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Understanding Assistive Mobility Barriers for People with Lower Limb Disabilities in Indian Homes through Participatory and Co-Design Frameworks

Submitted in partial fulfillment of the

Requirements for the award of the degree

Of

Masters in Design

By

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STUDENT'S DECLARATION

I hereby certify that the work presented in the thesis entitled "*Understanding Assistive Mobility Barriers for People with Lower Limb Disabilities in Indian Homes through Participatory and Co-Design Frameworks*" is my own work carried out during a period from **20th Aug 2025 to 25th May 2026** under the supervision of **Prof. Abinash Kumar Swain** & **Prof. Madhan Kumar Vasudevan.** The matter presented in the report has not been submitted for the award of any other degree of this or any other Institute.

Dated: **25th May 2026**

Signature of the Student

SUPERVISOR'S DECLARATION

This is to certify that the above-mentioned work is carried out under my supervision.

Dated: **26th May 2026**

Signature of the Supervisor(s) 26/05/2026

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Understanding Assistive Mobility Barriers for People with Lower Limb Disabilities in Indian Homes through Participatory and Co-Design Frameworks

by

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Submitted to the Department of Design, Indian Institute of Technology, Roorkee on May 26th, 2026 in partial fulfillment of the requirements for the degree of Master of Design

Abstract

Assistive mobility devices are meant to support independence for people with lower-limb disabilities. However, many of these devices do not fit well into everyday life inside the home. These everyday problems are often managed through habit, family support, or avoidance, and therefore may not always be seen as design problems. This thesis explores how participatory and co-design methods can help surface domestic mobility barriers and translate them into design directions for assistive mobility.

The research began with the issue of assistive technology abandonment. Through the literature review, abandonment was understood as a cause of limited user involvement in the design process.

The study was carried out through qualitative and situated research methodology. This methodology through workshops and semi-structured interviews helped participants respond more directly to the problems and suggest possible changes. The responses were analysed through thematic analysis and translated into design implications, sketches, and concept directions. Participant feedback on early concepts was then used to refine and bring the ideas together into one assistive mobility concept.

Ultimately, by using participatory and situated visual methods, the research demonstrates a process for moving from lived domestic frictions to design components for assistive mobility. The work contributes to a more grounded and contextual way of designing assistive mobility solutions or dialogues for Indian homes especially.

Keywords: *Participatory Design; Assistive Mobility; Indian Homes; Lower-Limb Disability.*

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List of Acronyms

Acronym	Full Form
ADL	Activities of Daily Living
ALIMCO	Artificial Limbs Manufacturing Corporation of India
AT	Assistive Technology
CAD	Computer-Aided Design
CHC	Community Health Centre
CPWD	Central Public Works Department
ISIC	Indian Spinal Injuries Centre
MU	Meaning Unit
PD	Participatory Design
SCI	Spinal Cord Injury
VR	Virtual Reality
WHO	World Health Organization
UNICEF	United Nations Children's Fund

To the quiet walks around basketball court that always gave me direction.

This is just the beginning.

Chapter 1: Introduction

1.1 Context and Background

This is when the match becomes particularly important within the context of the home. Activities like movement in and out of the bathroom, accessing the kitchen platform, transfers from bed to wheelchair, navigating through confined spaces, and navigating through small doorways are common for individuals with lower-limb disabilities. These tasks happen in cramped and shared environments that were never designed with assistive devices in mind.

The demand for assistive technology in India still persists even with inadequate availability of proper tools. In one of the latest quick assessments of the needs of assistive technologies in India, there seems to be an indication that some unmet needs exist due to issues such as high costs and shortages (Senjam et al., 2023). On the other hand, national building standards exist that offer guidelines for barrier-free construction including door width, ramp specifications, toilet access, and circulation areas (Ministry of Housing and Urban Affairs & CPWD, 2021). These standards are not always followed, especially in cramped domestic spaces in low- and middle-income communities.

As a result, individuals make accommodations to the environment instead of vice versa. They may brace walls or furniture, rely on family members, avoid some locations, use assistive devices selectively, or even develop their own makeshift solutions. While such adaptations facilitate routine activities, they may simultaneously mask the design problem at hand. A barrier that needs to be negotiated each day may cease to exist as a barrier.

1.2 Problem Statement & Motivation

Assistive devices for mobility have been investigated using a clinical, technical, or general accessibility approach. Such approaches are relevant but fail to address how a mobility device functions when introduced to a typical Indian household setting. A wheelchair that performs well in a hospital corridor will fail to perform in a bathroom doorway. A walker can aid balance but be hard to use in a congested kitchen. A crutch might enable locomotion but be dangerous to use on wet floor surfaces or thresholds.

Non-use of assistive technologies, as reported in prior studies, stems from multiple inter-related factors and cannot usually be attributed to one single cause (Phillips & Zhao, 1993; Scherer, 2005; Federici et al., 2016; Sugawara et al., 2018). Abandonment and underuse are therefore understood, in addition to being user behavior, as indicators of misalignment within the design and implementation process.

The inspiration for the study was, precisely, this misalignment. Initial interviews revealed that participants faced recurrent difficulties in their homes, specifically around bathroom facilities,

kitchens, threshold crossings, transferring positions, and tight mobility paths. Yet the difficulties mentioned were considered routine accommodations instead of design requirements. This became a methodological difficulty, as direct questions were not sufficient to reveal all mobility issues in the household.

This is why the thesis draws on co-participatory and co-speculative methodology to introduce daily mobility experiences into the discussion. It is not enough simply to elicit participants' descriptions of their difficulties; the point is to facilitate their visualization, reaction, analysis, and re-framing of such problems by means of photos, booklets, animated stories, and design prototypes.

1.3 Research Gap

From literature and fieldwork review emerged four gaps, addressed by this thesis:

- Mobility inside the domestic space is less visible than public accessibility. Accessibility is often studied in relation to ramps, transportation, institutional settings, and public buildings. But for users who have lower limb disabilities, the home becomes a repetitive source of mobility limitations.

- Devices are not developed to account for the domestic space of India. Devices can become problematic when considering narrow bathrooms, elevated doorways, small kitchens, crowded spaces, and uneven floors indoors.

- Adaptation through the course of everyday life may mask the design issue. The individual may get along with the help of family assistance, personal adjustment techniques, avoidance measures, or the Indian improvisational “jugaad.” Adaptations may make the barrier less noticeable while not solving it.

- User involvement in device design is frequently too delayed. User involvement as part of participatory design assumes users to be participants in the development process and not merely respondents and end-users (Sanders & Stappers, 2008; Bødker & Kyng, 2018). In the context of assistive mobility, this means that individuals utilizing these technologies have information on the use of domestic space that is not apparent to the designer, clinician, or manufacturer.

This thesis seeks to address these issues by analyzing domestic mobility as an everyday design challenge. It explores ways of making design friction explicit and transforming it into implications for assistive mobility in India.

1.4 Research Questions & Objectives

1.4.1 Research Aim

The purpose of assistive mobility devices is to promote independence and participation in activities of daily living. Nevertheless, most assistive devices end up being abandoned or

underused. Previous research indicates that abandonment of assistive devices occurs due to a mismatch between the person, device, activity, and context in which the device is expected to perform its function (Phillips & Zhao, 1993; Scherer, 2005; Federici et al., 2016; Sugawara et al., 2018). In this sense, abandonment can be seen as the product of design of the device, the selection process, and the fit of the device to the person's way of life.

One's house is an important site where activities of daily living are performed. The movement between different spaces, such as accessing the toilet, going to the kitchen, passing through a threshold, or transferring from a wheelchair to a chair is hindered if the interaction of the built environment and the assistive technology does not accommodate a person's movement. It should be noted that research in disability and the domestic space highlights that houses are built according to normative assumptions about an able-bodied body.

The aim of this research is to examine the mobility difficulties that persons with disabilities on their lower limbs experience during activities of daily life within their domestic environment in India. The research also seeks to study how these individuals cope with such difficulties and how the use of participatory and co-speculative methods may enable such expression and reflection.

1.4.2 Research Questions

The following research questions will guide my research:

- **RQ1.** What are the mobility constraints faced by people with lower limb disabilities during their activities of daily living within Indian households?
- **RQ2.** How have people with lower limb disabilities adapted to their domestic mobility constraints in their day-to-day life?
- **RQ3.** What are some ways that participatory and co-speculative approaches can enable people to engage with their domestic mobility constraints?

1.4.3 Research Objectives

In order to address the research questions posed above, the thesis has the following objectives:

- *Reviewing literature on assistive technology abandonment, domestic mobility, and participatory design of assistive technologies.*

  Such an objective will help in positioning the research within other studies that have addressed the topics of abandonment and participation. For example, Phillips & Zhao (1993) view abandonment as a critical problem in the usage of assistive technologies, whereas Scherer (2005) emphasizes that assistive technologies should be considered in the context of the individual's entire lifestyle and not just the devices themselves. According to Federici et al. (2016) and Sugawara et al. (2018), a number of factors determine abandonment, among which user needs, product suitability, provision services, and the physical environment.

- *Understanding how the everyday domestic mobility challenges are met and adapted to by individuals with lower limb disabilities in their homes in India.*

The aim here is focused specifically on activities of daily living performed indoors and in particular those involving mobility through bathrooms, kitchens, bedrooms, thresholds, and narrow indoor passages. The importance of understanding this issue is highlighted by Imrie (2004), who suggests that disability is defined by the interaction between a person's body and the physical environment. Imrie and Hall (2001) and Heylighen and Strickfaden (2012) also show that design and architecture often fail to account for diverse bodily needs.

These Objectives look at how people adapt to carry out their day-to-day activities if the home or the assistive device cannot help them fully. This adaptation can involve getting help from other individuals, leaning against walls and furniture, staying away from some places, altering the way an activity is carried out, and utilizing an assistive device selectively. This kind of adaptation may lead to barriers being considered normal since they still have some impact.

- *To enable the application of participatory and co-design methodologies in order to facilitate discussion regarding the participants' lived experience with domestic mobility.*

  The participatory design approach is used since it views participants as co-contributors to the design process and not just as respondents or testers (Sanders & Stappers, 2008; Luck, 2018). In this case, the use of semi-structured interviews, participant photography, and prompts within booklets is meant to facilitate discussion on the participants' experiences of domestic mobility.

  Co-speculative approaches are used to enable discussion, critique, and reflection of real-life scenarios related to domestic mobility. According to Desjardins et al. (2019), bespoke booklets can be used in co-speculative activities, which involve using visual prompts in relation to familiar scenarios. Speculative approaches are also helpful in challenging existing assumptions and discussing possible alternatives (Dunne & Raby, 2013; Bleecker, 2009).

- *To analyse the participants' responses and translate them into design implications and early conceptual directions.*

  Thematic analysis is used in the study to look for themes across interviews, booklet responses, sketches, photographs, and discussion from workshops. The authors of this research define thematic analysis as a technique for analysing qualitative data in terms of themes (Braun & Clarke, 2006, 2021).

  The final output is not considered to be the end product of a medical or business nature. It rather acts as the initial concept based on barriers, adaptations, and criticisms emerging from the study.

1.4.4 Scope of the Research

The current thesis addresses persons with disabilities of the lower limbs and mobility in Indian households. This project is interested in activities of daily life and how persons maneuver, adapt,

or cope in domestic environments. It is not designed to address all the challenges that may arise in assistive devices, policies, funding, infrastructure, and service delivery systems. However, they are mentioned when they emerge in participants' accounts; the thesis concentrates on domestic mobility challenges.

The design development of the current thesis represents an initial concept exploration stage. It is not intended to present a fully developed prototype of the assistive technology. The primary contribution of the thesis lies in the development of the concept through participatory and co-speculation techniques.

1.5 Thesis Structure

The thesis is organized as follows:

- **Chapter 1** introduces the research context, problem, research gap, aim, objectives, research questions, and scope.
- **Chapter 2** reviews literature on assistive technology abandonment, domestic accessibility, participatory and co-design methods, speculative design, and disability in the Indian context.
- **Chapter 3** presents the research methodology, including the conceptual framework, study design, participants, ethics, data collection methods, and analysis approach.
- **Chapter 4** presents the phases of the study. It describes the interviews, bespoke booklet workshop, scenario-based workshop, and design translation process.
- **Chapter 5** synthesizes the findings across phases and discusses the results in relation to the research questions.
- **Chapter 6** concludes the thesis by summarizing the key contributions, design implications, limitations, and future work.

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews literature related to assistive mobility, domestic accessibility, and participatory design. The focus is on people with lower-limb disabilities and the difficulties they face while using assistive devices inside Indian homes.

The chapter is organized into five areas:

1. Assistive technology use and abandonment;
2. Lower-limb disability and activities of daily living;
3. Indian domestic layouts and mobility barriers;
4. Assistive devices in relation to home environments;
5. Participatory and co-speculative design methods.

The aim of this review is to show why domestic mobility cannot be studied only as a device issue. It must be understood through the relationship between body, assistive device, activity, home layout, and everyday adaptation.

2.2 Assistive Technology Use and Abandonment

Assistive technology includes assistive products, services, and systems that support functioning, participation, and independence for people with disabilities (WHO & UNICEF, 2022). Mobility-related assistive technologies include wheelchairs, walkers, crutches, canes, orthoses, prostheses, and transfer supports.

The need for assistive technology is high, but access remains unequal. WHO and UNICEF estimates that more than 2.5 billion people need at least one assistive product, and this number is expected to rise by 2050 (WHO & UNICEF, 2022). In India, studies using the rapid Assistive Technology Assessment have also shown unmet need, with barriers related to affordability, availability, awareness, and service delivery (Senjam et al., 2023).

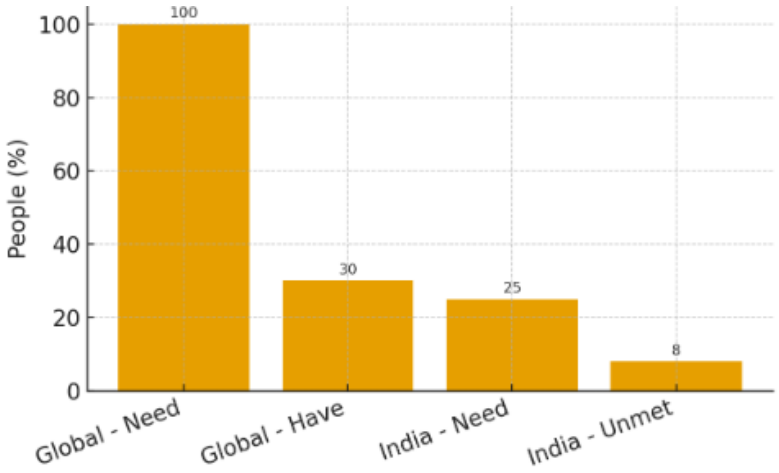

Figure 1 AT need vs. access (WHO & UNICEF, 2022)

However, access to a device does not ensure meaningful use. Assistive technology abandonment has been widely discussed as a problem where a device is acquired but later rejected, unused, or used only in limited situations (Phillips & Zhao, 1993). Research shows that abandonment can result from poor fit between the person, the device, the activity, the environment, and the service process (Scherer, 2005; Federici et al., 2016; Sugawara et al., 2018).

For this thesis, abandonment is understood as a design concern. When a mobility device is not used inside the home, it may not be because the person does not need support. It may be because the device does not fit the house, the task, the body, or the daily routine.

2.3 Lower-Limb Disability and Activities of Daily Living

Lower-limb disability can affect standing, walking, balance, transferring, reaching, and movement between rooms. In the home, these actions are linked to activities of daily living such as bathing, toileting, cooking, dressing, transferring from bed, and moving through circulation spaces.

- Entering and exiting rooms;
- Turning within limited space;
- Crossing thresholds;
- Balancing on wet or uneven floors;
- Reaching work surfaces;
- Transferring between bed, chair, toilet, or wheelchair.

This differentiates mobility in the home environment from general public access. Accessibility in the public context tends to center on entry, ramping, lifting, and movement. Mobility in the home environment entails frequent and limited movement through a confined space.

2.4 Indian Domestic Layouts as Mobility Barriers

Indian houses differ depending on income level, location, and family structure. Nevertheless, there are several spaces in common houses that may hinder mobility assistance. This includes small bathroom doors, raised thresholds, tiny kitchens, and differences in level inside the house, crowded furniture, wet floors, and multipurpose common spaces.

Accessibility standards in India provide guidance for barrier-free built environments. The Harmonised Guidelines and Standards for Universal Accessibility in India include recommendations for step-free access, ramp slopes, clear door widths, accessible toilets, and wheelchair turning space (Ministry of Housing and Urban Affairs & CPWD, 2021). For example, accessible design commonly requires wider doorways, sufficient circulation space, and safe movement across level changes.

In practice, many existing homes do not meet these standards. Retrofitting may be difficult because of limited floor area, cost, tenancy, old construction, or family priorities. This creates a gap between accessibility guidelines and actual domestic use (Ministry of Housing and Urban Affairs & CPWD, 2021).

