PROJECT III
walking aid for the elderly

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Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/ source in my submission. I understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Signature Pragati

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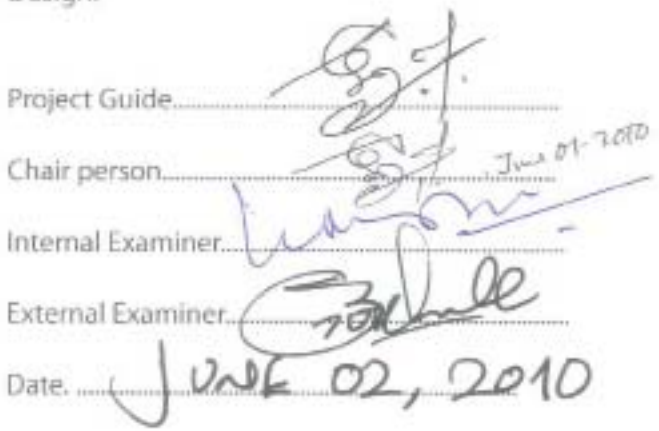
Date: 20/05/10

Approval sheet

The Product Design Project-III titled "Mobility aid for the elderly" by Pragati Kapur, 08613804 is approved as a partial fulfilment of the requirements for post graduate degree in Industrial Design.



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Date. ..... JUNE 02, 2010

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To my Parents who are always by my side.
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Abstract

The rapid increase in the elderly population in India and all over the world provides several opportunities to design for this segment of the society.

For the project, initiated by Department of Science and Technology of India, I chose to work on mobility as the basic premise, as it is the second largest cause of disability in India.

The project, titled 'Mobility aid for the elderly' is aimed at better:
- Functionality
- Aesthetics

The project required an understanding of the various stages of walking with an aid and deriving insights for building design solutions. The project inspired me to look for lacune in the current walking aid designs and look for possible design solutions to the same to help elderly walk better.

The final output shall be in the form of a full scale working prototype of the walking aid, valid in the Indian conditions.

Identifying possible areas of work

The areas of possible product interventions, as listed under, were identified keeping the elderly in mind and mobility was chosen as the focus area.
The reason I chose to adddress mobility as the core area is explained in the next page

Personal care
Safety/security
Mobility
Communication
Health and nutrition

VALIDITY of the project

As a result of interactions with caretakers in elderly homes and from the available statistics, it was identified that falls are the most common, disabling and frequently fatal events affecting approximately 30 – 50% of older individuals in India annually.
Studies indicate an annual fall incidence of 300 per 1000 in elderly.

Falls are associated with multiple risk factors as stated below.

1. Intrinsic (those related to the individual) - The factors can be physiologic or pathological

2. Extrinsic (those related to environmental features) - They involve the environment surrounding the person, such as placement of furniture, existence of obstacles, use of assistive walking devices

In India, falls are the second largest cause for injury hospitalisation among elderly.

Number of disabled in India by types of Disabilities

Types of Disabilities	Number of Disabled	Percentage
Seeing	10634881	48.55
Speech	1640868	7.49
Hearing	1261722	5.76
Movement	***6105477***	***27.87***
Mental	2263821	10.33
Total	21906769	100.00

Source: Census of India 2001

http://www.disabilityindia.org/djartjan06A.cfm - 15/01/2010
http://medind.nic.in/iba/t08/i2/ibat08i2p33.pdf - 15/01/2010

INTRODUCTION

Our bodies are designed by nature to stand upright and walk on two legs.
The inability to do so, limits one or more major life activities
Walking is the most basic and the main form of locomotion and transportation for human beings. Therefore, it is essential for optimal health and function so that this basic form of movement is a regular part of our daily lives.

The problem of disability is gaining more and more importance all over the world.
Mobility aids are made for those having balance or weight bearing problems.
There are a wide range of products aimed at improving the mobility of elderly but there are very few which concentrate on assisting people use their remaining ability.

A walking aid which would solve the above problems, would help the elderly over come their physical limitations and gain confidence, regain a high level of mobility, regain the ability to walk naturally with the body weight evenly distributed on both legs, thereby reducing stress and allowing them to walk longer distances and reduce both mental and physical ailments caused by immobility.

PURPOSE OF A WALKING AID

Mobility is the ability to move or the act of traveling by foot
Aid To support, either by furnishing strength or by means of cooperation. The person or thing that promotes or helps in something getting done; a helper; an assistant.

Walking aids
Equipment used to assist those who have problems with walking, balancing or standing up and as temporary means of support.
Walking Aids are made to keep users up on their feet and to give them confidence to continue walking and do the things they like independently.

The purposes of using walking aids are as follows

1. As *part of a rehabilitation programme* when the user is recovering from an injury or operation, so as to give temporary support to his lower limbs, so that he dosent loose his confidence in walking
2. As a *longterm aid* when the user has a permanent difficulty with walking, eg in old age. In this case, a walking aid acts as an enabling equipment to make the elderly physically independent.

Restoring the elderly's walking abilities can improve mental and physical wellbeing and improve their quality of life.

BENEFITS OF WALKING AIDS

There are several benefits of walking with a walking aid for the elderly which are as stated as follows:

- Walking aids help provide stability and safety in elderly people with mobility problems
- Use of walking aids increases body awareness
- Walking aids provide greater balance by providing a wider support base
- Use of walking aids facilitates the walking pattern of the user in terms of speed and evenness of stride
- Walking aids help the elderly maintain an upright body posture
- They help in increasing the confidence of the user in his/her walking ability
- Walking aids also help in weight redistribution as some of the weight is transferred through the arms of the frame

Benefits of walking

- An improved self-image
- Better blood circulation especially in the lower limbs
- Cardio vascular respiratory fitness
- Prevention of pressure sores
- More range of motion
- Helps alleviate symptoms of depression
- Maintaining blood pressure
- Controlling weight

Categories of the functionally impaired elderly

The functionally impaired elderly can be categorised into the following three categories based on the degree of walking impairment they have. A study of the categories of impairments followed by user studies in old age homes, helped me narrow down to the impairment for which a a design intervention was required.

THE MILDLY IMPAIRED

The first group includes people who have relatively mild impairments, such as mild arthritis, and can generally get by without help from other people.
Within this group, assistive devices can be a great boon. Examples include an elderly person with arthritis

THE MODERATELY IMPAIRED

The second category includes persons with moderate impairments, those who are functionally impaired in one or two activities of daily living. An example could be an elderly with arthritis plus the loss of leg movement.
For those in the second group,they may not be able to make the person completely independent and they might still require human help.

THE SEVERELY IMPAIRED

The third category of the severely impaired elderly makes little use of assistive aids. This group includes people with multiple health problems and severe functional limitations.
Such persons may have severe cognitive impairments, as well as several physical impairments such as loss of arm and hand movement.

Causes of walking disabilities

Symptoms specific to the various categories of the functionally impaired elderly that lead to walking disorders include the following:

For the severely impaired elderly, the symptoms are as follows

- Arthritis and joint diseases
- Diseases of the muscles or bones
- Neuropathic disorders
- Loss of cognitive elements of perception
- Circulation problems in the legs
- Problems after orthopedic surgery or stroke
- Low blood pressure when standing
- Dementia

For the mildly or moderately impaired elderly, the symptoms are as under

- Vision or balance problems
- Degeneration in joints due to old age
- Fear of falling
- Symptoms of pain, stiffness, dizziness, numbness, weakness
- Difficulties in initiation of gait
- Loss of symmetry of motion
- Poor fitness

Analysis of the existing walking aids

FIG 1a
Single point canes

FIG 1b
Quad point canes

The walking aids available, range from the original walking canes to mobility scooters and are used depending on the degree or severity of the walking impairment. The different types of walking aids have been classified into the following 6 groups:

1. Walking sticks or canes

A stick or staff carried in the hand for support when walking.

- Aid balance and stability and provide a small amount of weight transfer
- Help people maintain their balance, walk with more confidence
- Help get objects that seem out of reach

They are the most simple aids in construction and most widely used
The four pronged canes gives more support

Axillary crutch
FIG 2a

Forearm crutch
Fig 2b

Platform crutch
FIG 2c

2. Crutches (FIG 2)

Crutches are medical devices used when a patient is injured usually anywhere below the waist

FUNCTIONS
- Reduces weight load on one of the legs
- Broadens the support base to improve balance and stability
- It allows people with paralysis, the benefits of upright posture and lets them manoeuvre in places they cannot go with a wheelchair.

Crutches require considerable balance, strength, and coordination to be used safely which elderly mostly lack

3. Walkers (FIG 3)

It is a frame used by elderly or infirm people for support while walking
Walkers are used by individuals with a lower extremity that is full, partial, or non-weight-bearing.
The four legs give wider base support and more stability
The walker is the most stable of all the ambulatory assistive devices.

FIG 3a Standard walker

FIG 3b Four wheeled walker

FIG 3c 2 wheeled walker

FIG 3d Hemiwalker

FIG 4a

FIG 4b

4. Rollators (FIG 4)

These frames combine the support of walking frame with a seat to rest when out walking.
The 2 front castors will swivel to enable the frame to turn
The rear 2 are fixed for stability.
Some rollators are fitted with pressure brakes to help people with weak hands and wrists to control the rollator easier.

Since they have the provision of a seat and are equipped with wheels, they can be used outdoors

5. Wheelchairs (FIG 5)

A wheelchair is a wheeled mobility device in which the user sits. The device is propelled either manually or via various automated systems.

Wheelchairs are mostly used by people for whom walking is difficult or impossible due to illness, injury, or disability.

FIG 5a

Manually operated

FIG 5b

Electric powered wheelchair

6. Mobility scooters (FIG 6)

It is a mobility aid similar to a wheelchair but configured like a motorscooter.

A scooter is useful for persons without the stamina or arm/shoulder flexibility necessary to use a manual wheelchair. This aid is used for people with severe walking disability

FIG 6

EXAMPLES of walking aids

Various innovative walking aids exsting in the Indian and International markets were studied and their USP s were determined. This study helped me to gather knowledge about the various prodcut features which made one unique from the other

FIG 7

Carry-na mobility aid (Fig 7)

Has a *portable chair*, for users to take a short rest in between
Features a *wheel lock*, handbrakes and an adjustable-height handle
A *flexible handle mounts* and drops to the height of different users
The handle of the walker folds up vertically to become the backrest
A seat flips down, with a press of the foot pedal

FIG 8

(FIG 8) The principle function of elbow crutches is to aid walking by increasing stability, enlarging the support base and reducing the loads on the lower limbs.

Spring for absorbing shock from the ground

FIG 9

The MuSmate Walking Aid (FIG 9)

All walking movements are energy -intensive and so people with drop foot become tired quickly, and so tend to limit their movements.

It uses a shoulder harness and an elastic cord connected to the shoe.
When walking, the thigh muscles push down on the elastic cord and it in turn gently supports the raising of the foot.
The height to which the foot is lifted is controlled
Walking is made easier
There is less risk of trips or falls because the foot is not dragging

** Rehabilitation/ interaction*

FIG 10

The Giddy-Up Stick Helps the Elderly Get Up and Go

(FIG 10)

Dual-handle walking cane enables users to more evenly leverage body weight when standing. The top handle is stationary while the *bottom handle swivels a full 360°.*

Adjustable walking cane accommodates almost any height

USER STUDIES

After an understanding of the categories of impairments in elderly, their causes and the various walking aids used for different impairments, visits were made to elderly homes in Delhi and Mumbai with a fair understanding of their walking impairments and the reasons for the same.

A total of 15 elderly were interviewed.

The methodology followed was to observe and identify elderly with different walking impairments ranging from severe to mild and the difficulties they faced with the walking aids they were presently using.

This study helped me narrow down to the category of elderly for whom walking aids would be useful and also the aid, which needed to be redesigned.

Questionairre attached in the appendix

Observations derived from interactions with the elderly and the questionairre

The interactions with the elderly, helped me to derive the following observations which were used for design in the later stages

Most common aid	The most commonly used aids are the cane and the walker because of their ease of handling Walker use is tapered as the patient reaches a high level of mobility
Walking long distances	They get fatigued easily and have to take rest at intervals
Customisation	They make certain changes/additions to the aids some times depending upon their need
Dimensions	Standard sizes are used which some times are not suitable for the very tall and the very short people
Uneven surfaces	The end caps are usually worn out which causes skidding and slipping
Outdoor mobility	Limited due to lack of pedestrian pathways and uneven surfaces
Weight of the aid	Some aids are difficult to carry and move around with due to their size and weight
Durability	The MS walking frames are often seen rusting

* A sample of 15 elderly were interviwed

General observations from the visits to elderly homes

Visits were made to old age homes in Mumbai and the following observations were made

Age : 64 years

Support from furniture is required while lifting the body from the sitting position

- Insight - Hand support on a walking aid should be provided prefrably on both sides of the body

Age : 90 years

Severely disabled
Not enough space to manouver a wheel chair besides the bed

Width of 1'-9" is available next to the bed

It was observed that various aditions/changes are made to the existing aids to suit a patient's purpose.
Support to forearms. Useful for people who cannot take weight on their hands

Cane hung on the cupboard

- The cane is single pronged so it cannot be kept on the ground
- After it is hung on the cupboard, it is difficult to access it

Although additions made to existing aids help the user in overcoming one problem, it often leads to another.
Walker is difficult for the elderly to carry because of its increased weight

Age : 77 years

Apart from the walking aids, some elderly are adviced to wear the foot and leg brace for support while walking which is due to difference in the lower limb lengths.

Severe impairement

As discussed earlier, patients with severe walking impairments usually suffer from hemiplegia,orthoarthritis and they rarely benefit from any walking aids unless it is automatically operated which are often difficult to afford.

Age : 72 years

Support is required from two people to make him walk. The elderly requires to wear braces to keep his legs straight.
Support from two people is required for lifting him from the bed or for any of his other activities of daily living.
In his case, no walking aid can help him walk unless he is accompanied by atleast one more person

This study helped me eliminate this group of elderly from the user group I chose to work for

Mild to moderate impairement

The common disabling factors in people suffering from mild to moderate impairments are stiffness in joints, fear of fall, operation in one of the limbs. For this category of elderly, walking aids can be of great help. Some observations derived from visits to elderly homes are as follows

Age : 61 years

Support is required from the adjoining bed rail while getting up because the elderly is scared that 3 pronged cane might not be able to take his weight and might topple.
While walking though, support from the cane is enough

The user's physiological mechanism is good for walking and the cane helps to provide balance and physiological relief

Age : 68 years

The woman is a walker user but while getting up the two wheeled walker has to be held because she fears that it might roll with application of her body weight

A little assistance is required to get her to stand

The inference that was made from observing her was that some thing like a break or a stopper needs to hold to walker in place when the elderly are trying to get up.

Stages in walking

Posture as an indicator of activity during various stages of walking was studied with respect to time that each activity required and the activities which take most effort and time were observed

ACTIVITY	TIME (approximate time)
1. Sitting	-
2. Standing up from a chair	1 to 1.5 min
- Balancing the body on the legs	1 to 2 min
3. Walking - a distance of 20 feet	1 to 1.5 min
4. Turning - with/without support from adjoining walls/furniture	Few seconds
5. Walking back - a distance of 20 feet	1 to 1.5 min
6. Sitting	30 seconds

Sitting

Sit to stand

Balancing

Standing

Walking

The observations helped me derive insights leading me to possible solutions to the problems which the elderly faced with the aids they were currently using.

