

MUNIM

"Making people with reduced mobility useful and independent citizens of the society'

By

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## **Declaration**

This research report is the result of my own investigations, except where otherwise stated.

Others sources are acknowledged by giving references.

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*I dedicate this project to my grandparents; Ms. Shamim Akhtar-  
Mr. Wajid Hussain(late)-Ms. Khursheed Jahan(late)-Mr. Ashraf  
Ali(late), my constant source of inspiration*

## **Abstract**

Disability is a social condition where the ability to perform an activity is compromised. Barrier-free design is term that has been present since a few decades but hasn't been addressed the way it deserves to. Barrier free means that a building and its facilities can be approached, entered and used by persons with physical or sensory disabilities. A barrier free environment will enable them to carry out their daily tasks, minimize dependence on their families/caregivers and help them become useful citizens of the society. There has been an extensive amount of work done on human body extensions for physically disabled (lower limb), for example, wheel chair, mobility chair, crutches, canes, braces, prosthetics, etc. But there is still a need to improve the designs that focus on accessibility. Hence, we need solutions that are designed for extremes, with ergonomics and aesthetics that are fit for all. By employing a human-centered design approach, we provide accessibility to people with lower limb immobility. The solution will not only build social justice for people with disabilities but also their confidence and bring emotional stability by improving their quality of life. With this they'll be able to engage in social activities, employment, relationship and everyday life tasks. This design attempts to remove the stigma that is stuck with physically challenged persons. Designing for everyone rather than discriminating the specially-abled is how we improve the "Quality of Life".

## **Key Words**

Accessibility; Universal Design; Barrier-free Design; Paraplegic; disability; Mobility Chair

## Introduction

According to National Policy for Special Education, there are two definitions related to Persons with disabilities (PWDs):

“1. Disability means the lack of ability to perform an activity in a manner that is considered to be normal.

2. A person with disabilities means a person who, on account of injury, disease, or congenital deformity, is handicapped in undertaking any gainful profession or employment, and includes persons who are visually impaired, hearing impaired, and physically and mentally disabled. ”

Multiple terms are used as typical for this relatively new field but Universal Design is by far the most popular.

Mobility begins in the mind, but those who cannot move at all are dependent on outside assistance and since relatives help less and less in this regard, not everyone can all the time depend on a personal service robot. And even for that to come we may have to wait a couple more decades. In Pakistan, caregivers of the physically challenged are majorly assisting them willingly, they sympathize with them and do help them when they need it. Unfortunately, multiple times caregivers do not understand where and how they need assistance. In places such as toilets and while changing clothes etc. where privacy is essential especially in the cultural and religious context of Pakistan.

Paraplegic are dependent on assistance and may consider themselves burden on the society as well as themselves. Why is it happening? They are usually dependent financially as well as physically on other around them. They usually are not able to support themselves. They are looked upon with sympathy and treated differently. But no longer do people with physical disabilities want to be treated differently (i.e. with pity). There is only a minute number of solutions that support paraplegics to carry out their tasks independently. Paraplegia is when the level of injury occurs below the first thoracic spinal nerve. The degree at which the person is paralyzed can vary from the impairment of leg



movement to complete paralysis of the leg and abdomen up to the nipple line. Paraplegics have full use of their arms and their hands.

## **History**

The evolution toward Universal Design began in the 1950s with a new attention to design for people with disabilities. The first time the disabled were recognized was in 1960 when for the first-time barrier-free design specifications were published. But still barrier-free design was taken separately. By 1970's U.S.A. and Europe moving towards idea of normalization and integration. Mid 70's – Disability rights Movement was launched here people argued for equality of opportunity and against paternalism and care-taking. This was the first time designed was recognized as achieving the civil rights. Accessible design was now used in legal standards. Section 504 in Rehabilitation Act 1973, as amended as the civil rights law that prohibits discrimination on the basis of disability. The disability community of United States published a detailed requirement with the passage of The Americans with Disabilities Act in 1990. ADA – Americans with Disability Act 1990 with Act Title II cover “public entities” and Act Title III covering “place of public accommodation”

“Public entities” include state legislatures and courts, schools, police and fire departments, town meeting and motor vehicle licensing. “Public accommodation” is a private entity that owns or leases a place of public accommodation. This may include hotels, theatre's doctor's office

For the project I am designing solution that caters to their basic needs. Neither Pakistan nor any other part of the world keenly follow Fair Housing Act. Thus, to incorporate set of devices/products at homes especially solving issues related to the context of bathrooms and kitchen so that they carry out their house hold chores independently.

There are many associations and government and non-government organizations of Pakistan that are playing important role in welfare of paraplegics for example Paraplegic Center, Peshawar.

“Paraplegic Center Hayatabad, Peshawar, is the only state of the art facility, providing free of cost, Medical/Surgical and Nursing Care, along with Physical, Occupational, Vocational and Psycho-social rehabilitation services to patients with Spinal cord injuries from all over the country as well as Afghanistan.”

## **Study Question**

How can we provide a supportive environment to reduce dependency of Paraplegics bringing out their full potential?

## **Problem Identification**

- They are usually dependent financially as well as physically on other around them
- They are not able to support themselves
- They are looked upon with sympathy and treated differently

There are multiple products for extension of human body whether it is robotic or amplifying the function of the legs or foot. But there is very small number of solutions addressing the accessibility of people with reduced mobility.

## **Problem Statement**

Person with lower limb disabilities depend on assistance because they face lack of mobility and accessibility. As a consequence, they are unable to carry out everyday tasks without help. Moreover, people with physical disabilities no longer wanted to be treated differently, (i.e. with pity).

## **Solution Statement**

In order to facilitate them we provide a feasible solution adhering to their basic needs that maximize their accessibility.

