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Empowering Independent Mobility: An Innovative Solution for Individuals with Mobility Impairments in Delhi

Ananya Singh & Sara Sanwal

Abstract

As the emphasis on accessible design gains prominence in the physical environment, it is imperative to acknowledge that the streets of Delhi remain inadequately equipped to facilitate independent travel for individuals with mobility impairments. Despite the allocation of a substantial budget exceeding 500 crore rupees for the development of accessible transportation options for individuals with disabilities, a significant portion of this demographic continues to grapple with challenges in achieving independent mobility on par with their fully abled counterparts. This paper introduces an innovative service in India that addresses the mobility challenges faced by individuals with disabilities. This paper outlines the service's concept, design, and implementation, emphasizing its potential to enhance the quality of life for people with mobility disabilities and contribute to a more inclusive urban environment.

Keywords: ***Accessible Design, Transport Design, Persons with disability, User Centered Design, Application Design, Tandem Bike, Service Design***

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1. Introduction

1.1 Cost of Disability

According to the WHO, 10% of the world's population is disabled in some way.[1] In contrast, the National Sample Survey Organisation (NSSO) report [2] and 2001 Census data [3] stated that its prevalence in India was as low as 2%. To have a disabled member in one's family, increases the cost of expenditure by 17% than a family with all fully abled people. The Government of India has invested an estimated cost of more than Rs. 1,325 Crores in the accessibility sector for the Divyangjan (People with Disabilities), according to the recent 2023 reports [4]. New Delhi is one of the most accessible urban cities in India. However, it is still not fully accessible as a person of disability would still have to be dependent to travel in the city.

5 types of transports are available to the public for use - Delhi Metro, Delhi Buses, Autos, Rickshaws. Out of which two of them (Delhi Metro and Delhi Buses) are supposed to be accessible for a *divyangjan* (Persons with disability) however still these transports are not being used by being in a wheelchair.

1.2 Problem Area

Our Project focuses on identifying the limitations faced by persons with disabilities in the everyday span of life when the government has invested so much for easy access of public transport for persons with motor disabilities (PWMD).

This research paper presents a pioneering service as a solution to enhance the travel process for these individuals on wheel chair. It integrates a tandem companion bicycle with an attachable/detachable wheelchair system to offer a pragmatic

solution for short-distance travel, with a specific emphasis on enhancing accessibility to public transportation hubs. Complementing this service is a mobile application that streamlines booking and provides real-time tracking, ultimately improving the convenience and autonomy of those with mobility disabilities.

Overall, this service represents a transformative step toward a more inclusive and accessible urban environment, achieved through careful planning, user-centered design, and a strong commitment to accessibility.

2. Background Study and Related work

The mobility challenges faced by individuals with disabilities are a significant concern in urban environments, particularly in regions like India. Accessing public transportation is a vital aspect of daily life, yet it often presents formidable hurdles for people with mobility disabilities. One of the primary obstacles is the considerable distance that many individuals must traverse in order to reach transportation hubs with accessible options. For example, Delhi's unplanned, low-income areas have very limited access to affordable and efficient public transport services. Planned and wealthier areas are comparatively better connected, but still fall short. If all Delhi settlements, planned and unplanned, are not equally well connected to and accessible to public transport, the capital will fail to fully implement its sustainable, low-emission modes of travel (such as walking, cycling, or public transport).[5] The draft Delhi Master Plan 2041 (MPD 2041) projects a population of 27-30 million by 2041, with 50% of this growth due to migration. This surge will result in 46.2 million daily motorized trips. Without a substantial shift to public transport, as targeted by MPD 2041 (80:20 split in favor of public

and shared transport), Delhi will face persistent pollution and carbon issues, warns CSE reports.[5] Immediate enhancements in local accessibility to bus and metro services, along with minimizing interchanges, are imperative. Achieving MPD 2041's goal of 50% population within mass transit influence zones requires improved neighborhood-level design and infrastructure for safe and efficient access.[6]

3. Research Design Process

This research was carried out in the phases of the double diamond method with a few altercations (*fig.1*) according to our personal experiences.