Problem identification

Most elderly have sedantry lifestyles and are low on physical activity due to which there is stiffness in joints which results in difficulty in walking

Initialisation of gait is a unstabilizing event where the body is made to fall outside the foot

Most of the elderly have suffered falls due to uneven/slippery surfaces

There is rigidity in their movement/insufficient flexion/lack of muscle activity which makes them fall

Use of walker is associated with lower health status

They get fatigued after walking some distance

There is reduced floor reach

Additional support is required while getting up and sitting

The effort required to initialise the walk is more. Once they start walking, they gain control over their gait

Possible solution

Rehabilitation and regular walks/excercise. Incorporate some activity in the aid which keeps them physically occupied

To have some support while rising, so that they feel secure

To have a sensor built into the aid which gives a feed back on the ground condition/ shock absorbing material

They should be encouraged to involve in resistive excercises to reduce rigidity and provide support

Aids should be cosmetically treated to make them look non medical

Provision of a seat or resting surface

Reach bar/stick which can reach the ground

Hand support at a level where they can exert their body weight and lift it up

A forward force which helps them initiate the walk

Why walkers?

I chose to redesign the walker for the elderly because it has several benefits over the other walking aids.
It helps the elderly regain their ambulation and their confidence in walking in case they have suffered from a fall or an accident.

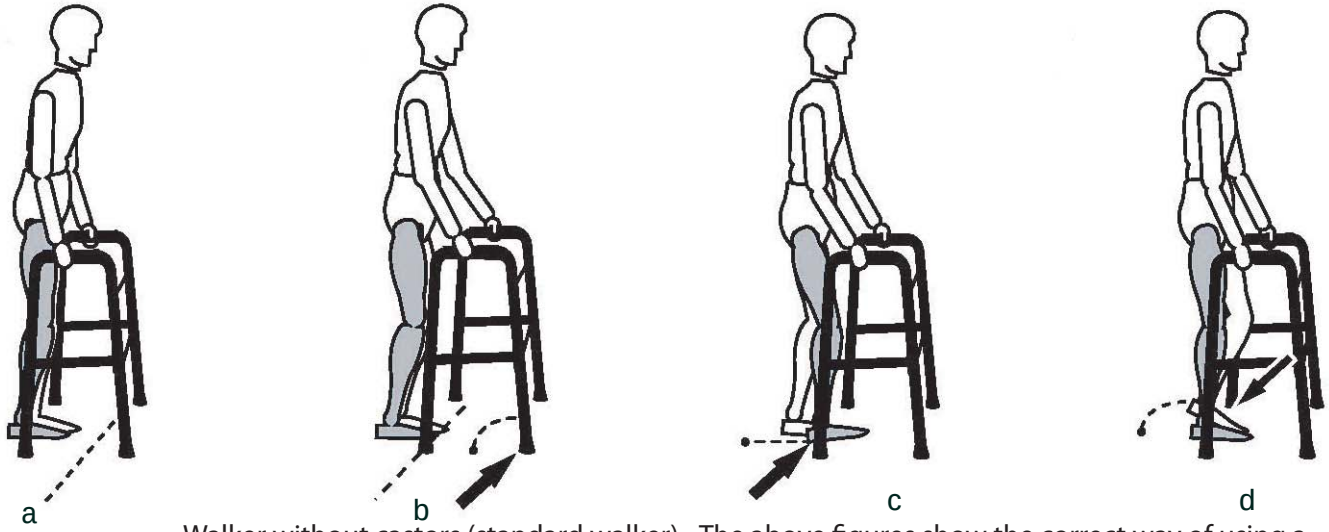
Walkers are desired because they provide more support and stability than any other manually operated aid like the cane or the crutches.

Walkers can be applicable for permanent use during old age and temporarily during rehabilitation of the lower limbs

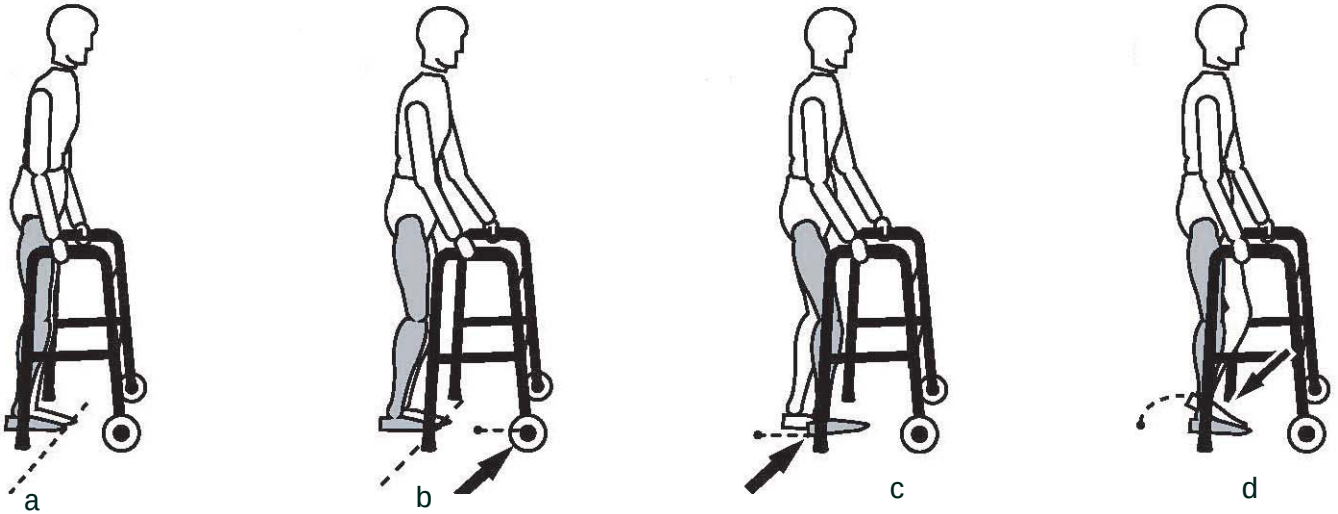
There are many good reasons (physiological and psychological) why it is good to stand and walk rather than use wheeled mobility,, like better blood circulation, reduced pressure sores and a means of physical activity.
Two wheeled walkers provide better stability and control over gait and at the same time also provide better manueverability.

Walking pattern with a standard and wheeled walker

The following figures show the walking patterns while walking with two different kinds of walkers.



Walker without castors (standard walker) - The above figures show the correct way of using a standard walker by lifting it up and stepping forward



Walker with castors - The above figures show the correct way of walking with a two wheeled walker by moving it ahead of the body and walking within the frame

USER PROFILE

Following the user studies and identifying the problems faced by the elderly, I pinned down to the user and product profile based on which the design brief was framed.

Age of the elderly : Above 65 years of age
Mobility impairment : Mild to moderate
Users needs : Support, balance, confidence in their walking ability
Activities of the elderly: Mostly indoor/ paved outdoor

The abilities and disabilities of the chosen user group were identified

Inabilities
- Mild walking impairment
- Mild arthritis
- Functionally impaired in one or two activities of daily living
- Loss of leg movement

Abilities
- Can get around with little or little help
- Can get up/sit down with assistance from furniture/ adjoining walls

Product profile

The product would be a 4 legged walking aid
Operation of the walking aid : Manually operated
Number of wheels : 2

PRODUCT BRIEF

After observing and identifying the problems faced by the elderly with the existing aids and after interactions with doctors and rehabilitation therapists, a need was felt for improvement in the existing mobility aids.

Product Brief Statement

To design a mobility aid for the elderly more than 65 years of age with moderate impairment.
The aid would help them get up and walk with little or no assistance.
The product shall be designed such that it demands less physiological cost from the elderly and ensures better usability.

- easier approach
- getting in
- use the walker
- getting out
- sitting back

The product shall ensure
- better stability and weight redistribution
- ease of holding and handling

The structure of the walking aid should be strong and weight bearing, and at the same time it should not look bulky and unapproachable.

The aid should also be aesthetically acceptable by the elderly.

AIM OF THE PROJECT : The project aims to identify the main ergonomic, functional and usability issues with current design and propose solutions

Visit to Anand Niketan, Mumbai

I pinned down to redesigning a walker for the elderly because it is the only aid which provides maximum stability, grip and sturdiness

More focused visits were made to the elderly homes which were aimed at identifying the problems associated with the use of a four legged walker. This study was useful to ascertain the various stages involved in the use of walker.
The complete cycle involved in the process of walking with a walker was studied with two walker users in old age homes in Mumbai.
The stages of walking have been classified into three categories with a series of pictures of the user and the insights obtained from those have been explained there after.

The three categories of walking with a walker as are under :

1. From sitting to standing
2. Balancing and walking
3. Turning and walking back

The pictures highlighted in the frame are identified as the major problem areas from which design insights have been obtained.

MOTION ANALYSIS - stage 1 - sit to stand












Stage 2 - balancing and walking












Stage 3 - Turning and walking back








Mrs. Kamala
Age 67 years
Has been using the walker with castors since 6 months after a fall

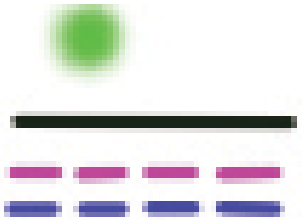
Observations derived from the above series of pictures and the insights obtained are as follows

Accessing the walker

One hand on the bed for support

Getting in

The body is bent in an unnatural position while getting up because the walker height is too high for her



Marking at joints

Line joining the points while performing the activity

Correct lines of joining

The wrist is bent at an acute angle which causes discomfort and pain

Standing up

While trying to get up,the rear wheels are lifted from the ground

- Foot is not resting on the ground and the pressure is on the toes
- The body thrust is on the front legs

Finger along the rear leg of the walker to ensure alignment

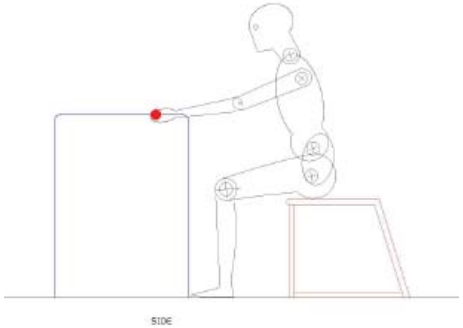
Balancing and walking

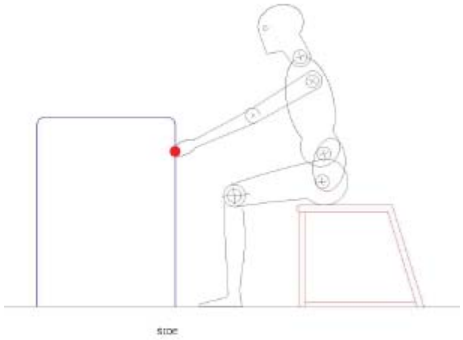
Part of the body weight is supported at the edge of the bed

The rear legs with casters provide ease of manueverability

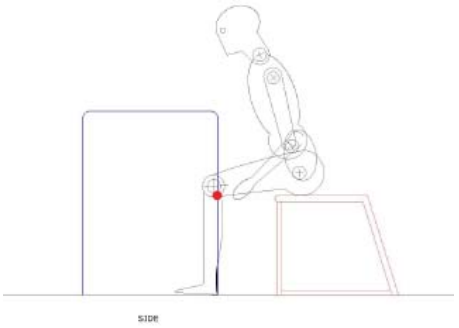
The walker frame was super imposed with the above pictures to obtain the following points while accessing the walker, using the walker to get up, for standing and walking with it and sitting back. All the points were then plotted on the frame which was used for the ideation

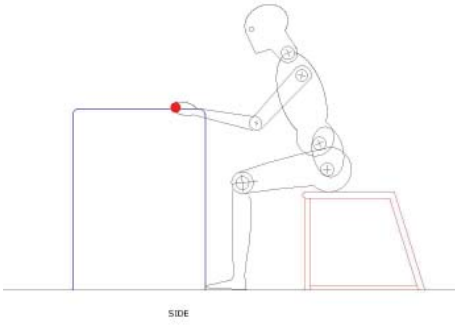
Accessing

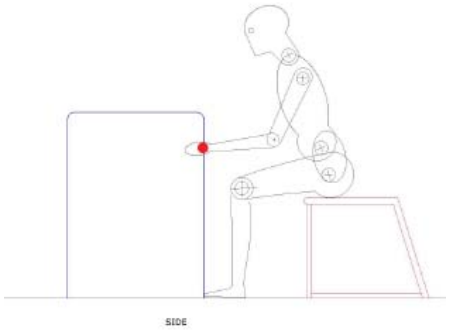




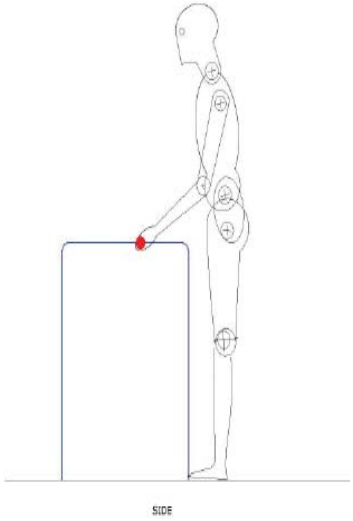
Getting up



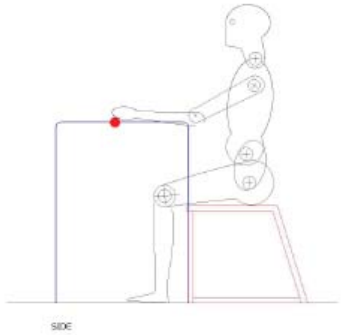


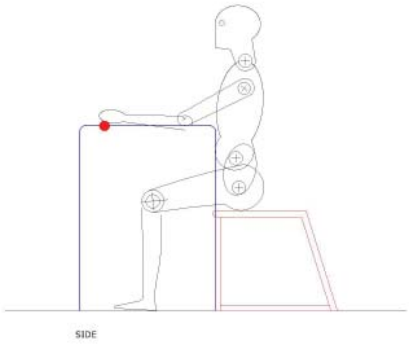


Standing and walking



Sitting





Ideations

Solutions to the problems identified, were sketched at different stages of the project.
To meet the needs of the design brief, the following were considered:

Space analysis

The maximum floor space requirement was inferred from the existing walking aids. An attempt was made to limit the size of all the ideas within a framework measuring
600 mm X 600 mm X 900 mm

In the first set of ideations the aim was to improve the aspects which lacked in the present walkers that the elderly were using.

It was also attempted to make the aid look as different as possible from the standard walker while keeping the basic functions of providing support and balance to the user intact.
In the pages that follow, the development of ideas from the very basic to the final dimensioned concepts have been explained.

