

An Assistive Technology for Physical Impairment

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Abstract: This research aimed to develop walking aids (crutch) for physical impairment. This research use method research and development. The development of producing the walking aids was done through seven production steps, they are: 1) Needs and problems analysis of crutch user, 2) Product design, 3) Product design validation, 4) Product design improvement, 5) Trial of the product, 6) Product revision, 7) Product making and product branding. The result of this crutch development research is named CRAIO (Crutch All in One). After product trials and revisions, this crutch was produced to be more flexible for its users. The crutch height can be adjusted according to the height of the user, the crutch has cantilever combined by dynamic spring, and the crutch has several base pads that can be adjusted according to the passed terrains. According to these assistive technology designs, it provides a new design recommendation for walking aids as an innovation of market quality product.

1 INTRODUCTION

Assistive technology can help people with physical impairment to be able to be independent in their activities. Crutch, for example, is one of the assistive technologies that help people with physical impairment to daily mobility. Crutch walking gait is a primary means for rehabilitation applications for foot injuries (Gholami, Kovecses, Llagunes Basically, 2011). Crutches, in one form or another have been used for 5.000 years (Epstein, 1937) The crutch is divided into two, namely the axillary crutches and crutch non axilla. Kruk non axilla can transfer 40-50% weight, while the axillary crutches can transfer up to 80% weight. This makes better axillary crutch to support the weight, so it is more widely used crutch axillary crutches users (Rahmi, 2013).

In general, people with physical impairment using crutches on the market. For most people, this crutch has many deficiencies, including brittle, less comfortable in the armpit crutch, and not flexible when used to its users (Shabas and Sheiber, 1986; Miski, 2016).

Crutches development based on ergonomics and anthropometry, which means based on the knowledge that the appropriate measurement is intact and the problems - the problems of human interaction with technology that made possible the existence of an

optimal system design technology. The purpose of this research is to develop a crutch based on the analysis of the users needs crutches. Expected later to make updates crutches on the market that is more convenient and flexible, so that the crutch users can perform their daily activities comfortably.

2 METHOD

The method used in this research is the research and development (R&D). Development tools is making these crutches with eight stages, namely: 1) Analysis of the needs and problems of the crutch, 2) Product Design, 3) Validate Product Design, 4) Improvement of Product Design, 5) Trial Product, 6) Revised Product, 7) Making the products and giving the name of the product, 8) Evaluation.

3 RESULTS

Based on interviews and observations of the crutches which have found it difficult to bring crutches to a variety of terrain (rocky, slippery, steep), felt pain in the palm of the hand and handle part in the armpits, and crutches are also easily broken due to less robust

in supporting pedestal body. Here is a crutch team development model developed.

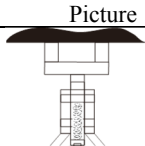
1. Product Components

Of products walker crutch that we made has several components and these components has its own function itself. The crutch component comprising:

a. Forearm

Figure 1 illustrates the support of thick rubber, combined with a spring at the bottom. When worn will feel soft to the armpit. We can see the support of alternative compilers to be made as shown below:

Figure 1: Forearm Crutches.

Picture	Description
	The support is made of rubber combined with a spring force on the bottom

b. Adjusted Handle

Figure 2 has been made from aluminum with 2 design, 1) aluminum covered with a sponge to make a handle not slippery by the hand sweat. This section attached to the stainless steel rods with kelingan process for attachment. The second alternative is aluminum rod coated sponge attached to the trunk settings crutch with bolts and nuts so that the hand grip can be adjusted according to the size of the wearer.

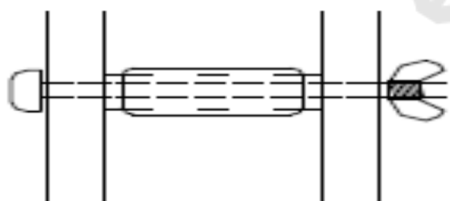


Figure 2: Adjusted Handle.

c. Function Settings

Altitude can be adjusted according to the desired size with the function settings. Function settings here shaped as a fastener hole. Expected from the hole can tighten the set long and short .For more details can be seen as shown below:

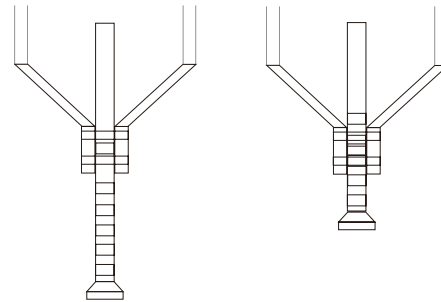
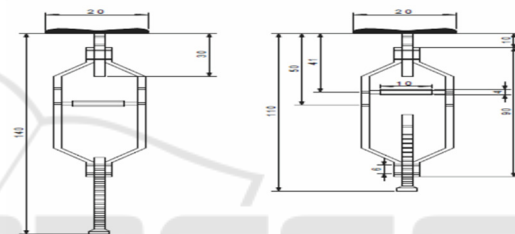


Figure 3: Under the support of crutch.

2. Product Concept

Having in mind the existing product



components, then proceed with the drafting of which combine the functions. Thus the product components that have to be got concepts as follows:

Figure 4: Overall crutch.




Specifications:

Part of: (1) Material Stainless steel 1 and 3/4 diameter with a thickness of 0.8 and 1mm, (2) Section armpit dynamic blend of rubber and springs, spring length 10cm.

Bottom: (1) Material Aluminium 1mm diameter, (2) Pedestal rubber vbelt CVT supported by the iron plate with 0,6mm thickness 5 mm long 10 cm Ring iron clad 8mm diameter hose.

3. Under the Support Section

Here is the bottom cantilever designed that adjusts to the terrain.

	Under Support of Type Crutch	Information
1.	For ordinary floor or smooth roads) 	The support is standard with the crutch designed for terrain with smooth roads like the floor. Tile and asphalt.
2.	For the rocky gravel roads 	The support is modified with the motor CVT vbelt material which has been revamped and adapted to gravel roads and rocky, shown on the bottom like serrations with hard rubber materials.
3.	For the road with field moist soil and grass) 	The support is modified with the motor and the CVT vbelt material circular iron wrapped with a rubber hose. With these modifications, the style fulcrum become wide and large, have been adapted to the soil is moist and the grass

3.1 Method of Operation Case

How to apply these crutches are some points that must be done step-by-resistant are as follows:

1. Set the appropriate length of the stick height. The trick is to adjust the position of the hole by pressing the two protrusions on the hole in the bottom of the stick. Do not get too attached to the armpit, allow approximately two fingers. If it is too stick will hit the nerves in the armpit and arm will feel pain if too much pressure.
2. Set the hand grip to maximize the strength of the hand holding the stick while it is running. The burden should be minimized so that the pedestal is at hand. Make adjustments on the part of the hand grip size can be adjusted.
3. When walking, do not slouch, because it is less good for the spine. Cultivated walk upright.
4. If using 1 stick, the stick is held on the healthy side. When walking, step foot and stick together then step your good leg, and so on.
5. To the rocky terrain and wetlands could be put on the foundation that has been provided.

After designing the crutches, the team made a name on the crutches that have been made. The team gave the name "CRAIO" which has a length of crutch all in one. Few things in this naming crutches hope

this development could include the needs of the users of crutches in daily life and can be an accessible walk in every field and place.

4 IMPLEMENTATION

4.1 Planning

4.1.1 Function

Walker was created to help the user mobility crutches in the running quality of life, other than that this tool is a technology that helps contribute to the quality of life for users of crutches. The advantage of this tool technology can be considered, and can dramatically improve the lives of someone who has obstacles in running, if the tool is not used it will affect the difficulty to access other devices or provide barriers to mobility for the subject.

4.1.2 Comfort

In terms of comfort or ergonomics of the tool is designed as comfortable as may be seen from some of the convenience features embedded as a buffer spring

dynamic and silicon for supporting the armpits so as not to cause pain like that have been complained by the subject, buffer spring is flexible adjustable adjust the weight of the user's body, besides other comforts like a cantilever down to suit the terrain ranging from smooth roads, graveled and moist soil or grass.

4.1.3 Aesthetics

The tool is designed with attention to aesthetic value that these tools in addition to providing benefits can also be used without making others feel sorry for users, the design of this tool follows the design tool on the market with a few modifications to the design of the tool does not look strange.

