a replicable model which can be initiated in other cities as well. The interface incredibly enhances the daily commuter's experience. It may also be noted that the tourists and first timers in the city will be benefitted

immensely through the application. With certain infrastructural inclusion in the existing system, for example, close circuit television cameras (CCTV) in buses, parking spaces, metro rails, ring rails and strategic points over the roads, and also being consistently connected with the meteorological department, the proposed system may be launched. These are required to gather minute-to-minute data and further updates.

The proposed system is organised with the potential to save time of the commuters and reduce the amount of fuel burnt [inclusive of diesel, petrol and compressed natural gas (CNG) vehicles] due to idling of vehicles at traffic jams, thereby the annual financial loss incurred due to traffic congestion, which is over $8.5 billion (Financial Express, 2018). The government may initiate it or offer private parties to pitch in, even under schemes like start-up India or make in India.

Acknowledgements

The research is an outcome of the subject 'Design and Society' at Fashion and Lifestyle Accessories Department, National Institute of Fashion Technology. The authors are deeply indebted to news agencies—*The Hindustan Times, The Financial Express, The Times of India, The Economic Times* and *The Indian Express*. The authors are thankful to all the respondents and focus group experts for their time and efforts.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding

The authors received no financial support for the research, authorship and/or publication of this article.

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