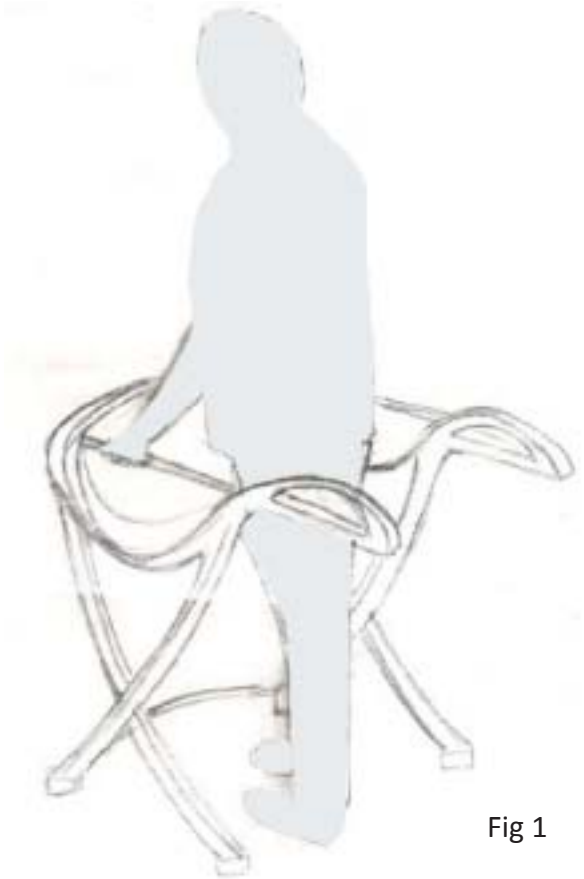


Fig 1

rigid handles for walking

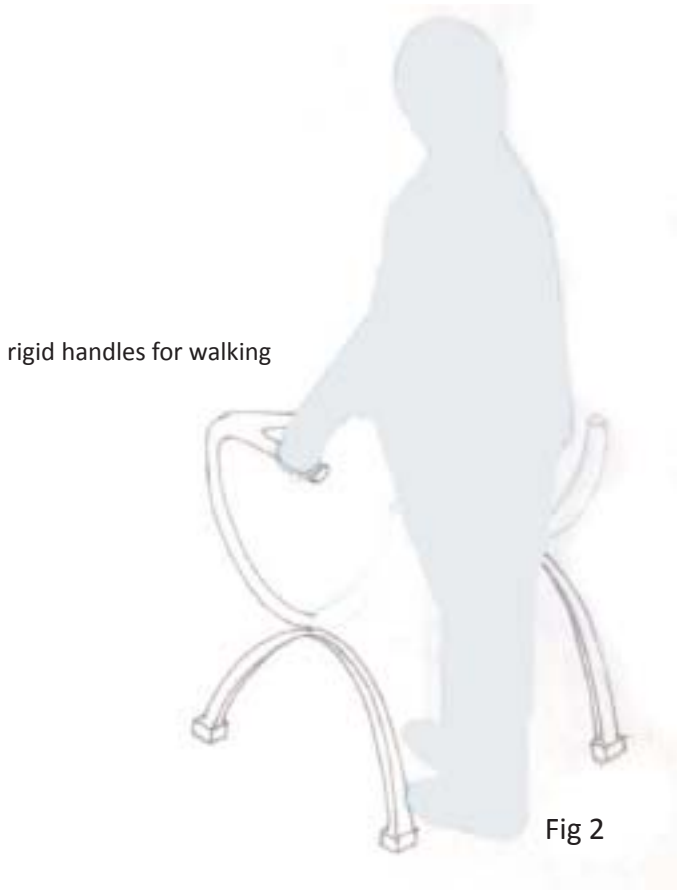
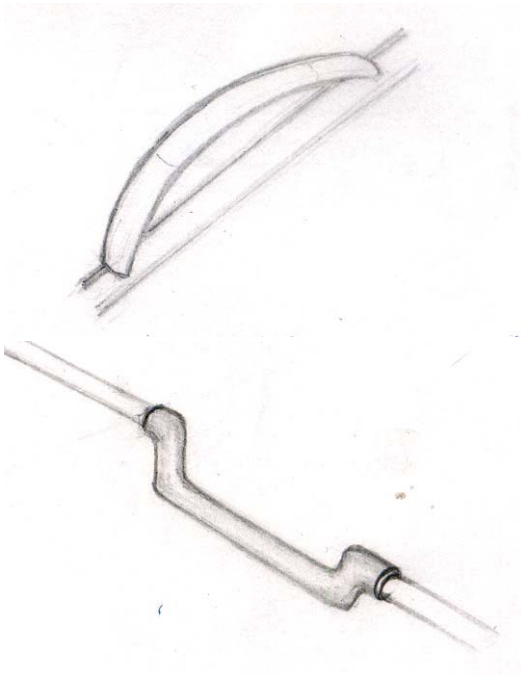
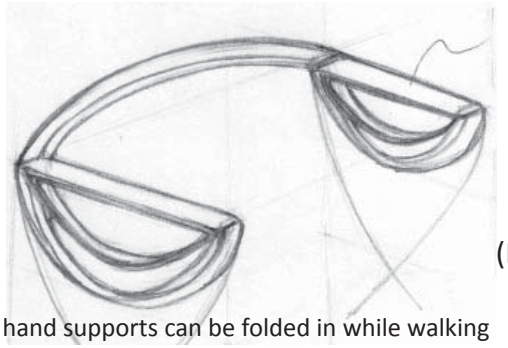


Fig 2





(Fig 1a)

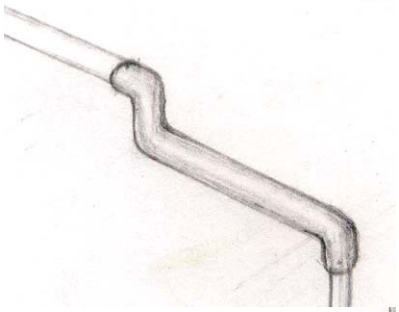
hand supports can be folded in while walking

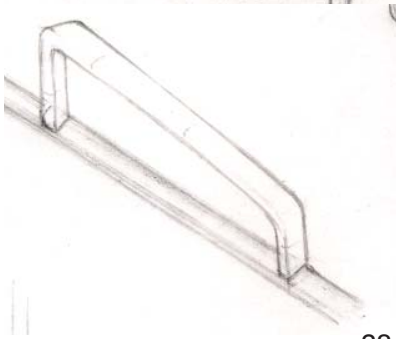
(Fig 1b)

hands like support while getting up

Fig 2a

push/pull the flexible
handles while getting up





Ideas based on multiple levels of holding

Most of the early sketches did not take into consideration, the provision of wheels.
The ideas were sketched on four legs with rubber stubs.

The X configuration of handles in following ideas is based on the understanding of walking within the walker frame.

The placement of handles a little towards the inside forces the user to walk within the frame and not away from it.

Two levels of holding
- while getting up
- while walking

Fig 3

Broader base tapers towards the top

Fig 4

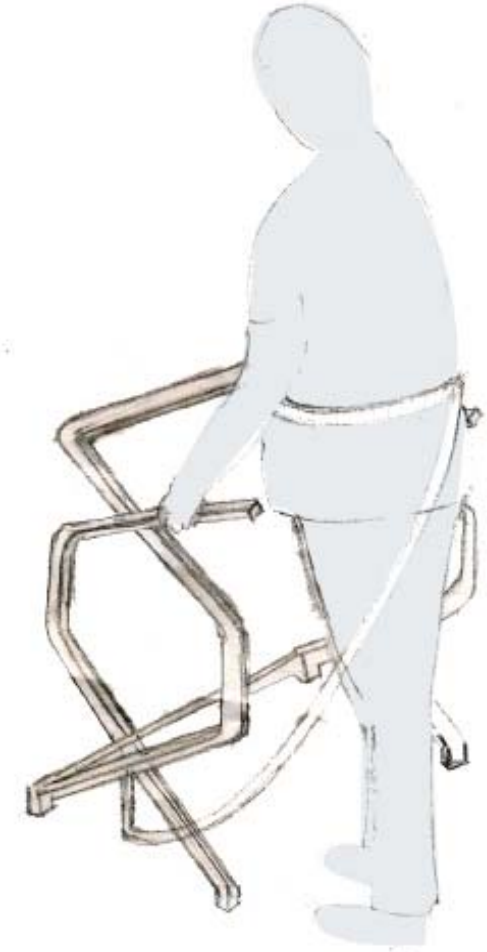
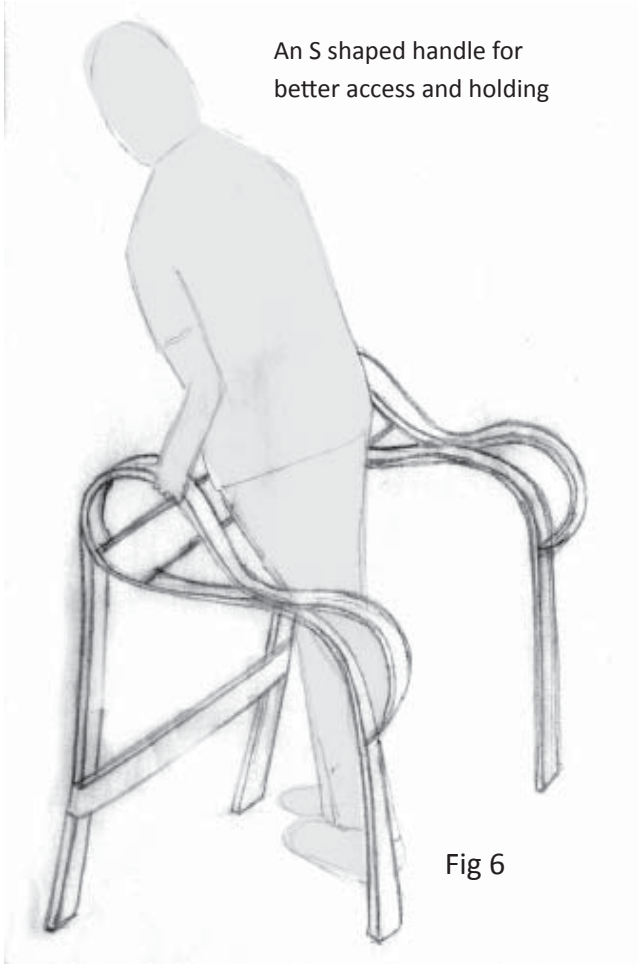


Fig 5

Shock absorbing spring loaded ends

These ideas were sketched keeping in mind, ease of approach and usage and the element of support for the forearm while sitting with it



An S shaped handle for
better access and holding

Fig 6

Fig 7

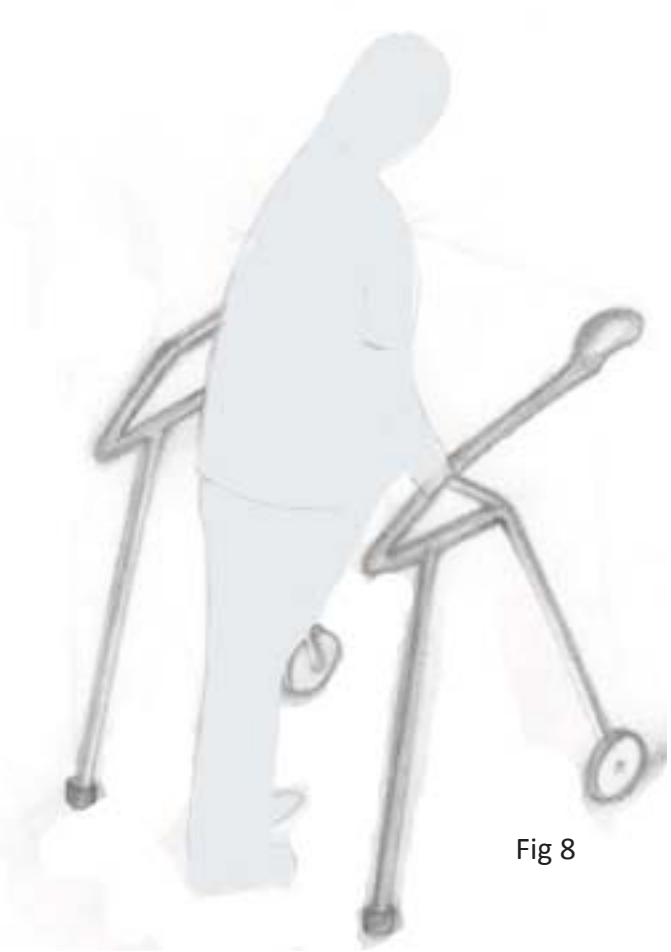


Fig 8

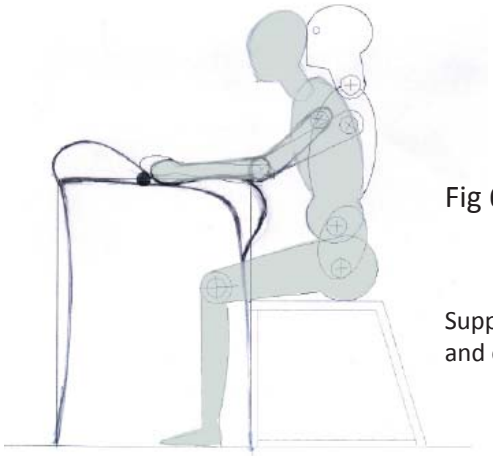
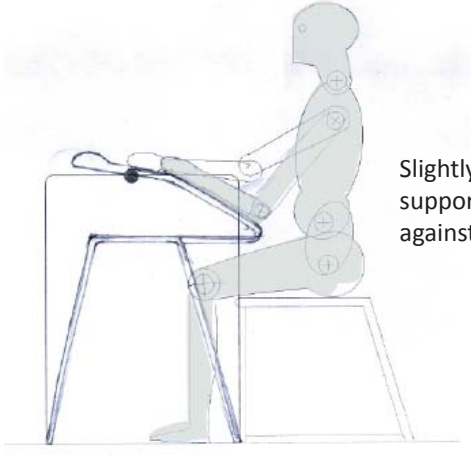


Fig 6a

Support to the forearm
and elbow while sitting

Support for hands while getting up

Shock absorbing spring loaded tubes on the front legs to reduce impact from the ground



Slightly flexible hand
supports to press
against while getting up

Fig 8a

The existing walking aids available are adjustable in height. This idea is based on width adjustability of the aid.