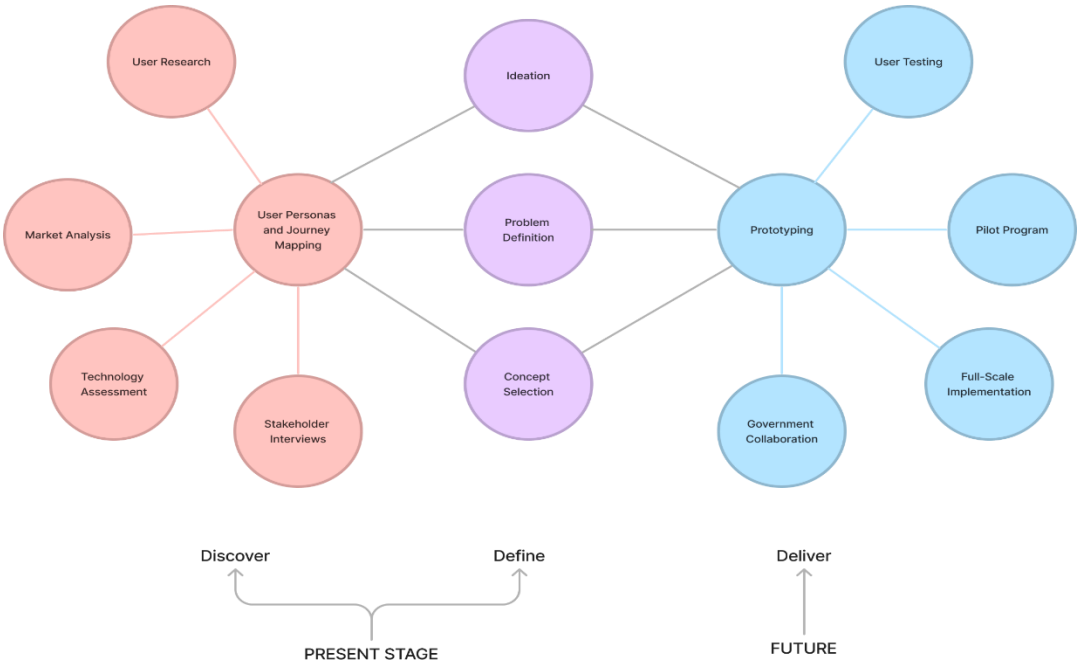

Figure 1- Research Design Map

3.1. Literature Research

The literature review for this research project involved conducting a comprehensive secondary research using various online sources. Research papers and design studies were utilized to gain insights

into the current state of the research topic, identify gaps in the existing literature, and evaluate outdated information that needed to be revised.

3.2. Defining Research Goals

Following the literature review, the research objectives were defined based on the insights gathered from the document analysis. The main goal of the research project was to gain a better understanding of the limitations that a person using a wheelchair faces which leads them to not choose Delhi Transports for the travel.

3.3. Shadowing

We spent time following one of the participants in their daily routine to understand and get insights on the struggles of traveling on the streets of Delhi as an independent individual. We conducted this activity to observe and notice the pain points in the journey from start to end. This helped us gain an in-depth understanding of the daily experiences and challenges faced by a person with disability.

3.4 User Interviews

In-depth interviews were conducted with people with disabilities, asking questions about their backgrounds, reasons for not using public transports, and their experiences with traveling independently in Delhi. This provided valuable insights into the user's perspectives and helped identify key pain points and areas for improvement.

4. Literature Review

Over the years, there have been several conceptualizations of disability, encompassing models such as the medical, individual, social, religious, inter-social, market, moral, economic, spectrum, rights-based, charity, and authenticity models. [7] posits that disability can be primarily categorized into two paradigms: the medical model and the social model. The former focuses on an individual's medical condition, while the latter views disability as an interplay between individual limitations and the environment, with a stronger emphasis on societal barriers [8]. The social model advocates for the dismantling of societal barriers that marginalize individuals with disabilities, including physical, institutional, and attitudinal obstacles. Research by Otmani and Imrie and Kumar [9] reveals that the constructed environment, typically not designed with disabilities in mind, perpetuates the exclusion of disabled individuals from social life. [10] Further elaborate that today, disabled individuals encounter various forms of discrimination, leading to a range of challenges and barriers, much like in the past. Issues such as suboptimal designs, insufficient information, and prejudicial practices have contributed to the social isolation of disabled individuals. In considering the plight of the disabled, the built environment emerges as a powerful symbol of their exclusion from social life [11].