## **Identified Problems for persons with reduced mobility that may be catered in the project**

1. Getting out of Bed
2. Shifting onto the Wheelchair
3. Moving to the washroom
4. Shifting to the toilet seat
5. Getting towards the sink
6. Unable to reach tap
7. Water spilling onto clothes
8. Shifting positions in the kitchen
9. Wheelchair unable to fit under the sink
10. Arms stretched due to muscle stiffness
11. Unable to reach high cabinets or higher fridge shelves
12. Unable to hold glassware with a grabber
13. Weight shifting due to bending for lower shelves
14. Changing clothes
15. Pans and small pots placed on lap while hot
16. Posture Maintenance
17. Self-Catheterization

## **Literature Search**

"Society can find or make a place for its handicapped citizens which will provide an opportunity for them to make their best contribution to the world in which they live. Although an individual's inheritance cannot (as yet, at least) be altered, his environment can." -<sup>1</sup> CMAJ

In Brian Berube's chapter "Barrier-free design - making the environment accessible to the disabled" he discusses the problems faced by the disabled quite rationally as placing oneself in their shoes. Furthermore, Patricia Falta -an architect and a paraplegic herself talked about how it's important for designers to know that if they overcompensate it becomes a hurdle making people uncomfortable.

Another feature the chapter highlighted was how the disabled are prevented from being normal. She discussed how there have been attitudinal and physical barriers both that prevent normalization of disabled. "Physical barriers make life difficult for the disabled. Consider the home - coping with daily routines such as cooking, making a bed, doing the laundry, using the washroom; consider transportation - finding a way to get to work, to go shopping, to live a reasonably normal life; consider trying to cope with a working environment designed with only the able-bodied in mind." - Falta

The chapter discusses an interesting case study about Fokus Society in Sweden, their mission is to make the disabled responsible for themselves. They enable disabled to rent apartments in housing developments for general public and assist in making modification especially in washrooms, kitchens and bedrooms. And all of them are vertical adjustments including sinks and wardrobes.

"With respect for their rights, with some thought to removing barriers to their independence, disabled people will be able to prove that they are really not handicapped" <sup>2</sup>

UN has adamantly made Universal Design as a means of rights to the disabled peoples. It states that Universal design "means the design of products, environments, programs and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design." <sup>-3</sup>

Country Profile on Disability - ISLAMIC REPUBLIC OF PAKISTAN (March 2002)  
Japan International Cooperation Agency - Planning and Evaluation Department

"Persons with disabilities is a marginalized group in the country." They are deprived of their rights because of barriers in education, skill development and daily life.

There is considerable amount of work done for children but such services aren't offered to adult persons with disabilities.

"In Pakistan, no single ministry or federal department deals with issues with disabilities." People with physical disabilities face problems related to social, economic, political and physical becoming hurdle in their freedom of movement in their environment. By virtue of this, employment opportunities for people with physical disability is scarce thus becoming a liability for their families. In 1981, Disabled Persons (Employment and Rehabilitation) Ordinance was passed. Which stated, "Sets a quota of 1% (this 1% quota has now been increased to 2% by a special directive of the Prime Minister) for the public and private sector to employ persons with disabilities. Organizations which do not comply to the employment quota are required to pay 2000 rupees<sup>6</sup> per month per person to the NCRDP. This collection is to be used to support persons with disabilities and assistive devices."

## **Research Methods**

To gather information multiple methods for research were adopted. The main target of research was to understand and empathize with the user and their needs. Both primary and secondary methods were used to conduct research. Primary methods for research were mainly taken from IDEO design kit tools.

Primary Research included ethnographic research that was conducted in Peshawar Paraplegic Centre, Different patients and their daily activities were observed.

Video Journaling another method from design toolkit was observed where a closer look was taken at the life of people with physical disabilities

One on one interviews were conducted with people with physical disabilities, Physiotherapists, Caregivers and Occupational therapists. The problems identified with the users were different from the stakeholders (mentioned above). But this showed and explained various problems that needed to be tackled.

## User Personas

The Personas revolves around persons with physical disability. I have narrowed down to two different personas. First persona, named Mr. Irfan Ullah who is an engineer turned social worker after his injury. He faces level1 spinal cord injury. He plays sports and is also CEO of an NGO Friends of Paraplegic. He often engages in counseling and awareness of people with physical disabilities. He is also fighting for disability laws. In sports he plays hockey that enabled him to gain upper body strength.

The second persona, is about lady Fehmina Qureshi. She was 14 years old when she had the injury and since then was paraplegic. She is an MBA graduate and a devoted mother to 15-year-old daughter. She worked with the victims of Oct,2005 Earthquake. She works as a project manager in corporate firm.

The age group targeted for this project is between age 20-40. This age demographic is the productive period in the lifetime of every person. Young adults to adult targeting the employed or self-employed people. According to Forbes.com, "about 70 percent of the demographic "favor cool experiences over great products."

Other stakeholders include caregivers, physiotherapists, occupational therapists and manufacturers and investors.

There are two types of caregivers; spouse or assisting staff. Spouse assist in carrying out their daily activities. They also help in performing daily exercises at home. But not only that they provide emotional support as well. The other kind of caregivers are assisting staff. This is trained paid assistance who help to perform daily activities. They also assist in daily exercises but often wouldn't be able to give emotional support.

Physiotherapists rehabilitates the patient using training and exercises. They teach the patient methods to prevent from future injuries. They assist patient in resuming his/her daily activities. Occupational therapist is also very important for people with restricted mobility especially paraplegics. They use treatment to develop, recover and maintain daily skills. They focus on improving patient's fine motor

skills (as their legs can't function O.T. needs to improve the upper body strength). They help client to have an independent and productive life.

The manufacturers and investors empathize with the project and the user. They are social entrepreneur and part of social awareness programs.

## Case studies

### Leveraged Freedom Wheelchair

Leveraged Freedom Chair is a wheelchair design for the developing countries. It is a mobility aid that is made with off-the-shelf bicycle parts and can be used in any part of the world. The main criteria for the design was to provide 20 million people of developing countries wheelchairs. Instead of using multiple gears to change the speeds Lever Freedom requires on sliding of hands up and down the lever. Through analysis it was found by the MIT lab that levers can be grabbed between 86cm to 22 cm from the pivot, as this is the maximum efficiency on common terrain as well as harsh terrain. The next test was to calculate high power output performance. This was hill climb trial in which stepped as well as indoor concrete ramp were used. There was more exertion required in the wheelchair compared to LFC.