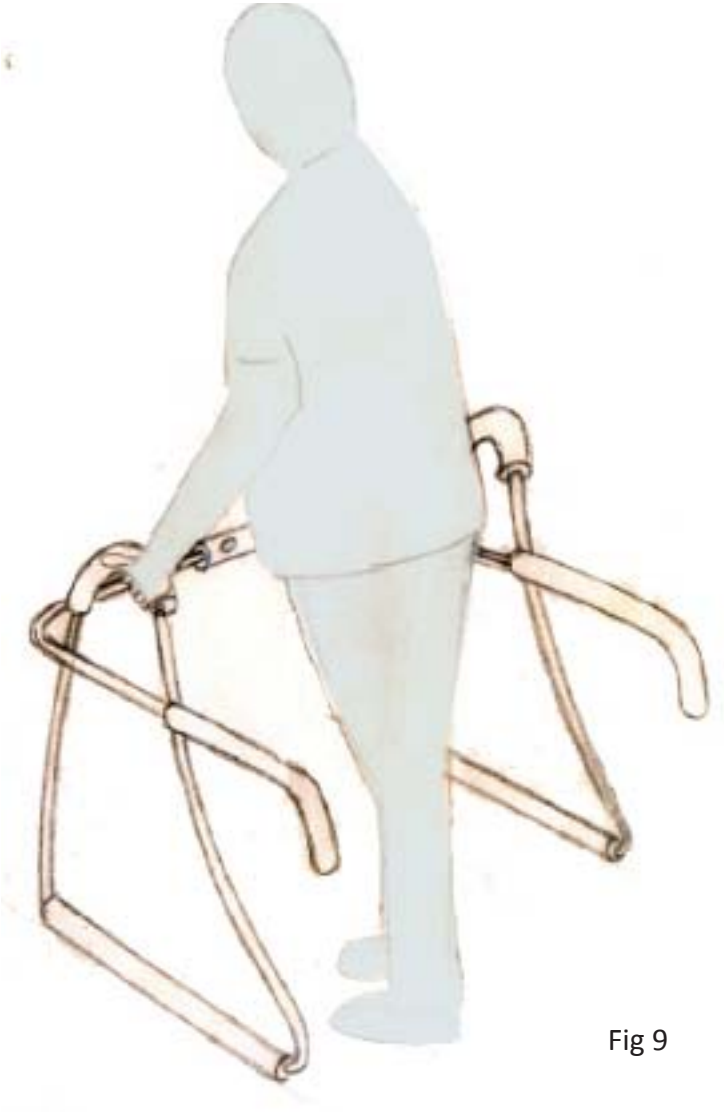


Fig 9

Less width at the base - easy to maenuever in tight spaces
More width at the base- better stability due to larger base area

Fig 9a

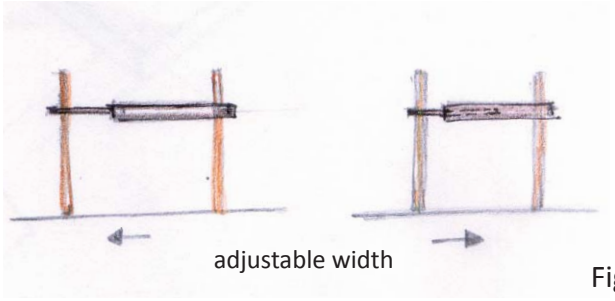


Fig 9b

The idea is based on the comfort of using the aid while not walking with it. The provision of hand and foot rest is necessary to prevent the dangling feet and unsupported elbow

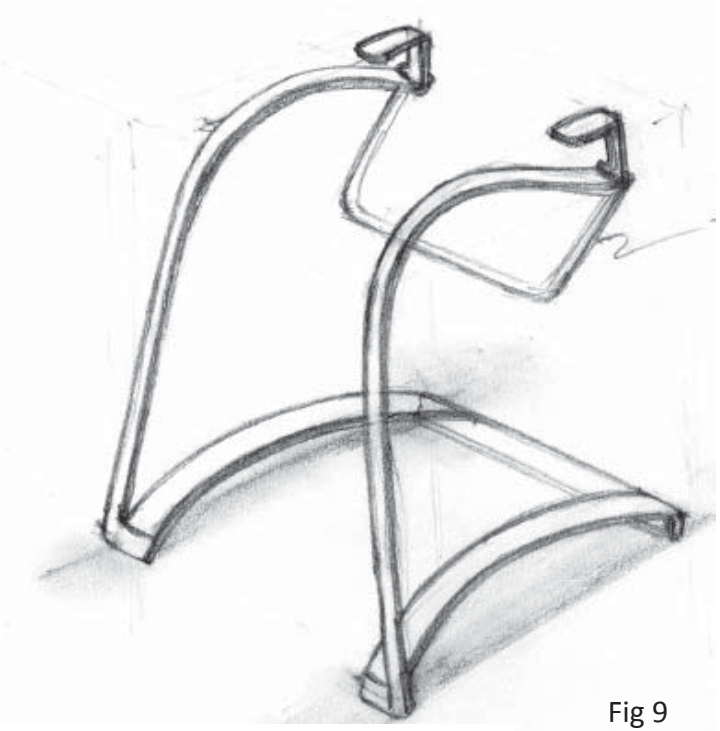


Fig 9

Fig 9a

feet are rested against the foot rest

place for keeping belongings

flexible handle to push against while rising

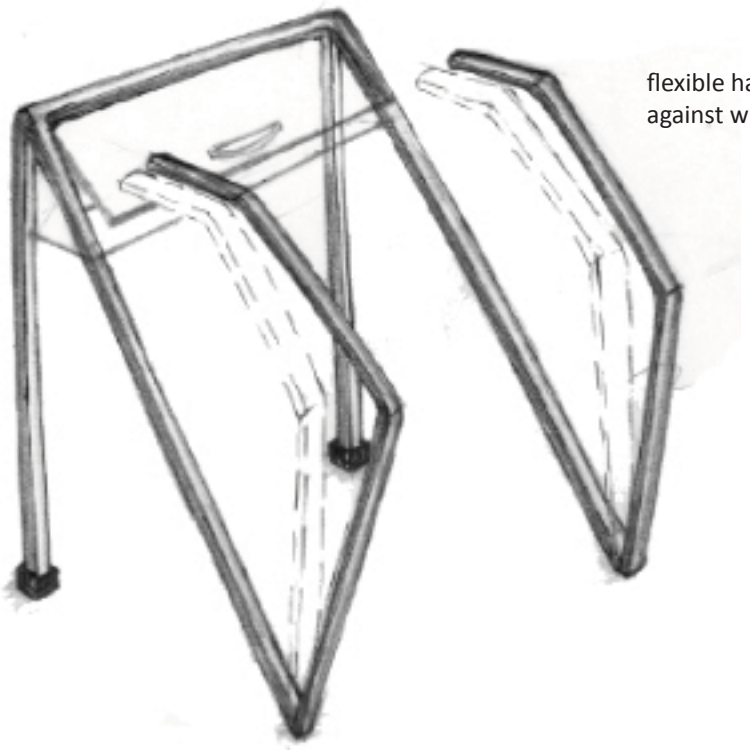


Fig 10

Fig 10a

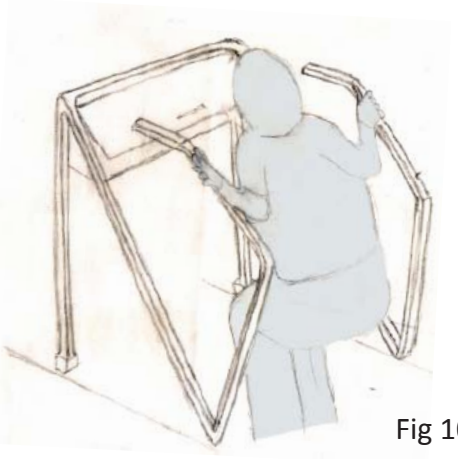


Fig 10b

THE AUGMENTED WALKER

A part of the project also dealt with the augmentation of an existing walking aid (the rollator).
It was aimed at improving the interaction abilities of the aid. This was done as a part of a two month training at the IT University of Copenhagen.

Interactions with elderly rollator users and the therapists led us to derive insights on aspects of walk which could be monitored.

Applicability in the Indian context

The concepts were developed with mobility as the key issue which is also a major disabling factor among the Indian elderly.
Therefore nearly all the concepts developed are equally applicable for the Indian elderly using walking aids, especially the concept of self monitoring as there is lack of aid training and rehabilitation centers for the elderly in India.

The addition of sensors to the walking aid design for the Indian elderly can be taken up as an extension of the project at a later stage.

* The full text is attached in the appendix at the end of the report.

Design considerations for the walking aid

The design of the walking aid was done on the basis of the user studies conducted in Mumbai and Delhi and is applicable in the Indian context.
The current design as explained in the next few pages does not incorporate any technology and is aimed at improving the functionality and aesthetics.

- Ergonomics - The aid should be suitable for users, both males and females ranging from 5th to the 95th percentiles

- Usability - The aid should not topple with the application of weight
- It should not slip/topple when the user takes support from it while standing

- Construction and materials - The materials used for construction should be easy to maintain and use. The surface finishes should be pleasing to look at and the materials for handles should provide adequate grip

- Parts like stubs which are likely to get weared off, should be easily replaceable

- Accessories such as the shopping basket should be easy to remove when not in use

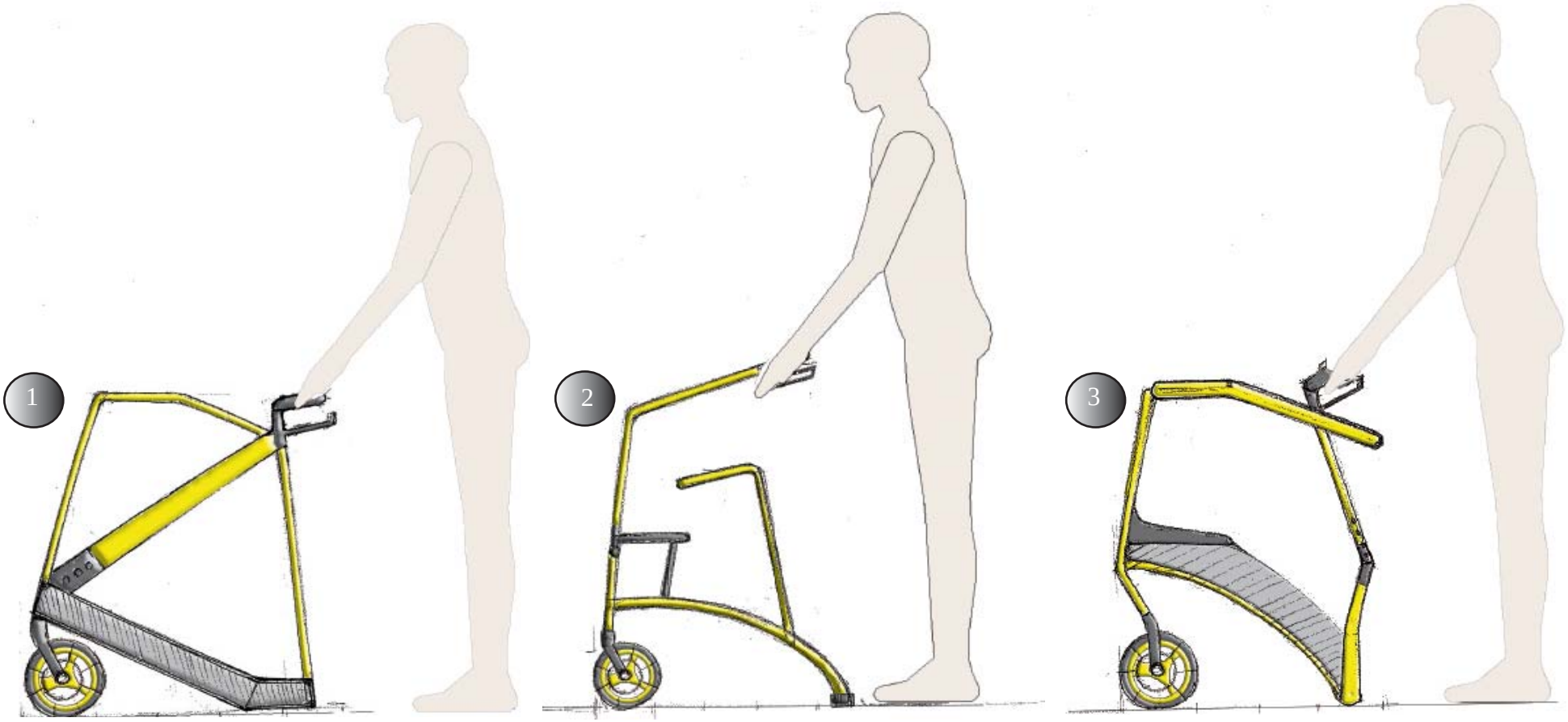
CONCEPT 1

The form expression is inspired from walking canes which is one of the most commonly used aid by the elderly. The baisc intent was to take an object they use everyday for walking and incorporate it into the design such that it is not stigmatizing for them to use it.

Walking cane

Initial sketches for concept 1

The initial sketches for the concept 1 were aimed at addressing issues of interference of walking aid legs with furniture. Also it was aimed to explore different forms of the frame to make it look as distinctive as possible from the standard form of a walker

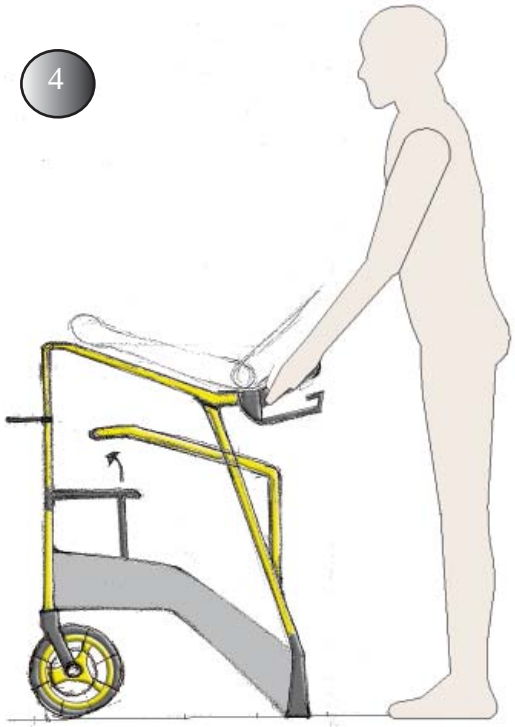


Components of the walking aid

a Cross bar connecting the front and rear legs - To reduce interference with other pieces of furniture
b Support for hands while getting up
c Adjustable height of the handle to suit a wide range of users

Initial sketches for concept 1

4



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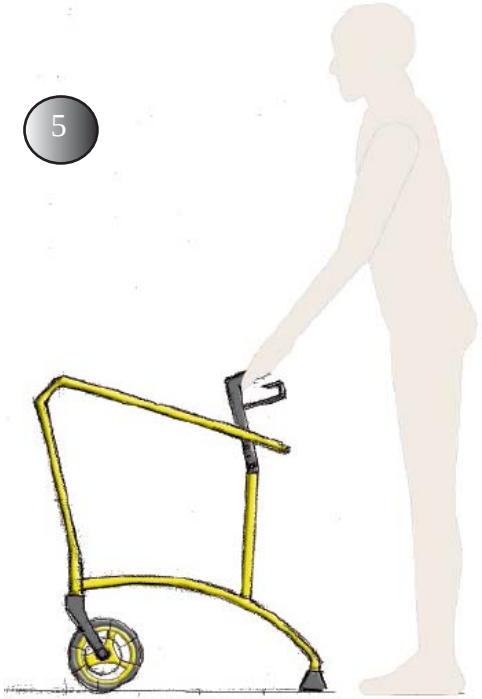
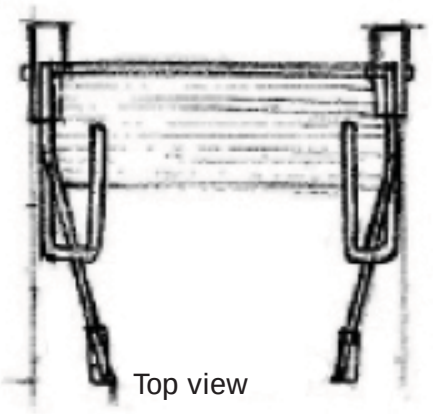
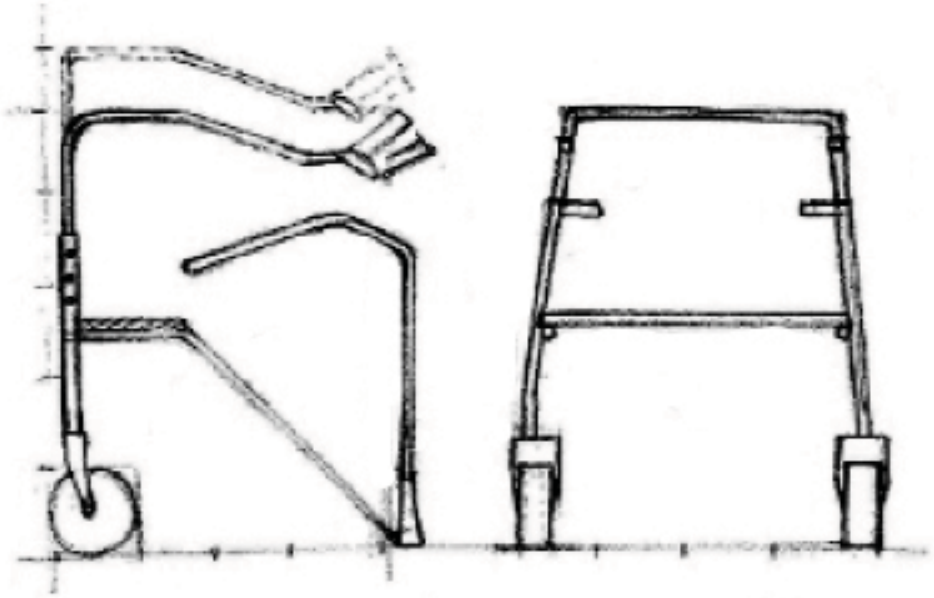