4.2 Implementation

4.2.1 Effectiveness

Visible indicator of the effectiveness of the role and functions of the background that is whether or not the

activity help users of previous activity so that it can be concluded that an appliance is said to be effective.

4.2.2 Efficiency

Efficiency is a product or has the flexibility as easily be carried in a variety of situations elasticity, lightweight, reasonably priced but have a high mobility because it is designed that facilitate the users.

4.2.3 Effectiveness and Efficiency

From the above data it can be concluded the acquisition of this tool against efiktifitas and efficiency is very satisfactory means this equipment in accordance with expectations based on user ratings crutches. Seen from the figure 1.

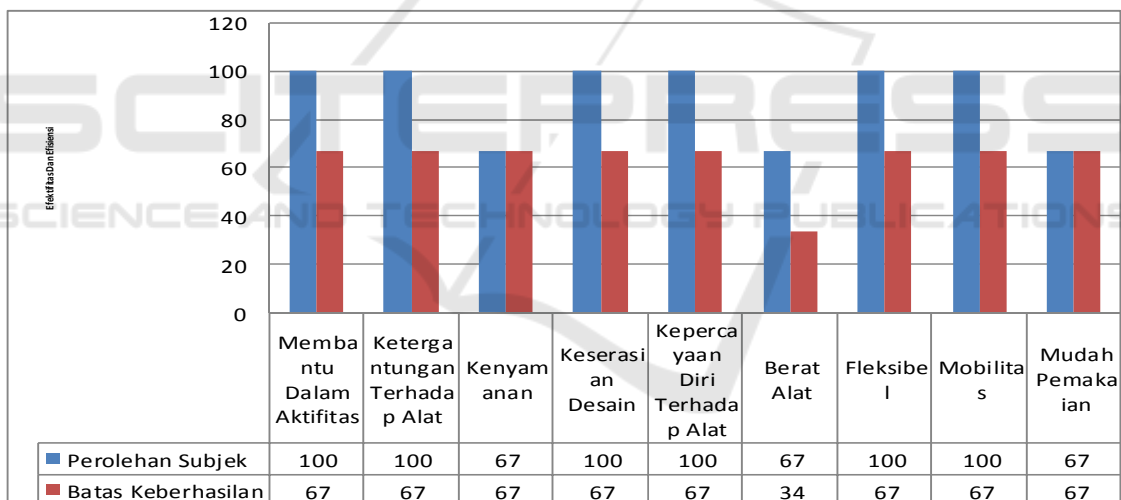


Figure 1: About effectiveness and efficiency crutch.

In the evaluation of the effectiveness (function tools, the reliance on the tools, comfort, harmony tools, and confidence in using the tools) and efficiency (heavy tools, flexible, easy to carry, easy operation of the device. The acquisition of this tool on the effectiveness and efficiency of the tool is very satisfactory means in accordance with expectations.

5 DISCUSSION

According to the crutches for the next tool can be painted or in the airbrush and the settings can be shaped nut or bolt that can be set with a set of tools to make it easier to install / release / menyetting crutches crutches without having to bring it to the workshop. For further development can create a crutch with a material lighter and stronger materials such as aluminum dural the main ingredient of the design of a walker, and for the next innovation tools can be

folded or separated pairs in order to facilitate the user in storage or when not being used without changing the power tool the spring and the closing part from being pinched.

6 CONCLUSION

The result of this crutch is named CRAIO research development (Crutch All in One). After product trials and revisions, this crutch was produced to be more flexible for its users. The crutch height can be adjusted According to the height of the user, the crutch has cantilever combined by dynamic spring, the crutch has several base pads that can be adjusted According to the passed terrains. According to Reviews These Provides assistive technology design a new design recommendation for walking aids as an innovation of market quality product.