If more speed is required the user moves the lever grasping it closer to the pivot. "The relationship between chair speed and hand speed is represented by Eqn. 1"

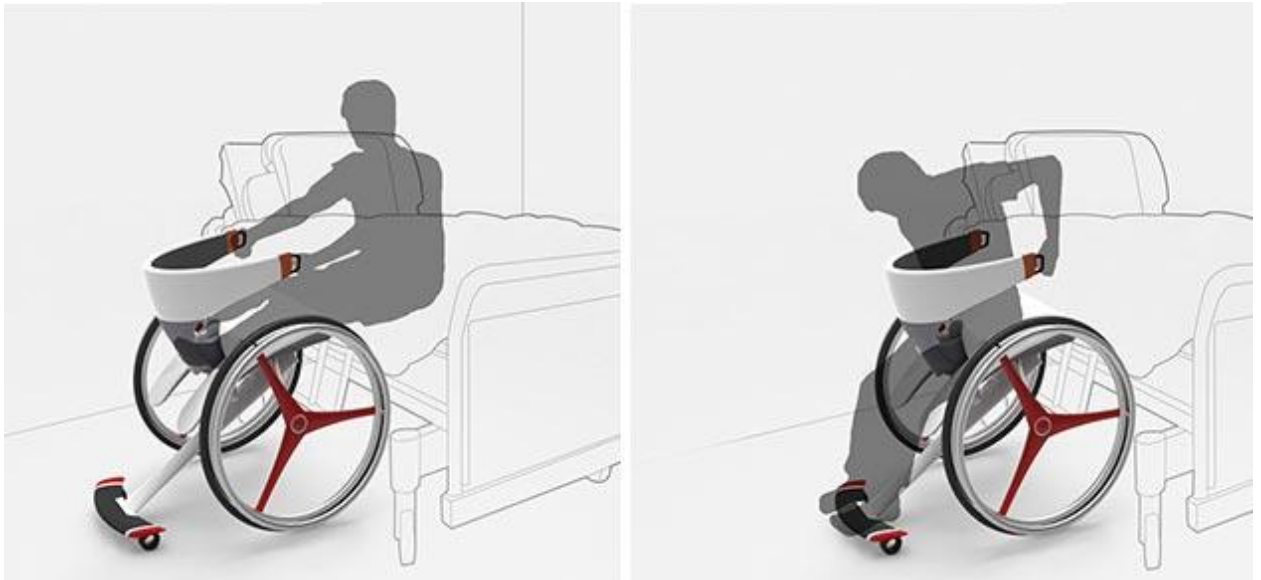
$$V_{Chair}/V_{Hand} = D_{CR} R_W / D_{FW} L$$

"Where  $V_{Chair}$  is the chair velocity,  $V_{Hand}$  is the users hand velocity,  $D_{CR}$  is the chain ring diameter,  $R_W$  is the wheel radius,  $D_{FW}$  is the freewheel diameter, and  $L$  is the lever length. "

LFC was tested and compared against average manual wheelchair and tricycle. The results shower LFC (lever freedom chair) had the fastest team up av. Velocity of 1.59m/s followed by regular wheelchair (22.7% slower) and tricycle (17.9% slower to LFC).



## Slide Chair – Red Dot



The slide chair was submitted in the Red Dot Design Challenge. The challenge was to rethink of the ways the user approaches the wheelchair. Through my research I found how difficult it was to shift onto the wheelchair and usually the person requires assistance from another person while doing so. The way the problem is addressed in this particular design is very innovative and the designer has looked at the situation from a different angle. The chair does not contain any back rest instead it has support in the front. The user only has to slide on to the wheelchair. But this design isn't practical. The first thing while designing a seating is to make sure to stabilize the pelvis. The assisting help who transfer the user onto any wheelchair make sure to stabilize the pelvis first followed by hips and thighs. In this design the user doesn't have stabilized pelvis and all the weight is on the chest and abdomen. This is not recommended in medical terms.

## Flume Bath Tub

Flume bath tub came from the idea of principle of see-saw. Bathtub is tilted towards the seat of the bath tub allowing the user to shift easily from wheelchair to the tub. The water when flows into the bath tub the bathtub shifts to the centre by the weight of the water. After taking a bath and draining water the bath tub shifts back to its earlier position.



## Local Case Studies

Basic necessities for person with restricted mobility were studied. During market research different options available were observed.



Walker that can be used as seating to rest. This was a hybrid product where its basic use was of walker that can be used as a seating while resting or when the user had to remain stationary at their place.



The wheelchair shown above was a upgradation of average manual wheelchair with cushioned seating as well as a head rest for supporting the neck. It had an attachable toilet for patients who needed a separate bed pan.

## **Analysis**

To understand the project deeply, SWOT and PEST analysis were carried out. This helped in knowing how to utilize strength and weaknesses.

### **Strengths**

- Previously catered to problem
- Empathy
- One of the basic necessities and not catered to, properly

### **Weakness**

- Lack of knowledge about engineering
- Understanding mechanisms was time consuming
- Lack of resources for the building of the prototype

### **Opportunity**

- Paraplegic center in Peshawar
- STEP (Special Talent Exchange Program) willing to raise funds
- A collection of data can be taken from the statistics house

### **Threat**

- The unavailability of labor during prototype

## **Interview Questions 1**

1. How long has it been since you got lower limb impairment?

Ans. It happened in 2015 around may

2. Was it an accident?

Angela: wore plastic slippers to a place where it is all wet. I stepped in the keecharh stepped my foot right in there and twisted it.

3. Would you like to share the kind of case of impairment you face?

Angela: My ankle broke on both sides in a lot of fragments kiunke it was a very awkward position kiunke that foot dislocate bhi hoa hai aur twist bhi hoa hai tou they had to like fix it up with screws and wires.