Our aim is not to rely solely on government initiatives to render facilities accessible. Instead, we aspire to establish robust transit services tailored to the needs of individuals with motor disabilities. Through this research and our ultimate objective, we strive for a form of progress characterized by equivoqual advancement. This approach aligns with our vision of inclusivity and self-sufficiency for all members of the community.

5. Participant Study

For this project, we included 30 participants to infer experiences and insights on the problem. Out of 30 participants, there were 9 interviewees, 6 participants in focus group discussions and 15 survey responses. Apart from this, we also shadowed 1 participant in her daily commute from home to college.

6. Findings

We mapped the insights from the interviewees into an affinity diagram (*fig.2*) to categorize the users' experiences and thoughts into a structured format which could help us identify the problems with the existing features.

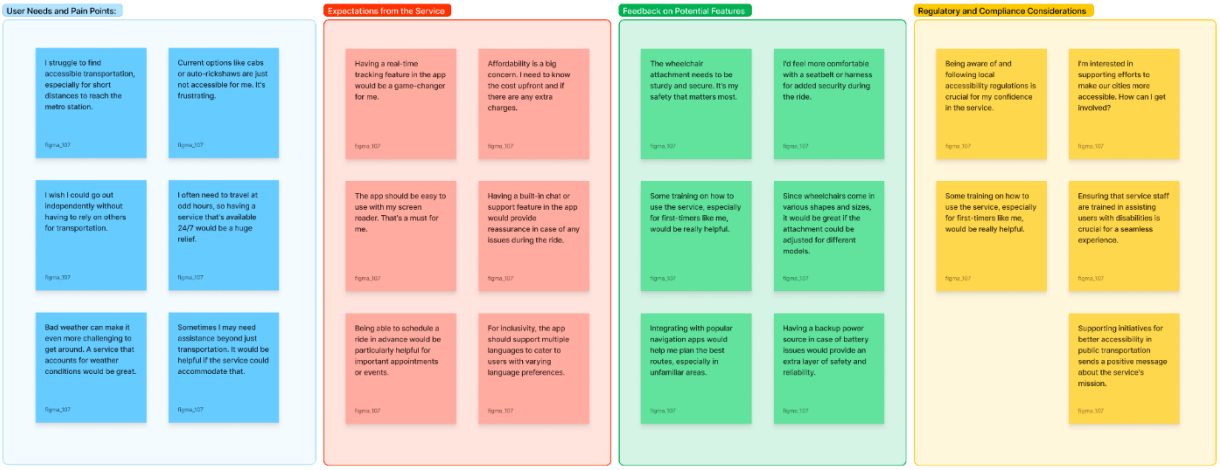

Figure 2 - Affinity Mapping

We followed the 5-W method (Who, When, Where, What, Why and How) to understand the user and the factors affecting the problem area.

1. **WHO -** ***Our user is a wheelchair bound individual with limited mobility.***
2. **WHEN -** ***The user faces the problem when they have to cover short distances.***
3. **WHERE -** ***The local roads and pathways are inaccessible for a person on wheelchair.***
4. **WHAT -** ***To connect the user to disable friendly public transportations seamlessly.***
5. **WHY -** ***A wheelchair bound person could travel independently in the city like any other individual.***

The next step after the research was to analyze the data into valuable insights which could ultimately be used for defining the problem factors. To get to the root cause of the problem, we used fishbone technique (*fig.3*) to move forward.