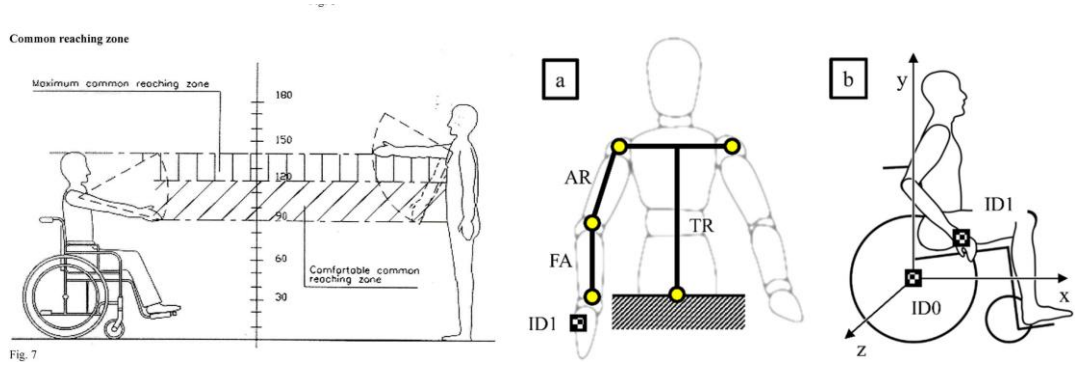

Figure 2 Ergonomic considerations in and around surroundings, Adapted from the WHO ergonomics study and guidelines

This is because the house is a place where these devices are tested continuously through everyday use. A wheelchair may work well on the street or in hospital corridors, but may fail at a bathroom sill; similarly, a walking aid may support standing, yet become difficult to use in a small kitchen. This shows that assistive devices cannot be evaluated separately from the domestic environments and daily activities in which they are actually used (MacLachlan et al., 2018; Scherer and Craddock, 2002).

2.5 Assistive Devices in Relation to Home Layouts

A majority of mobility aids are meant to cater to the requirements of basic movements only. It is not mandatory that they have been developed considering the small space available within the house. Such issues arise when the equipment has to be used in toilets, kitchen, bedroom, or corridors (World Health Organization, 2008).

The problems encountered by manual wheelchairs may include:

- Small front casters getting stuck while passing through thresholds;
- Limited turning capacity in confined spaces;
- Unsuitable seat height for bed or platform height;
- Difficult to enter the bathroom;
- Needs help from others to maneuver slopes or levels.

However, while walking devices such as walkers or crutches can help balance, they do need hand control, surface friction, and adequate space to maneuver around. In slippery areas like bathroom floors, they can exacerbate the risk of falling by inducing fear. According to Bateni and Maki, even though walking aids provide stability and confidence, they may lead to physical constraints and safety hazards when used in inappropriate settings (Bateni & Maki, 2005).

From this we learn that the design of assistive devices can never be seen independently from its environment of use. As for Indian households, some major design criteria for any aid are: threshold management, turning radius, adjustability in height, foot placement, range, stability, and storability (Iwarsson & Ståhl, 2003) .

These issues are directly pertinent to the present thesis. This research does not look at the wheelchair or assistive device as a standalone item.

2.6 Ergonomics, Anthropometry, and Wheelchair Use in Domestic Space

The subject of ergonomics is pertinent in relation to this thesis as the use of the wheelchair in domestic settings hinges on the interaction between the user's anatomy, the chair itself, and its surroundings. Ergonomic design is important in this context since factors like the height of the seat, width of the seat, depth of the seat, height of the armrests, the position of the footrests, and wheel placement can impact the comfort of the user, ease of transfer, the user's reach, and stability (World Health Organization, 2008).

As we move closer to domestic settings, these ergonomic issues become more noticeable and more prominent. Bed transfer is dependent upon the relationship between seat height and bed height. Kitchen use will depend on the user's seated reach, platform height, and the distance between the body and work surface. The use of the bathroom will depend on turning space, threshold height, floor grip, and safe shifting ability. Thus, while ergonomics does pertain to the design of the wheelchair body, it also involves how well the wheelchair integrates with activity space (Iwarsson & Ståhl, 2003).

While standard wheelchairs and mobility devices may be designed to help navigate from one place to another, the narrow entrances, small bathrooms, elevated thresholds, wet floors, crowded rooms, and inadequate space to turn can make maneuvering inside Indian houses difficult. Accessible design guidelines specify minimum measurements for ramps, doorway sizes, toilets, and wheelchair movement, but not all Indian homes meet these specifications (Ministry of Housing and Urban Affairs & CPWD, 2021). Thus, there exists a difference between what is prescribed regarding accessibility and domestic usage.

Wheelchairs and mobility aids help users balance and move, but they may also impose extra demands while used in inappropriate settings. According to Bateni & Maki (2005), using a cane or a walker helps with stability but can impose extra demands on upper body muscles and pose safety hazards depending on users' situations. Using a wheelchair in small houses is only possible depending on how suitable it is for safe turning, transferring, reaching, etc.

As a result, ergonomics and anthropometry are employed as practical methods in this thesis. Ergonomics and anthropometry allow for a deeper analysis of the descriptions that the participants offer on topics such as their experiences of being too tall, reaching issues, transfer challenges, poor support for feet, problems with turning, and barriers when going through thresholds.

2.7 Adaptation, Dependence, and Normalized Barriers

The participants usually get accustomed to the domestic barriers rather than seeing them as problems. Thus, one would find oneself pressed against the wall, leaning on furniture, depending on relatives, avoiding certain areas of their homes, and finding ways to do things differently (Hodgson et al., 2018).

All of these actions have a practical purpose, but in many cases, they disguise design-related issues. For instance, while the participant would talk about her ways of managing the bathroom threshold, it may not necessarily mean that there is no risk, effort, dependence, or any other discomfort associated with the task.

This observation carries significant implications for the research methodology itself. An interview may bring out some of the concerns, but it is unlikely to uncover all of the barriers that have been normalized in the course of the participant's life (Wilson et al., 2019).

2.8 Participatory and Co-Design Approaches in Assistive Technology

According to participatory design, individuals who are involved in a certain design should be part of the design process. The relevance of user participation in assistive technologies arises due to the fact that people living with disabilities possess knowledge concerning their bodies, daily routines, environment, and possible threats (Luck, 2018).

User participation might help to ensure more relevance of assistive technologies; however, such participation needs to take place sufficiently early to influence the problem definition rather than confirm a ready-made design solution. Hence, participatory design and co-design transform users from respondents or testers to contributors in the process of designing (Sanders & Stappers, 2008; Bødker & Kyng, 2018).

In the current thesis, participatory approaches are employed to explore:

- Where there are domestic obstacles for participation;
- How the participants cope with those obstacles;
- How they evaluate the current tools;
- The ways they propose design modifications upon exposure to familiar situations.

Figure 3 Examples of participatory and co-speculative design methods from prior research

Participation is not taken for granted. There may be participants who are uncomfortable with writing, drawing, or envisioning future devices. That is why this thesis employs multiple approaches, namely interviews, photographs, booklets, animation prompts, and discussion.

2.9 Co-Speculation and Bespoke Booklets

Speculative design involves imaginary worlds, artifacts, and possibilities in order to challenge current assumptions (Dunne & Raby, 2013). The design fiction approach also involves fictional

artifacts or scenarios to render the potential of possible futures discussable in the present (Bleecker, 2009).

However, in this thesis, co- speculative design is not employed to envision some far-off futuristic products. Rather, it is adopted as a means of looking at existing domestic challenges from a new perspective.

Bespoke Booklets were invented by Desjardins et al. as a technique of situational co-speculation, whereby personal photography, drawings, cues, and empty pages were utilized to facilitate discussions about future possibilities (Desjardins et al., 2019).

This method is relevant because the home is difficult to discuss through words alone. A booklet allows participants to look, mark, write, draw, or respond verbally. In this thesis, the booklet method was adapted to assistive mobility by including:

- Domestic friction images;
- Existing assistive device prompts;
- Future mobility prompts;
- Space for participant comments, markings, or sketches.

The later scenario-based workshop further developed this approach by showing domestic mobility as movement rather than as static images.

2.10 Summary and Research Gap

The literature shows that assistive mobility devices are shaped by more than their technical function. Their use depends on cost, availability, body fit, training, repair, domestic layout, family support, and activity needs.

For people with lower-limb disabilities in Indian homes, the main gap is not only access to assistive devices. It is whether those devices can support activities of daily living within actual domestic layouts (Ministry of Housing and Urban Affairs & CPWD, 2021).

The review identifies the following gaps:

Table 1 Literature gaps through literature review

Literature area	What is known	Gap addressed in this thesis
Assistive technology access	AT needs are high, and access is shaped by affordability, availability, awareness, and service systems.	Less is known about whether mobility aids can be meaningfully used inside everyday Indian homes.
Device abandonment	Abandonment is linked to poor fit between user, device, environment, and service process.	Domestic space is often not studied as a central reason for limited use or adaptation.
Domestic accessibility	Homes may include thresholds, narrow passages, bathrooms, kitchens, and level changes that restrict mobility.	There is limited design research on how these barriers affect ADLs for people with lower-limb disabilities in Indian homes.
Participatory design	User involvement can improve relevance and accountability in assistive technology design.	Users are often still positioned as respondents rather than contributors in early problem framing.
Speculative and co-speculative methods	Visual and future-oriented artifacts can support discussion and critique.	These methods are not widely adapted for assistive mobility in Indian domestic contexts.

Chapter 3: Research Methodology

This chapter outlines the methodology used to address the research questions introduced in Chapter 1. It describes the research approach and paradigm, the conceptual framework guiding the study, the overall four-phase study design, how participants were recruited and selected, the ethical basis of the study, the positionality of the researcher, and the limitations of the approach taken.

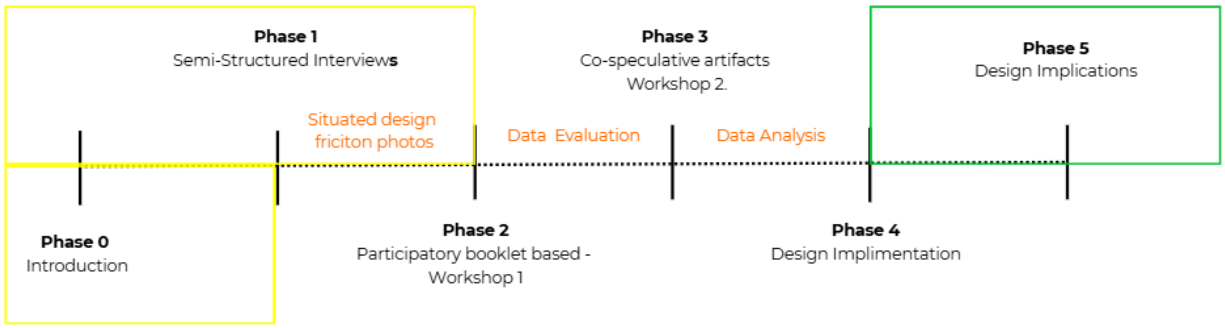

Figure 4 Methodology map (Source: Author)

3.1 Research Approach

This study is situated within a constructivist qualitative research paradigm, which recognises knowledge as co-constructed through participants' lived experiences and interpretations (Creswell, 2013). The goal is not to produce statistics or generalizable numbers, but to understand how people with lower-limb disabilities experience and navigate the physical conditions of their own homes. These barriers arise not only on a personal level but also on spatial and contextual levels with respect to life within Indian households. Qualitative research would be the most appropriate methodology for conducting this kind of study.

In contrast to conventional qualitative methods where the participants are viewed as information providers, the current study views the participants as experts in their context. Individuals who suffer from lower-limb disability together with their carers and family members possess knowledge that cannot be gleaned through observation by an external researcher. This basic premise is reflected in all methodological decisions made during this study (Sanders and Stappers, 2008).

3.2 Conceptual Framework

This study will make use of two design frameworks: speculative design and participatory co-design. These frameworks informed both the research design process and its ultimate aim.

3.2.1 Co-Speculative Design

Co-speculative design is a branch that refers to a design strategy which ignores issues related to technological feasibility and economic sustainability altogether. Instead of asking what can be built right now, it asks what could be possible (Dunne and Raby, 2013). The outputs of

speculative design, such as prototypes, models, or simulations, are not meant to be finished products. They are proposals that help people think, discuss, and imagine different futures. Design fiction, in particular, situates speculative futures within recognizable everyday contexts through narrative and artifacts (Bleecker, 2009; Dunne and Raby, 2013).

This approach is particularly useful in the early stages of a design problem, when the issues are not yet well understood and the range of possible responses is still open. In this study, the domestic barriers faced by people with lower-limb disabilities in India are not yet well documented in design research (Devi et al., 2013). Speculative design provides a way to work productively in this space: to produce outputs that are concrete enough to respond to, without claiming to be final solutions.

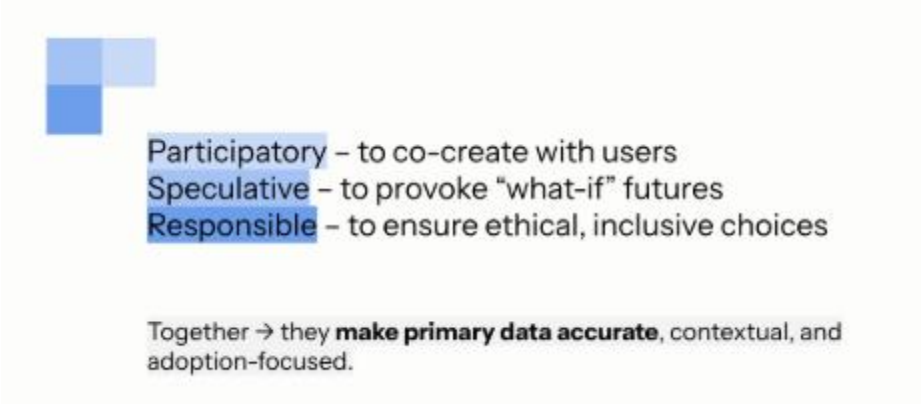

Figure 5 Framework distinction between participatory, speculative, and response-oriented design, adapted from Dunne and Raby

The 3D-printed artifacts and Virtual Reality simulation produced in Phase 4 of this study should be understood in this way. They are not products ready for manufacture. They are design propositions, built from what participants shared across the earlier phases, and intended to open conversation about what future design responses could look like. This framing is not a limitation of the research. It is a deliberate methodological choice.

3.2.2 Participatory Design

It is believed that people who are affected by the design choices must be able to influence the development of such designs in some way (Gregory, 2003; Sanders & Stappers, 2008). Meanwhile, co-design takes this perspective even further by involving people as collaborators in the design process and not merely participants of consultation (Sanders, 2002). In disability studies, the application of participatory methodologies is seen as crucial for ensuring legitimacy of design efforts (Light et al., 2017).

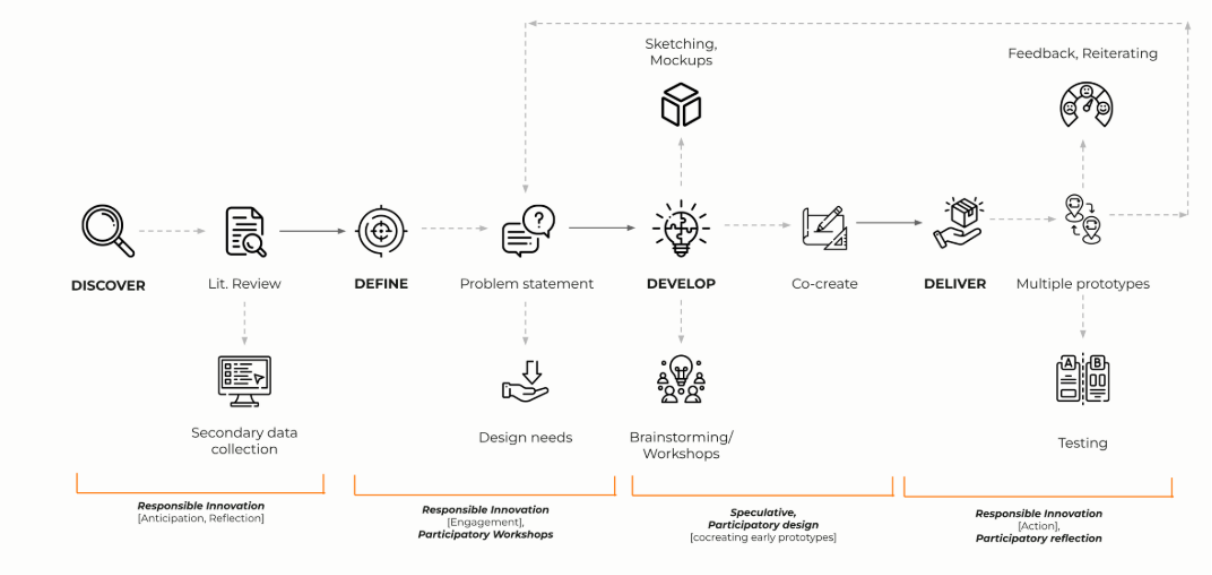

Figure 6 Design Process - Initial Phase to Final Outcome

It is now well-established that the involvement of users into the design process has beneficial outcomes for assistive devices, especially when the design is participatory or co-design (Sanders, 2002; Light et al., 2017). The largest problem in the assistive device industry is that approximately one-third of all assistive devices are being abandoned within the first year after acquisition (Phillips & Zhao, 1993; Scherer, 2005). One of the key reasons behind such high levels of device abandonment is associated with the absence of involvement of users in the design process, which causes the resulting products to be unsuitable for daily life (Scherer, 2005; Federici et al., 2016).The study takes a participatory and co-speculation design approach to all four phases. The participants are not merely interviewed regarding their issues. They are also allowed to take part in the booklet workshop in phase two, provide feedback about the animations in phase three, and make comments on the prototypes during phase four. These techniques sought to ensure that the researcher's role would change from being an evaluator to a facilitator who will be guided by the participants through the process of critical thinking and reflection.

3.3 Overall Study Design

In the study, a four-phase sequential qualitative design is adopted. Every phase is an extension to the findings collected from its preceding phase. In this case, the outputs obtained from the succeeding phases are anchored by what the participants have articulated in the previous phases. The combination of the methodology included the conduct of semi-structured interviews, domestic friction mapping, customised booklet-based participatory workshops, animation workshop based on media, and speculative design outputs (Desjardins et al., 2019).

Phase 1 (Study A): The semi-structured interviews were conducted amongst the people with disabilities of the lower limbs, together with their families and care-givers, in hospitals and

rehabilitation centres. The interviews were conducted in Hindi. The aim here was to find out the daily friction points and mobility barriers faced by the participants within their own houses.

