

# Redesign of the Walking Stick for the Elderly Using Design Thinking in the Indian Context



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**Abstract** This paper addresses the walking stick issues with the target demographic being Indian elderly. The study includes an understanding of the various types of walking aids, the requirements of the target demographic, and the duration of usage of pertaining walking aid by them. Methodologies both existing and constructed were deployed to further understand the root level needs and reform of current designs. Ideas were generated using Indian anthropometric dimensions and requirements.

**Keywords** Design thinking · Concept design · Product ideation · Design for the elderly

## 1 Introduction

A large segment of the elderly is affected by pain in the knees, osteoarthritis, stooping back, and other ailments usually associated with old age, which affect their daily lives by restricting them from walking without support or aids [1]. The purposes of this study was to identify the challenges associated with the current design of walking aids available and understand the perception of elderly people toward them through experimental behavior analysis and changes in their perception with changes in the functionality and aesthetics of the aids, and then propose a solution to overcome these challenges to reduce their discomfort.

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## 2 Walking Stick

It is a product used to facilitate walking and for clarity of definition, a very personal non-medical usage has been referred to in the study we are referring to its usage for a very personal non-medical usage; used by elderly for support, relief and confidence while walking. The basic parts of a walking stick majorly are the hand grip, the lower stand, and the base grip [2]. The various designs in the market were available with different types of hand grips, and bases are shown in Figs. 1 and 2, respectively.

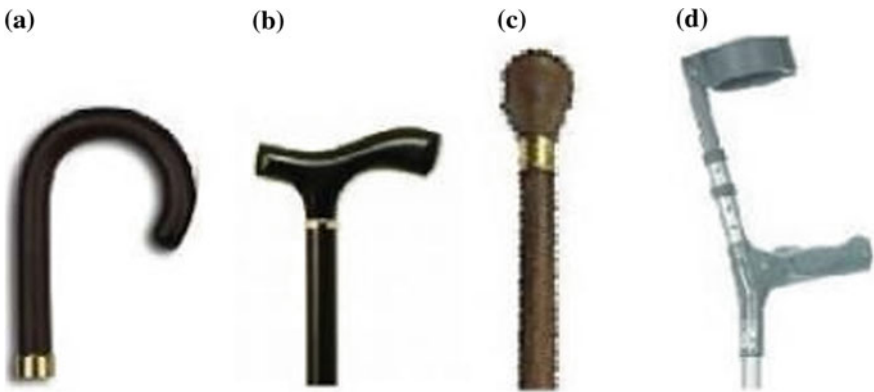


Fig. 1 Types of handles of a walking stick

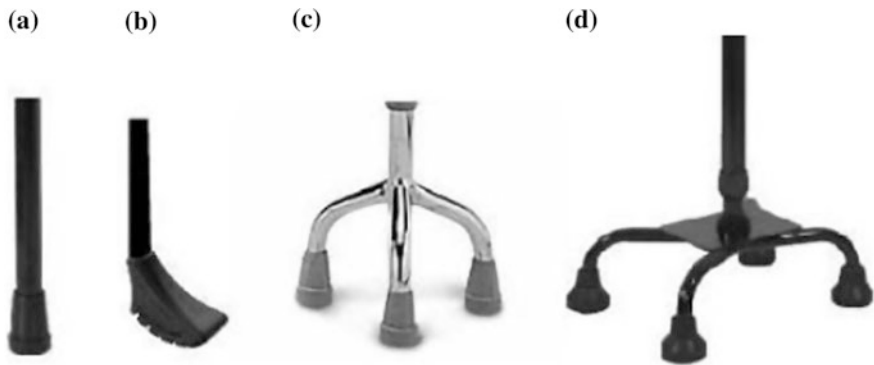


Fig. 2 Types of bases of a walking stick

### 3 Design Process

The design process was divided into four distinct phases Discover (Research), Define (Insights), Develop (Ideate) and Prototype. The double diamond [3] is a simple visual map of the design process. Throughout the process, a number of possible ideas are created (divergence) before refining and narrowing down to the best idea (convergence).