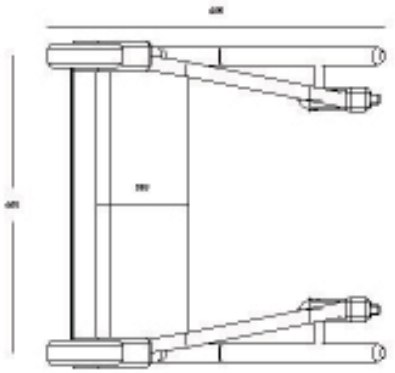
Top view



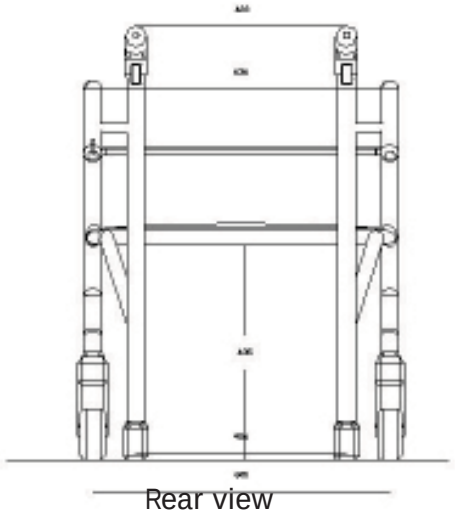
Side view

Front view

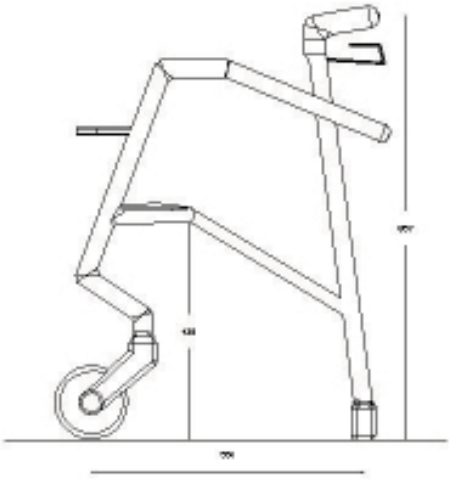
Dimensioned drawings of concept 1

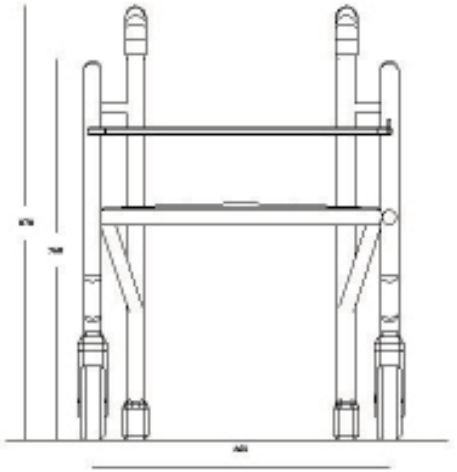


Top view

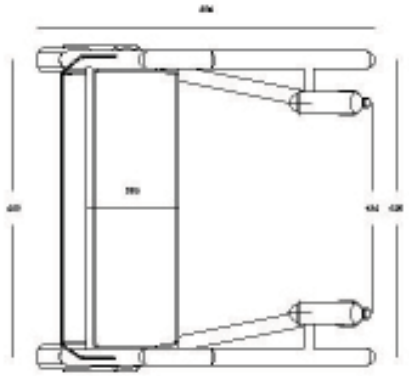


Rear view





Front view



Bottom view

CONCEPT 2

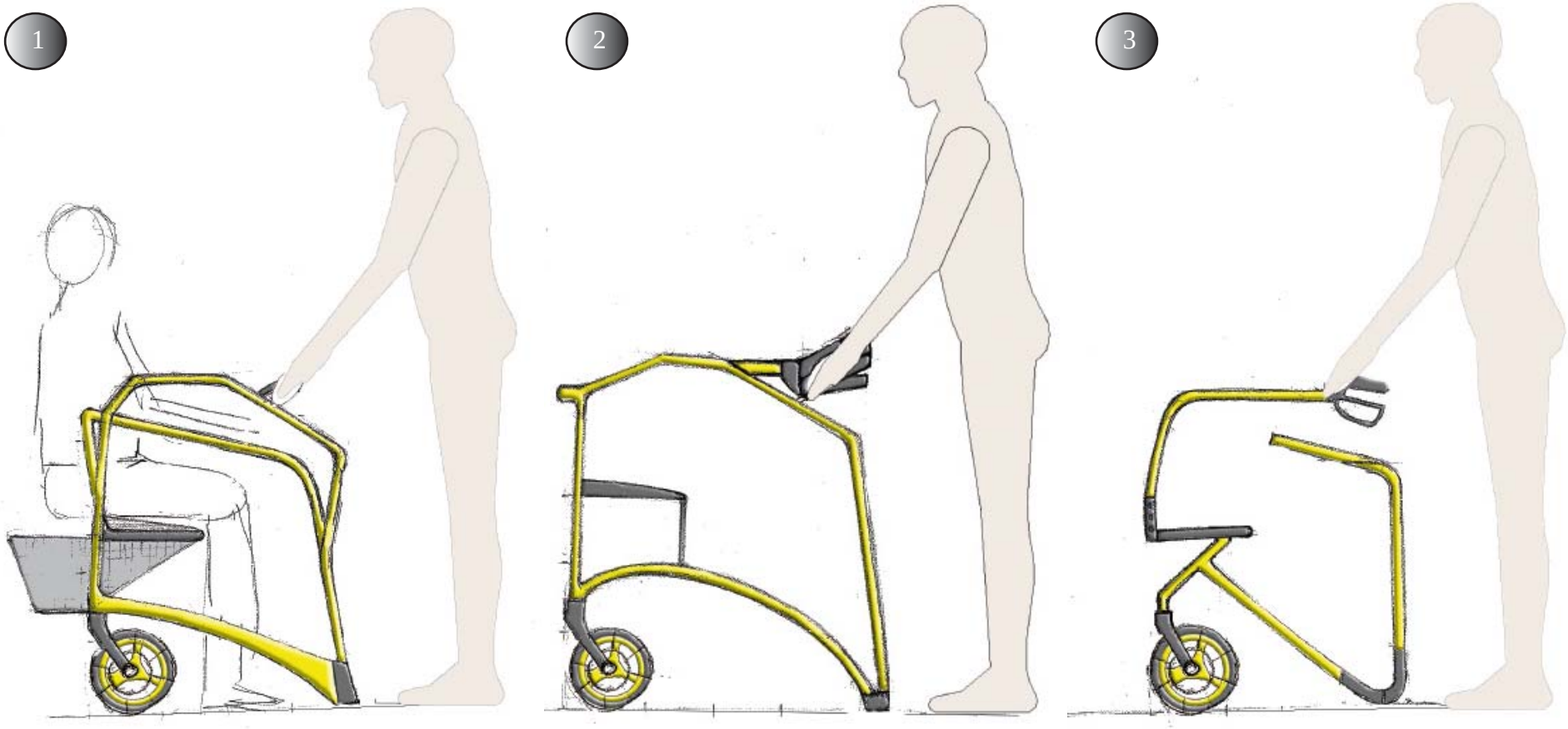
Concept 2 has features derived from the ideations done in the earlier stages.
Since the conception of this idea, it has undergone several changes, both in form and functionality.

The aid has been made to look visually lighter by using detached elements which creates a sense of lesser weight and more space.

Support at a lower lever assists the user while getting up at different stages

Initial sketches for concept 2

The initial sketches for the concept 2 were aimed at improving aesthetics and functionality. Easier access and handling while using the aid were the major objectives while developing the form



Components of the walking aid

a Provision of seat on the frame
b Lower level of handle for accessing and as a support while getting up
c End caps and other parts can be replaced

The walking aid semantics borrows clues from the posture of an elderly in various stages of getting up
The semantics of the product is easy to understand and it suggests to the user, the way it is to be used

Product features

1 BACK SUPPORT

-support to the back while sitting

2 STUBS ON FRONT LEGS

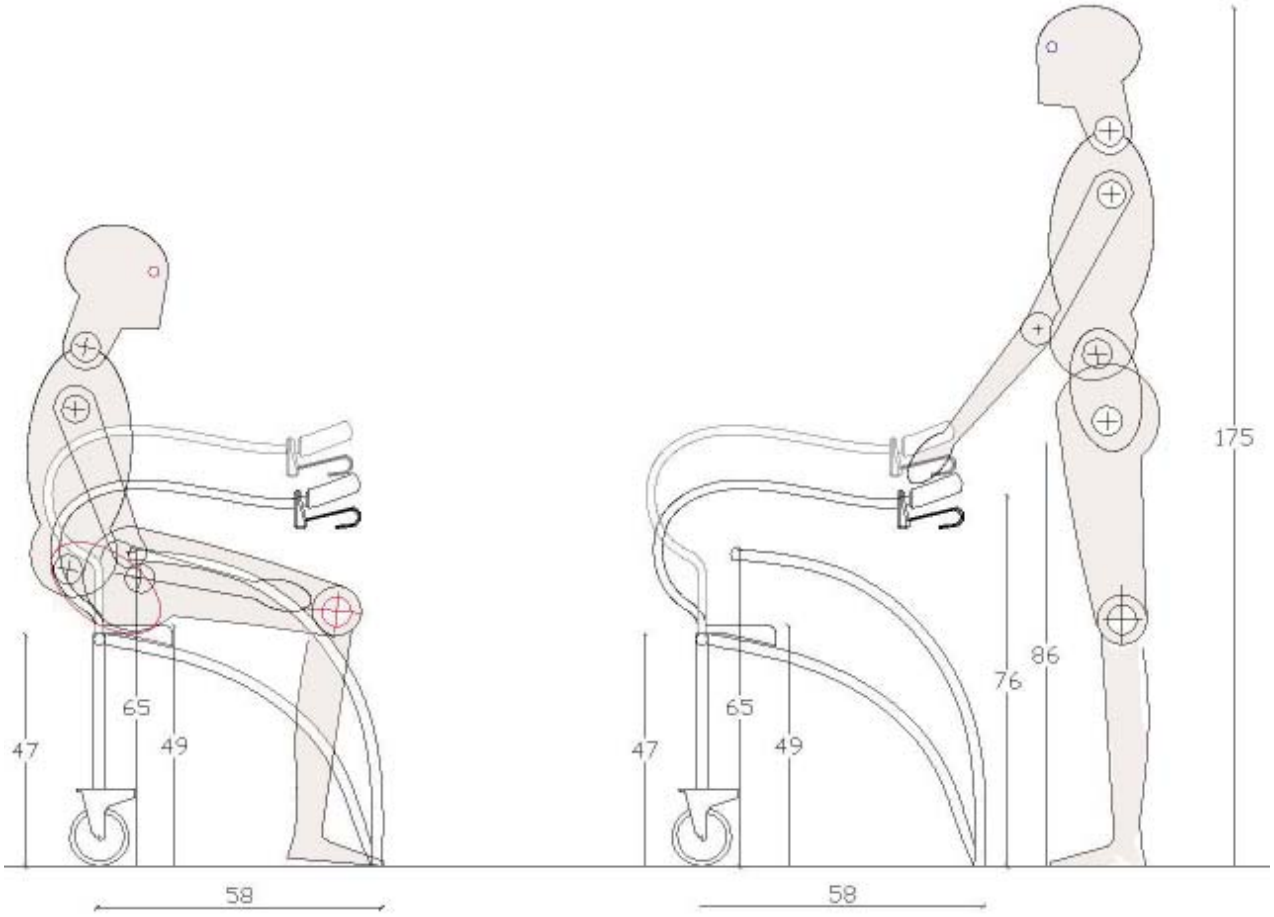
-the stubs on the front legs provide resistance necessary for walking

3 BIG REAR WHEELS

-for using the aid outdoors
Brake wires concealed within the hollow aluminium frame

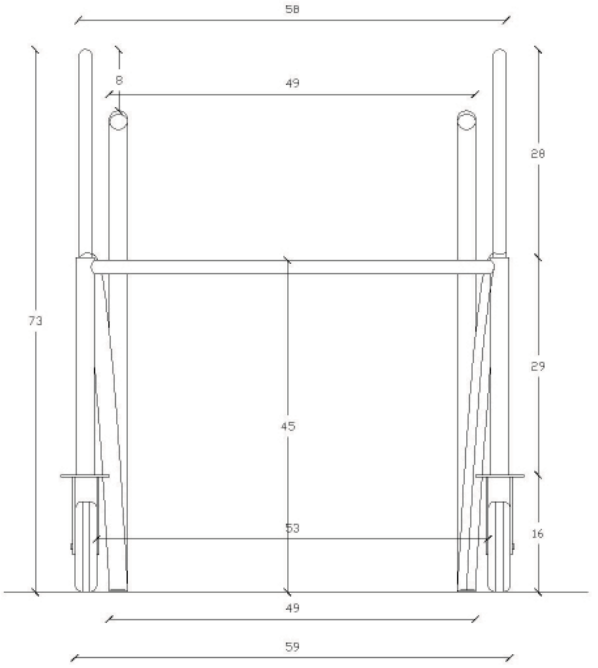
The rubber sleeve on the lower handle can be of different colors and textures depending on the user's choice

Space requirements for concept 2

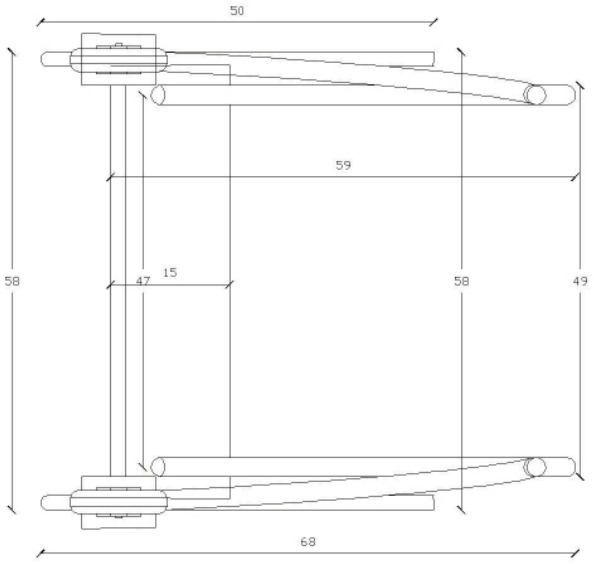


Side view

Side view



Front view



Top view

Floor area occupied = 1.85 ft * 2.13 ft = 3.94 sq.ft.