Phase 2 (Study B): From the findings of Phase 1, a unique participatory booklet workshop was created. It involved a bilingual Hindi-English booklet that allowed the participants to highlight barriers that meant something to them through their annotations and sketches.

Table 2 Total number of participants across different phases and locations

No of Participants	**Phase(s)**	**Age range**	**Gender**	**Condition / mobility limitation**	**Device used**	**Recruitment site**	**Data contributed**
9	1	15-20	M & F	Polio-related / accident / SCI etc.	Wheelchair	CHC, Dasna	Semi structured interview responses
14	2	21-30	M & F	Lower limb injuries, accidents, Spinal cord injury	Wheelchair	ISIC New Delhi, KIWANIS, New Delhi and ALIMCO, New Delhi	Interview + photographs + booklet
8	3	31-40	M & F	Lower limb injuries, accidents, Spinal cord injury	Wheelchair /	ISIC, New Delhi	Animation discussions through daily life
2	4	28, 32	F	Polio	Wheelchair	IIT Roorkee	Evaluation response
Total No. of Participants: 32							

Phase 3 (Study C): The media and animation workshop employed animated snippets produced based on the results of Phase 2 to enable discussions. Animation was used since it is an efficient way of depicting spatiality and physical experiences and enables the depiction of scenarios visually as opposed to descriptions.

Phase 4 (Study D): Based on the results of Phases 1 to 3, design suggestions were developed into two printed physical models and a Virtual Reality model designed using Unity. These results were then shown to participants and stakeholders, who were requested to give their input and initiate discussions about possible designs.

Not all participants engaged in each stage of the study. A core group of participants was taken from Phase 1 to the next phases. For instance, two participants from the interviews held in Phase 1 were involved in the booklet workshop during Phase 2, and new participants were included in each phase. Long-term participation by some participants may have been difficult due to recruitment from a clinical environment. This was another conscious decision to introduce new perspectives at later stages instead of confining the discussion to the original interview participants only.

3.4 Participant Recruitment and Selection

The data was collected from various locations in the areas of New Delhi in order to involve individuals who have access to common healthcare and rehabilitation facilities. In all, 32 individuals with lower-limb mobility limitations participated in the study. Participants were sampled purposefully from hospitals and rehabilitation centers. The reason for this was that these locations offer regular encounters with individuals having lower limb disabilities, which include the use and adjustment of their assistive devices. Moreover, the locations also helped in ensuring that the participants had practical knowledge about the use of mobility devices and the home environments in which they can be used successfully.

Figure 7 Four locations from where data was collected for the study

3.4.1 Inclusion Criteria

Individuals who had lower-limb disabilities, were adults living at home and not in institutional care, had experience using assistive mobility devices, and could be interviewed in Hindi language were recruited for the study. Careers and family members sharing the same house as the individual with the lower-limb disability were also considered for recruitment because of the critical role they play in making decisions regarding mobility at home.

3.4.2 Exclusion Criteria

Participation was precluded from individuals who had a temporary disability which had a total recovery outlook, those staying in institutions instead of the domestic setting, or inability to give consent due to cognitive limitations. Additionally, participation was precluded among

individuals who lacked the ability to engage with the study using the Hindi language since the entire session and materials were in Hindi.

3.4.3 Participant Description

The semi-structured interviews were done during a routine disability camp at the Community Health Centre (CHC) Dasna, Ghaziabad. The age group of the participants was 17 to 40 years old. Some of the mobility impairments possessed by the participants included polio, accident-related, and no assistive device. After the end of each interview, participants were informed about an optional phase. Two participants, comprising of one woman and one man, agreed and were requested to provide photos of difficult areas around their homes.

The Phase 2 bespoke booklet workshop was conducted at the Indian Spinal Injuries Centre (ISIC), New Delhi, with 14 participants. The two returning participants from Phase 1 also took part. Phases 3 and 4 engaged additional participants recruited through the same purposive approach. All participants are referred to by pseudonyms throughout the thesis. Anonymised participant profiles, including disability type, duration, household composition, and location, are provided in the appendices.

All Phase 1 interviews were conducted in Hindi. This was a deliberate choice. Requiring participants to speak in English would have placed an unnecessary burden on them and risked losing important detail and nuance in their accounts. The bespoke booklet was bilingual, presented in both Hindi and English, to support participants' engagement across varying levels of literacy. Where participant accounts are referenced in later chapters, these are presented in English translation.

3.5 Data Collection and Analysis

Data sources across the four phases included audio recordings from interviews and workshops, annotated bespoke booklets, participant sketches, photographs of domestic environments shared by participants, and researcher field notes. All audio recordings were transcribed, and visual and material artifacts were digitised and catalogued.

Data were analysed using reflexive thematic analysis, following Braun and Clarke (2006, 2021). Coding was conducted inductively across transcripts, booklet annotations, sketches, and images, with attention to recurring patterns, contrasts, and modes of articulation. Verbal, visual, and material contributions were treated as complementary sources of evidence rather than hierarchical forms of data. Rather than treating themes as objectively discoverable, coding and theme development were understood as interpretive and shaped by ongoing engagement with the data, field notes, and the broader aims of the study. This proved crucial not just in understanding what the participants spoke about but also where articulation failed, altered, or became indirect.

3.6 Positionality

The researcher is a postgraduate student of industrial design at IIT Roorkee who has no experience of living with lower-limb disabilities. It would be necessary to acknowledge this fact since it impacts on the way research was planned and carried out.

In order to overcome this obstacle, several measures were taken. The interviews took place in the participants' language. The workshops were planned in such a manner that participants had opportunities to offer their perspectives rather than answer questions posed by the researcher. Finally, the speculative outcomes that form the basis of Phase 4 were formulated as hypotheses and not the results obtained independently by the researcher.

3.7 Ethics

The current study is an exploratory participatory workshop inquiry. Ethical clearance by any formal institution was not available during the time of data collection. However, permission was taken from the respective institution regarding conducting the semi-structured interviews at the Community Health Centre (CHC) Dasna, Ghaziabad, and conducting the custom designed booklet workshop at the Indian Spinal Injuries Centre (ISIC), New Delhi. The process was done based on the protocols set by the Department of Design at IIT Roorkee.

For recruitment, there was no ambiguity about the voluntary nature of the procedure. It was clear that it was a research activity and not clinical intervention. Clinical staff at recruitment sites were briefed on the study's purpose and asked to support introductions in a way that preserved participant choice.

Participants were informed about the purpose of the study, the voluntary nature of participation, and their right to withdraw at any time before any data was collected. Written informed consent was obtained from all participants before participation began. All data from interviews and workshops were anonymised before analysis. Identifiable participant images were blurred for any dissemination. No personally identifiable information appears in the findings chapters. Data are stored securely and are accessible only to the researcher and supervising faculty.

3.8 Limitations

There are several limitations to this study that should be noted from the outset.

The study is qualitative and does not aim for statistical representativeness. The findings reflect the experiences of 32 participants recruited at specific sites in and around New Delhi. They should not be assumed to apply to all people with lower-limb disabilities or to all types of Indian homes.

The participatory workshop formats used in Phases 2 and 3 require time, energy, and engagement from participants. Some participants found certain formats more accessible than others. For instance, in the Phase 2 booklet workshop, speculative future prompts elicited very little written or drawn engagement compared to architectural and domestic friction prompts. It is likely that the format of each phase shaped, to some degree, what kinds of responses were possible within it.

The translation of Phase 1 interview data from Hindi to English introduced some risk of interpretive loss. The translation process took place with care; while more emphasis was put on

the meaning rather than word-to-word translation, there is still a possibility that some aspects of the original talks were lost.

Lastly, the speculations created in Phase 4 do not go through validation; instead, they form an idea that can be used as a basis for further discussion. This is part of the speculative design methodology. Future research will be needed to take these propositions further and evaluate them in practice.

3.9 Chapter Summary

This chapter has set out the methodology for this study. A constructivist qualitative approach is used (Creswell, 2013), guided by the frameworks of speculative design and participatory co-design. The study is structured across four sequential phases, moving from semi-structured interviews in Hindi through participatory booklet and animation workshops to speculative prototyping and simulation. A total of 32 participants took part across the study, recruited through purposive sampling at CHC Dasna, Ghaziabad, and ISIC New Delhi. Inclusion and exclusion criteria ensured participants had direct lived experience of domestic mobility with a lower-limb disability. Data were analysed using reflexive thematic analysis following Braun and Clarke (2006, 2021). Ethics, positionality, and limitations have been addressed throughout. The following chapter describes each phase of the study in detail.

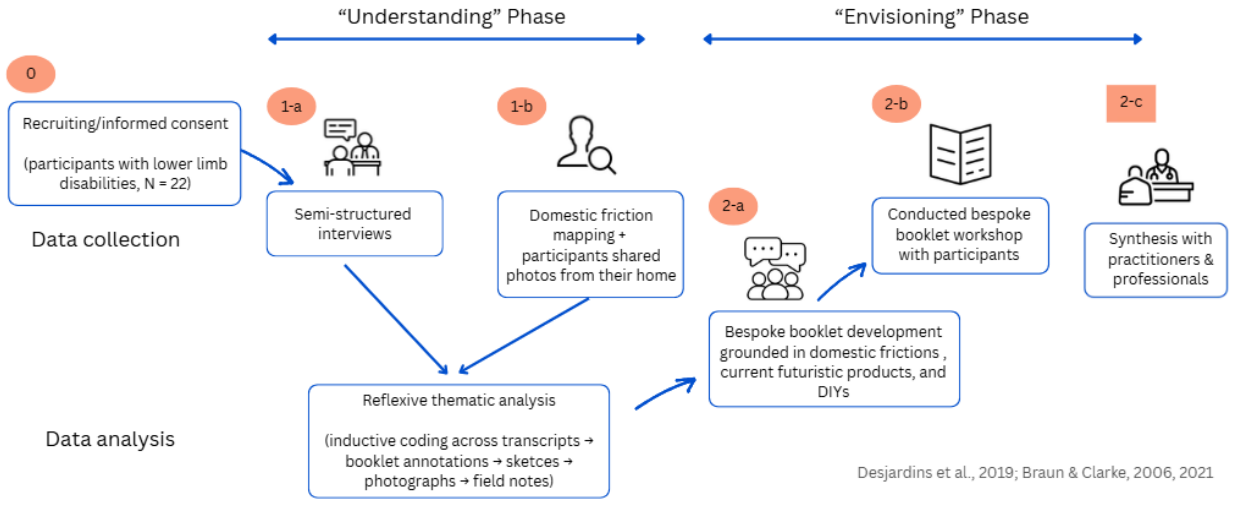

Figure 8 Participant descriptions and stages of involvement

Chapter 4: Phases of the Study

4.1 Phase 1, Study A: Semi-structured Interviews

4.1.1 Introduction

The literature research demonstrated that user preference and device malfunction is not the main factors contributing to assistive technology abandonment. It is frequently influenced by how well the user, the assistive technology, the activity, and the setting all work together (Phillips & Zhao, 1993; Scherer, 2005; Sugawara et al., 2018). This fit becomes particularly crucial for those with lower-limb impairments in the home, where daily tasks are completed in fixed spatial settings.

Although the house is frequently viewed as a private and comfortable place, it can also become a source of ongoing challenges for those with mobility disabilities. As per the literature on disability and domestic environment, the design of the domestic environment is based on people without disabilities, thus forcing the person suffering from disability to adjust his/her routine and mobility pattern within such an environment (Imrie, 2004; Imrie & Hall, 2001). The issue assumes significance in relation to Indian domestic environments since everyday mobility involves narrow doorways, high door thresholds, small toilet areas, and kitchens not conducive for assisted mobility.

Thus, Study A was planned as the first step in the process of understanding the issues related to mobility in the domestic environment from the perspective of persons suffering from lower-limb disability and the person assisting them. The objective at this stage of research was to understand the mobility problems faced by the participants on a daily basis in relation to their activities in the domestic setting.

Thus, the research process began with Study A. It helped define initial problem areas, and served as a foundation for further participation activities. The stage was initiated through participants' descriptions of moving, getting help, experiencing difficulty, and adapting to the domestic environment, without pre-defining a design solution at the outset.

4.1.2 Method

The study A employed semi-structured interviews to learn about the difficulties that people with lower limb impairments faced in terms of moving around their domestic environments. The choice of interview was based on its capacity to use a uniform set of questions, while allowing for individual responses (Kallio et al., 2016).

Figure 9 Semi structured interview held at CHC, Dasna, Ghaziabad

The study was conducted at the Community Health Centre (CHC), Dasna, Ghaziabad. Permission to conduct the study at the site was obtained before data collection.Recruitment was done during their visit to the centre. The purpose of the study was shared with them in Hindi language. Voluntary participation in the study was ensured. The consent was taken from the participants prior to the interview session. Participants were also informed that they can decline to give answers to any question and also terminate the session whenever they wish to do so.

9 participants participated in this phase of the study. Participants had lower-limb disability owing to poliomyelitis, recent accident, spinal cord injuries, and paraplegia. Ages of the participants varied from 15 to 50 years. There was an equal representation of men and women in the selected sample. At times, there was involvement of caregivers/family members in the interview session. Information provided by them was utilized only to understand the routine of mobility within the domestic environment and their support.

Interviews were carried out in Hindi language. Questions related to mobility routines within the house such as room-to-room mobility, accessing bathroom, accessing kitchen, transfers, crossing thresholds and areas where assistance is required by the subject. They were also asked about assistive devices, barriers experienced with assistive devices, and modification made in daily routines.

Participant identities were anonymized during documentation.

Table 3 Phase 1 Participant Overview

Participant ID	**Age**	**Gender**	**Condition**	**Device used**	**Quote**
P1	16	M	Polio-related lower-limb impairment	Wheelchair	Difficulty moving independently inside the house, especially where floor levels change or support is not available.

Participant ID	Age	Gender	Condition	Device used	Quote
P2	22	M	Accident-related lower-limb injury	Wheelchair	Found bathroom entry and movement in narrow spaces difficult, especially when turning or balancing.
P3	24	M	Spinal cord injury	Wheelchair	Reported getting restricted at thresholds and doorways while using the wheelchair inside the home.
P4	24	F	Accident-related lower-limb injury	Wheelchair	Faced difficulty in kitchen-related activities because standing for long or reaching the platform was uncomfortable.
P5	28	F	Polio-related lower-limb impairment	Wheelchair	Managed movement through habit, but reported difficulty in transfers and moving through crowded areas.
P6	34	M	Paraplegia	Wheelchair	Reported that bathroom access and raised thresholds made independent movement difficult.
P7	40	M	Spinal cord injury	Wheelchair	Faced difficulty moving between rooms because of narrow passages, furniture placement, and turning space.
P8	40	M	Accident-related lower-limb injury	Wheelchair	Needed support during daily movement and avoided some areas of the home when movement felt unsafe.
P9	42	M	Polio-related lower-limb impairment	Wheelchair	Reported adapting to the home layout over time, but still faced difficulty with steps, thresholds, and uneven floor levels.

As a concluding note of the interview, participants were asked if they would willingly provide pictures of those spaces inside their houses where they feel constrained in their movement. It was not mandatory, but voluntary. In total, two participants provided six photos. However, after evaluating these pictures, two pictures were left out since they depicted the same space. Hence, only four pictures remained to be used in the second phase of the research.

All the material collected in the interviews and from participant photographs was analysed through a preliminary descriptive synthesis. It was done with the goal of identifying problems in relation to domestic mobility before doing a more complete thematic analysis later on. The material was categorized according to spaces and activities mentioned by participants: bathroom, kitchen, threshold, transfer and confined movement areas, among others. All participant-provided pictures were then evaluated together with notes taken during the interviews to determine how participants felt about particular spaces inside their home.

4.1.3 Result

These are the first reported difficulties with domestic mobility as noted in Study A. These results are offered as initial problem areas because they would be instrumental in informing the subsequent participative stage.

In terms of bathroom mobility, the most consistent difficulty encountered by participants was gaining entrance into the bathroom, traversing over thresholds, balancing while walking in the wet bathroom, and negotiating in small spaces. For those participants using wheelchairs, the doorway and thresholds were the greatest problem. For those with crutches or support from their own bodies, the difficulty revolved around balance.

Movement within narrow or crowded spaces was another problem area that emerged from the interview findings. In many cases, participants relied on the walls, furniture, or family members to navigate throughout the household spaces. Some individuals avoided certain areas while others had designated pathways within their homes that were consistently used. Thus, mobility within the domestic setting was largely a matter of routine adaptation. The kitchen also emerged as a problem area. This indicated that reaching a space was not enough; the space also had to support the activity being performed.

The interviews also showed that many barriers had become normalized. Participants often described adaptations as part of daily life rather than as problems. This finding informed the need for visual and situated prompts in the next phase.

Two participants shared six photographs of difficult areas in their homes. After review, two photographs were removed because they repeated similar spatial information. The remaining four photographs were retained and used to inform the Phase 2 booklet prompts.

Figure 10 Participant-shared photographs of domestic mobility friction points retained after review.

Overall, Study A identified four initial problem areas:

1. Bathroom access and thresholds;
2. Narrow or crowded movement spaces;
3. Kitchen access and reach;
4. Everyday adaptation through support, avoidance, or changed routines.

These findings provided the basis for Phase 2.

4.1.4 Discussion

Barriers to domestic mobility were not found to be caused merely by the presence of the assistive device in Study A. They arose due to the combination of factors relating to the interaction between the body, the assistive device, the task performed, and the domestic environment. This conforms to previous literature, according to which the use of assistive devices is highly dependent on the fit of the device to the person and its environment of usage (Phillips & Zhao, 1993; Scherer, 2005; Federici et al., 2016).