4. When it happened did you stay in a facility?

5. Can you pinpoint as to what aspects of your life changed? Or were affected by it?

Angela: Initially it was getting used to crutches and having people help me. At the moment the way I am sitting (cross-legged sitting) I can't normally sit this way I keep a cushion under my foot because the screw is directly on the floor.. You step on a lego but it's inverted lego.now it just hurts when the weather is changing.

6. How would you believe was reaction of close to you? Or is?

7. How long did it take you to become as independent as you are today?

8. What are the aspects of your life that you still need assistance in?

Angela: like my friends would hold my crutches or help me climb up the stairs to the studio

9. Considering your office/university, how facilitating is the institute according to you?

Angela: There is a little difficulty in climbing the stairs.

10.Do you consider any facility or aid that lacks in your office/university?

Angela: There was usually problem with the washrooms but even the ramps outside weren't that useful most of the times

11.If for example you needed human assistance what were the places you were able to get that?

Angela: Not really during the time I had a plaster I would do everything on my own my parents might come and help in fixing pillow under the leg but otherwise there was no such help and I didn't really visit any place where they would provide such assistance

12. Would you like to specify what increases your time of performing any regular task?

Angela: Shifting from one position to another would be difficult it would take twice more time to move from one position to the other

13. How do you think places such as bathroom or kitchen be modified to suit your need?

Angela: Oh yes there should be some method for floors not to be too slippery as they make my crutches slip from under my arm while I am working.

14. How do you think our society lacks when taking especially abled people into account?

Angela: Well people are generally very helpful. Whenever I needed help even when I didn't need any help there was always someone coming to my rescue.

15. Was it easier to climb the stairs or walk on the solid floor?

Angela: Once I got used to climbing the stairs it was actually fun. Easy or tough I can't say because main uss tarha centaurus bhi gai hun I went on the trail as well. It wasn't difficult I got really tired of the crutches because your hands hurt at one point with all that weight.

When I came back in summer I had to walk from Fatima hostel to SADA and metal of the crutches would get hot and then I'd have weird bumps on my hands because of them

## **Interview Questions 2**

1. How long has it been since you got lower limb impairment?

I was almost a months ago

2. Was it an accident?

Yeah it was I fell in a ditch

3. Would you like to share the kind of case of impairment you face?

It was a foot twist but sort damaged tissues but nothing permanent

4. When it happened did you stay in a facility?

No, I stayed in my bedroom after getting medicines and bandage from the medical center

5. Can you pinpoint as to what aspects of your life changed? Or were affected by it?

The ability to go to the washroom primarily, ablution especially got tricky business, I couldn't reach out to grab things all the time. Walk to my department to take classes

6. How would you believe was reaction of close to you? Or is?

They were very caring and were ready to help me even take me to the washroom to which I politely declined.

7. How long did it take you to become as independent as you are today?

When I got the hang of it. At first it was difficult for me but once I was able to maneuver my chair things seemed a lot easier. But still washing feet during ablution was very difficult. And oh yeah, I couldn't move down the ramp outside my department for the fear of falling down.

8. What are the aspects of your life that you still need assistance in?

Moving down the ramp still is hazardous to me at least psychologically, or like if one has to wait long hours in a bank line. Maneuvering in the kitchen or getting myself something to eat.

9. Considering your office/university, how facilitating is the institute according to you?



There is a steeper than children slide ramp apparently made for persons with lower mobility, or bathroom stalls but they aren't really there in ladies' washroom.

10. Do you consider any facility or aid that lacks in your office/university?

There is zero assistance for climbing the stairs. Lack of grab rails in washrooms. No assistance for climbing the stairs. I wanted to walk on my own but even crossing my lobby by myself was difficult task.

11. What was that one major reason you decided to be as independent as you are today?

People wanted to help me whole heartedly but I felt like I am taking too much of their time and I am at once becoming a liability for them, Or I'd have to go out of my comfort zone and take help from people I am not really comfortable with.

12. If for example you needed human assistance what were the places you were able to get that?

There is always porters available at airports or hospitals but except for that there is no other place I can think of right now.

13. How was the treatment of the paid human assistance?

At the hospital it seemed okay but I don't know I didn't take such help elsewhere.

14. In places such as washroom or kitchen do you find lack of aids for you to carry out a task?

Yes definitely, even at the comfort of my home I was not really able to carryout task independently of something as small as making coffee

15. Would you like to specify what increases your time of performing any regular task?

The time it takes me to shift from one place to another, even if its half a foot. Then trying to place my foot in the proper position

16. Do you believe if especially abled people should get separate treatment in public places such as bank or NADRA etc.?

By special I wouldn't want to be highlighted or be under special notice. But yes, there needs to be aids to help me be independent

16.a Why do you think that?

There need should be a method bring a seamless solution that does help the paraplegics but doesn't come in the way of anyone.

17.How do you think places such as bathroom or kitchen be modified to suit your need?

Some supportive systems or mechanical devices with hydraulic hinges to help bring out extensions and place them back when not required

18.How do you think our society lacks when taking especially abled people into account?

There is not any harsh behavior that you see people are usually quite helpful mostly if people like me want assistive aids unfortunately we have minimum to none modifications in our systems

19.Was it easier to climb the stairs or walk on the solid floor?

It was much easier to climb the stairs compared to walking for stairs I sat on my butt and glided up or down.

While conducting interview with Ms. Fehmina Puri, her daily routine was discussed elaborately.

**Daily Routine of Fehmina Puri**

Physical Disability: Paraplegic

Employee  
 Age when got disabled: 14  
 Wheelchair Bound PPAF years

Sitting hours recommended by doctor: 4- 5 hours

Average time spent sitting: 12 hours

Daily routine

Wake up at Fajr – 6.00 a.m.

