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Promoting Urban Mobility: Bus Crutch Support Project

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ABSTRACT: *The theme of this project is focused on assistive technology related to reduced mobility of people that have the amputation of his lower limbs. This project had as main objective the development of a support in the field of mechanical engineering for crutches, bound within the highway buses, to facilitate the movement of people who use crutches, providing a support for the crutches, the time when the user stay within the city bus and with this crutch users will have greater accessibility to the use the buses. In this project the Group undertook a visit to Central company to analyze the urban bus models available and chose the model company Mega Neobus to projection and scale of support. Were conducted questionnaires applied to users of crutches and also to motorists in order to the members of the group know the opinion of those people about the project. Finally, the projection and the scaling of the Mega bus line. In this way it was possible to conclude the assembly of the projection, the responses of the crutches users and the tensor analysis in the Inventor. The group concluded that the objectives outlined were achieved and that support is fully functional.*
KEYWORDS: *Amputation, Support, Crutches, Bus, Accessibility.*

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I. INTRODUCTION

Physical disability is a serious issue and has great importance in conducting studies around the world, as researchers and students try to seek with their research and projects ways to facilitate the lives and social interactions of these citizens. A limitation of this theme is the amputation of the lower limbs, which is a factor that is classified as a physical disability, since this can cause individuals to have to use crutches, due to several factors [1]. This population tends to move around to carry out their tasks daily, and public bus transportation considered, even though they do not have the appropriate infrastructure for this occasion. Therefore, this project sought to develop support for crutches, applied to public buses in the public network, aimed at people who use crutches due to their reduced mobility, resulting from the amputation of the lower limbs [2].

The research is included within the assistive technology, since it is a subject that consists of the help of people with disabilities, trying to seek the advancement of several ways to help these individuals so that the difficulties in carrying out tasks on the part of these people can become more accessible [3-4]. The project encompasses physical disability since it is a change in one or more parts of the body, where the individual can no longer be independent and have difficulties in performing movements with the physical part of their body compromised. Crutches have a direct relationship with the project because the main study object of the research directed to crutches since orthoses are devices for external use intended to align and correct deformities or are used to improve the craft of moving parts of the body. And, therefore, crutches are classified as orthoses [5].

The project is of great importance since physical disability is one since its manufacture for people who have crutches based on law n° 5296. The law requires all models and brands of vehicles collective road for use in the country, are manufactured in an accessible way, and are available to operate and guarantee their use by people with disabilities or reduced mobility. The last element that gives significance to the project is that amputation is a serious problem. Amputation can have a genetic or acquired cause, such as the removal of a limb or part of the body surgically due to severe infection or trauma, or even in the case of patients with a cause known genetics, such as agenesis [6]. From the justifications mentioned above, we can conclude that in this way, we can assume that there are people who have suffered amputations and that these same people use bus transportation daily to get around as a result of their occupations [7].

The problem of this study is to find a way to facilitate the accessibility of users of crutches who use urban buses on the public network with a physical disability, through support that can accommodate the crutches. In contrast, the user remains inside this vehicle, the main objective of the group is the development of support for crutches, which provides adequate accessibility for users of crutches so that they can support their crutches on buses [8]. The overall objective happened in the projection of a versatile structure in the Autodesk Inventor software. The specific purposes are to understand the internal spaces of buses and to carry out the dimensioning of the support projection so that it adapts to vehicles and crutches [9].

The research observes, records, analyzes, and correlates facts and phenomena (variables) without a problem due to multifactorial causes that affect many people. According to data from IBGE (Brazilian Institute of Geography and Statistics) that express in numbers the number of people with physical disabilities 45,606,048 Brazilians; of this total, 3,192,423 citizens have motor disabilities. Another fact that increases the relevance of the research is the lack of laws for people who use crutches since the decrees only question the fact that the vehicles are modified. In addition to the description of support limitations, such as the current situation of Brazilian buses that suffer from overcrowding, dimensioning, and projection of support for crutches occurs. According to the technical procedures, the research is classified as experimental since the pair had as objectives the development, the projection, and the dimensioning of support for crutches, for the use of people who suffered an amputation, generating innovation and consequently seeking accessibility.

The research is also classified as field research because they visit the buses in the companies' yards to make the most appropriate bus model. The interviews with bus company owners and employees occurred and with the users of crutches who suffered amputations in a doctor's office and at the home of users of crutches, respectively. The group conducted interviews with owners and employees of the bus companies, generated discussions with the physically disabled who use crutches, to find out what difficulties they face, and the projection of the project in the software occurred.

II. LITERATURE REVIEW

Over the years, happens a modernization in the world with the development of new technological resources. Along with this advancement, the equipment, and devices intended for the assistance of people with special needs have evolved rapidly. In the constant evolution of this evolution, the term assistive technology has gained recognition and fame among people all over the world. But according to Kleina (2012), even though it is a matter that is not popular. This concept has been present in humanity since Prehistory, when, for example, after a fractured leg, a man used a tree branch to support himself, making this adapted cane allow him to resume a function.t This gait was prevented by the accidental fracture because when we use any tool or resource to help someone who has a limitation, we are using assistive technology [10-11].