The most prominent issue in terms of barriers to domestic mobility that emerged from this analysis was that of gaining access to the toilet area. The participants identified the difficulty of accessing this area due to the inability to perform smooth movements inside of it due to limited space. Thus, for instance, P3 mentioned the toilet door as the place where it becomes difficult to navigate:

"mai hamesha waha atak jata hu or fir apni patni ko

bula kar aaghe ka pahinya uthana padta hai".

The other challenge was movement in tight or busy areas. The participants spoke about movement within fixed routes, using support from walls or furniture or from the help of relatives. P1 justified this by stating

"kabhi-kabhi mujhe chalna pasand hai toh mai sofe ya bed ki madad se apni

wheelchair chordkar chalti hu".

This indicates that the domestic challenges faced by the individuals were adjusted for in terms of daily routine.

Access to the kitchen was another factor that became apparent, especially when the individuals had to stand or bend close to the platform. P4 described this difficulty in relation to everyday tasks: *"Khana banane ka itna mann hone ke bawajood bhi mai slab tak phonch nahi paati"*. This proved that there was more to mobility within the house than just getting to the room. Rather, it entailed being capable of carrying out the activity once arriving at that room.

In sum, Phase 1 provided evidence that several domestic barriers had been normalized. The participants did not view these cases as a design problem since they had adjusted themselves to living with them. This was one of the primary insights gained during this phase. Though interviews were an effective way of recognizing emerging issues, they were inadequate to reveal normalized domestic friction.

4.1.5 Conclusion

The following four difficulties of domestic mobility issues were found from Study A: bathroom access and threshold; narrow or crowded space for movement; kitchen access and reach; and adaptation through support/avoidance. The results obtained in this study were used in developing Phase 2, in which visual cues helped direct discussions about mobility issues within the home.

4.2 Phase 2, Study B: Bespoke Booklet workshop

4.2.1 Introduction

Phase 1 identified initial domestic mobility difficulties related to bathroom access, thresholds, narrow spaces, kitchen reach, and daily adaptation. However, the interview responses also showed that several barriers were already normalised in participants' routines. Participants often described these situations as things they had adjusted to, rather than as clear design problems.

Phase 2 was therefore designed to use a more visual and participatory format. A booklet-based workshop was selected because it allowed participants to respond to images, questions, and imagined situations through writing, marking, stickers, sketches, and discussion. Desjardins et al. (2019) describe bespoke booklets as material artifacts that support situated co-speculation by placing prompts close to participants' own domestic contexts and allowing them to leave written or drawn responses.

In this study, the booklet method was adapted for assistive mobility inside Indian homes. The aim was not to ask participants to design a complete device. Instead, the booklet was used to understand how participants responded to domestic frictions, existing assistive devices, and possible future mobility ideas.

4.2.2 Method

Study B used a bespoke participatory booklet workshop (Desjardins et al., 2019) with 14 participants with lower-limb disabilities. The workshop was conducted at the Indian Spinal Injuries Centre (ISIC), New Delhi, after formal site permission was obtained. The booklet was developed from Phase 1 interview findings and the participant-shared home photographs.

The booklet was designed as a simple paper-based tool. It included visual prompts, short contextual questions, and open spaces for participant responses. Such a form of presentation was chosen since it allowed each participant to give answers in various forms, depending on how comfortable he or she felt with either writing or drawing. The booklet would provide an actual document that could later be analyzed after the workshop.

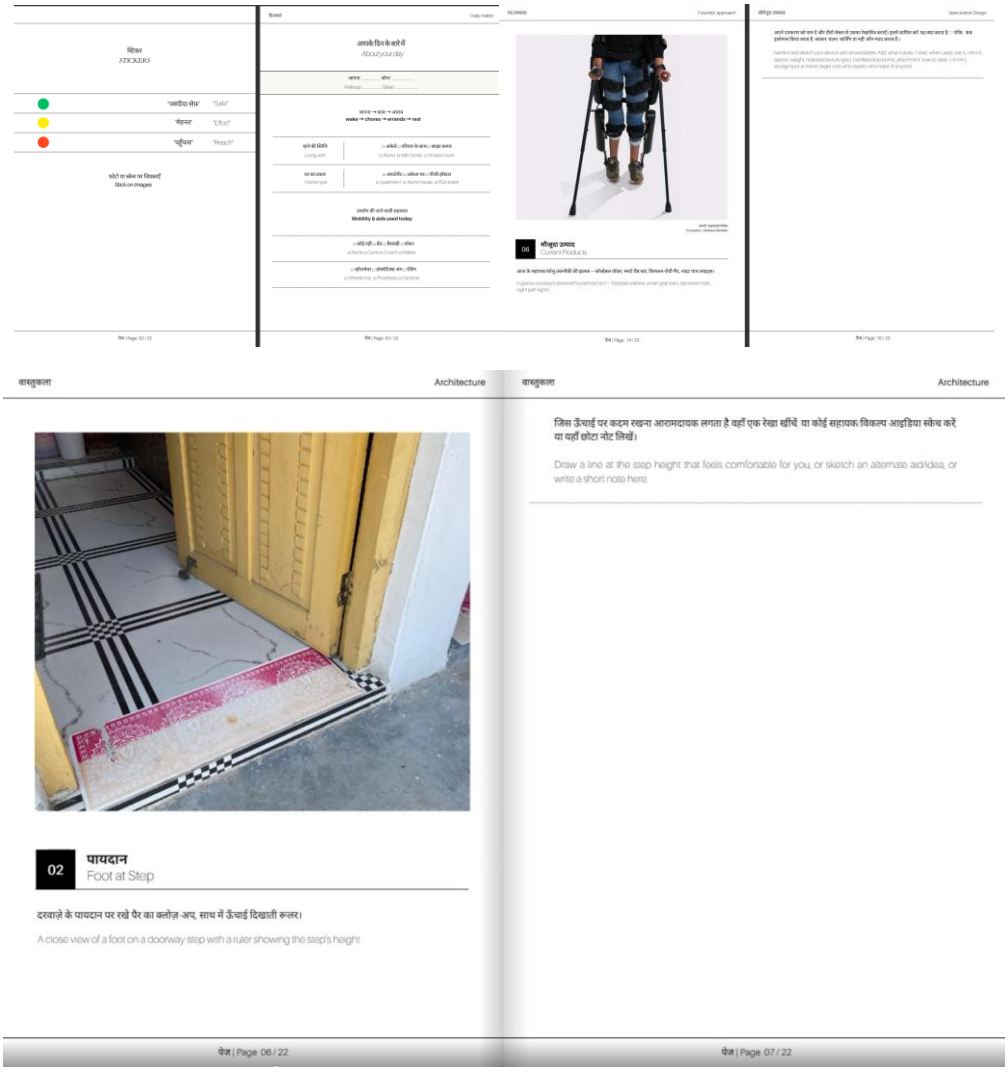

Figure 11 Introduction to the booklet in both Hindi and English with Futuristic devices

The first part of the booklet included drawings that dealt with domestic friction concepts such as bathrooms, thresholds, tight corridors, and kitchens. In the second part of the booklet, the

participants had to respond to images depicting devices that are currently used to help people move inside houses. The third part contained drawings by the AI concerning assistive mobility.

Respondents answered through direct interaction in the booklet, as well as discussion within the workshop session. Answers ranged from written comments, marked areas, stickers, drawings, and explanations provided verbally. Participants were identified by anonymous codes P1, P2, and P3.

Figure 12 Workshop 2, ISIC, New Delhi, Artifact used: Booklets

Booklets, field notes, drawings, and comments made orally were digitized and analysed after the workshop. Analysis was done by applying thematic analysis (Braun and Clarke, 2021). The approach was used to identify repeated patterns across qualitative material, including written responses, annotations, sketches, and discussion notes (Braun & Clarke, 2006; Braun & Clarke, 2021).

Figure 13 Consultation with clinicians, doctors, and occupational therapists on participant responses

After the initial analysis, selected responses and emerging interpretations were discussed with practitioners and doctors who had experience working with people with lower-limb disabilities. It was not analyzed as an independent clinical test, but it served as the context for validating the findings, by determining if the analysis of the answers of the participants is consistent with rehabilitation and assistive mobility practices.

4.2.3 Results

The workshop for the Phase 2 booklet was attended by 14 participants. The booklets filled out by the participants, their annotations, drawings, verbal responses, field notes, and input from the practitioners/doctors have all been combined for analysis. This is done since the outcomes obtained in Phase 2 are themes.

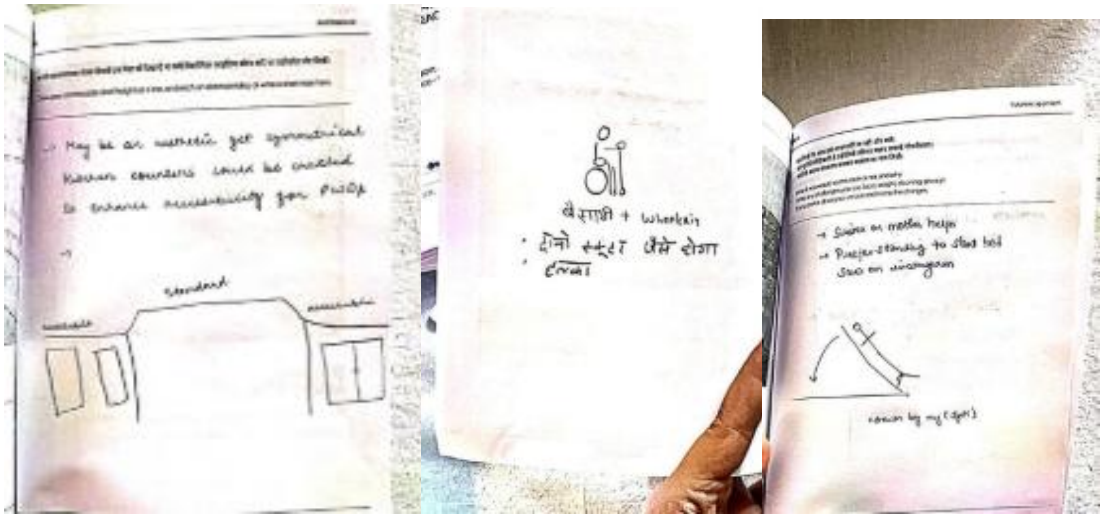

Figure 14 Responses from Participants after Workshop 1

Five themes emerged from the thematic analysis, reflecting participant responses to barriers associated with domestic mobility, available assistive technology, and future mobility scenarios. Information provided by practitioners and the physician was used as feedback for data analysis purposes, not as a clinical assessment.

From the results, it is clear that the booklet helped to elicit written and marked responses and verbal concepts from participants, but its main outcome was critique instead of concept development. Participants found it easier to respond to concrete barriers at home than to speculative technologies. It was also seen that participants were majorly concerned about the policy and government laws pertaining to the current infrastructure for disability than imagining or providing their inputs. This reinforced the choice to change from the use of booklet to animation prompts during Phase 3, focusing on two daily activities: getting from the living room to the bathroom and getting from the living room to the kitchen which can elicit embodied scenario based responses.

Table 4 Thematic Analysis of Workshop 1 Data

Theme	**Codes**	**Participant quotes**	**Practitioner feedback**	**Design Implications**
Access and policy concerns came before design needs	Cost of device; government support	**P3:** *"Achhi wheelchair ya device lena mushkil hai. Agar government se support mile toh hi log soch sakte hain."* **P8:** *"Device ka idea achha hai, par sabse pehle yeh dekhna padega ki cost kitni hogi aur repair kahan hoga."*	One Practitioner (KIWANIS) said participants often speak first about cost and access because they decide whether the device can be used at all.	Design concepts should consider affordability, repair, and local access.
Domestic barriers were recognised but treated as routine	Habit, family support, wall	**P1:** *"Ghar mein chalne ke liye main wall ya furniture ka support le leta hoon. Ab aadat ho gayi hai."* **P5:** *"Bathroom jaana dikkat wala hota hai, par roz karna padta hai toh manage kar lete hain."*	Rehab practitioners (ALIMCO) said long-term users may not report repeated barriers as problems because they become part of daily management.	Use activity-based prompts instead of only asking general questions.

Theme	Codes	Participant quotes	Practitioner feedback	Design Implications
Existing assistive devices were useful but not fully suitable inside homes	Wheelchair turning, walker balance	**P6:** *"Wheelchair bahar theek chalti hai, par ghar ke andar jagah kam hoti hai. Turn karna mushkil hota hai."* **P11:** *"Walker se support milta hai, lekin bathroom ya kitchen ke paas space kam hota hai."*	said standard mobility devices are usually not designed around compact Indian home layouts.	Focus on indoor turning, threshold crossing, stability, and transfer support.
Kitchen and bathroom emerged as high-friction spaces	Bathroom threshold, wet floor, no support, kitchen platform height	**P2:** *"Bathroom ke entrance par chhota sa step bhi problem ban jaata hai, especially jab floor wet ho."* **P7:** *"Kitchen platform tak reach karna mushkil hai. Baith ke kaam karna possible nahi hota."*	identified bathroom and kitchen activities as common points where independence reduces inside the home.	The concept should support both movement and activity, especially bathroom entry and kitchen reach.
Speculative prompts produced critique more than future ideas	Too expensive, unrealistic, unsafe, difficult to maintain	**P4:** *"Yeh future wala device dekhne mein achha hai, par India ke gharon mein use karna mushkil lagega."* **P10:** *"Agar device heavy ya costly hoga toh practical nahi hoga. Simple aur repairable hona chahiye."*	said future ideas need to stay close to users' real routines, home size, cost, and trust in the device.	Phase 3 should use familiar ADL scenarios instead of abstract future device images.

The results show that the booklet was useful for collecting written, marked, and verbal responses, but its strongest output was critique rather than detailed concept generation. Participants engaged more directly with familiar domestic barriers than with abstract future devices. This supported the decision to move from booklet prompts to situated animation prompts in Phase 3, where the focus shifted to two specific activities of daily living: moving from the living room to the bathroom and moving from the living room to the kitchen.

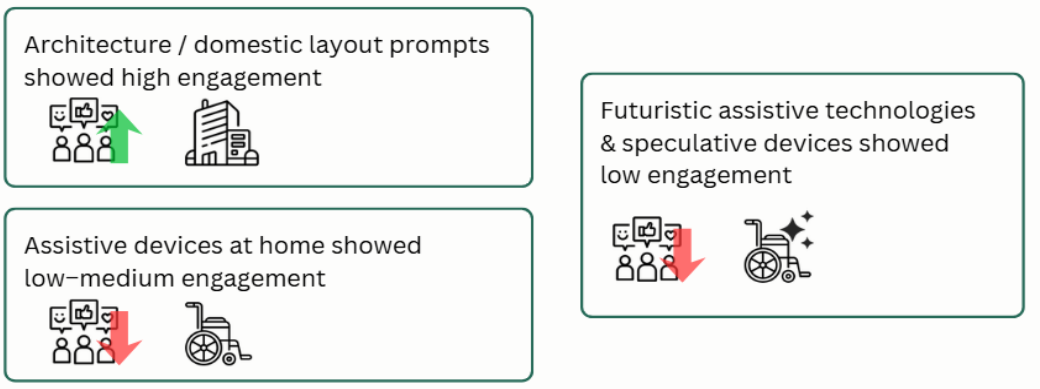

Figure 15 Trends that emerged from Workshop 1

4.2.4 Discussion

Study B showed that the booklet was useful for opening discussion around domestic mobility, but it also revealed limits in how participants engaged with speculative material. The booklet allowed participants to respond through writing, marking, and discussion. This supported the use of booklets as material prompts for reflection, as discussed by Desjardins et al. (2019). However, the responses in this study were shaped strongly by the disability and Indian domestic context.

The strongest finding was that participants often moved toward policy, cost, and access concerns. These concerns were not separate from design. Their views influenced how the participants assessed the possibility for the assistive devices to be used in everyday contexts. An item may be considered a great invention in terms of technical possibilities; however, its adoption by a person may be impossible due to financial, reparability, and availability reasons.

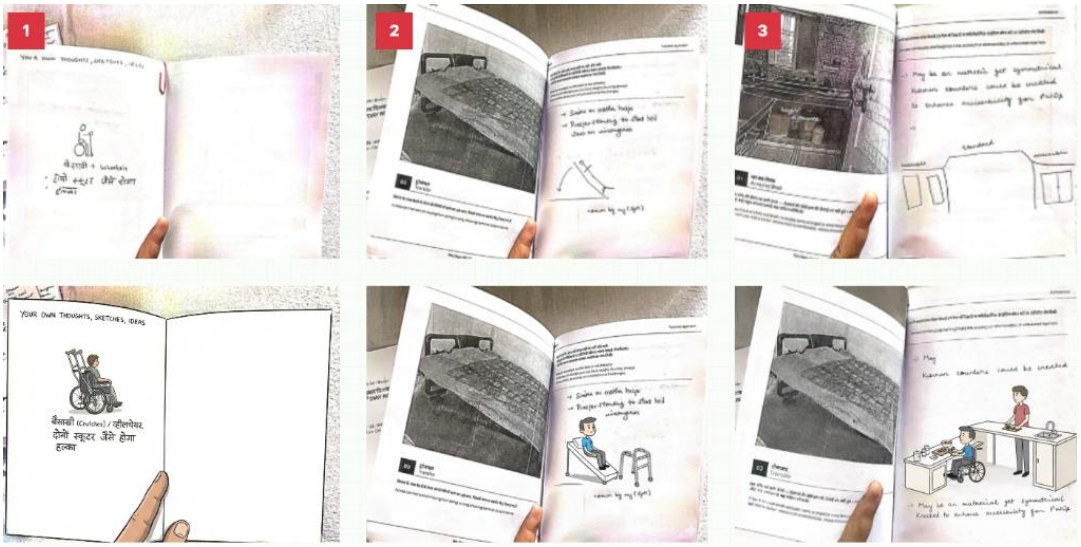

Figure 16 Participant responses to AI-assisted interpretation

The second outcome of this round was that the domestic mobility barriers were normalized. The participants had found ways of dealing with problematic bathrooms, doorways, spaces, and kitchens, which allowed them to sustain their routine activities. However, at the same time, these

solutions hindered participants from describing some of the barriers straightforwardly. It was clear why some answers in booklets were concise and vague despite the connection with existing difficulties.

