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SOCIAL INCLUSION THROUGH DESIGN AND ERGONOMICS: INFORMATION INPUT DEVICE FOR PEOPLE WITH SUPERIOR MEMBERS DISABILITIES

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1 Context

This article presents the project of an input device of information _which communicates to computers_ designed for people with congenital malformation of the upper limbs. In this project, it was required, through design and ergonomics, finding solutions to facilitate people with special needs' everyday use of devices _keyboard and mouse_ which are instruments of work, study or pleasure.

The theoretical basis was given through research on: congenital malformation of superior members (immersing in anatomy), rehabilitation medicine, social inclusion and assistive technology process. The collaboration of the AACD (*Associação de Assistência à Criança Deficiente*, which means: Disabled Children Assistance Association) was fundamental once has permitted not only the use of interviews with its staff, but also the observation of the target audience's experience with everyday objects, allowing a deeper knowledge on Occupational Therapy. Through this cooperation, based on Gui Bonsiepe's method, knowing the characteristics of people with upper limbs deficiency and their experience on similar devices as well, it was possible the product's project development. All this content together provided the basis for the definition of specific solutions to problems concerning structure, information, sensory formal trouble, usability, productivity and physical resistance, which can be found during the operation of input devices of information that communicate with computers in various environments. Ergonomics, as the study of the working conditions, provides studying conditions for a better use of devices, ergonomic parameters for demansioning, comfortable postural angles, and the basis for analysis of possible psychophysiological, anthropometric and biomechanical constraints, suffered by upper limbs disabled people, beyond the parameters prepared by ABNT _ Associação Brasileira de Normas Técnicas, which means Brazilian Technical Norms Association.

With the recognition and delineation of problems found during the research, some guidelines were proposed as project requirements. It was necessary to offer:
a) Greater comfort in performing the activity: typing and controlling the mouse through the feet;
b) Respecting the maintenance of sitting posture in the seat while operating the device at floor level, presented by the users during the observation of performing the task;
c) Definition of actional and visual areas to provide comfort throughout the task execution;
d) Product's ergonomic design dimension considering the smaller woman's 1 percentile and the greatest man's 99 percentile (serving approximately 98% of the population).
e) Anthropometric study of the toes' dimensions for defining the keyboard's keys and the heel's dimensions for defining the feet's resting area, in addition of finding the properly angle to postural comfort of the feet and view of the keys in the position of use (person sitting);
f) Anthropometric study also considering the ideal sitting height for extreme cases of users in order to allow a greater comfort and better operation, depending on body variable.
g) Good view of the keys and the recognition of their information by increasing the size of the letters, respecting the sitting position and the distance between the eyes and the keyboard;
h) Good contrast of colors leading to the recognition of the letters and their comprehensibility;
i) Shapes, textures and colors according to devices for not disabled users;

With the intention of avoiding the product to be similar to the stigmatizing aesthetics of accessible products, the device is intended to people with physical disabilities in upper limbs, respecting their limitations, needs and extreme percentiles, but with an undifferentiated aesthetic of other products intended to the non-disabled. The objective is to please and be accepted by everyone without stigmatizing.

2 Method

Based on Gui Bonsiepe's method for product design development, it was necessary to know the characteristics of upper limbs disabled users, through experience with similar devices, and also recognize problems, delimitate them and present solutions. The bibliographical and documentary review based on several authors who have addressed the issue in question was used, plus semi-structured interviews with AACD's (Disabled Children Assistance Association) professionals, and also *in loco* observations of the target public use of similar devices, in order to obtain data on the special needs of disabled users of computer hardware. The gathering of all this information made it possible to establish the ergonomic design specifications and parameters for the product concerned. For choosing and validating these were built three-dimensional tests models and very positive results with the alternative chosen were obtained.

3 Results

In the step of generating alternatives, these were divided into three different categories: A, B and C. All of the generated ones were analyzed and positive points of the most interesting ideas were selected for the use in the functional model (scale 1: 1), referring to each category, and respecting their specific characteristics. The alternative chosen was the result of the model features that best suited the needs and comfort in operation with the addition of elements related to the other categories that have proven to be the most effective. The functional models allowed to come to a more accurate decision, made from the results of the tests performed on them.

In order to validate the product developed, new functional tests were made with the final model, on a real scale. In this way, it was possible to check the sizing of keys, their spelling, contrast and color quality, the use of structure and accessories as well as observe the operating of the product at all. The results were very satisfactory and it was noticed in the speech of users with disabilities in upper limbs a great motivation in the research participation and hope in the tested model production and trade. They noticed a greater ease in the use of information input devices and the possibility of a bigger and better communication and socialization, providing a better quality of life.