Go to Washroom  
 >Self Catheterize  
 >Pass Stool  
 >Ablution

Pray

Go to the kitchen  
 Prepare Breakfast  
 (Have to sit while preparing breakfast so need to get ready afterwards or else they'll get dirty)

Place the breakfast on the table.  
 Have breakfast

Prepare to get ready  
 Wardrobe reachable  
 Pick out clothes  
 Press Clothes  
 Change clothes and get ready by herself  
 Leave for office at 8.30 a.m.



Name: Mr.Irfan ullah (eng.)



Owner of NGO – Friends of Paraplegics  
Participated in Asian Games

Disability case: Level1 Spinal Cord injury

Began social work in 2012 after becoming paralyzed.

Mobility is very weak and he stated how he had to start from zero. Would make an excuse of not going out because very difficult in shifting in car and gall bladder also became weak.

**“No one thinks of solutions everyone just sympathizes”**

He became independent after entering sports which gave him strength in forelimb. When he saw other cases which are much worse than his own condition and people much better condition than him asked for help but

Very difficult to climb stairs or any issue in environment

Accessibility is mostly an issue

There is a lack of awareness

Washroom is an issue it isn't accessible

Long distance travelling is very difficult

The sink should be in a way that knees can go inside because hands can't reach and clothes get wet at least washbasin below chest

Also, in shifting there is a lot of problem.

In kitchen, cabinets are very high. And the level should be below height, things should be in the reach

There is a problem of balancing while taking out clothes out of the wardrobe. The clothes sometimes in the reach.

He wants special treatment in the sense that he can move independently

Cooking stove should be at least one near you. Distance between user should be less.

#### His To-Do List

Striving to make rapid transport accessible for people with disabilities. Also filed a case against Public transport that they don't have proper modification for Paraplegics

Has initiated a project called Accessible Pakistan. Where we are striving to bring about modifications in the country to make environment suitable for everyone

Striving to increase employment of the people with disabilities

Working on introducing laws that can be implemented throughout the country according to the rights of people with disabilities.

## **Mechanism**

### **Camera dolly, Rails and tracks**

Camera dollies and Rails and tracks were considered as a mechanism for implementing in the design. It does solve the problem of raising height where the motion is smooth. But the motion is slow but majorly it has a complex system. The system requires large investment. While the tracks need to be built throughout the region that the mobility chair has to move in. This would require alteration in the present infrastructure of the area. Resulting in greater investment of time and money. Moreover, using rails and tracks will become hurdle for those not using the mobility chair attached to the them. The mechanism solving for one group of people

### **Tea pourer stand**

A celebrated example for tea pourer stand is SimpliciTEA. This stand holds the teapot and makes pouring tea easy without any spillage and does not require greater quantity of force enabling it to be used large spectrum of users. The tipping quality without spilling is because of the form of the stand. It only allows the spout to bend rather than the whole pot. Less of a mechanism and more of an inspiration, this case study highlighted how one could solve the problem of tipping things letting their center of gravity aligned to the ground. As this form made me realize that one can bend their body forward to grab things that are far away and it is a natural human behavior.

### **Forklift**

Forklifts have the ability to lift several kgs of load with the power of two intertwining mechanisms, a pair of hydraulic cylinders and a pair of roller chain pulleys. They are either wired or manual. Manual works by revolving handle attached to the mechanism and lift the height moderately slow. Unfortunately, they are expensive compared to other mechanisms but more importantly they require a heavy base on which the chair is built. By using this mechanism, it may only solve the problem

of change of height but other mechanisms become difficult to incorporate that solve other objectives.

### **Pneumatic pressure**

This is a branch of engineering where gases or air is pressurized is used to make a product, machine or component of any device function in a particular manner. Pneumatic pressure is used in office chair to lift and lower the seating using compressed air. This is a very effortless and cost-efficient method. But if used in seating the user has to get off the chair to raise the height unfortunately this isn't feasible when user is person with reduced or restricted mobility. As this doesn't solve the objective of raising height while seated.

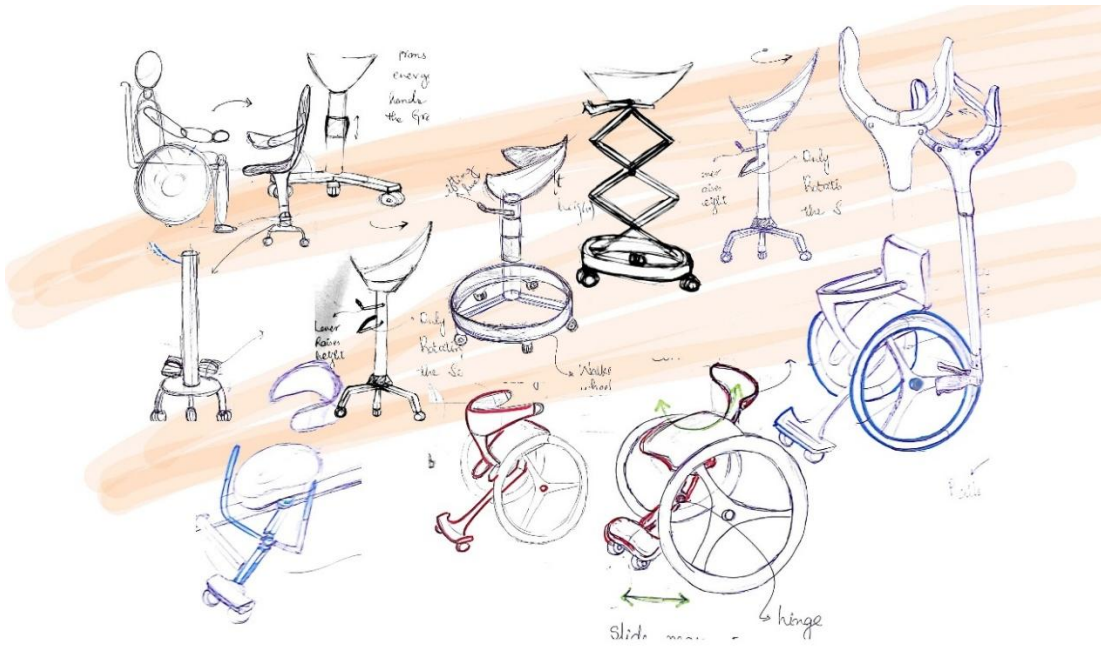
### **Gas Strut suspension**

A gas spring, unlike ordinary mechanical spring relies on cylinder containing compressed gas/air sealed by sliding piston. It is in automobile as well as furniture or heavy machinery. In the mobility chair, for the dynamic seat height adjustment gas springs are used according to the load it has to bear i.e. 90-110kg. It is a cost-efficient method that is readily available in the market. This causes a displacement of around 10". This method also requires only small space and doesn't need a separate structure for it (unlike forklift).