CONCEPT EVALUATION - reasons for choosing concept 2 over concept 1 - A comparitive analysis

CONCEPT 1

If lower handles are pulled or if force is applied, the rear wheels will tend to rise from the ground

The form is inspired from the walking canes and looks unfriendly

The cross member supporting the seat, joins the handle in the middle which makes the junction very weak

Adjusting the height is at an angle and is difficult

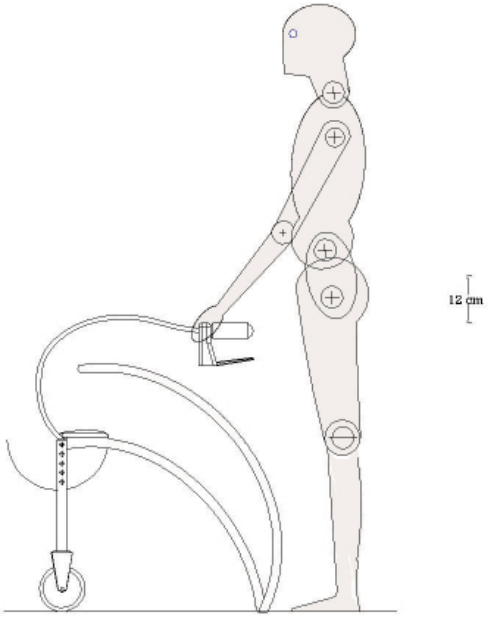
CONCEPT 2

Since the force is applied in the forward direction while getting up, the force is transferred to the ground and the aid does not topple

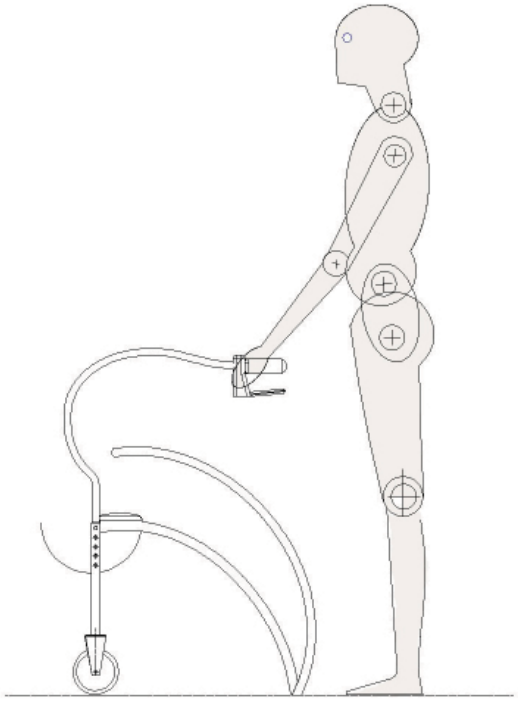
The smooth curves are inspired from the posture of the body while getting up which is translated into supports which assist the process of getting up

The lower handle is connected at the end of the seat support which gives it strength

Adjusting the height is simple with telescopic channels



Height of upper handle adjustable by 12 cm



Detachable storage below the seat

The final concept adopts a design comprising of :

- A fixed lower hand support
- Adjustable height for the upper handle which supports sizes corresponding to the 50 th and 95 th percentile values

Materials used

- Frame of the walker made from welded aluminium pipes with telescopic channels for height adjustment
- PU wheels with hand operated brakes
- Cushioned seat surface with a wooden base

Methodology followed in dimensioning of final concept

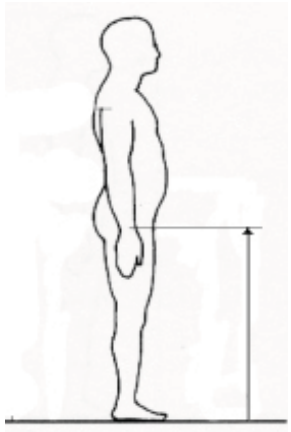


Fig 1

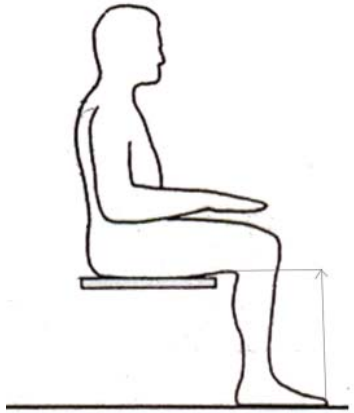


Fig 2

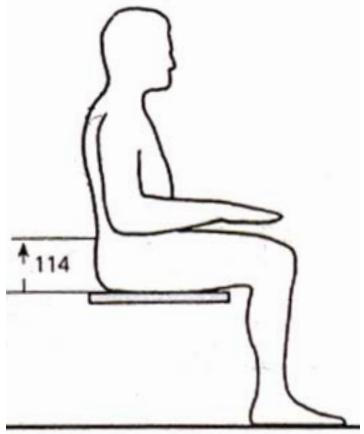


Fig 3

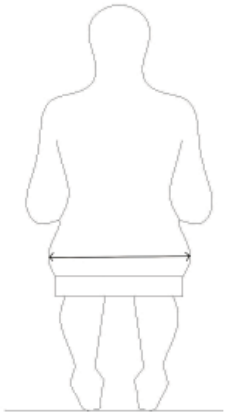


Fig 4

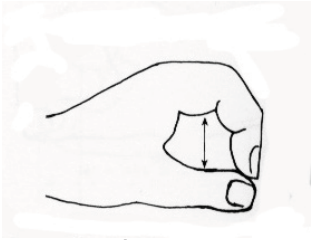


Fig 5

Use of percentiles

A percentile is the value of a variable below which a certain percent of observations fall. So the 20th percentile is the value (or score) below which 20 percent of the observations may be found.
The design should generally be concieved to accomodate population between 5 th and 95 th percentile

The dimensions of the final product are based on ergonomic principles of human body through the use of Indian body dimensions.

The product can be adjusted in height
- the least height corresponds to the 50 th percentile
- the height can be adjusted between 50 th and 95 th percentile

The following dimensions were considered for the design

1. Wrist height (Fig 1)
2. Popliteal height (Fig 2)
3. Lower lumbar height (Fig 3)
4. Hip breadth (Fig 4)
5. Grip inside diameter (Fig 5)

First prototype of the Upholder

The first sketch of the concept 2 was realised in mild steel sections, of 25 mm and 18 mm diameters.
The sections were bent and welded to each other to obtain the desired profile.

Wheels with out brakes were used

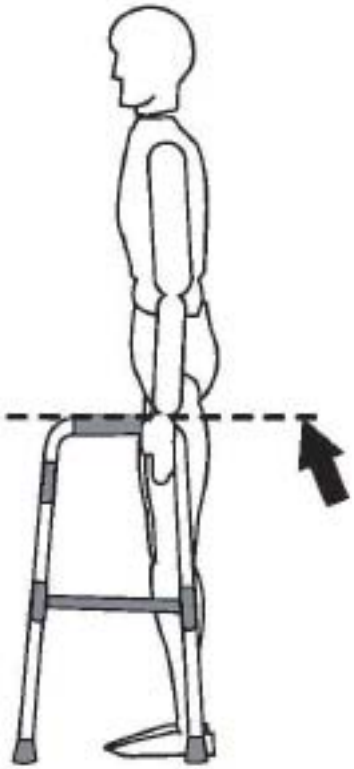
Only the essential features of the concept were incorporated in the prototype.

The features as illustrated in the pictures are as follows:

- Adjustable height to suit any adult
- Easy to control with bicycle style brakes
- Detachable shopping basket
- Seat on the frame for taking rest breaks
- Back rest height increases with increase of handle height

The first sketch had some compatbilty problems with the height and width of the aid while walking and sitting on it

The prototype was tested with the elderly and their feedback was taken before moving on to the final walking aid in aluminium.



Correct sizing of a walking aid is when the handle reaches uptil the wrist of the user while standing upright with hands on the sides

First testing with the walking aid

The walkers existing in the Indian market are mostly folding (Fig 2), a feature seldom used by the elderly. The more essential feature of height adjustment is often not considered which is a fundamental requirement of walking correctly with a walking aid.

Fig 1. The walking aid height can be adjusted to suit the user's height

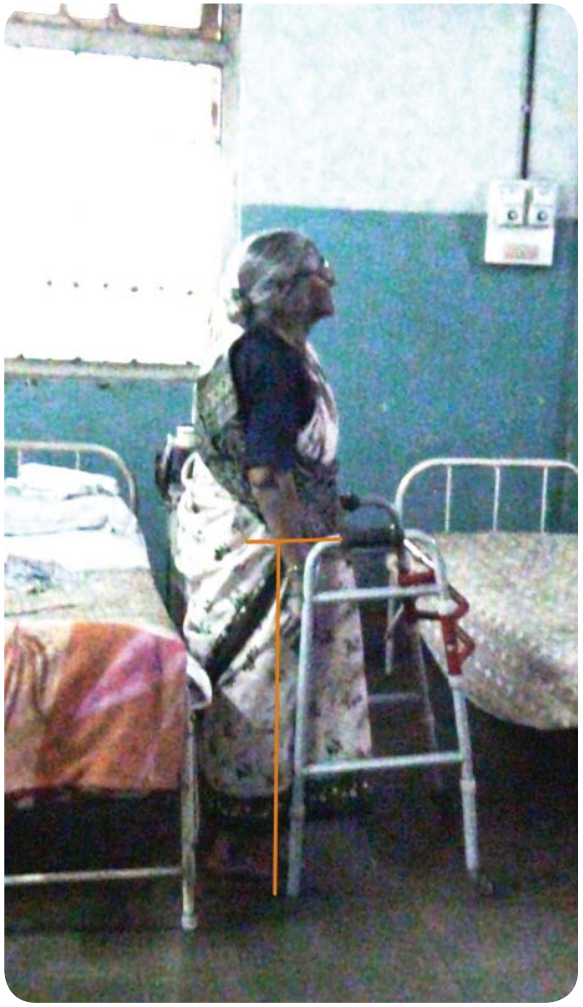


Fig 2. The standard walker being used by the elderly is of fixed height which reaches almost till mid of her forearm

The reason for having the walking handle a little on the inside than the standard walker is to make sure that the elderly walk within the walker and not away from it as in figure 3

The lower handle helps the elderly not only while accessing the aid and getting up, but also assists them to stand from the aid when they are sitting on it

Fig 3. Elderly walking almost 2' away from the rear legs of the walker which is the incorrect way of walking

Fig 4. To ensure that the elderly walk within the walker frame, the holding handle has been offsetted from the rear legs

Fig 5. The elderly sitting on the aid with her hands rested on the handles

Fig 6. Elderly takes help of the lower supports while getting up

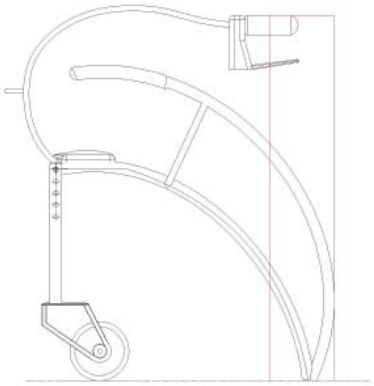


Figure 7 to 10 are images of the elderly woman while performing the activities of accessing the aid, getting up using it, balancing herself and walking with it. The lines of joining the joints in the hand, wrist and elbow are straight as opposed to the lines of joining using her standard walker
(Refer to page numbers 34 and 35)

The lines connecting the joints are straight indicating that the height and orientation of handles is correct for her height and stature

Fig 7. Accessing

Fig 8. Getting up

Fig 9. Balancing

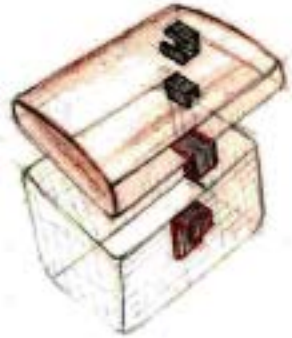
Fig 10. Walking

Marking at joints

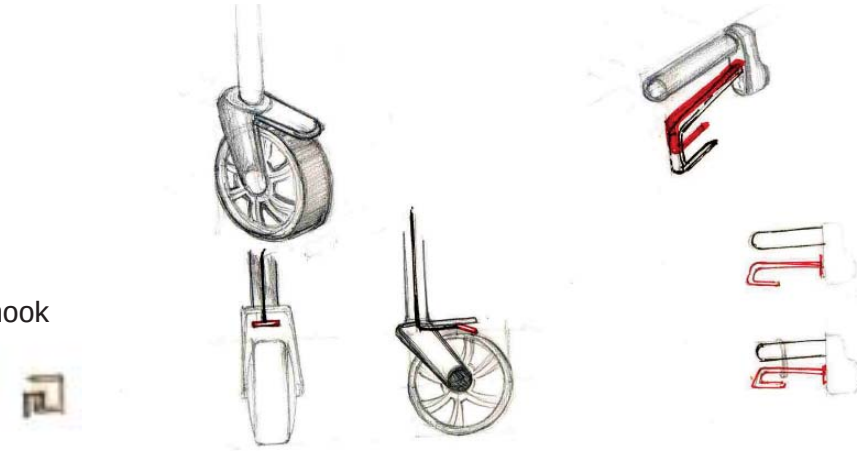
Lines joining the points

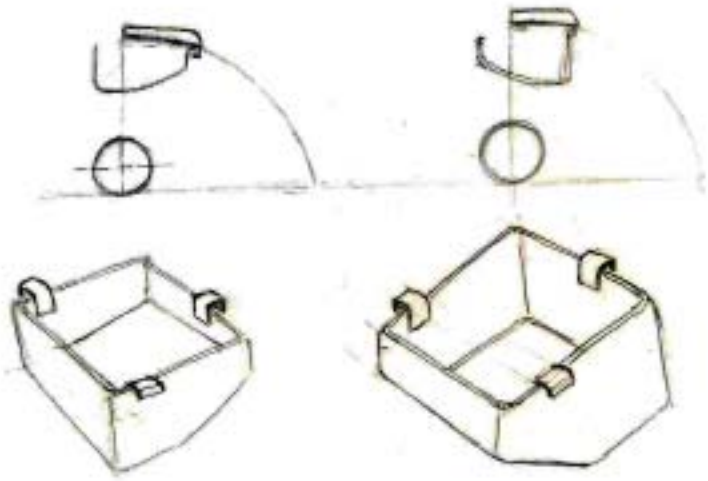
Details

Hooks for hanging the basket below the seat

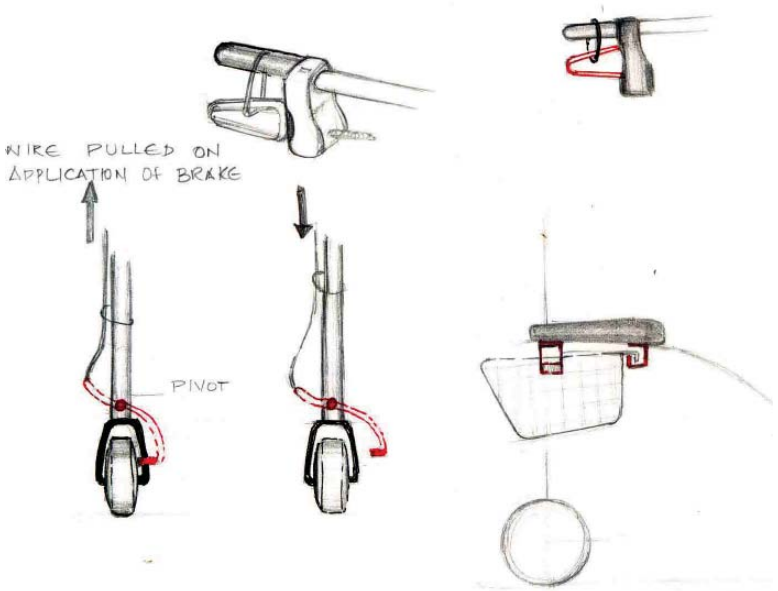


Interlocking of one hook into the other





Orientations of the basket on the Upholder



Brake system using a pivot and a brake shoe mechanism

User feedback

At first, the aid was given to the elderly and they were asked to use it as they thought it should be used. Following that, I explained to them, what the Upholder is designed for. This led me to get some insights on the changes I could incorporate in the final design.
The following feedbacks were obtained from interaction with the elderly during the first testing with the aid.