Practitioner review was helpful in solving this issue as well. Practitioners pointed out that barriers that occur on a regular basis in the case of mobility limitations may stop being perceived as obstacles for a person. Hence, this finding became one more reason to shift to situated prompts.

The speculation part of the booklet was effective, but not in the expected manner. Instead of generating lots of new concepts for the future by participants, it generated critique. Participants criticized their affordability, safety, realism, and appropriateness for Indian households. The criticism was essential since it indicated under what conditions the assistive mobility ideas were accepted or rejected by participants.

In general, Phase 2 confirmed that visual prompting worked; however, it revealed that static prompts through booklet pages were inadequate in eliciting the problems related to movement. Domestic mobility is dynamic, involving movement actions such as moving from point A to point B, turning around, reaching out for something, maintaining balance, and transferring positions. Hence, the idea of using animation prompts related to two particular movements in Phase 3 was introduced – namely, moving from the living room to the bathroom and moving from the living room to the kitchen.

4.2.5 Conclusion

Study B employed a bespoke booklet workshop to investigate how people with lower limb disabilities perceived problems associated with barriers to domestic mobility and existing assistive devices as well as future mobility concepts..

The following four themes emerged from the results: Firstly, the issues of policy and access framed participants' discussions on the topic of assistive mobility. Secondly, multiple domestic constraints had been normalised by habituation. Thirdly, current assistive technologies were valuable but not entirely fit for purpose due to limited home spaces. Finally, speculative questions elicited criticism rather than designs.

These themes were important to informing Phase 3. In the latter phase, the prompts were designed to encourage activity-focused interaction, specifically around particular domestic movement scenarios.

4.3 Phase 3, Study C: Participatory Artifact Based Workshop

4.3.1 Introduction

It was found in Phase 2 that participants were better able to respond to familiar domestic activities than to future technology-based prompts. With this understanding in mind, Phase 3

employed situated scenarios to further draw the discussion towards everyday movement within the domestic setting.

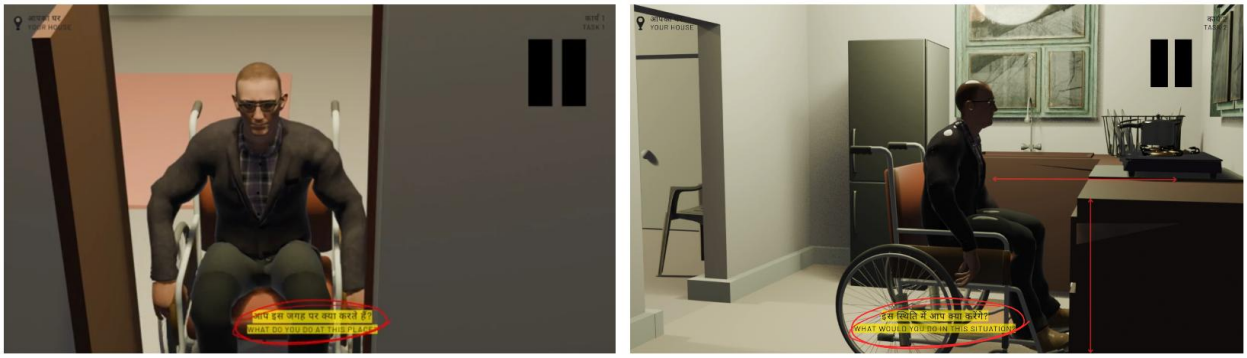

Figure 17 Snippets from artifact of Workshop 3, Artifact: Animation

In order to accomplish this task, two scenarios of animation were designed from previous results. Scenario 1 demonstrated movement from the living room to the bathroom area, paying particular attention to the threshold and difficulty in entering this space. Scenario 2 depicted movement from the living room to the kitchen area, emphasizing reach, platform height, and positioning.

This phase was intended to examine the reactions of participants when barriers to mobility within the domestic setting are illustrated by movement.

4.3.2 Method

For this research exercise, a short animation-based scenario artefact was used, coupled with questions about context was used as an artifact. There were 8 participants whom the 2 scenarios were shown and asked to reflect on what they had seen, what was familiar from their personal experience, how they could make it easier for themselves, and the adjustments they would make to the wheelchair or mobility aids.

This discussion revolved around:

1. Navigation across bathroom doorways and variations in floor level heights;
2. Body fitting, height of the seat, transfer, and reach while doing activities at home;
3. Adjustments that can be made to the wheelchairs.

The participant responses were recorded and segmented into meaning units (MU). Meaning units were coded and categorized. This research used thematic analysis methodology. Thematic analysis is a six-step process through which repeating codes are clustered into categories and further clustered into themes (Braun & Clarke, 2006; Braun & Clarke, 2021) as was used in Phase 2.

A total of **28 MUs** were analyzed in the end, categorized in seven categories and synthesized into three themes. Below are these categories and themes.

Figure 18 Glimpses from the Phase 3 animation-based workshop, ISIC New Delhi

4.3.3 Results

The scenario-based exercise gave more design suggestions directly than the booklet phase. The participants gave their ideas based on the animation prompts regarding the size of the wheelchair, body fit, crossing the threshold, height adjustment, foot support, fear of falling, and cost-effectiveness. These findings have been presented in two tables.

Table 5 Thematic Analysis Steps against participant quotes

MU Id	**Category name**	**Meaning**	**Codes**	**Representative participant evidence**
MU-01, MU-02	C1: Wheelchair size as per body fit	Participants felt that wheelchairs are often made as one standard size, without considering body type, height, gender, or user need.	Body-specific measurement; one-size-fits-all	**P5***: "One wheelchair is made for everyone - woman, child, or man. This cannot be the solution."*

MU Id	Category name	Meaning	Codes	Representative participant evidence
MU-03, MU-04, MU-10, MU-12, MU-14, MU-15, MU-19,MU-24, MU-26, MU-28	C2: Affordability, modularity, and multipurpose use	Advanced wheelchairs have useful features but are expensive. Basic wheelchairs are more affordable but solve only one or two problems.	Affordability; advanced features; foldable; height adjustable; modular parts	**P3***: "It is better to have one wheelchair with useful parts than having four different wheelchairs."*
MU-05, MU-06, MU-07, MU-09, MU-15, MU-17, MU-20, MU-22, MU-25,	C3: Barriers and obstacles	Small barriers in daily spaces created repeated difficulty during ADLs, especially thresholds, pavements, slopes, and raised edges.	ADL barriers; thresholds; pavements; bed transfer; floor level changes	**P1***: "Even a small step in the bathroom becomes a problem when the wheelchair has to cross it."*
MU-23, MU-2, MU-20, MU-18, MU-17, MU-11	C4: Independence and fear of falling	Participants linked mobility difficulty with dependence on others and fear of falling, especially while crossing slopes, raised surfaces, or thresholds.	Assistance required; inability to perform tasks alone; fear of falling	**P4***: "If there is support at the back, then the fear of falling will reduce."*
MU-23, MU-22, MU-21, MU-20, MU-18	C5: Foot support	Foot positioning was a concern for users whose legs lacked strength or moved due to tightness. Existing footrests did not always hold the feet securely.	Footrest cage; footrest material; leg tightening; poor hold	**P2***: "My feet go back again and again. There should be a barrier so they stay in place."*

MU Id	Category name	Meaning	Codes	Representative participant evidence
MU-06, MU-07, MU-08, MU-12, MU-15, MU-24, MU-25	C6: Height adjustment, threshold, and proportion issues	Participants connected height adjustment with bed transfer, kitchen reach, and matching the wheelchair to furniture height.	Height and reach adjustability; bed transfer; kitchen reach; ADL inclusion	**P1***: "The kitchen cannot be broken, so the wheelchair should adjust to the height."*
MU-04, MU-07, MU-09, MU-10, MU-16	C7: Wheel modification with respect to threshold	Participants suggested changes in wheel and tyre design to cross thresholds, pavements, and uneven surfaces more safely.	Wheel size; tyre grooves; rear wheel modification; front caster modification	**P4***: "If the wheel is like a tractor or tank, it will climb. Speed may reduce, but it will cross."*

Table 6 Final themes and Design implications

Categories clubbed	Theme	Meaning	Participant solutions	Design implication
C3 + C7 + C4	**Theme 1**: Change in floor level creates difficulty in crossing	Small level changes such as bathroom thresholds, raised edges, pavements, slopes, and uneven surfaces stop the wheelchair or make movement unsafe. These barriers also increase dependence on another person.	Participants suggested tractor-like tyres, grooves, tank-like chain movement, larger front wheels, and rear support to reduce the chance of falling while crossing thresholds or slopes.	1. Wheel configuration should support threshold crossing. 2. The front caster or front wheel should be larger than standard small casters. 3. Tyres may need grooves or chain-like grip for uneven surfaces. 4. Rear support should reduce backward fall risk.

Categories clubbed	Theme	Meaning	Participant solutions	Design implication
C1 + C5 + C6 + C3	**Theme 2**: Wheelchair proportions do not match the body or home activities	Participants described difficulty when wheelchair height, seat position, foot support, and wheel placement did not match the body or the home. Bed transfer, kitchen reach, and shifting became difficult when the wheelchair did not align with furniture height or body movement.	Participants suggested height adjustment using a manual jack mechanism, similar to office chairs. They also suggested changing the wheel position, using angular framing for stability, and adding stronger foot support or a cage for users whose feet move due to tightness.	1. Seat should be height adjustable. 2. A manual jack-like mechanism can be explored. 3. Rear wheel position may need repositioning. 4. Angular frame can improve stability. 5. Footrest support or foot cage should be included.
C2	**Theme 3**: Users need one affordable modular direction, not many separate solutions	Participants felt that advanced wheelchairs are expensive, while basic wheelchairs solve only limited problems. They preferred one affordable wheelchair direction with modular components that can be added based on need.	Participants suggested foldable systems, modular rear wheel updates, attachable foot support, and small add-on components that improve the existing wheelchair instead of replacing it completely.	1. Components should be attachable to existing wheelchairs. 2. The concept should avoid becoming a fully expensive robotic wheelchair. 3. Multipurpose parts should support more than one ADL issue. 4. The design should remain repairable and locally understandable.

4.3.4 Discussion

The animation phase yielded more ideas concerning designs than the booklet phase. Animation images displayed actions like crossing, moving from one place to another, balancing, reaching out, and turning, among others. This provided the participants a platform to give comments about activities, thereby making the discussion easy.

The first major finding was that small changes in floor level are a big barrier for people's mobility. The participants constantly associated slopes, thresholds, raised edges, and pavement levels with inability to cross and fear of falls. The observation gave insight into modifying wheel configurations.

Secondly, it was established that wheelchair design had something more than mobility. The participants linked wheelchair heights, seat position, foot support, and wheel position to ADLs such as transferring to bed and use of kitchen equipment. Thus, the wheelchair should conform to the user as well as his or her domestic surroundings.

The third major finding was affordability. Participants did not object to innovations but wondered whether those innovations would be affordable. Their responses gravitated towards modularity - making improvements to an existing wheelchair by adding components as opposed to developing an entirely new and costly design.

In general, Phase 3 represented a translation of earlier domestic friction into implications for design. The results had a direct impact on the following phase, particularly as far as threshold crossing, seat elevation, footrests, and modularity were concerned.

4.3.5 Conclusion

In phase 3, participatory scenario artifacts were employed to explore domestic mobility impediments through situated action. The outcomes of the workshop were 28 meaning units, seven categories, and three themes. The results from the identified themes indicated that changing the floor level creates a challenge when crossing, wheelchair dimensions do not suit body and house actions, and there is a preference for one affordable modular approach than several others.

From the findings, thematic analysis was extended to design implications, leading to sketches and concept directions in phase 4.

4.4 Phase 4, Study D: Design Implications

4.4.1 Introduction

Phase 4 translated the findings from the earlier phases into design implications and early speculative prototypes. The aim was not to produce a final assistive mobility solution, but to make the design problem more visible, situated, and open to discussion.

This phase follows an anti-solutionist position, where design is not used to close a complex problem too quickly through a fixed product answer. Instead, design artifacts are used to create a space for critique, reflection, and possible future directions (Blythe et al., 2016; Dunne and Raby, 2013). This is especially important in assistive technology, where abandonment and underuse are rarely caused by a single factor. They are shaped by the fit between the user, the device, the activity, the environment, and the service process (Sugawara et al., 2018; Phillips et al., 2024).

The starting point for this phase was the three themes developed in Phase 3. First, small changes in floor level, such as bathroom thresholds and raised edges, created difficulty in crossing. Second, wheelchair proportions did not always match the user's body or domestic activities such as kitchen work, bed transfer, and foot positioning. Third, participants preferred one affordable modular direction rather than several separate or highly expensive solutions.

4.4.2 Method

The method followed five steps: design implication mapping, sketch development, AI-assisted visual interpretation, CAD modeling and 3D printing.

Design implication mapping

The first step involved extracting keywords, participant statements, and repeated concerns from the Phase 3 themes. These included threshold crossing, bathroom entry, kitchen reach, bed transfer, foot support, fear of falling, cost, repair, and modularity. These were translated into design implications and then into non-negotiable criteria.

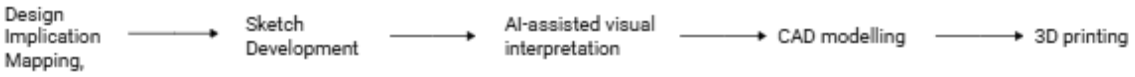

Figure 19 Infographic of Design Implications

The non-negotiable were:

- Concepts should be responsive to small-scale changes like bathroom thresholds, raised edges, and paving surfaces.
- They should help with domestic tasks, not just with getting around.
- They should take account of seated reach, transfer height, body fit, and foot support.
- They should not be entirely robotic and out-of-reach wheelchairs.
- They should stay modular and fixable and locally comprehensible.

Concept sketching

Participant and researcher sketches were reviewed and sorted based on the three possible directions of conceptualization. Participant sketches were not intended to be complete concepts in themselves, but rather a visualization of the ideas they came up with or cared about during the workshops.

Three concept directions were discerned:

- Threshold crossing assistance through modification of the front wheel or extension thereof;
- Support for height and reach through adding a cushion or using a lift-support system;
- Modular addition such as foot support, rear stability support, or add-ons.

This approach ensured participation in the design process at this stage. Concepts did not arise out of nowhere and in isolation from prior discussion among participants.

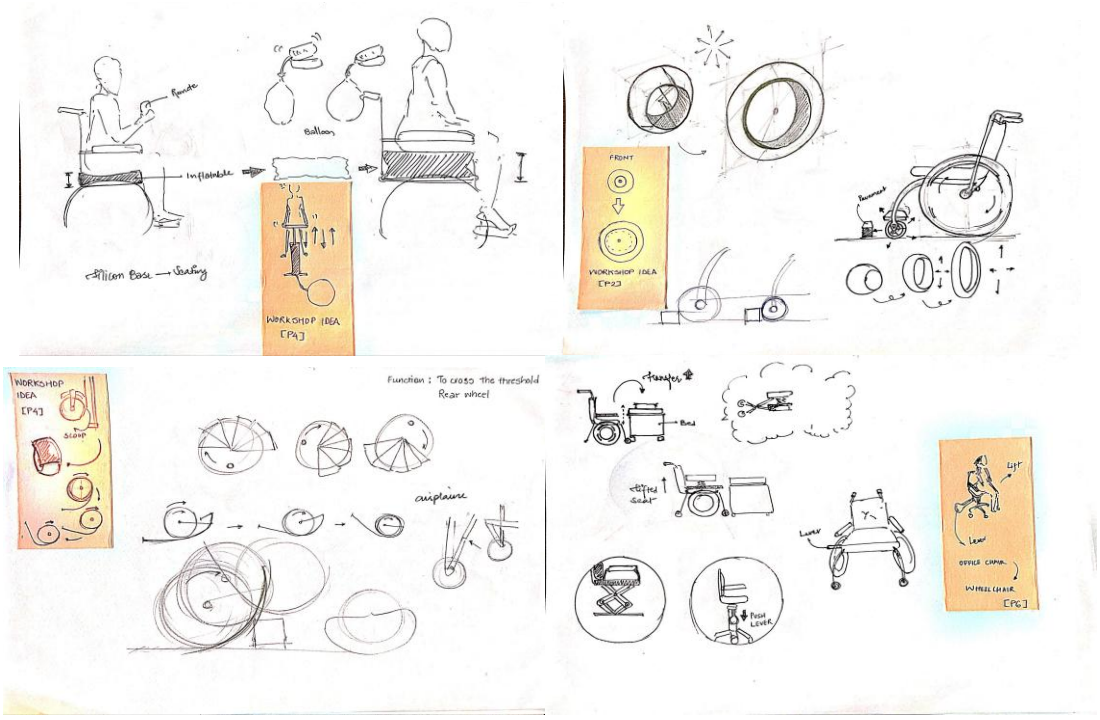

Figure 20 Participant and researcher sketches grouped by theme

AI-assisted visual interpretation

AI-assisted visualizations were then generated from selected sketches, keywords, and scenario descriptions. These images were used only as intermediate visual prompts. They were not treated as independent design outputs.

The AI images helped make rough ideas easier to compare and discuss. However, they were filtered carefully. Images that appeared too futuristic, expensive, unsafe, or unsuitable for compact Indian homes were removed. The role of AI in this phase was therefore limited: it acted as a visual catalyst, not as a design authority.

This was important because participatory design fiction gives value to future-oriented artifacts only when they remain connected to the people most affected by those futures (Nägele et al., 2018). In this study, AI-assisted visuals were kept accountable to participant-derived criteria.