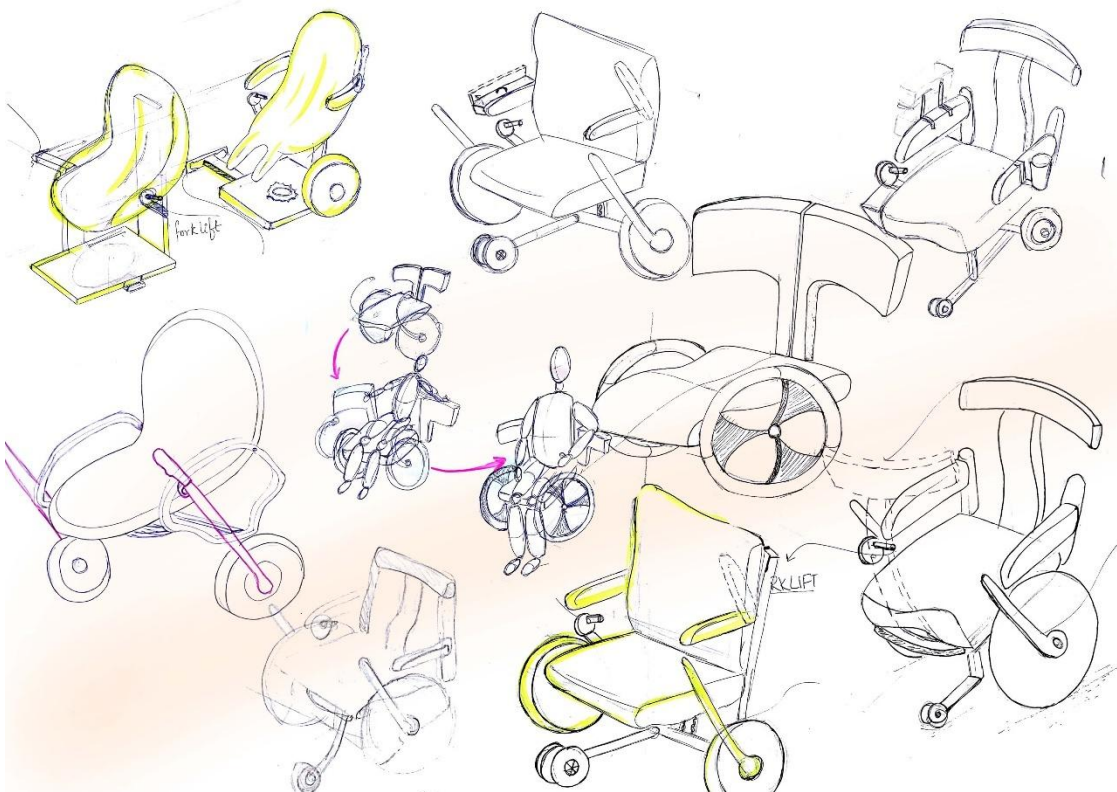
# Criteria and Ideation

Initial

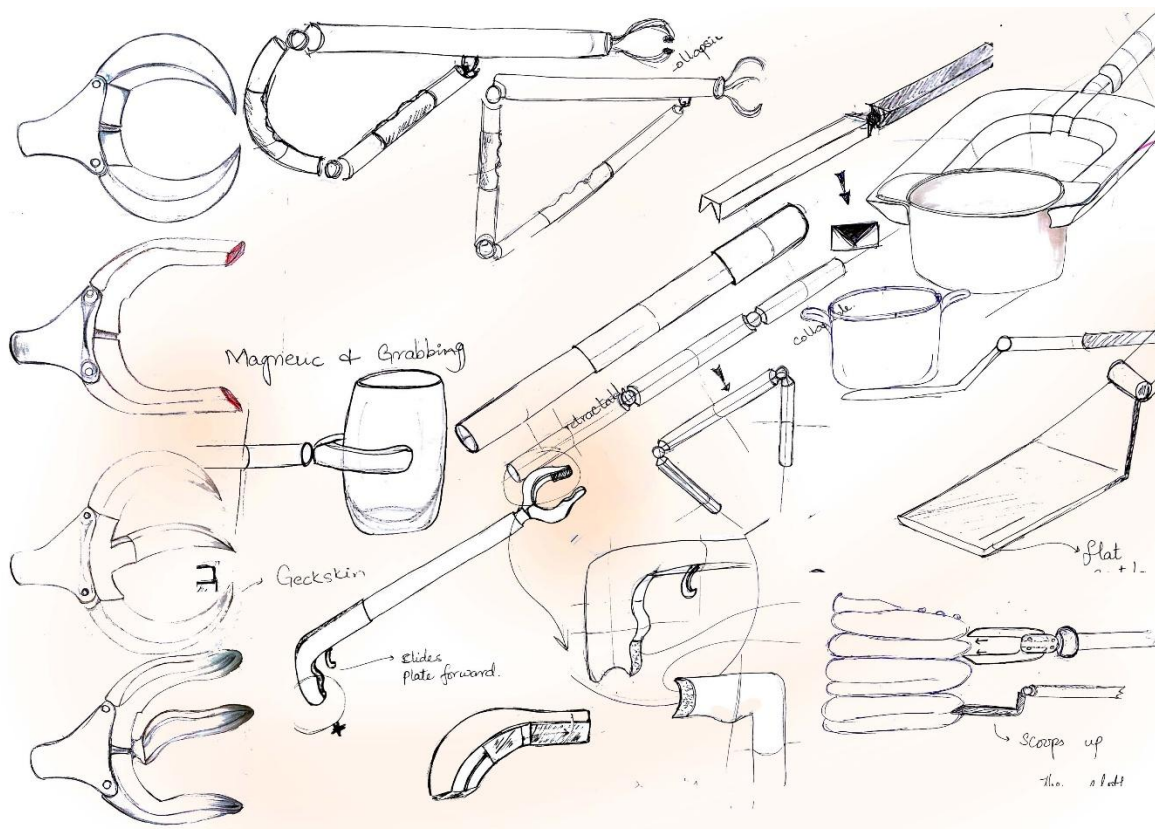