_ The elderly like the idea of having a seat. They said it would be useful in case they wanted to take a break when walking outdoors.In case of using a standard walker, they needed to look for a bench to take a break

_ Most of them had folding walkers, which was a redundant feature, never used by them

_ The aid could look different every time with the change of color of the lower handle sleeve and they liked the idea

_ The prospect of having accessories such as the bag, with the walking aid was also well accepted by the elderly as it would allow them to keep some things which they need most of the time

_ The elderly found the aid, easier to manuever than the standard walker with casters, they were presently using

_ User comment : A final model of the aid should be left in the elderly home so that people know how to use it properly and also for other people to use it.

* 2 elderly, a male and a female (both residents of Anand Niketan, Mahalaxmi, Mumbai) used the Upholder during the first test

Evolution of the concept

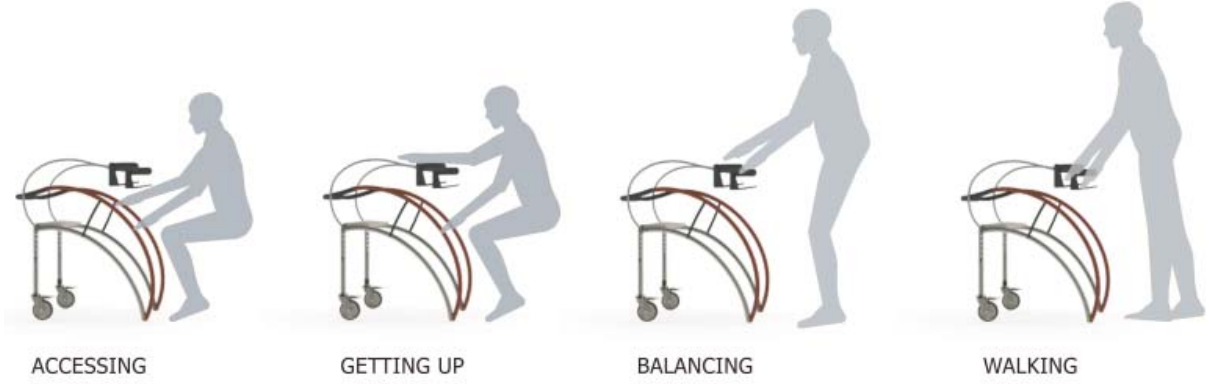
Handle oriented upwards which might cause fatigue in the hands while holding

The original concept was percieved to be in gas injection molded parts to make it hollow and lightweight. This would have increased the cost of the product.

The cantilevered lower handle might not be able to take load of the body while some one takes support from it for getting up

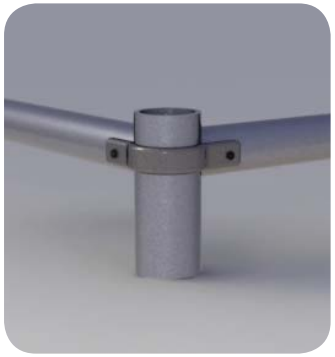
A cross bar has been provided between the lower and the upper handles to give it strength and make it more load bearing

There is also a back rest support for the elderly while sitting



Second prototype in aluminium sections

Rubber bush to secure one section into another - Detail B

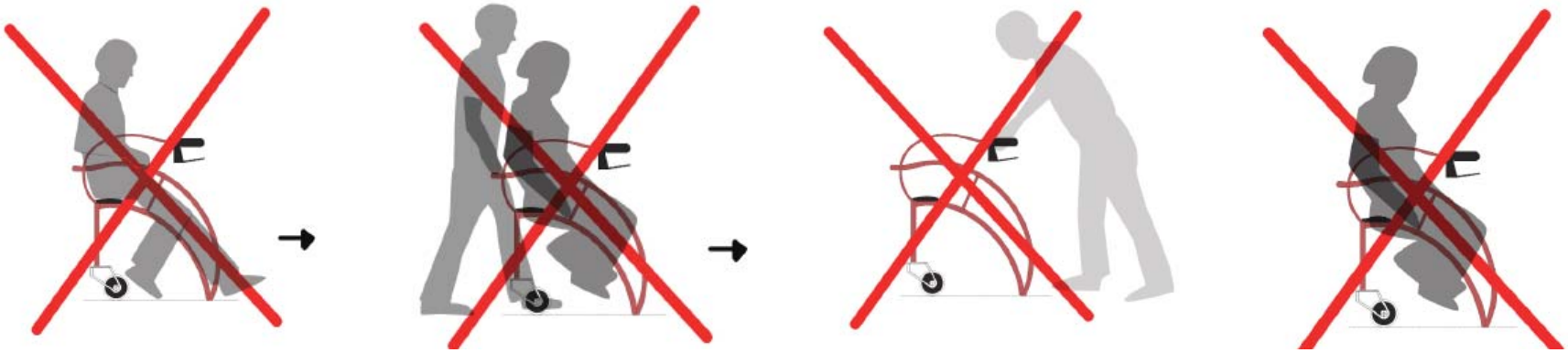


Section joining three welded tubes

The end cap for the rear legs fits inside the hollow tube - Detail A

The front legs shall have to be moved outside to prevent the aid from toppling over when some one sits on it

Safety directions



Do not sit without locking the wheels

Product specifications

Height Adjustment:	Min to 75 cm to 88 cm
Overall Width:	62 cm
Overall Depth:	60 cm
Wheel Size:	10 cm
Product Weight:	4.5 Kg
Width Inside Hand Grips:	40 cm
Width Inside Front Legs:	44 cm
Space requirement :	60 cm X 62 cm X 90 cm

Why aluminium

Light weight: The weight of aluminium is one-third of iron, steel, copper or brass. It is easier to carry and handle

Strength: Aluminium products and aluminium extrusion profiles can be made as strong as needed.

Strength and weight ratio: The united property of strength and lightness in aluminium extruded products makes it a key component of several industry based applications.

Rust resistant: The metal has a natural protective coating against environmental, chemical and physical corrosive materials.

Easy to manufacture: The metal, by using the conventional methods, can be given any shape.

Ability to join: Methods like welding, soldering, brazing are used to join extrusions.

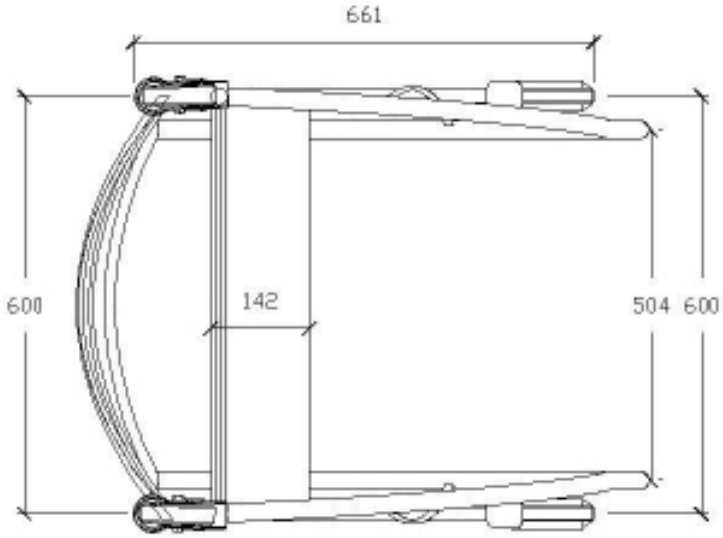
Superior quality: Aluminium extruded products guarantee trustworthiness and uniformity in quality.

Variety in finishing: Aluminium extruded products is known for their finishing varieties.

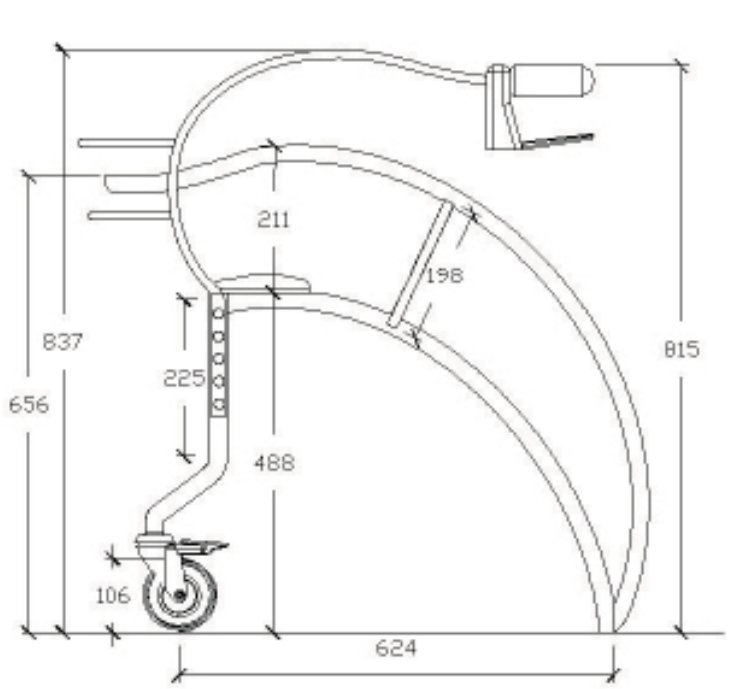
Final working model of the aid

The final prototype is made in mild steel tubular sections welded to each other

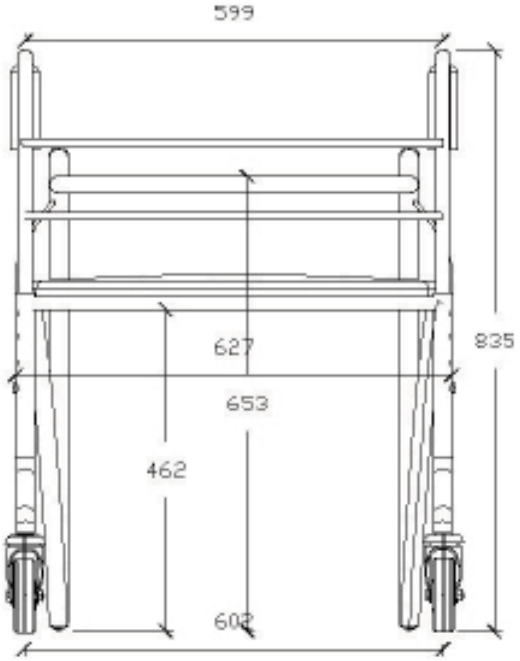
- Helps the elderly get up and walk
- Adjustable height
- Lightweight aluminium construction
- Small bag to keep belongings
- Resting surface
- Easy to operate hand brakes



TOP VIEW



SIDE VIEW



FRONT VIEW

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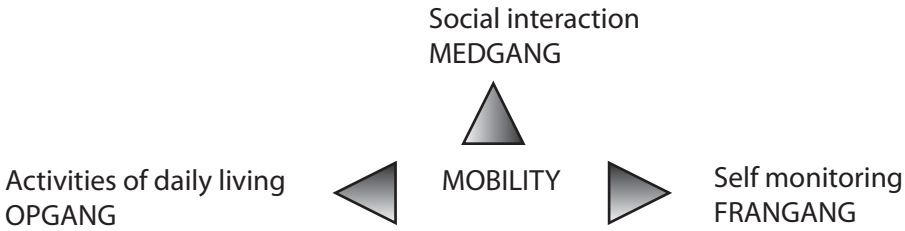
Questionairre for the elderly

Name
Age
Gender

- What is the walking aid you use?
- Since when have you been using the walking aid?
- What is the reason for your using the walking aid?
- Which places in the house do you mostly move around with your aid?
- Where do you go outdoors with your aid?
- Do you go out shopping with your walking aid?
- Do you replace parts of the aid when they get weared off?
- Is your walking aid comfortable?
- Do you use your walking aid for any other purpose?
- Do you face any other problems with your walking aid?

Possible areas of technological interventions in the aid

The start point of the project was identifying the areas which could be worked upon. Behaviour, walking patterns and current technology for augmentation of walking aids for the elderly in Indian and Danish contexts was studied and the problems they faced with the existing aids were identifi ed
The following are the three aspects which can be built with mobility as the primary concern



Social interaction amongst elderly is a very important considering that people become lonely as they age.
Locally, it helps one to be a part of the community where one lives and participate in activities which need you to be outdoors.
Being outdoors helps to augment physical activity and be a part of group meetings and discussions.

The physical aspects were further narrowed down to what could be monitored

1. HOW YOU WALK

- This would include the correctness of posture and right balance when you walk using a walking aid

2. HOW MUCH YOU WALK

- This would measure the distance you walk, the duration of walk, the speed at which you walk etc.