The prototype must be made of anodized aluminum and materials resistant to impact and the weight of the feet. The device has a sealed keyboard, allowing a proper and safer cleaning, and smooth and frosted texture to avoid the waste accumulation in its parts and also to minimize light reflection, allowing a better visualization of parts and comprehension of the information. It provides this information also in Braille. Its keys are designed to be driven with the biggest toe known as hallux (big toe). And it features a comfort angle of 10°, fixed in its structure.

Other device characteristics are arranged below:

a) mouse control keys separated for greater comfort, respecting the area required for operating using the feet; b) rest areas for the feet with rubberized material and angle of 10°, indicated as comfort angle; c) Mounting bracket (non-slip) to the ground plane; d) Bluetooth connection, without the presence of cables; e) USB device with ergonomic measures, suitable to be handled with the toes (with the big toe and the second toe); f) Pen Help, with non-slip beak and handling area with appropriate measures for the toes (with the big toe and the second toe), with rubberized material; g) Mouse Trackball; h) Readjustable lamp, able to move 180° to the side, forward and back and with ergonomic handle, suitable to be operated with the toes (with the big toe and the second toe).

4 Conclusions

Based on the final tests with the functional 1:1 model offered in two colors, many gains were obtained in the device operation: there has been noticed no difficulty in its

handling, there was a great facility on typing the keys and operating accessories, as well as better viewing and readability of graphical information.

From these results and the number of reports of participants belonging to the target audience, it can prove a real increase of psychic and physical comfort of the user in question. The positive comments validated the design in all its components in particular in relation to visual comfort and motivation to use. It can be stated that all objectives were achieved.

It's expected to get the interest of hardware manufacturers, in order to have this device on market and provide real and daily benefits to its users.

5 References

1. ABNT NBR 9050:2004. 97 páginas. NORMA. BRASILEIRA. ABNT NBR. 9050. Segunda edição, 2004.
2. ASHKY,M.F. Materiais e design: arte e ciência da seleção de materiais no design de produto / Michael Ashby e Kara Johnson; Tradução de Arlete Símile Marques; revisão técnica de Mara Martha Roberto e Ágata Tinoco. Rio de Janeiro: Elsevier, 2011.
3. ASSISTIVA, O que é Tecnologia Assistiva? 2011. Anais Eletrônicos. Disponível em: <http://www.assistiva.com.br/tassistiva.html#topo>. Acesso em: 30 de mai. 2011.
4. ASSOCIATES, Henry Dreyfuss / Alvin R. Tilley. As medidas do homem e da mulher – Fatores Humanos em Design. Tradução de Alexandre Salvaterra. Porto Alegre : Brookman, 2005.
5. BERSCH, Rita. SARTORETTO, Mara Lúcia. Centro Especializado em Desenvolvimento Infantil. Introdução a Tecnologia Assistiva. Porto Alegre, 2008. Disponível em: <http://www.assistiva.com.br/Introducao%20TA%20Rita%20Bersch.pdf> Acesso em: 12 mai. 2011.
6. BONSIEPE, Gui. Teoría y práctica del diseño industrial - Elementos para uma manualística crítica. Colección Comunicacion Visual. Barcelona: Editorial Gustavo Gili, 1978.
7. BRASIL. Constituição (1985). Lei nº 7.853. Brasília, DF: Senado Federal, 1985.
8. BRASIL. Constituição (1989). Lei n° 7.405. Brasília, DF: Senado Federal, 1989.
9. BRASIL. Ministério da Saúde. Política Nacional de Saúde da Pessoa Portadora de Deficiência. Brasil, 1989.
10. CENSO DEMOGRÁFICO 2000. Características gerais da população, religião e pessoas com deficiência. Rio de Janeiro: IBGE, 2000.
11. CENSO DEMOGRÁFICO 2010. Características gerais da população, religião e pessoas com deficiência. Rio de Janeiro: IBGE, 2010.
12. LIMA, Marco Antonio Magalhães. Introdução aos Materiais e Processos para Designers. Rio de Janeiro: Editora Ciência Moderna Ltda. 2006.
13. NORMAN, Donald A. Design emocional: por que adoramos (ou detestamos) os objetos do dia-a-dia. DEIRÓ, Ana (Tradutor). Rio de Janeiro: Rocco, 2008. 278 p.: il. ISBN:9788532523327. Tradução de: Emotional design : why we love (or hate) everyday-things Inclui bibliografia.
14. SASSAKI, Romeu Kazumi. Inclusão: Construindo uma sociedade para todos. 3ªed. Rio de Janeiro: WVA, 174p,1999.
15. Entrevistas:

OLIVEIRA, Sulla. Reabilitação. Entrevistadora: Danila Gomes. Nova Iguaçu, RJ: AACD, 2011. Entrevista concedida ao AACD, RJ, maio. 2011.