#### 3.1 Discover (Research)

The design process according to the double diamond model begins with the discovery of user needs, current design and choice of various methods for the same, is depicted as Red color in Fig. 3.

**Literature review**—Existing patent of walking canes includes the ‘Illuminating walking stick’ which has a light source disposed within cane shaft adjacent to a translucent section for emitting flashes of light, a battery housed within the cane for supplying power to said light source, the generic ‘walking stick’ comprising an elongated hollow stick having upper and lower parts which are provided on its

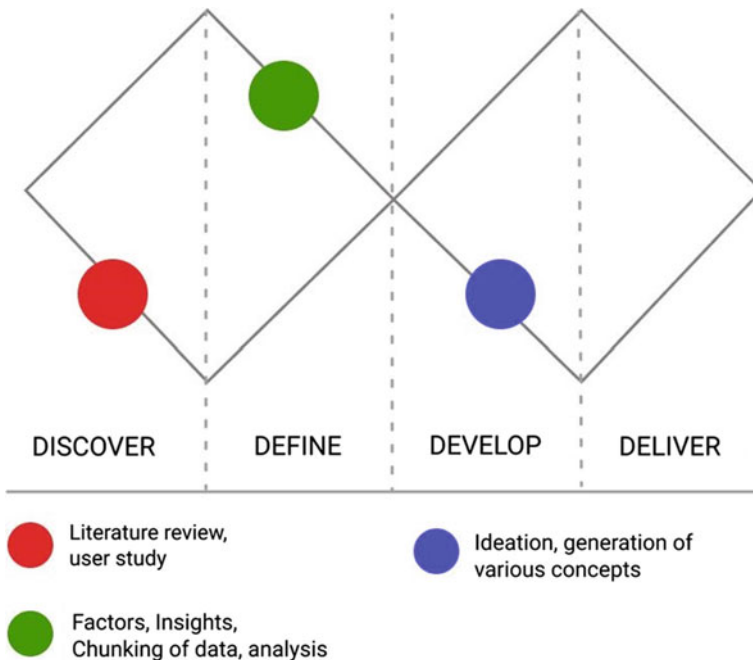


Fig. 3 Double diamond model

lower part with two supporting legs which are tiltable between a folded-in position and a folded-out, active position, and finally the ‘multi-functional walking stick,’ its electric torch can be adjusted by a finger at any time for pinpointing a small location or for shining a wide area. The shaft is adjustable by double-safe construction for keeping adjusted shaft firmly in position and is more solid and stable than any prior art after adjusting.

**User study**—The methods deployed for user study were:

*Shadowing* is the behavioral observation of a user in their natural environment that provides direction for further user research. Shadowing as a tool is much stronger than interviews and questionnaires as it refrains from bias in answers under the Hawthorne effect [4].

*Interviews*—Semi-structured interviews were conducted with all the participants of the study to collect qualitative and quantitative data among different categories: objective measures of the environment, residents’ perceptions and attitudes about the environment and walking stick, walking behavior data, pain reception, and habit formation. In a lot of the cases, the interview was the correct alternative to the questionnaire and was narrated.

*Questionnaires* A set of questions for obtaining statistically useful or personal information from individuals. The questionnaire had both qualitative data and quantitative data collection.

*Likert scale*—Qualitative data describing the pain felt on various parts of the hand were also quantified using the Likert scale. It is a psychometric scale commonly involved in research that employs questionnaires. It is the most widely used approach to scaling responses in survey research. The kind we used quantified pain as 0 is not felt at all and 10 being extremely painful. The various pain points were then marked on the image of the palm by the users to describe the regions where they felt it.

### 3.2 Define (Insights)

Defining the areas of interest and development by analysis of data collected in the previous stage. Factors associated include storage, reason for use, parallel tasks, illumination, and the terrain. The define is depicted as green color in Fig. 3.