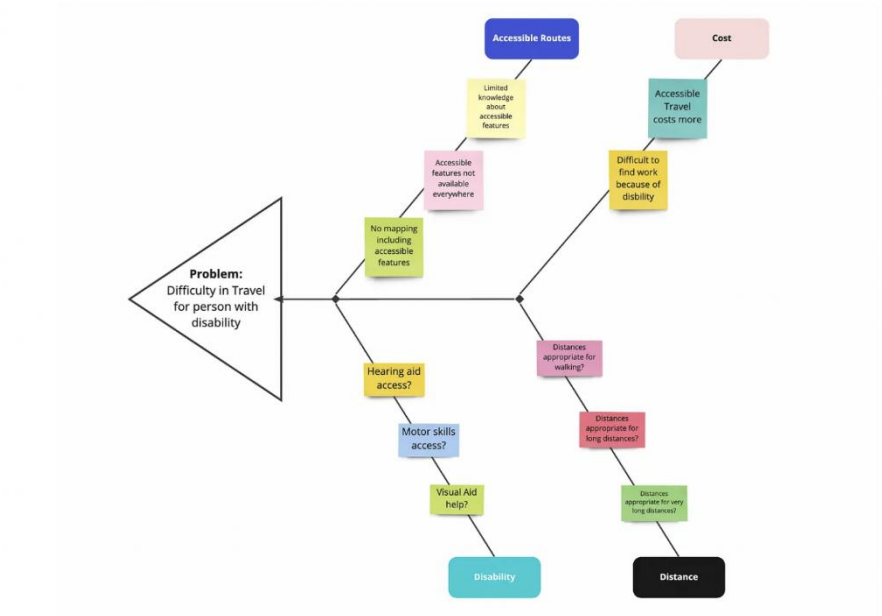

Figure 3 - Fishbone Diagram for root cause analysis

According to the findings, the primary problem being people with motor disabilities not using the public transportations like the Delhi Metro and the Delhi Bus in spite of them being pwd friendly, was further divided into possible sub problems :-

1. **Poor Infrastructure Design within living communities**
2. **Lack of Empathy amongst people**
3. **Lack of opportunities amongst the crowd**
4. **Cost of Travel high for private vehicles**

According to Census 2011, there are 2.68 crore persons with disabilities in India who constitute 2.21 percent of the total population. Out of the total population of persons with disabilities, approximately 1.50 crore are men and 1.18 crore, are women. [12]

It was necessary to get direct real-time insights from the stakeholders in this problem (*fig 4.*):-

1. **Primary user on wheelchair**
2. **Person in contact with the user in the wheelchair**
3. **People in direct environment with the user**

Sno.	User Type	Gender	Age	Usage of Public Transports	Usage of Private Transports	Usage of Bus Stations ?	Usage of Metro Stations ?	Road Infrastructure between Bus stations ?	Road Infrastructure between Metro stations ?	Insights
1	DAP	F	23	+	+	-	+	-	-	Doesn't travel in metro alone
2	SAP	F	31	+	+	+	+	O	-	Usually someone gives her a seat in the metro/bus
3	SAP	M	17	-	+	-	-	-	-	Using private vehicle is expensive but atleast it caters to all my needs.
4	FAP	F	21	+	+	-	+	-	+	Usually take metro for long distances and cover short distances using private vehicle.
5	DAP	F	19	+	-	+	+	-	-	I cannot afford to travel with Private vehicles. Using public transport is tough, but I have no choice.
6	SAP	M	26	+	+	-	+	O	O	I have had a fracture in my do
7	SAP	NB	20	+	+	-	+	O	-	I don't know anything about the bus stations but I have travelled once in metro when I was injured. I realised that was very difficult
8	FAP	F	19	+	+	+	+	+	+	For a person like me, Its quiet difficult to with crowd and all. I suppose for a person with disability, it would be very difficult.
9	DAP	M	24	-	+	-	-	-	-	Its difficult for me to come from my car to the department. Imagine how difficult it would be to travel on the street.
10	FAP	M	21	+	+	+	+	+	+	I usually help my friend to go from one place to another between classes. You need to have a lot of compassion and empathy to do that.

Figure 4 - User Data

The following pointers lead to the inference that prevents the user from using the public transportation system in delhi -

1. **The local delhi metro is a disabled friendly public transportation for wheelchair prone and visually impaired individuals.**
2. **The network of Delhi metro is spread across the whole city, with metro stations at and within every 5 km.**
3. **The problem lies amongst this short distance because of poor road infrastructure, potholes and an unstable path for a person in a wheelchair or who cannot see.**

7. Hypothesis

After comprehension of all the information gathered from the research phase, we started constructing the problem statement on the basis of it. We followed the format of the How Might We Statement to create a clear, cut defined statement to build ideas upon.

How Might We Statement

How might we create travel easy and accessible for people with motor disabilities for short distances to reach accessible public transportation (Delhi Metro) ?

8. Discussions

After defining the problem space, it was necessary to decide how to move forward with ideating the solutions (*fig.5*). We divided the scale into a priority-feasibility matrix which could help us in keeping aligned to our goals.

Engaging with accessibility experts and developing a user friendly app interface was kept at high priority to create a meaningful and seamless experience for the users. We also investigated the potential regulatory hurdles with the purpose of high desirability but low feasibility.