3. WHERE DO YOU WALK

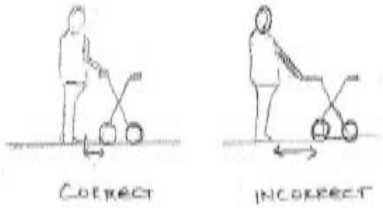
- This would comprise of the community or the space where you walk and doing it in a way that others see where you are

Scenarios were built on all the three aspects and discussed with the therapist. Later they were communicated to the elderly

INDICATORS OF INCORRECT WALK

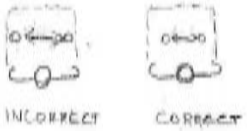
1. DISTANCE FROM THE ROLLATOR

Walking too away from the walking aid is incorrect



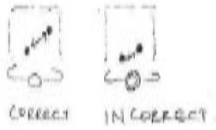
2. DISTANCE BETWEEN THE FEET

Walking with the feet too much apart is incorrect



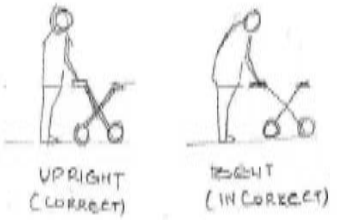
3. STRIDE LENGTH

Walking with short stride length is incorrect

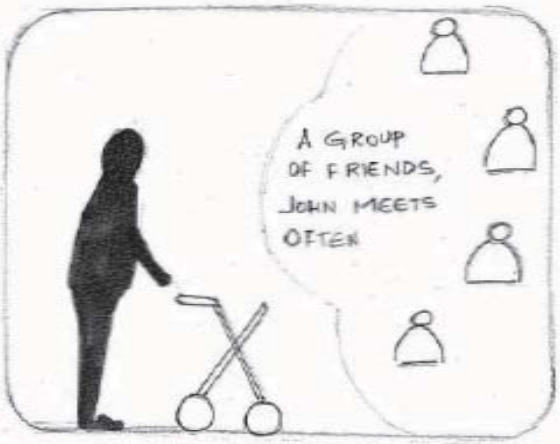


4. POSTURE

Walking with the back bent, is incorrect

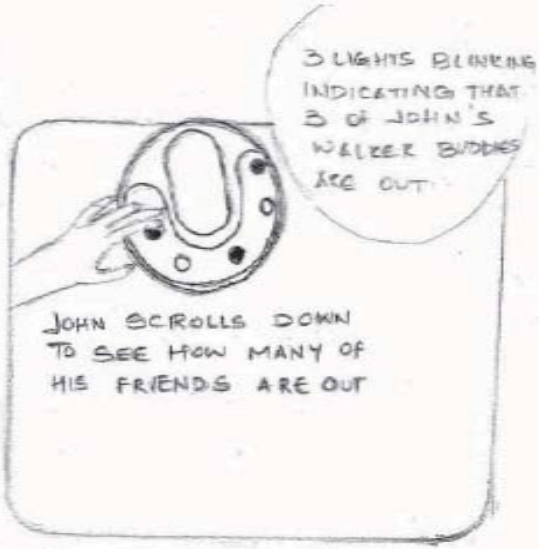


WHERE YOU WALK

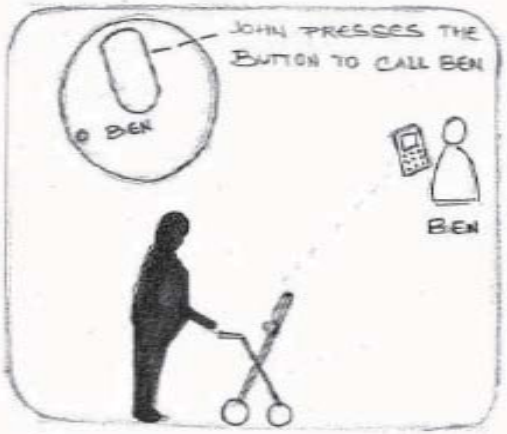


JOHN ON HIS WAY FOR A WALK

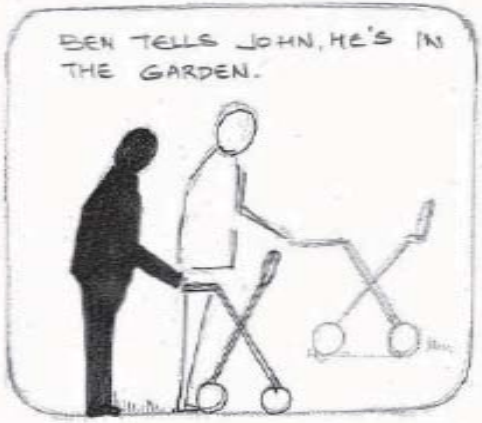
WHEN JOHN IS AT HOME, HE USES THE DEVICE AS A PICTURE FRAME WHICH IS KEPT NEXT TO THE TV/FRIDGE



JOHN PRESSES ONE (OR MORE) OF THE BLINKING LIGHTS ON THE DEVICE

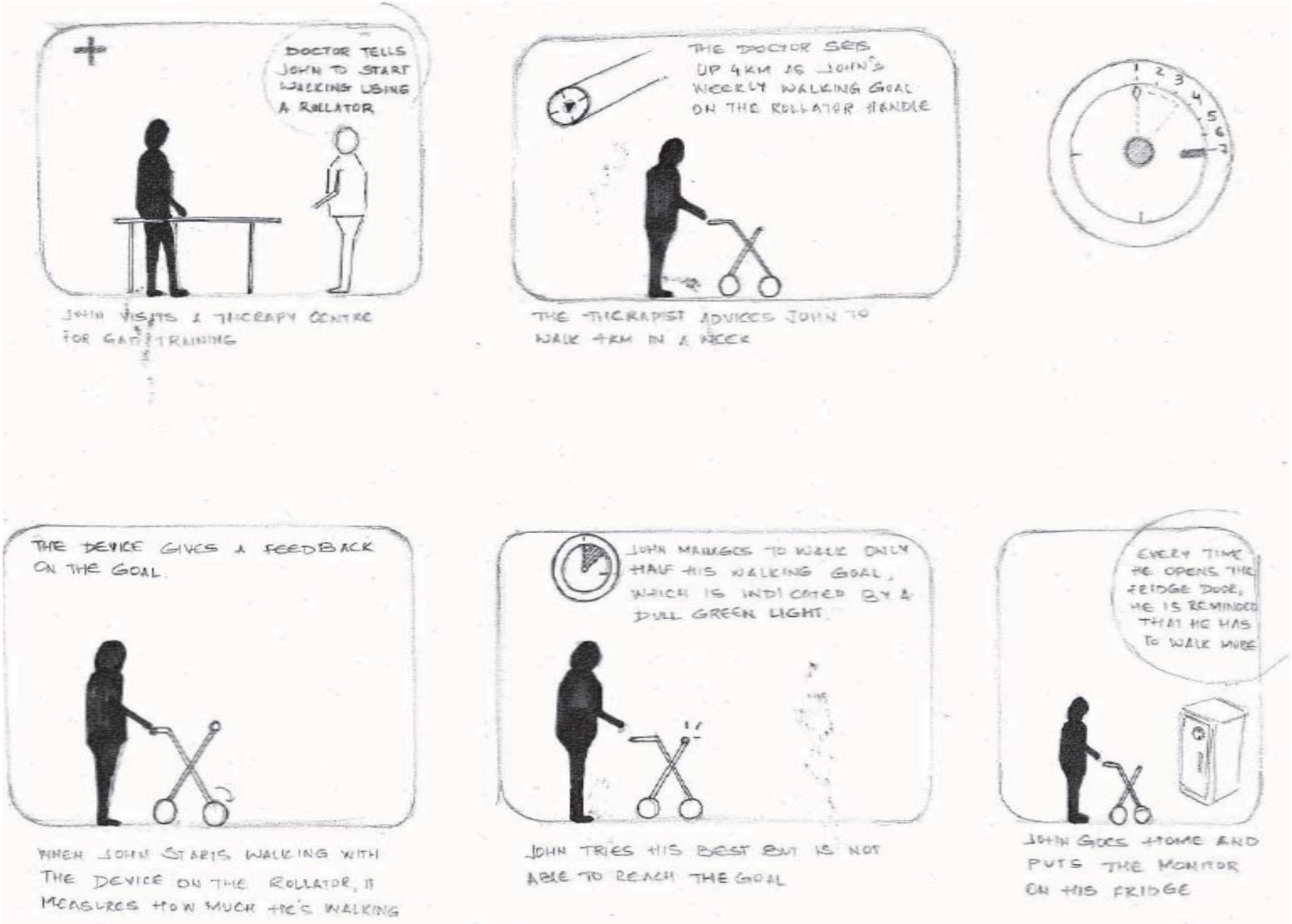


JOHN USES THE DEVICE TO CALL BEN AND ASK HIM WHERE HE IS

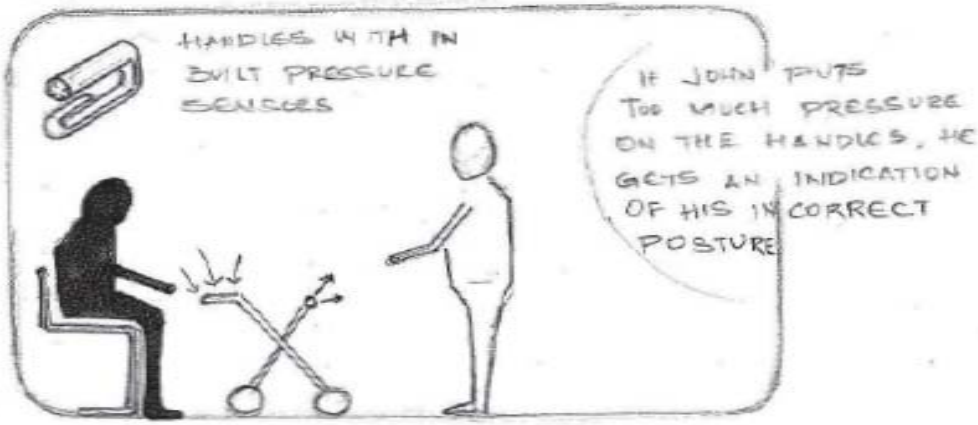


JOHN AND BEN WALK TOGETHER

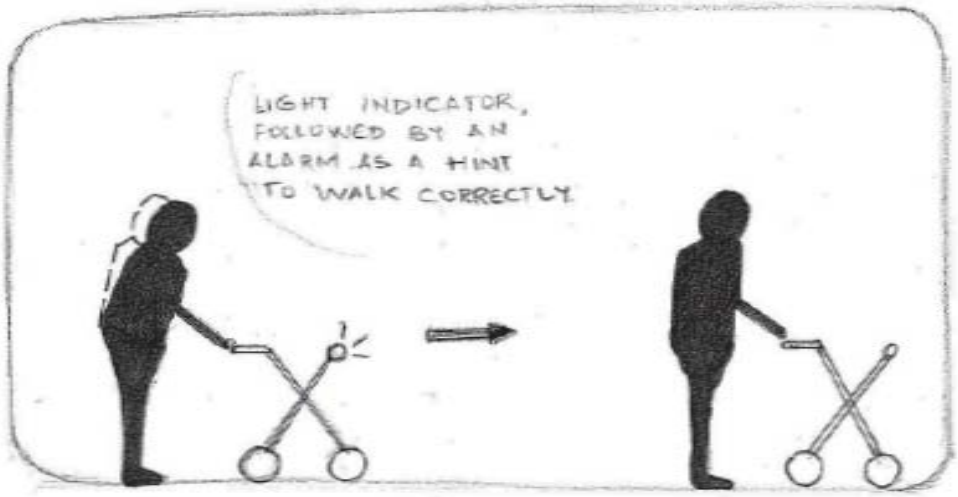
HOW MUCH YOU WALK



JOHN HAS SUFFERED FROM A FALL AND IS ADVICED TO USE A ROLLATOR



JOHN STARTS USING A ROLLATOR, CALLIBRATED BY THE DOCTOR



NEXT TIME JOHN WALKS INCORRECTLY, HE IS REMINDED TO WALK CORRECTLY

The three themes

Walking as an activity of daily living woman walking to the supermarket which she does everyday

Social interaction- a group of elderly talking in the rehab center while excercising

Self monitoring - elderly watching their steps while at a gait traning session

Indian and Danish contexts

Similarities

- Large percentage of ageing population
- Walking/mobility problems are a major disabling factor
- The elderly are lonely and need company

Dissimilarities

- Context – How and where people walk
- The environment where the aids are used

Need for social interaction

An elderly in an old age home in Mumbai, India

Woman in a supermarket in Copenhagen, Denmark

Need forself monitoring

Woman in an elderly home in India - walker placed very far from the body

Woman in Denmark - using the rollator like a cart

The first visit

Feedback – self monitoring – goal visibility

In the first exploration,a meeting was organized with an elderly woman who visited the reahbilitation center twice a week. All the interactions were in the presence of the therapists, who collaborated in introducing the three questions and the three concepts. The sketch of the augmented rollator, was very useful to involve our co-designers in the process and engage them in discovering new opportunities for design.

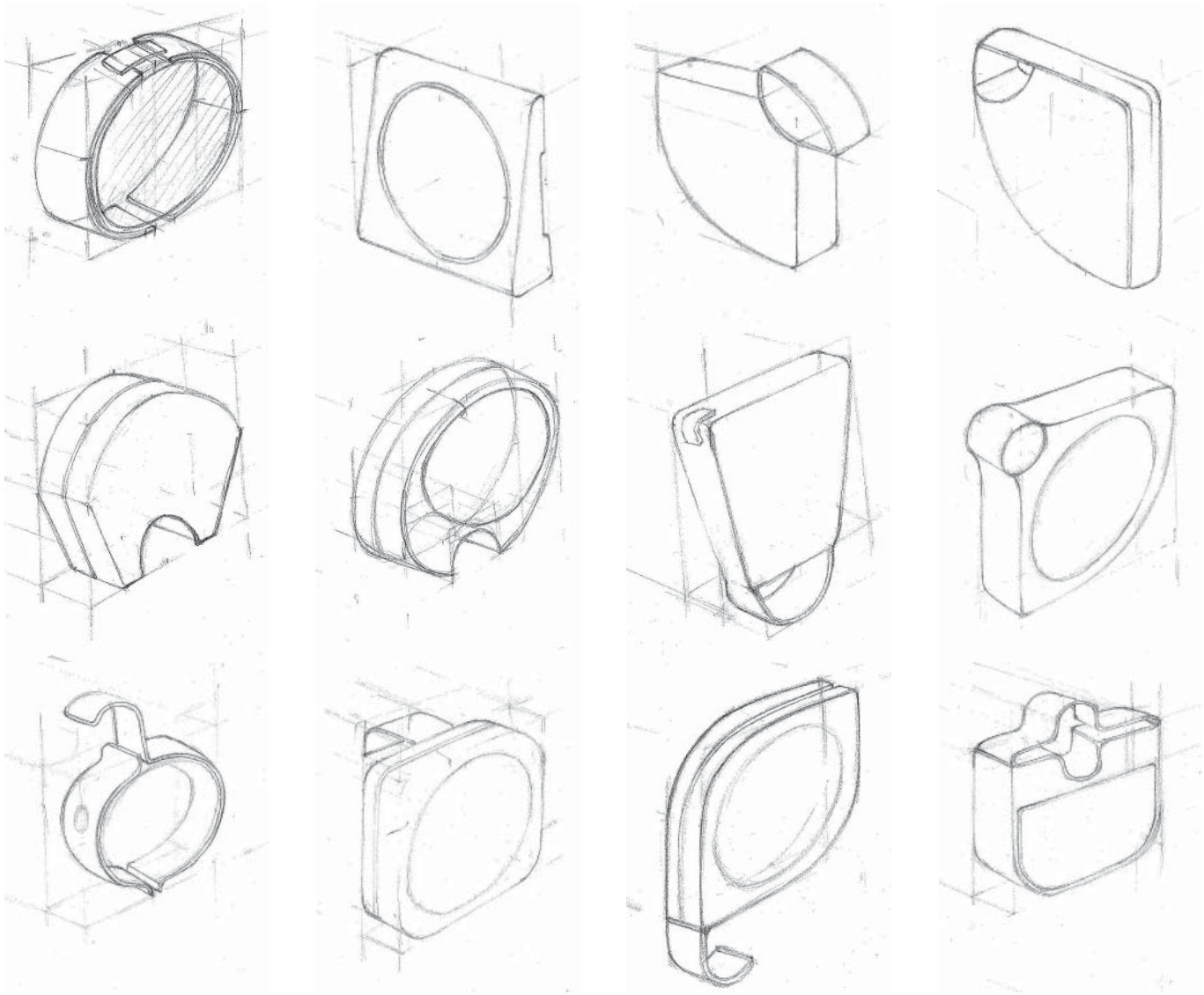
Sensors on the rollator - fi rst sketch

The concept of the movable device

The device communicates with the rollator and displays information about walking
It is the physical link between walking and all the other activities of daily living
If placed on the rollator frame it acts as selfmonitoring display
If placed at home on a picture frame or on the fridge, it acts as goal reminder or display of the community activity

The display changes color as an indicator of incorrect posture

Early sketches of the movable device



The second visit

Rehabilitation centre - Integration with everyday life - Home environment

The second visit was focused on the questions of “howmuch you walk?” and “where you walk?”.A short walk was organised outside and around the
rehabilitation center. The center was a part of her own neighborhood, and a familiar place for her. She decided the direction and the distance, she could walk.
During the walk she was given feedbacks on how much she was walking in meters.
The cardboard sketches of the movable device were used to visualize the feedback and to show her, the possible interactions

Continuity of rehab in home - rehab cycle