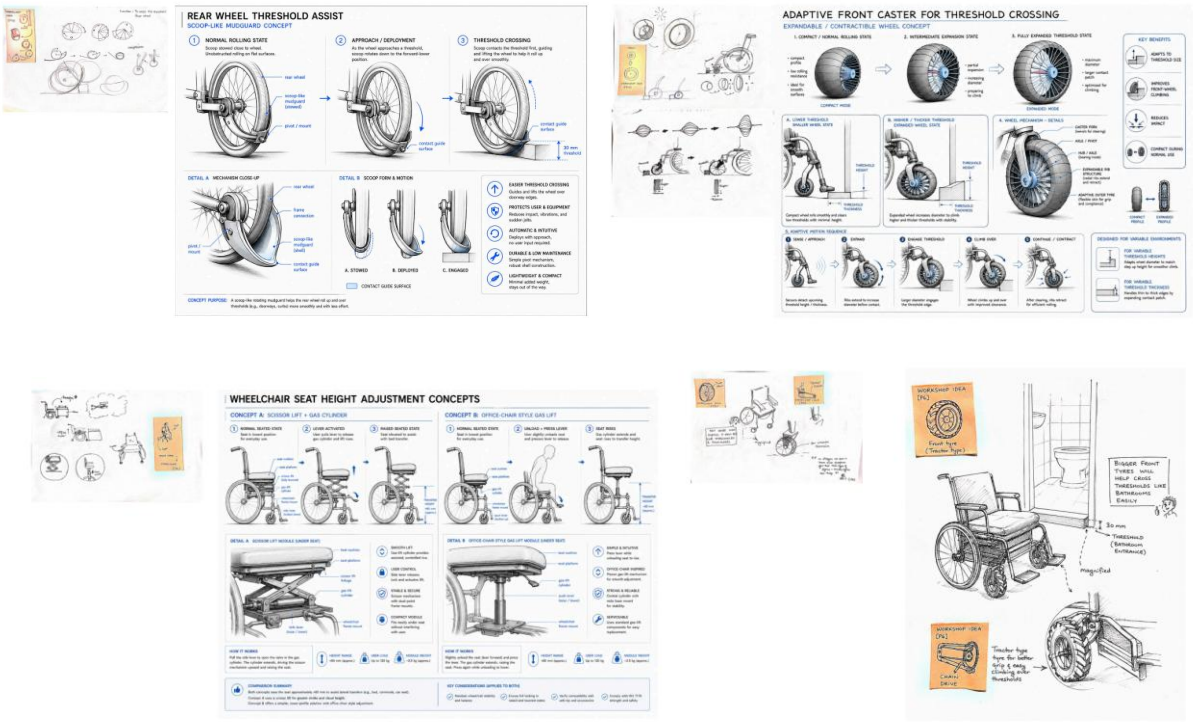

Figure 21 AI-assisted visual interpretations used for concept clarification

CAD modeling, 3D renders, and 3D printing

Two directions were taken forward into CAD modeling. The first explored an expandable or modified front-wheel system for crossing small thresholds and raised floor edges. This direction responded to participant concerns about bathroom entry, pavements, small front casters, tractor-like tyres, and fear of falling while crossing level changes.

The second explored a height-support direction through a cushion/lift logic. This responded to participant concerns around kitchen reach, bed transfer, shifting, and seated alignment.

The CAD models were used to study form, proportion, movement logic, and spatial relationship. Selected parts were then 3D printed as small-scale speculative artifacts. These were not functional prototypes ready for use. Their purpose was to make the design implications physically understandable and available for discussion.

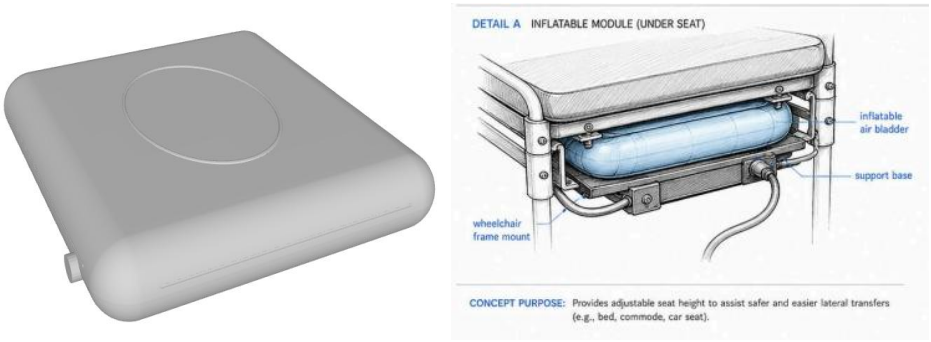

Figure 22 CAD model of height-support-cushion concept

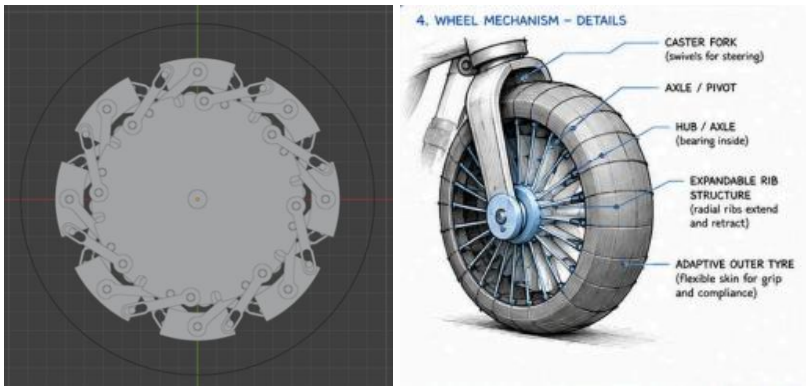

Figure 23 CAD wheel concept

VR simulation

A VR simulation was created to place the design propositions back into a domestic environment. The simulation focused on the situation of maneuvering inside home from living room to bathroom and getting stuck, viewing how modified wheelchair components might behave within a compact home layout.

The VR simulation was used as a scenario-based discussion tool. This was necessary because the central problem in the thesis was not the wheelchair alone, but the relationship between the wheelchair, the body, the activity, and the home.

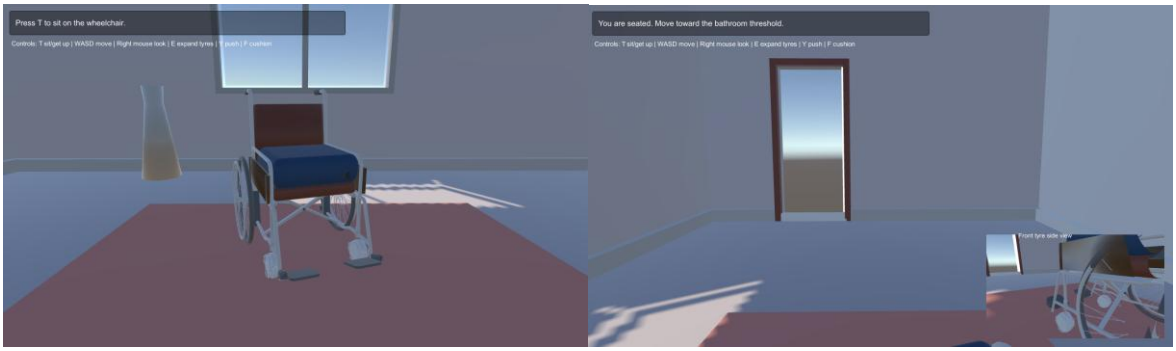

Figure 24 VR home environments

4.4.3 Results: Post-Evaluation Questionnaire

The post-evaluation questionnaire was used to understand how participants and stakeholders responded to the sketches, AI-assisted images, CAD renders, 3D printed artifacts, and VR simulation. The aim was not to measure product success, but to understand whether the propositions helped clarify future design directions. Two participants took part in this stage and interacted with the VR setup and 3D-printed artifacts after informed consent was obtained. The responses were organized under two areas.

1. Understanding of the concept

   Participants and stakeholders were asked whether the visual and physical materials made the design ideas easier to understand. It was asked whether the stimulus created by the 3D printed artifact was enough to give them real-life sense of touch when using VR simulation

2. Relevance to domestic mobility barriers

   Responses were examined in relation to the domestic barriers identified in the previous phases. Particular attention was given to bathroom thresholds, and reachable height through the inflatable cushion concept.

4.4.4 Discussion

Phase 4 shows how participatory findings can be translated into design propositions without claiming to solve the problem completely. This is important because assistive technology abandonment is not only a product issue. It is shown that abandonment is shaped by user-related, environmental, device-related, and service-delivery barriers (Phillips et al. 2024). In this sense, assistive technology is better understood as a complex or wicked problem rather than a problem with one fixed solution (Buchanan, 1992; Valentine et al., 2017; Phillips et al., 2024).

The strongest design direction was threshold crossing. Across the earlier phases, small level changes such as bathroom thresholds, pavements, and raised edges repeatedly appeared as moments where mobility became unsafe or dependent on another person. The expandable front-wheel concept therefore makes this barrier visible as a design concern. It does not claim to solve threshold crossing completely, but it allows the threshold to be discussed as a recurring domestic mobility problem.

Figure 25 Co-Designed concepts with AI model for wheel interpretation (ChatGPT & Gemini)

The second direction was height and reach. Participants did not discuss wheelchair use only as movement from one room to another. They connected it with kitchen work, bed transfer, shifting, seated reach, and foot support. This suggests that domestic mobility must be understood as activity support, not only locomotion. Reaching the kitchen or bathroom is not sufficient if the user cannot safely perform the activity once they arrive there.

The third direction was modularity. While innovation was not seen negatively, the issue of cost, reparability, weight, and trust kept coming up for participants. This meant that, rather than designing an entire robotically-controlled wheelchair, the research had to consider ways of adding modules to an existing wheelchair. This is also in line with participatory methods in assistive technology design, whereby user lived experience needs to influence design choices from the beginning and not just in the evaluation process at the end (Quintero, 2022; Phillips et al., 2024).

Using AI-assisted images also provided an additional methodological insight. In this case, the images generated by AI were valuable only if their generation was constrained by the user language, domestic context, and non-negotiable design aspects. Without these restrictions, the images would have risked losing their connection to the lived experiences of the participants.

The VR simulation extended this same logic. It placed the propositions back into domestic scenarios rather than displaying them as isolated objects. This mattered because the research problem was never only the form of the wheelchair. It was the relationship between assistive mobility, body movement, domestic architecture, and activities of daily living.

Figure 26 Co-Designed concepts with AI model for reach & support interpretation (ChatGPT & Gemini)

The contribution of Phase 4 is therefore not a finished device. Its contribution lies in showing how lived domestic frictions can be translated into design dialogue through sketches, AI-assisted visualization, CAD models, 3D printed artifacts, and VR simulation. The outputs remain open, unfinished, and available for further critique.

4.4.5 Conclusion

This phase does not claim to present a final assistive mobility device. Instead, it demonstrates how participatory and co-speculative methods can carry lived domestic barriers into design discussion. The propositions remain intentionally open. In the current study we explored the

frameworks and different stimuli that can evoke interesting insights which otherwise are neglected.

Chapter 5: Results and Discussion

5.1 Synthesis

The aim of this chapter is to bring together the results of the four phases of research conducted. The purpose of this section is not to list the results obtained during each of the phases. The study started with the observation that mobility devices were frequently designed, prescribed or evaluated irrespective of the spaces within which they would be used. It is especially true in the case of Indian households due to other elements such as narrow pathways, height of the thresholds, compact bathrooms, kitchen platforms, arrangement of the furniture, family assistance, and so forth.

It is based on the assumption that obstacles that limit the mobility of persons in their dwellings are not only physical barriers but rather can already have become part of their practice and therefore do not appear as such during their conversation with the researchers. Thus, a person can be able to talk about the walls, furniture, and other family members who assist them during mobility in the house without considering it to be an obstacle at all. However, in case the person is provided with the scenario using imagery, sketching, animation, or prototypes, then the design friction starts to become apparent.

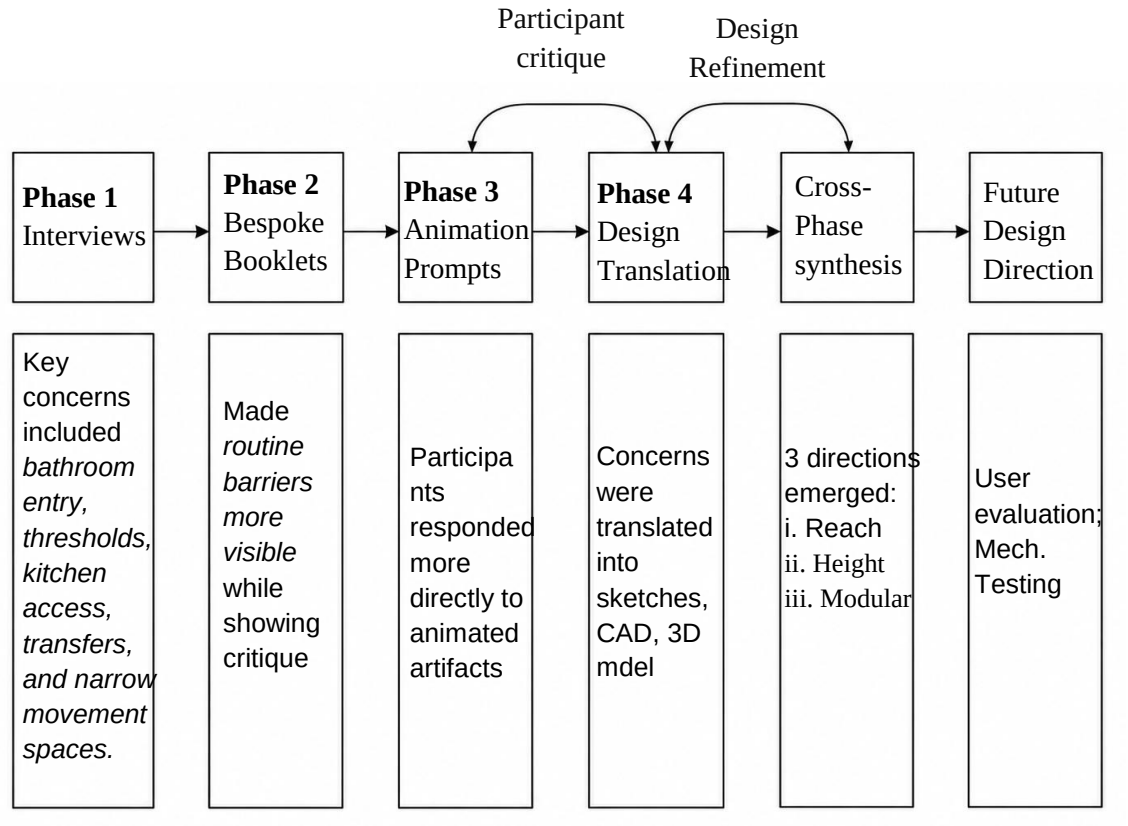

Figure 27 Cross-phase synthesis of participatory process and design translation

As can be seen from the results, they confirm the research goal of examining the limitations of mobility of people with lower-limb disabilities, as well as how they cope with it and how participatory and co-speculative approaches help participants consider domestic mobility as a design challenge. The study makes no claims regarding the direct production of completed assistive devices using co-speculative or participative methodologies. Instead, it demonstrates how these techniques can open up new possibilities, provoke more grounded discussion, and offer novel design approaches that might not come from interviews alone.

This is significant when it comes to the abandonment of assistive technology. Previous research demonstrates that user preference or device malfunction alone cannot account for desertion and underuse. Fit between the individual, the activity, the environment, the assistive technology, and the larger service process shapes them (Phillips & Zhao, 1993; Scherer, 2005; Federici et al., 2016; Sugawara et al., 2018). A significant cause for such a mismatch may lie in the involvement of users much too late in the process, where they come in as evaluators of near-finished products instead of being participants in defining the problem in its early stages of conception. Thus, early user involvement cannot be seen merely as one possible way of designing; it is an essential means of exposing otherwise hidden domestic friction.

5.1.1 Domestic mobility as an interaction between body, device, action, and home

Thus, it becomes apparent that this project has achieved all of its set objectives. These include exploring the difficulties of domestic mobility faced by people who suffer from lower limb disabilities, learning about the coping mechanisms used to compensate for these difficulties, and finally using a participant or co-speculative research method as a means of helping participants to address their problems of domestic mobility. It should be noted that this study does not present such methods as a way of developing assistive devices. It shows, however, that these methods help develop interesting new scenarios and discuss important aspects in grounded design terms.

This finding becomes crucial in understanding the problem of assistive technology abandonment. Previous literature reveals that abandonment cannot be attributed simply to user preferences or malfunctioning of the assistive technology. Abandonment/underuse arises from the complex interaction between the individual, the assistive technology, the tasks involved, and the larger service process (Phillips & Zhao, 1993; Scherer, 2005; Federici et al., 2016; Sugawara et al., 2018).

The issues encountered during Phase 1 involved accessing the bathroom, threshold crossing, entering the kitchen, turning in tight spaces, and transfers. It should be noted that this list of obstacles was not an exceptional occurrence but rather a regular part of people's everyday activities. For example, accessibility of the bathroom presented particular challenges since it represented multiple obstacles at once, namely the presence of a raised threshold, slippery floor, insufficient turning space, and the necessity to maintain privacy. Also noteworthy was the issue of entering the kitchen as it revealed that mobility is more than just getting into a room.

It is vital to understand that domestic mobility involves much more than just moving between different points in space. A mobility device that supports travel but not activity remains incomplete within the home.

5.1.2 Normalized adaptation as a hidden design issue

A second finding was that many barriers had become normalized through everyday adaptation. Participants described using walls, furniture, family members, fixed routes, avoidance, or altered body movements as part of routine. These adaptations helped them continue daily activities, but they also made the design problem less visible.