Figure 5 - Kano Model

This paper introduces a cutting-edge service designed to address the mobility challenges that people with disabilities face in India. The service combines a tandem companion bike [13] with an attach/detachable wheelchair design to provide a practical and innovative solution for short-distance travel. This service aims to bridge the accessibility gap in a country where accessibility remains a major concern, particularly in reaching public transport stations (*fig.6*).

The accompanying mobile application simplifies the booking process and provides real-time tracking, ensuring users' convenience and efficiency. Individuals with mobility disabilities gain a new sense of independence and mobility as a result of this

service, allowing them to navigate urban environments more easily.

The safety and stability of the bike-wheelchair attachment, user-friendly app design with accessibility features, and compliance with local regulatory standards were all important considerations in the service's development. Furthermore, community engagement and feedback were critical in refining the service to meet the specific needs of its target audience. This paper describes the conceptualization, design, and implementation of the service, highlighting its potential to significantly improve the quality of life for people with mobility disabilities in India. This service represents a transformative step towards a more inclusive and accessible urban environment, thanks to careful planning, user-centered design, and a commitment to accessibility.

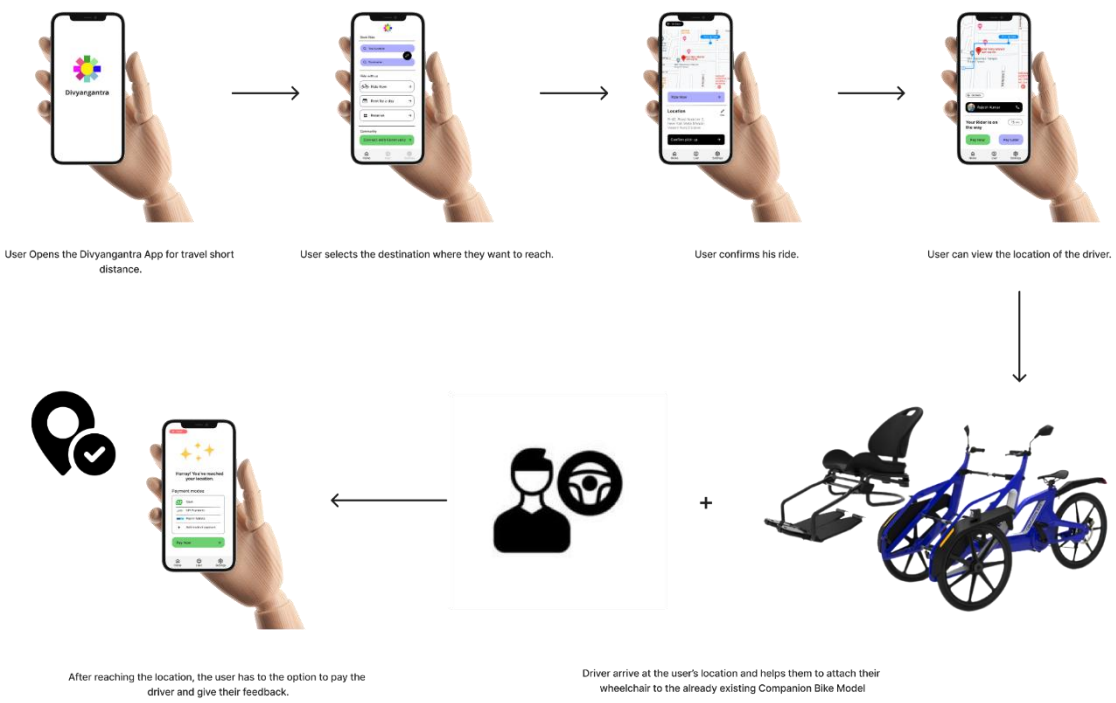

Figure 6 - Userflow Diagram

9. Social Impact

This project is instrumental in directly enhancing the travel experience for individuals with motor disabilities. The service is meticulously crafted to empower individuals who use wheelchairs, enabling them to travel with self-sufficiency and ease, without the need for external assistance. Consequently, this service transforms the act of traveling for a person with a disability from a cumbersome liability into a normalized and inclusive experience. The underlying principle is founded on the belief that individuals should have the capacity to travel without being encumbered by the societal constraints and limitations often imposed upon them.

10. Limitations

This service imposes a constraint wherein the user's ability to travel is limited to solitary journeys; it does not facilitate travel with a companion. It should be noted that this service primarily functions as a rehabilitation solution, designed with the intent of mitigating the issue to a certain degree.

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