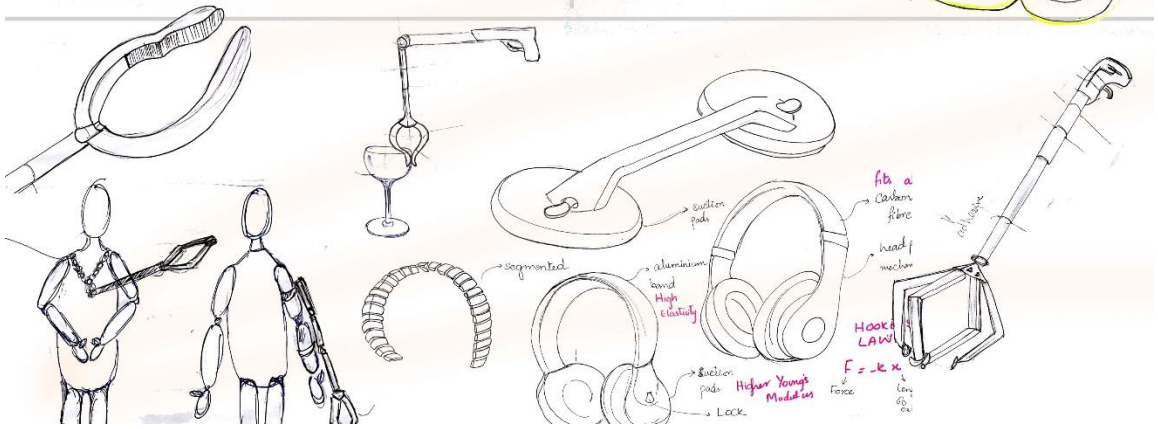
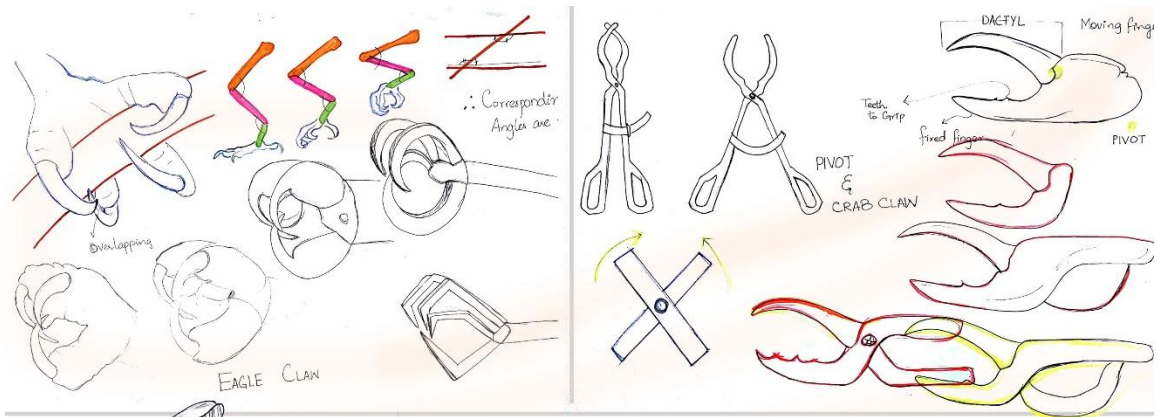
Ideation