**Analysis** The analysis of various insights and user data [5].

*Mapping the pain points of the palm*—Users were asked various parts of their palm which pained while using their walking stick, users then marked various spots on the image of their palm. These images were then traced and converted into 10% opacity overlays and then all marked on one common hand frame to pinpoint areas which were common in the complaint about pain. The higher the opacity of the area the usual the spot was for pain or discomfort. This graphically explained and analyzed the common pain points with similar handles in Fig. 4.

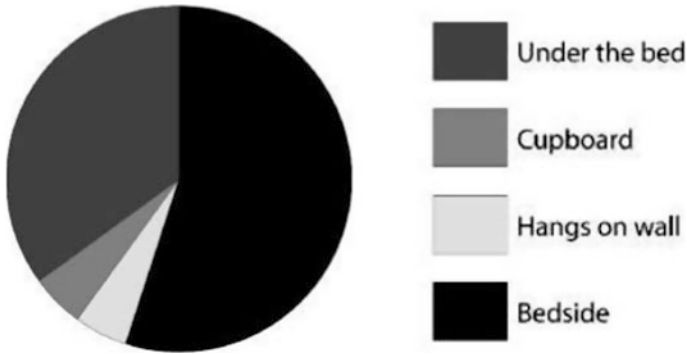
**Fig. 4** Pain points on palm

*Graphical chunking of insights*—This step included identifying the quantum of users that fall under different categories depending on their usage and preference. The users were asked what was the reason they opted to start using a walking stick in their daily life and what purpose do they think it serves for them and what they did with the stick when not in use for the short and long duration of time (minutes while sitting to hours at night). A repetition was observed in the responses after interviewing less than twenty-five percent of the participants, and thus the data were separated into the major categories and plotted on a pie chart to show the similarity in user preference and behavior.

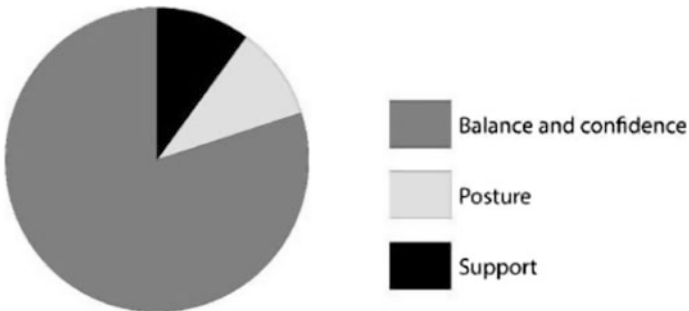
From the plotted data, we come to know that bedside and under the bed are the most preferred location of storage for a longer duration, which is shown in Fig. 5 and that most people believe that their walking stick helps them keep balance and gives them confidence which is shown in Fig. 6.

**Insights** The various pain points collected by user study are shown in Fig. 4.

*The purpose of using a walking stick include* The recommendation by a doctor, purpose for strengthening the gait, to provide the elderly with confidence and independence, reduces pain caused by knee or leg ailments, and reduces the fear of falling.



**Fig. 5** Graphical data of storage



**Fig. 6** Graphical data of utility

*The various issues with the walking sticks in the market* include incorrect or damaging usage by the elderly, the tendency to develop over-dependence and obsolescence by under usage.

*Reasons for issues with a walking stick*—The lack of independence or fear of over-dependence, poor or damaging usage due to lack of semantics, the lack of features required by the elderly, bulky, and restricting style of walking sticks and the general stigma associated with the walking stick that restricts either usage or positive association with the walking aid.

### 3.3 Ideation

The ideation process is depicted as purple color in Fig. 3. Various designs worked with different feasible solutions followed Indian anthropometric dimensions and had certain constraints in mind:

1. Great illumination
2. Ergonomic
3. Easy storage
4. More of a fashion accessory than a medical aid
5. Adjustable
6. In tandem to the Indian elderly’s mental model.