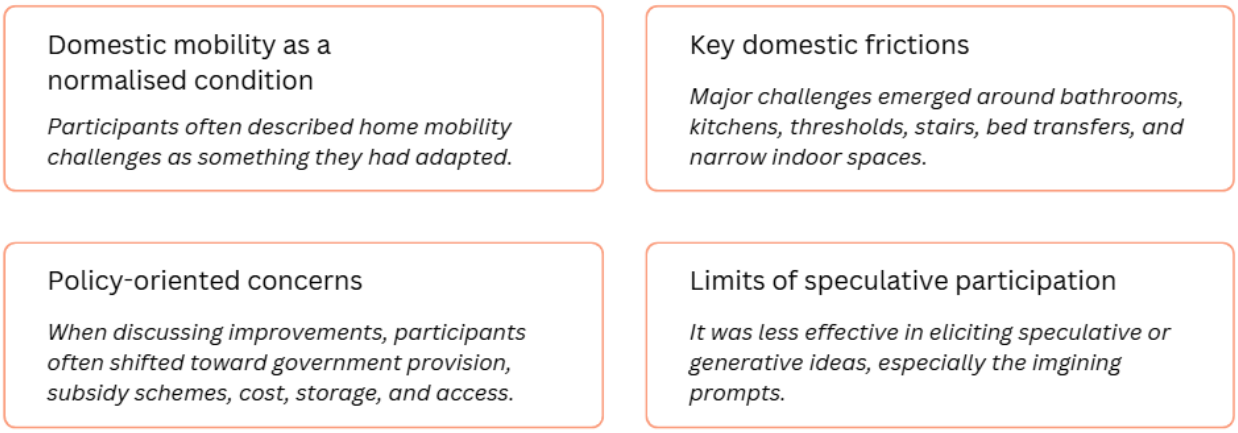

Figure 28 Challenges that emerged from different phases of the Workshop

This became clear during Phase 1 and Phase 2. When participants spoke about their homes, some barriers were mentioned only briefly or indirectly. However, when they responded to images and domestic friction prompts, the same spaces became more discussable. The booklet workshop showed that participants recognized barriers, but often treated them as something to be managed rather than something that could be redesigned.

This has an important implication for design research. If a study only asks participants what problems they face, it may miss barriers that have already been absorbed into daily practice. In this study, creative and contextual methods helped slow down that familiarity. They allowed participants to look again at the bathroom entrance, the kitchen platform, the wheelchair wheel, the footrest, and the act of crossing a small level change.

5.1.3 Visual and situated prompts changed the quality of participation

The three participatory formats did not work in the same way. Interviews served as an aid in the first step of identification of problem areas. The booklet exercise aided in dealing with domestic visuals, already existing devices, and the possibility of future concepts. In this respect, however, speculative exercises in the booklet format resulted in more criticism than idea generation. Questions arose concerning cost, feasibility, safety, maintenance, repair, and the fit with an Indian home context. This was not a failure of the process. It only indicated that the participants were using lived-in parameters to evaluate the concepts.

The animations generated for Phase 3 resulted in a very different reaction. Since animations included motion, participants could make comments about action such as crossing, turning, reaching, shifting, balancing, and falling. There was an active discussion based on observations. Problem identification moved to solution proposals concerning changes in the wheel size, tyre friction, footrests, seat height, back supports, and modularity.

This implies that participatory design approaches are not neutral vessels. The form influences what type of response is created. Static provocations allowed participants to understand and criticize. Movement provocation helped bring the discussion into embodied experience. And

physical, and VR-based provocations in Phase 4 facilitated placing the resulting implications of design into spatial context.

5.1.4 Themes to design implications

Thematic analysis of phases two and three gave rise to three design directions.

Firstly, the crossing of the threshold came up as one of the main themes. Thresholds, level transitions, paved areas, and stairs were perceived by the participants as obstacles. Participants mentioned getting stuck, fear of falling, and dependency on somebody else for help as problems. These problems inspired the idea of changing or expanding the front wheel of the wheelchair.

The next direction was reach and height. Participants related concepts like wheelchair height, body fit, foot placement, and seat positioning to tasks in their household such as cooking and bed transfer. In doing so, participants moved beyond the issue of mobility to consider how the wheelchair could assist them once they have reached the task location. Namely, from the question “How does the wheelchair move?” to “How does the wheelchair help me once I am at the task location?”

The third direction was modularity. Participants didn’t resist advanced design proposals but continued to query their affordability and reparability in the Indian setting. In essence, a direction that offered an improvement to an already existing wheelchair was more appealing to participants than a direction that would introduce a completely novel, complicated system or even a robotic wheelchair.

All of these themes informed Phase 4 where sketches, visualization by means of AI-based technology, CAD models, 3D printed artifacts, and VR scenarios informed the development of speculative design proposals. As in speculative and participatory design practices, design propositions were intended to open a discourse rather than validate a solution (Dunne & Raby, 2013; Nägele et al., 2018).

5.2 Design Components

Components of design that have been developed during Phase 4 are only intended to serve as early proposals. These designs are by no means final, nor should they be considered as scientifically and technologically tested medical devices. The importance of these designs is in how they transform participant issues into testable forms.

5.2.1 Component 1: Threshold-crossing front-wheel direction

First, the problem relates to the difficulty encountered when transitioning through changes in floor levels that are perceived to be small in terms of architecture. However, for participants, such thresholds in Indian homes were places where mobility risked becoming unsafe, interrupted, or contingent on others. It is particularly pertinent for those who use wheelchairs as the small front casters of their wheelchairs can get trapped when crossing the threshold.

Design-wise, there was an exploration of an adjustable or extended front wheel configuration. This did not necessarily mean that a new wheelchair would have to be designed, rather how the front wheels can better respond to the thresholds of domestic spaces. Participant suggestions about using bigger front wheels, tractor-like tires, grooved wheels, and chain movement led the way towards this direction. Such suggestions were never directly incorporated as specific design features. They indicated what participants cared about: grip, climbing, stability, and reducing dependency.

The second problem highlights a different framing of the threshold-crossing component. Whereas a bathroom threshold is seen as an architectural inconvenience in many designs, it is a mobility encounter with its own design requirements.

5.2.2 Component 2: Height and reach support

This second aspect addresses the problem of the mismatch in terms of height between the wheelchair and engagement in daily activities. Respondents reported problems with reaching kitchen platforms, posture adjustment, bed alignment, and stable foot positioning. This means that an important criterion for designing mobility devices must be not only assisting users in moving about but facilitating performance of activities.

A design direction in response to this problem would be based on the cushion idea or lifting support design. The idea was to explore whether the introduction of additional height or lifting capabilities will facilitate reach in the kitchen and aligning transfers. This direction should be approached very cautiously because any modification of a wheelchair will inevitably impact balance, centre of gravity, and safety. Thus, the design direction proposed above should not be considered a viable solution but rather a thought-provoking question about height adjustment and related issues.

The significance of this design direction is in its activity-oriented nature. The kitchen platform cannot always be adjusted, and the bed can rarely be changed. In most Indian households, the pertinent question is how to accommodate the user in the existing environment without compromising safety, affordability, and practicality.

5.2.3 Component 3: Modular add-on direction

Whereas the second item concerns a physical element, the third component pertains to the process of design. Over the course of the study, users consistently mentioned elements such as affordability, reparability, local knowledge, and practicality. These factors informed the direction of designing modules rather than creating a complete alternative to the wheelchair.

Possible modules in this context might be add-on features like threshold-support wheels, foot-support improvement, rear stability support, or height-adjusting attachments. Modularity becomes important because it enables the designer to remain close to the existing usage of wheelchairs. Additionally, it allows for the possibility that the device does not have to solve each and every problem for each possible individual.

These results tie into the discussion about abandonment. Abandonment occurs when the assistive device cannot meet all needs or when it does not suit the environment of its intended user (Phillips & Zhao, 1993; Sugawara et al., 2018). In other words, abandonment may occur if it does not provide enough customization options for its user.

5.2.4 The role of AI, CAD, 3D printing

Neither the software nor the hardware employed during Phase 4 were treated as evidence of solution. AI assisted renderings facilitated translation of the vague participants' and researcher's drawings into more readable visual prompts. CAD modelling aided analysis of proportions and direction of mechanisms. 3D prints made the ideas tangible for discussion. Virtual Reality simulation situated the propositions within a domestic setting.

This was critical to the research problem being addressed. Wheelchair components cannot be analyzed as isolated objects but in their relation to the bathroom entrance, kitchen platform, bed height, turning area, and user movement. VR simulation therefore aligned itself with the main argument proposed in the thesis: domestic assistive mobility must be understood through the relationship of the body, device, activity, and home.

On the other hand, it was crucial to apply caution while employing such tools. AI-assisted renderings are notorious for giving the impression that an idea looks much better realized than it actually is. CAD models could give the false impression of engineering certainty prior to engineering evaluation. 3D prints might make experimental propositions seem prototype-like. This was why the products of this research were referred to as discussion artifacts. They are useful because they create a more concrete basis for future dialogue, not because they prove that the design is complete.

5.3 Limitations

This study has several limitations.

First, the study is qualitative and situated. It does not aim to produce statistically representative findings. The findings reflect the experiences of participants recruited through specific sites in and around New Delhi. They should not be generalised to all people with lower-limb disabilities or all Indian homes. However, the study offers contextual and design-relevant insight into how domestic mobility barriers are experienced and discussed.

Second, the participant group was diverse in disability type, body condition, device use, and domestic context. This diversity was useful for understanding a range of barriers, but it also means that the design propositions cannot be assumed to fit all users. Further research with more specific user groups would be needed before developing any functional prototype.

Third, the study relied on participant memory, workshop responses, photographs, sketches, and scenario-based discussion. Direct observation inside participants’ homes was limited. As a result, some domestic arrangements and movements could only be understood through participant description and visual materials rather than through in-situ observation.

Fourth, the methods of participation influenced responses to the questions posed. The booklet workshop encouraged written and verbal responses, but some found the hypothetical scenarios harder to understand. The animation workshop elicited more concrete suggestions, but it also meant that there was more focus on the two selected topics: the ability to enter the toilet area and reach the kitchen worktops. Topics such as dressing, getting items from storage, moving from outside to inside, and assisted transfers got little consideration.

Fifth, translating answers from Hindi to English could have led to loss of meaning. While the translation took account of meaning over word-by-word translation, some emotional content, humor, or hesitance might be lost in translation.

Sixth, Phase 4 products lacked technical validation. These CAD models, 3D prints, and VR simulation designs were speculative artifacts, not yet evaluated for issues of safety, reliability, load bearing capacity, sustained utility, and clinical appropriateness. Specifically, it would be important to consider the ergonomics of the height support design since any additional seat height could affect balance.

Finally, the researcher's own positionality informed the research process. The researcher is an industrial design postgraduate student who has not lived with a disability affecting the lower limbs. However, this was overcome through use of participatory methods, engagement in Hindi, participant response generation, and speculative output presented as propositions rather than conclusions.

5.4 Reflection

Even though this thesis started by addressing the topic of assistive technology abandonment, the research itself slowly evolved into addressing another question: under what circumstances do mobility devices lose their functionality or become limited when used within the familiar context of the domestic space?

With the adoption of the participatory and co-speculative design approach, the role of a researcher was altered. Rather than diagnosing the problem, or prescribing the needed design solutions for users' needs, it became necessary to provide participants with an environment which would enable them to reflect upon and re-frame their everyday mobility routines. This approach is often referred to as "anti-solutionist". The process allowed the problem to stay open, and the use of design artifacts facilitated further discussions.

One important takeaway from the research process was the need for designing participation. It cannot be assumed that all participants will write, draw, speculate, or respond in the same way. Some participants responded more easily to familiar domestic images. Others became more expressive when movement was shown through animation. It should not be taken for granted that each participant would engage with the activity using the same processes. Some participants found it easier to engage with domestic imagery. Others felt more comfortable using animation for their expressions and actions. In other words, it is possible to argue that participatory design for assistive mobility requires more than one method of interaction, particularly when dealing with participants who might find certain design exercises difficult.

The second reflection is about the use of speculative tools. Speculation, in this case, was not employed in imagining far away futures disconnected from reality. Speculation was used in imagining reality differently. Future prompts, AI-assisted visualizations, CAD renderings, and VR simulations would be relevant only if they were connected to the actual experiences of participants. Speculation was critiqued and questioned by participants as soon as it diverged from cost, repair, safety, and compact spaces. This criticism was helpful because it demonstrated that participants were active evaluators of future ideas, rather than passive recipients of them.

The findings also underscore the need for involvement from early on in the process. If users only become involved after the technology has been created, then their involvement becomes a means of evaluation instead of framing. Early involvement will not provide an immediate answer, but it will shift the focus of inquiry.

The final contribution of this thesis is therefore methodological as much as conceptual. It shows one way of moving from lived domestic frictions to design implications through interviews, photographs, booklets, animation, sketches, speculative prototypes, and VR simulation. The outputs remain unfinished, but they are not without value. They create a forward direction for assistive mobility design in Indian homes, grounded in dialogue rather than assumption.

Chapter 6: Conclusion

6.1 Summary

This thesis has looked at the barriers faced in the use of mobility aids by individuals with lower-limb impairments within Indian homes. Specifically, this has included looking at the activities of daily living such as using the bathroom, reaching areas in the kitchen, crossing thresholds, transfer mechanisms, and moving around small spaces within the domestic setting. This work was inspired by the broader context of the problems of abandonment of and lack of use of assistive technologies and the theory that perhaps assistive devices failed not due to technological constraints alone but rather because of the absence of user participation in the problem framing process.

There were four phases in this research. In Phase 1, there was the use of semi-structured interviews for exploring the day-to-day mobility barriers within the domestic setting. Phase 2 included the development of a customized booklet workshop to facilitate the exploration of the domestic challenges visually and through writing. Phase 3 saw the use of animations as a means to portray mobility as movement and generate design solutions. Phase 4 translated these findings into design implications through sketches, AI-assisted visuals, CAD models, 3D-printed artifacts, and a VR simulation

RQ1: What mobility limitations do people with lower-limb disability encounter when going about their everyday lives in Indian households?

According to the study, participants encountered difficulties with bathroom access, elevated thresholds, damp floors, limited mobility areas, kitchen reach, bed transfers, foot placement, and turning in small spaces. The usage of assistive technology was not distinct from these obstacles. They developed as a result of how the body, activities, house design, and device interacted.

RQ2: How have individuals with lower-limb disability adjusted to their daily mobility limitations at home?

These included habituation, family, physical support from the walls and furniture, prescribed movement paths, avoiding some locations, strategic use of technology, and adaptation in the way that tasks were carried out. These adaptations allowed for the participants' continued functioning, yet they also resulted in the normalization of certain barriers. Normalization was one of the important discoveries made in this thesis.

RQ3 : In what ways could participatory and co-speculative practices allow people to engage with the domestic constraints of their mobility?

In this thesis, it is argued that users should be involved much sooner during the development process than just at the evaluation phase of the process. Otherwise, there is a danger of not being able to tap into the situated domestic expertise needed to be able to use the device. However, the complexities of the assistive technology development process are not alleviated by participatory or co-speculative practices.

6.2 Future Work

Future work should continue this research in several directions.

1. First, the design propositions developed in Phase 4 should be taken back to participants for deeper critique and refinement. The present study used co-speculative artifacts to open discussion, but further work should involve repeated cycles of co-design, feedback, and redesign with users, caregivers, clinicians, designers, and engineers.
2. The second recommendation is to test these concepts on a greater range of users with differing physical dimensions, disability experience, wheelchair types, housing layouts, and support structures.
3. The third recommendation is for further technical development. The expandable front wheel concept needs further mechanical testing related to carrying capacity, steering, braking, stability, wear resistance, and safety for varying thresholds. The height support concept requires further ergonomic consideration regarding the potential effect of changing seat height on center of gravity, balance, transfers, and confidence.
4. The fourth recommendation relates to closer examination of actual homes. Methods such as in situ home visits, spatial analysis, motion tracking, and video observation might reveal insights into assistive devices used in domestic contexts. This could help draw links between design considerations and concrete spatial limitations like door width, threshold height, turning radius, bed height, and kitchen platform height.
5. Finally, the modular direction deserves additional consideration. Rather than designing an entirely new chair, future work might consider attachable devices in response to particular barriers in the home environment; future work could examine attachable components that respond to specific domestic barriers. This may include foot-support modules, threshold-crossing add-ons, rear stability support, or adjustable seating accessories. Such work should also consider affordability, local manufacturing, repair, and maintenance.
6. Sixthly, future iterations of the VR simulation might incorporate the development of a participatory evaluation tool, enabling participants to make comparisons among various home designs, heights of thresholds, and wheelchair configurations.

Lastly, future research must address connections between assistive mobility design and service provision and policies. In this thesis, the focus was on domestic mobility, and early exploration of design ideas. However, several key themes arose related to issues of cost, availability, repair and maintenance, and government support. This reveals that designing for assistive mobility involves consideration beyond the design process itself, including issues of service delivery, training, and affordability. Future research must engage the range of actors involved.

The thesis ends by returning to its fundamental perspective – designing for assistive mobility in Indian homes should not be based only on assumptions of what users need. Rather, it should involve working with people as they move, adapt, struggle, critique, and envision mobility in their domestic setting. The result of this kind of engagement will not necessarily lead to a single answer. Its value will lie in providing a more thoughtful approach to framing the problem.