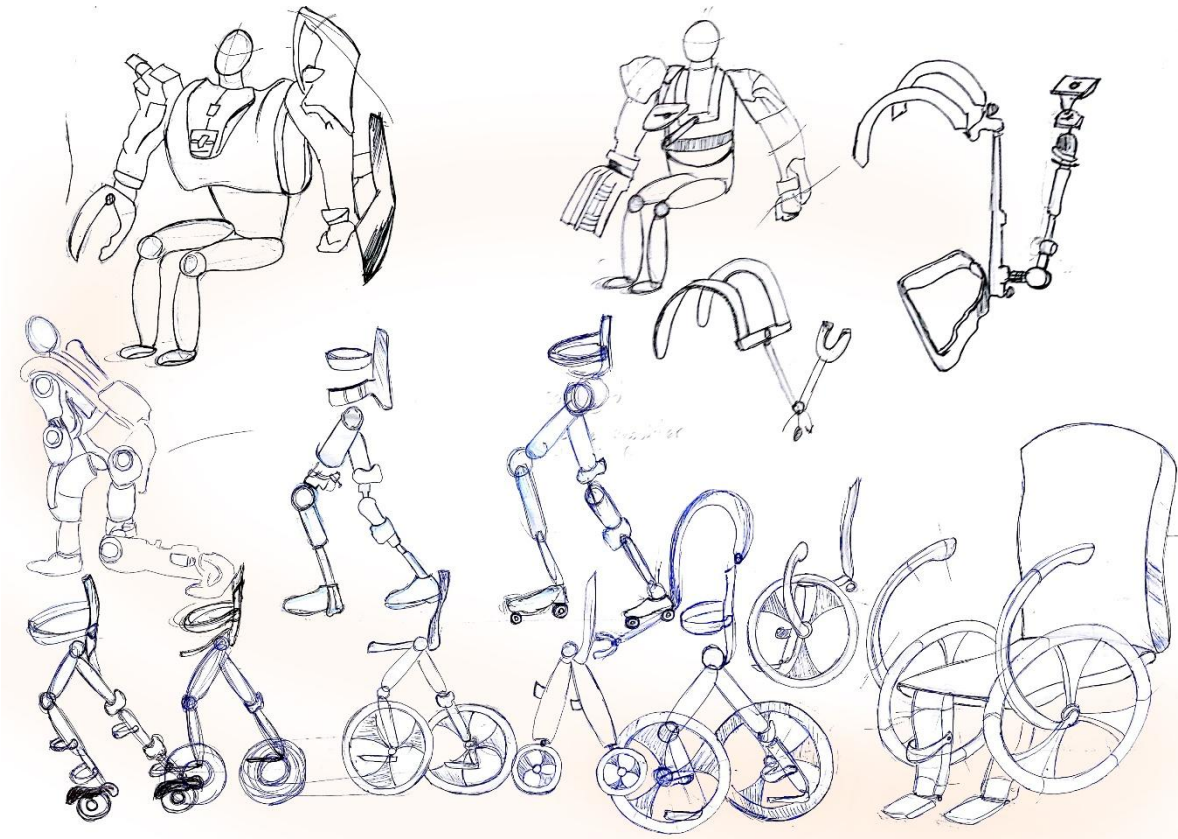


## Development Sketches









## **Ergonomics**

The dimensions of seating were resolved after intensively studying different papers and articles published along with "The Time Saver's Standards". Majorly the measurements were taken from the article published by Cornell University Ergonomics Web "Sitting and Chair Design".

Sitting is a body position in which the body weight is transferred through the pelvis to the seating. It helps to release weight off the feet and maintain a stable posture. But this a fact too that there isn't one ideal position for sitting, the 90-degree posture is basically for the anthropometric drawings. To maintain an ideal posture there needs to be minimum postural stress. When discussing the biomechanics of sitting we see that the weight of the whole body is transferred to the floor via seat pan, arm rest, foot rest and backrest.

Lumbar Region – this the lordotic region i.e. it is concave to the stomach and it helps to reduce stress on the vertebrae.

Pelvis – the rotational movement of the pelvis effects the vertebrae. Forward rotation will lead to lordosis in the lumbar spine while on the other hand tilting backwards of the pelvis may result in kyphosis because of flattening of the lumbar spine. Sitting posture is classified into three types; anterior (forward leaning), middle (relaxed, unsupported) and posterior (backward leaning).

Factor influencing the posture include hamstring muscle. These muscles begin from lower leg to the pelvis and influence the configuration of lumbar spine and posture. Preferred seating angle is also an important part of the seating as sitting causes 40-90% more stress compared to standing. Through studies it was found that 15-degree backwards incline is suited for comfort.

### **Seat Design Criteria**

Seating height – optimum/desirable seating height has always been debatable. Minimum height according to the 5<sup>th</sup> percentile women should be 15" and the fixed height should be 17" but its only a compromise. A chair too high will cause stress on the popliteal muscles (underside of knee)

Seat pan – the optimum depth of seat pan is 16.5". If it is greater than that the user (i.e. women 5<sup>th</sup> percentile) will not be able to use the back rest.

Seat pan contours- a flat seating will cause pressure on the ischial tuberosities (seat bone) but if the cushioning and contouring of the seat is considered it helps to distribute weight across the seat pan.

Seat Cushioning - seat cushioning should be firm and thicker in the back and thinner and softer in the front. A soft seating is comfortable first but increased time causes body to sink, raising the body temperature and reducing blood circulation and increases the compression under the thighs.

Armrest – Arm rest should be padded to rest the fleshy part of the arm. There should be a distance of 4” between the arm rests and the back rest to ensure the elbows don’t rest to prevent the sensitive ulnar nerve to come in contact with hard surface.

Backrest – There are three categories for backrests – the low back rest which supports the lumbar region, medium level back rest that gives support to full shoulders and high backrest that gives full support to head and neck.

## **Final Outcome**





The final proposed design is revolving around the problems identified earlier. Enhancing accessibility by height adjustment and easy maneuvering of the chair by use of levers increasing efficiency of maneuvering by 40%. The back open with a hinge and allows easy transferring of the user onto the chair. The design also enables easy bending down while sitting on the chair.

Making user more independent and self-sufficient.

## **Conclusion**

We are in a technological boom, this is a new age and finally since the beginning of mass production there is a focus on the customer their needs, wants and desires. The time that is ahead of us doesn't pick technology and fit a product into it rather, it celebrates technology understands it as a tool to incorporate. We need to remove barriers beginning with those in our minds. The basic purpose of this project is to help them psychologically so that they face hurdles of the society or in their lives themselves and to make them independent and useful citizens of the country.

People with reduced mobility do not want to be treated with sympathy. Between the ages of 21-40 is the prime age of achieving goals in life; the age when there is thirst to prove oneself and their capabilities; in this age people with physical disabilities majorly try their hardest to give back to the society regardless of their physical deficiencies.

Munim is the product that enables person with reduced mobility to become independent. Enhancing accessibility of the user whilst improving the mobility. The design has clean and bold aesthetics, where they will not be perceived as deprived.

The product can be conveniently taken to mass production with in six months. There are vast possibilities of upgrades to this design. The design is capable of generating colossal amounts of revenue in a country which lacks barrier free architecture. The product gives an option to people to invest in Munim instead of less cost efficient but uncomfortable seating.

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Munim

A Research Report

**Eisha Warda**

A research report submitted for evaluation to School of Art, Design and Architecture on

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June 2018, in partial fulfillment of the requirement for the degree of B.ID.

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(Signature) (Signature)

**Graduation Projects Coordinator Examination (SADA)**

2018

**School of Art, Design and Architecture**

National University of Sciences and Technology

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