The anthropometric constraints considered for ideation is tabulated below (Table 1) [6].

#### Concept 1

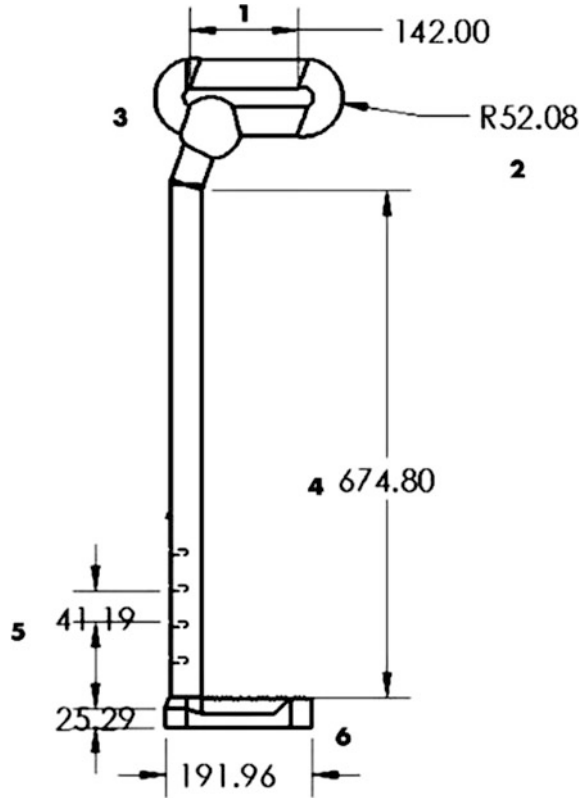
Proposed ideation of Concept 1 is shown in Fig. 7. *The features are as follows:*

1. Height adjustable to both extremes; the length is adjustable from 5th percentile gluteal furrow height to the 95th percentile; The furrow between the buttocks and the thigh muscles make up the gluteal furrow.
2. The base is the step height of 19.7 cm standard step size so while climbing stairs the elderly do not have to open or raise the height of foot more than 19.7 cm breaking down the step height into smaller steps.
3. The bearing attached to handle to trunk allows multi-angular movement, easy to rest against wall, or change grips; easy product departing.
4. The cavity also allows better storage by means of hanging on walls.
5. The illumination button is a simple slider taken from generic torches to the mental model of the elderly.
6. The loop-shaped handle reminds elderly of bus handles/support which is up to the mental model of an active youngster thus detaching the walking stick from the stigma of a medicinal/elderly aid.

**Table 1** Anthropometry reference to Figs. 7, 8, and 9 [4]

Reference	Anthropometry	Dimension (mm)
Handle width	Handbreadth without the thumb, at the metacarpal	117
Grip diameter	Grip inside diameter	42
Cavity	finger-tip depth	18
Height min	Gluteal furrow min	682
Height max	Gluteal furrow max	923

**Fig. 7** Dimensions of Concept 1



### Concept 2

Proposed ideation of Concept 2 is shown in Fig. 8. *The features are as follows:*

1. Two gripping postures are enabled by the handle. Depending on the comfortable wrist angle, the user can switch between the two postures.
2. An accessory like look is given by the triangular form of the stick. This is in contrary with the circular form which is associated with a walking stick used for medical aid.
3. As per the user's preference, the base can be switched from 1 leg to 3 legs depending on the surface.
4. Depending on the context of use, there are 4 combinations the user can adjust as per their comfort.
5. The body of the walking stick can be made of glass fiber reinforced polymer (GFRP), also known as fiberglass.
6. Mechanical advantages like high strength, water resistance, and low weight-to-strength ratio will be provided by GFRP.
7. The look of GFRP will suit the triangular form of the stick and give an overall premium aesthetic to the walking stick.