REFERENCES

- Adamczyk, P.G., Collins, S.H., Kuo, A.D. 2006. The advantages of a rolling foot in human walking. *The Journal of Experimental Biology*, 209, 3953-3963.
- Basford, J.R., Rhetta, M.L., Schleusner, M.P. 1990. *Clinical Evaluation of the Rocker Bottom Crutch*. *Orthopedics*, 13 (4), 457-450.
- Chandra, G. P., Jumenon., D. n.d. *Perancangan Alat Bantu Jalan Crutch Bagi Penderita Cedera dan Cacat Kaki*. Padang:Jurnal Ilmiah. Mahasiswa Program Sarjana, Program Studi Teknik Industri, Universitas Andalas Fakultas Teknik, Jurusan Teknik Industri, Universitas Andalas Padang, Kampus Limau Manis.
- Dounis, E., Rose, G.K., Wilson, R.S.E., Steventon, R.D. 1980. *A Comparison of Efficiency of Three Types of Crutches Using Oxygen Consumption*. *Rheumatology and Rehabilitation*, 19, 252-255.
- Epstein S. 1937. *Art, history, and the crutch*. *Ann Med Hist* . 9: 304- 13
- Fitriadi, T. 2008. *Perancangan Alat Bantu (Crutch) Yang Praktis dan Ergonomis Dengan Menggunakan Software Catia*. Surakarta:Jurnal Nasional.
- Frizera, dkk. 2014. *The Smart Walker as Geriatric Assistive Device. The SIMBOSIS Purpose*. *International Journal on the Fundamental Aspects of Technology to serve the ageing society*. Vol. 15, Number. 4.
- Gholami, Kovecses, Llagunes. 2011. *Parametric Analysis Of Impact Configurations In Crutch Walking*. *Multibody Dynamics, EcomasThematic Conference Number 1-8*.
- G. G. Suarez, J. G. Garcia, and L. P. Carro, *Stress Fracture of the Ulna Associated With Crutch Use*. *Journal of Orthopaedic Trauma*, vol. 15, no. 7, 2001.
- Graf, Birgit. 2009. *An Adaptive Guidance System for Robotic Walking Aids*. *Journal of Computing and Information Technology*. Vol. 17, Number. 1, Page. 109-120.
- J. Nyland, T. Bernasek, B. Markee, and C. Dundore. 2004. *Comparison of the Easy Strutter Functional Orthosis System and axillary crutches during modified 3-point gait*. *Journal of rehabilitation research and development*, vol. 41, no. 2, pp. 195–206, 2004.
- LeBlanc, M.A., Carlson, L.E., Nauenberg, T. 1993. *A quantitative comparison of four experimental axillary crutches*. *Journal of Prosthetics and Orthotics*, 5, 40–48.
- Miski, Adnan. 2016. *Design Evaluation of Crutches from an Engineering Perspective*. *American Journal of Engineering Reseach (AJER)*. Vol. 5, Issue. 9, Page. 33-38.
- Mullis, R., Dent, R.M. 2000. *Crutch length: Effect on energy cost and activity intensity in non-weight-bearing ambulation*. *Archives of Physical Medicine and Rehabilitation*, 81, 569–572.
- Nielsen, D.H., Harris, J.M., Minton, Y.M., Motley, N.S., Rowley, J.L., Wadsworth, C.T. 1990. *Energy cost, exercise intensity, and gait efficiency of standard versus rocker-bottom axillary crutch walking*. *Physical Therapy*, 70, 487–493.
- Nugroho, A. 2011. *Perancangan Tongkat Sebagai Alat Bantu Jalan Bagi Lansia*. Surakarta:Jurnal Nasional.
- Rochyadi, E. 2016. *Modul Asistif Teknologi*. Departemen Pendidikan Khusus. Fakultas Ilmu Pendidikan. Universitas Pendidikan Indonesia.
- Souza, dkk. 2010. *Multiple Sclerosis And Mobility-Related Assistive Technology: Systematic Review Of Literature*. *Journal of Rehabilitation Research & Development*, Vol. 47, Number. 3, Page. 213-224.
- Sherif, dkk. 2016. *Analysis of Hand Pressure in Different Crutch Lengths and Upper – Limb Movements During Crutched Walking*. *International Journal of Industrial Ergonomics*. Vol. 53, Page. 59-66.
- Segura, A., Piazza, S. J. 2007. *Mechanic of ambulation with standart and spring loaded crutches*. *Archieves of Physical medicine and Rehabilitation*, 88, 1159 -116.
- Ulrich, Karl T., dan Eppinger, Steven D. 2001. *Perancangan dan Pengembangan Produk*. Salemba Teknika: Jakarta.
- Wignjosoebroto, Sritomo. 2006. *Ergonomi Studi Gerak dan Waktu*. Guna Widya: Surabaya.