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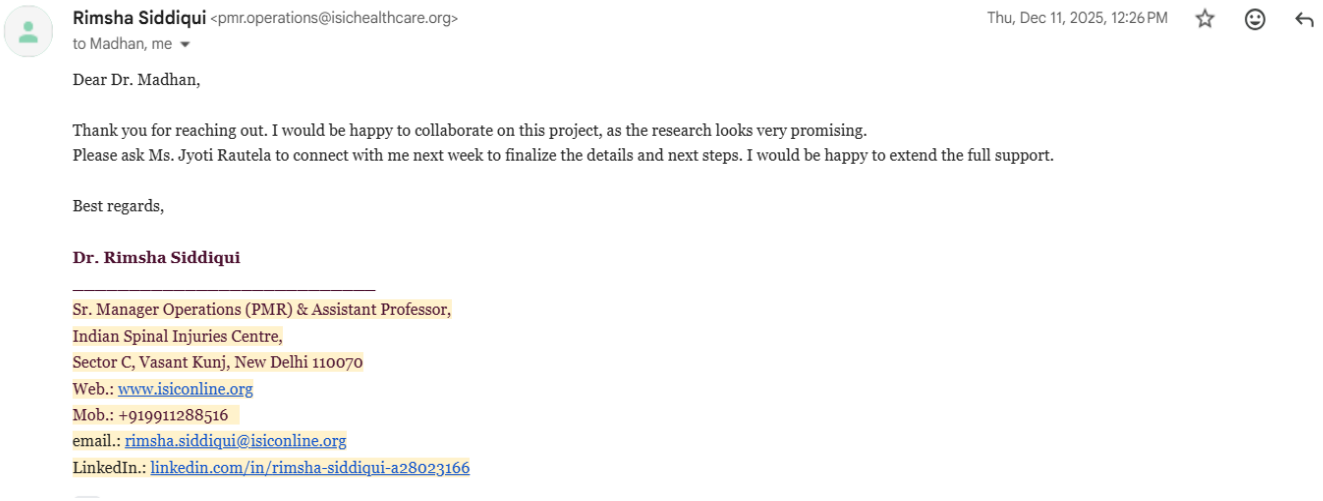
Appendices

Data Collection

Approval Email from ISIC, New Delhi to conduct pilot study and workshop



Rimsha Siddiqui <pmr.operations@isichealthcare.org> Thu, Dec 11, 2025, 12:26 PM

to Madhan, me

Dear Dr. Madhan,

Thank you for reaching out. I would be happy to collaborate on this project, as the research looks very promising.
Please ask Ms. Jyoti Rautela to connect with me next week to finalize the details and next steps. I would be happy to extend the full support.

Best regards,

Dr. Rimsha Siddiqui

Sr. Manager Operations (PMR) & Assistant Professor,
Indian Spinal Injuries Centre,
Sector C, Vasant Kunj, New Delhi 110070
Web.: www.isiconline.org
Mob.: +919911288516
email.: rimsha.siddiqui@isiconline.org
LinkedIn.: linkedin.com/in/rimsha-siddiqui-a28023166

Informed Consent form - ISIC, New Delhi (English)

INFORMED CONSENT FORM (ICF)

Study Title:

Study Number: _____

Subject's Name:_____ Subject's Initials: _____

Date of Birth / Age: _____

Please initial box [ ]

(i) I confirm that I have read and understood the information sheet dated _____ for the above study and have had the opportunity to ask questions.

(ii) I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. [ ]

(iii) The procedures required for the study and the time involved have been explained to me, and any questions I have about the study have been answered to my satisfaction.

(iv) I understand that the Principal Investigator/Site Investigator of the study, others working on his/her behalf, the Ethics Committee and the regulatory authorities will have access to my health records both in respect of the current study and any further research that may be conducted in relation to it. I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published. [ ]

(v) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s) [ ]

(vi) I agree to take part in the above study [ ]

Informed Consent form - ISIC, New Delhi (Hindi)

Indian Spinal Injuries Centre

सूचना सहमति प्रपत्र

अध्ययन शीर्षक:

अध्यन संख्या:

प्रतिभागी का नाम:

जन्म तिथि/आयु : _____

1. मैं पुष्टि करता /करती हूं कि मैंने कथित अध्ययन के लिए सूचना प्रपत्र दिनांक _____को पढ़ और समझ लिया है तथा मुझे प्रश्न पूछने का अवसर दिया गया है ।

2. मैं समझता/समझती हूं कि इस अध्ययन में मेरी भागदारी स्वेच्छिक है तथा मैं किसी भी समय तथा बिना किसी को कोई कारण बताए खुद को अध्ययन से बाहर कर लेने के लिए स्वतंत्र हूँ। इससे मेरी चिकित्सा तथा मेरे कानूनी अधिकार प्रभावित नही होंगे।

3. जांचकर्ता द्वारा मुझे अध्ययन का स्वरूप और प्रक्रिया अच्छी तरह से समझा दी गयी है तथा प्रश्न पूछने का अवसर भी दिया गया है।

4. मैं समझता/समझती हूं कि अध्ययन के प्रधान अन्वेषक/साइट अन्वेषक, उनकी ओर से काम करने वाले अन्य लोग, आचार समिति और नियामक अधिकारियों को वर्तमान अध्ययन और आगे किए जाने वाले किसी भी शोध के संबंध में मेरे स्वास्थ्य रिकॉर्ड तक पहुंच प्राप्त होगी। मैं इससे सहमत हूं. हालाँकि, मैं समझता/समझती हूँ कि तीसरे पक्ष को जारी या प्रकाशित किसी भी जानकारी में मेरी पहचान उजागर नहीं की जाएगी।

5. इस अध्ययन से उत्पन्न होने वाले किसी भी डेटा या परिणाम का उपयोग वैज्ञानिक उद्देश्यों के लिए करने में मुझे कोई आपत्ति नहीं है।

6.. मैं कथितअध्ययन में भाग लेने के लिए सहमत हूँ।

प्रतिभागी के हस्ताक्षर:

गवाह के हस्ताक्षर :

कानूनी स्वीकार्य प्रतिनिधि के हस्ताक्षर:

जांचकर्ता के हस्ताक्षर :

Informed Consent form - ISIC, New Delhi (English)

INDIAN SPINAL INJURIES CENTRE, NEW DELHI

INFORMED CONSENT FORM

Study Title_____

Study Number_____

Subject's Full Name _____

Date of Birth/Age_____

Address _____

_____

1. I confirm that I have read and understood the information sheet dated _____for the above study and have had the opportunity to ask questions.

   OR I have been explained the nature of the study by the Investigator and had the opportunity to ask questions

2. I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason and without my medical care or legal rights being affected.

3. I understand that the sponsor of the clinical trial/project, others working on the Sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. However, I understand that my Identity will not be revealed in any information released to third parties or published.

4. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s)

5. I agree to take part in the above study

Signature (or Thumb impression) of the Subject/Legally Acceptable Representative:_____

Signatory's Name_____ Date_____

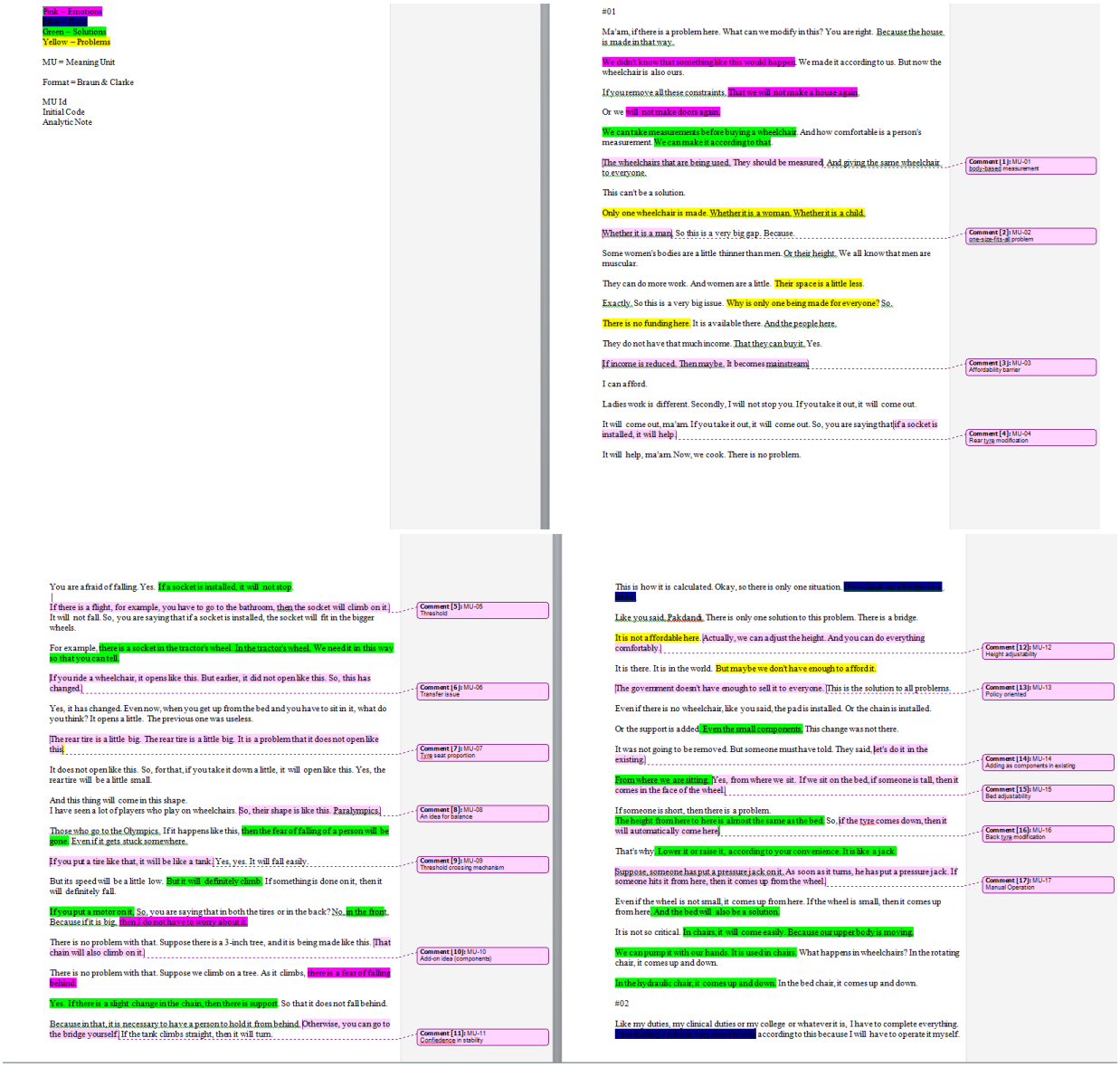
Signature of the Investigator_____ Date_____

Study Investigator's Name _____

Signature of the Witness _____ Date_____

Name of the Witness _____

Coding from Raw data through Thematic Analysis



#01

Ma'am, if there is a problem here. What can we modify in this? You are right. Because the house is made in that way.

We didn't know that something like this would happen. We made it according to us. But now the wheelchair is also ours.

If you remove all these constraints. That we will not make a house again.

Or we will not make doors again.

We can take measurements before buying a wheelchair. And how comfortable is a person's measurement. We can make it according to that.

[The wheelchairs that are being used. They should be measured] And giving the same wheelchair to everyone.

Comment [1]: MU-01
body-based measurement

This can't be a solution.

Only one wheelchair is made. Whether it is a woman. Whether it is a child.

[Whether it is a man] So this is a very big gap. Because.

Comment [2]: MU-02
one-size-fits-all problem

Some women's bodies are a little thinner than men. Or their height. We all know that men are muscular.

They can do more work. And women are a little. Their space is a little less.

Exactly. So this is a very big issue. Why is only one being made for everyone? So.

There is no funding here. It is available there. And the people here.

They do not have that much income. That they can buy it. Yes.

[If income is reduced. Then maybe. It becomes mainstream]

Comment [3]: MU-03
Affordability barrier

I can afford.

Ladies work is different. Secondly, I will not stop you. If you take it out, it will come out.

It will come out, ma'am. If you take it out, it will come out. So, you are saying that [if a socket is installed, it will help.]

Comment [4]: MU-04
Rear tyre modification

It will help, ma'am. Now, we cook. There is no problem.

If I have to do any work or if there is any emergency on the patient's side, then at least I can take my things and go near it. So, your hands are always tied in this? Yes, I am operating this, I am keeping my things here. Yes, there are such wheelchairs, but in that, you cannot adjust the height.

There is something in someone and there is something in someone. Now, we cannot climb the stairs.
And this one, which I have seen myself, we can climb the stairs and we can get down from the stairs. There is no fear of falling. And my feet run a lot behind.

Now, they have given this in this, but it does not work. It goes behind suddenly. Because a lot of people have a lot of tightness in their feet.
This is just a buckle. Yes.

So, no matter how much it is stopped, but sometimes there is a lot of tightness, so it runs behind suddenly. If we put a plastic barrier here, then it will not move so fast. And this is a very normal thing.

There should be a barrier in this. Now, this is it. My feet still go behind again and again.

Because there is a lot of tightness in my feet.
This is what I am telling you.

So, after going from here, I want to join college. So, my focus is that if there is any government fund from anywhere, then I can afford that thing. Okay.

So, it will be a little helpful for my college. Okay. Because I want that they do not give any excuse that I cannot work anywhere.

I have to go ahead and teach. Earlier, I had to do it clinically. But after the accident, now I have other options other than teaching.

But there is no chance of clinical. Okay. But I want, I had completed 2 years.

Okay. And I am going to college to switch. But my focus is that, I agree that everyone gets an apron.

Okay. Whether they get a diploma or something. But as a nurse, I have connected myself with patients.

So, I think that, now I have not even thought about it. I do not think so. I think that I will not be able to connect those things by going to the field.

Exactly, the love for the apron, it is still there. Everyone is saying that leave it.

You can do something else. Do something else. Do some preparation.

Comment [18]: MU-18
Hands Occupied

Comment [19]: MU-19
Various solution in varied options

Comment [20]: MU-20
Biological barrier

Comment [21]: MU-21
Leg Support for better comfort

Comment [22]: MU-22
Poor hold on the foot pedal

So, one thing is that, I have always been in the medical field. So, I was very interested in all these things. So, now that field will be completely different for me.

I have to start from zero. And you do not even want to think about it. Just because I had an accident, so why should I change my profession because of the inability of this device.

Basically, people say that, my mother says that, I wish you were preparing for a government job. So, you would still be involved in it. So, I said, okay, but I was interested in it.

And I feel a connection. When I work for a patient, I do not have sympathy with the patient. I had empathy with them.

I also feel that, my two-year main luck will also go away. And I do not want to let that go. Plus, the profession in which I am now, I also say that, after completing it, I will be involved in other things too.

If you are saying, then okay, I will try. But now, the main point comes that, there is a barrier for me. If I join college, then how will I manage? Because I have to do CIC too.

Now, if I am taking this normal wheelchair, then in college, or in hospital, or in clinical, I cannot do CIC. For that, I would need another wheelchair. I would need a permanent wheelchair there.

At home? Not at home, I would need it in the hospital too. Or if I am in college, I would need it there too. Because there too, I would have to do CIC.

And then, if I am at home, I cannot bring it daily. So, it should be at home. Exactly.

So, for everything, a separate wheelchair. And the body should also adjust accordingly. Adjust.

In every wheelchair, we have to adjust it according to our needs. We have to remove this, we have to do that. We have to make it according to our comfort zone.

So, one person, one person does not have four wheelchairs. All these things, a lot, a lot.

the way I feel that how will I join college, it has become a big issue for me.

The same thing I have seen, robotic, because I have searched a lot about these things, so I think all those things are available in these things, that your height can also be adjusted. For example, you cannot work in the kitchen, so what happens in the kitchen, now we cannot break the kitchen, so what does this wheelchair do, it adjusts your height, then you come to the same level. Okay.

Now it is that somewhere the bed is up, somewhere the bed is down, so if this wheelchair is in the plain surface, means it is equal to it, then it is fine, but if it is up and down, then there is a problem in shifting it. Then you need some help. Then you need it.

Comment [23]: MU-23
Limits in normal manual wheelchairs

Comment [24]: MU-24
Multiple works mismatch

Comment [25]: MU-25
Barrier in kitchen

So, such wheelchairs which are adjustable in height. I have seen all of them, but they are very expensive here. Okay, so you are saying that one factor is height adjustability. The second factor, which I feel, is support again.

The third factor is that we can go to the stairs. As sir said, there should be a support on the slanted surface. Yes, we can go to the stairs or anything, we can come back.

Now it happens that at home or in the village, all the lights have gone, or anything, the inverter has broken, so everyone is at home. Everyone has gone to the roof, and the patient is at home. At home, yes. And he is not able to say that brother, take me too, the rest of the people are saying to take him, but we also know that there is less space there, if you carry him in your lap, he will also get tired.

And secondly, there is another danger that something may happen. Yes. Then a person is stopping with you. He is also falling, so all these things.

Okay. So, I have seen all this, so all those robotic ones, but in that, I have not found only one wheelchair, there was one wheelchair in which all the features were there. Okay.

In the rest of the wheelchairs, there were some features, in the rest of the wheelchairs, there were some features which were missing. So, there was only one feature in it. So, what you are saying is height adjustability, support at the back, plus this support, and then also, don't you think it should also be lightweight, because you also need a place at home where you have to keep it.

So, it is also foldable. Okay. If you fold it and keep it on one side, then it is not too much, it only takes up that much space of your chair, not more than this.

So, I don't think it is a big deal. No. Now, it is better than having four wheelchairs, that there is only one wheelchair and all the components are missing in it. the issue is that it has hydraulic, machine, motor, whatever it has, battery, whatever it has, then you cannot do CIC in it.

This is a very big issue. This is a very big issue. profession-related problem.

You cannot do CIC in it. Now, I have seen a wheelchair here, it was a normal wheelchair and it was a little thick here and the front side it was made for the pot you take it out and adjust it again I think it is a very good solution for CIC but it is not robotic it is manual there is some inability

Comment [26]: MU-26
Advanced features are expensive

Comment [27]: MU-27
Feeling of exclusion

Comment [28]: MU-28
Multiple modularity

Animation video frames

Scenario 1: Bathroom

Scenario 2: Kitchen

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