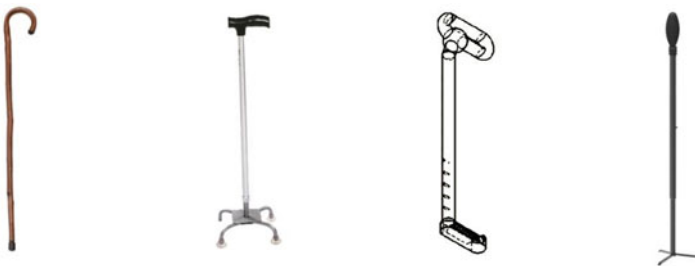




Fig. 8 Concept 2

## 4 Discussion

The study follows the design thinking methodology for creation of ideas that solve the issues with the current designs of walking aid for elderly, specifically to the Indian context. The comparison of ideas and current designs in the market is on the basis of various qualities. Figure 9 shows the existing and proposed designs of walking sticks [7–13].



Existing Design 1(E.D 1); Existing Design 2(E.D 2); Proposed Design 1(P.D 1); Proposed Design 2(P.D 2)

Fig. 9 Existing designs compared to proposed designs

**Table 2** Design comparison of proposed with existing products

Designs	Balance	Grip	Ergonomic	Adjustability	Storage	Illumination	Aesthetic	Total
E.D 1	2	0	1	0	2	0	1	6
E.D 2	2	1	2	2	1	0	1	9
P.D 1	2	2	2	2	1	2	1	12
P.D 2	2	2	2	2	1	0	2	11

*E.D.* Existing Design, *P.D.* Proposed Design

Table 2 compares proposed designs with existing designs. The features of the designs are evaluated on 0–2 scale (minimized Likert scale).

0—No presence of the feature

1—Weak presence of the feature

2—Strong presence of the feature.

Proposed designs scored more score than the existing designs.

## 5 Conclusions

The study helped in creating walk aids that cater to the needs of the elderly. The survey was done in institute and no ethical clearance was needed. Also, the data are anonymized. First is the multipurpose usage (Concept 1) and second is the aesthetics and accessory like appearance (Concept 2). The target audience includes the urban elderly and ideally elderly.

With previous experience of using a walking aid, the aim of the walking aid is to not only fulfill the needs of the elderly but also extend the needs of people involved in their lives.

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## References

1. Tutuncu Z, Kavanaugh A (2007) Rheumatic disease in the elderly: rheumatoid arthritis. *Rheum Dis Clin North America* 33(1):57–70
2. Van der Esch M, Heijmans M, Dekker J (2003) Factors contributing to possession and use of walking aids among persons with rheumatoid arthritis and osteoarthritis. *Arthritis Care Res Official J Am Coll Rheumatology* 49(6):838–842
3. Informa Healthcare, Karwowski W (2006) *International encyclopedia of ergonomics and human factors*, 2nd edn., vol 3. CRC Press
4. Norman AD (2013) *Design of Everyday Things*, expanded and revised. Basic Books Publishing
5. Moustakas, C (1990) *Heuristic research: design, methodology, and applications*. Sage Publications

6. Chakrabati D (1977) Indian anthropometric dimensions for ergonomic design practices. National Institute of Design
7. Holliday R (2018) Walking stick papers Al Haines
8. Kroemer KHE (2005) Extra-ordinary ergonomics. CRC Press
9. Williamson D (1988) Walking stick standards. *Physiotherapy* 74(3):121
10. Robinson JP (2000) Phases of the qualitative research interview with institutionalized elderly individuals. *J Gerontological Nursing* 26(11):17–23
11. Sainsbury R, Mulley GP (1982) Walking sticks used by the elderly 284(6331):1751–51
12. Kumar D, Shankar H (2018) Prevalence of chronic diseases and quality of life among elderly people of rural Varanasi *IJCMR* 5(7)
13. Fabbro PA (1965) Walking aid 45(1):34–34