Kleina (2012, p.33), refers to the origin of assistive technology, stating that “Assistive technology is a term implemented in Brazil in 1988 and origin in the English name assistive technology, and its function is to differentiate some equipment others in the medical and hospital fields and standardize them. This standardization aims to assist in the drafting of laws that need a categorization of these resources and equipment. In Brazil, we find derivations of this term, such as adaptations, technical aids, self-help, and support aids [10]. From the above quote, we can conclude that assistive technology is not a term originated in Brazil and that it promotes the combination of several limitations that human beings acquire, which are not very related to medicine. Bersch and Tonolli (2006, p. 2) describe the technology realizing that it is a still new term, used to identify the entire arsenal of resources and services that contribute to providing or expanding functional abilities of people with disabilities and consequently promoting independent life and inclusion. In a broad sense, we realize that technological evolution is moving towards making life easier [12]. Without realizing it, we continuously use tools that developed to favor and simplify everyday activities, such as cutlery, pens, computers, remote controls, automobiles, cell phones, watches, in short, an endless list of resources that transpires assimilation into our routine.

Assistive Technology AT is a current topic, which emphasized to help people with disabilities. AT represents an aid that promotes the expansion of deficient functional skills and enables the performance of the desired function, which is impeded by circumstances of disability or aging [12].

Crutches, as well as walking sticks, are classified as orthoses. Orthoses are devices for external use for aligning and correcting deformities used to improve the craft of the moving parts of the body [5].

Axillary crutches are made of anodized aluminum, polyurethane, polypropylene, rubber, or only steel, using pins, screws, wing nuts, and washers in their structure. All axillary crutches are regulated, both for children and adults, being classified in sizes P, M, and G each.

Adult axillary crutches have a size P between 94 cm and 120 cm, a size M between 109 cm and 130 cm and a size G between 129 cm and 160 cm. Axillary crutches also have a maximum rate, for their use, being the user's mass, which can be up to 90,100 and 130 kilograms of weight depending on the brand chosen by the user. Canadian/forearm crutches are made of anodized aluminum, polypropylene, rubber, and using a pin. Most

Canadian crutches are manufactured with regulation, each having a size established by the manufacturer, and the crutches can be a minimum size of 57 cm and a maximum size of up to 120 cm. Canadian/forearm crutches also have a maximum charge for their use, being the user's mass, and can be up to 90 and 130 kilograms of weight depending on the user's option. The two models of crutches mentioned above have a variation in the diameter of the aluminum tube that makes up the crutches, which can vary between 3/4" (three-quarters of an inch), 7/8" (seven-eighths of an inch), 5/4" (five quarters of an inch), 5/8" (five-eighths of an inch) and 1" (one inch) in the diameter of the crutch. The weight of the crutches may vary according to the manufacturers, but it is, on average, 1.2 kilograms for infant crutches and 1.5 kilograms for adult crutches. An important feature for the user to have greater comfort is the fact that the baluster is applied to the back of each seat (individual or double), thus improving the balance of the user.

Fig. 1. Preferred seats in urban collectives.

III. MATERIALS AND METHODS

The application of questionnaires applied to five drivers of the bus transport company in the region occurred. These drivers observe the problem, and the difficulties encountered by users of crutches who use public urban buses daily may have a different look or an opinion, making doubts regarding the feasibility of the project clear up. An interview was conducted with users of crutches, through questionnaires to identify what are the problems that these users of crutches encounter when using urban buses and what is the viability of a device that will help these individuals to place their crutches during their locomotion within city buses. For the project, the Canadian model fixed or regulated crutch occurred to standardize the use for a category of crutches. The standardization facilitates the projection and the fact that it is the most used and also chose as a base the Mega bus model, manufactured by the company Neobus by it has the baluster straight, without any rounding. The design occurs by using the Autodesk Inventor software, the components that make up the device without their useful dimensions. The device consists of three distinct main parts and two elements used to fix the main components to the baluster and the other to attach the crutches to the device.

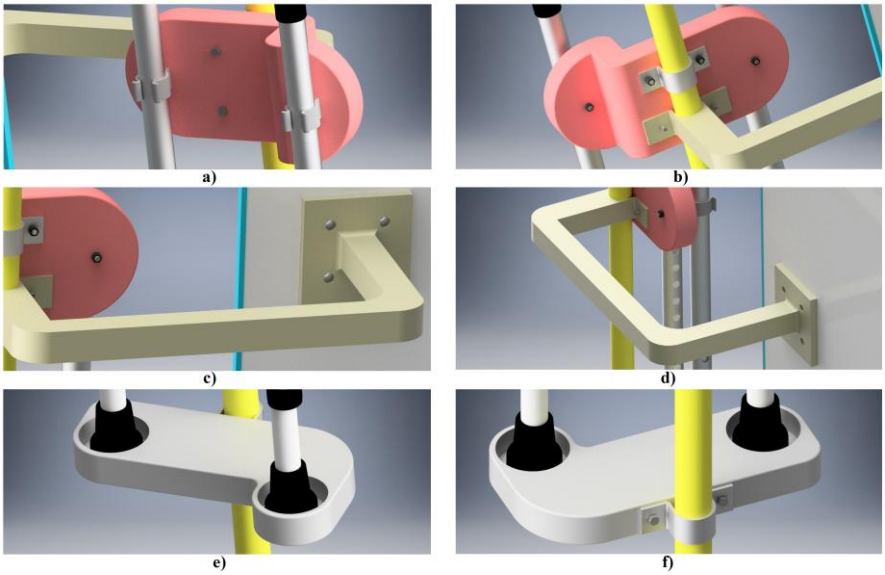

Fig. 2. Project modeling. a) Mounting the fixation; b) Assembly of the posterior fixation; c) Mounting the support fixing support; d) Mounting the support fixing support, rear part.

The elements mounted in front of the preferred seat and behind the driver in the vehicle from Neobus(Fig. 2a). The main plate will be fixed to the baluster using an omega clamp type 2 b) and the support so that the main plate does not rotate, together with four M5x0.8 screws, four nuts, and four nuts and four washers, in the holes positioned closest in the middle of the main plate. In the holes located near the ends of the main plate, the clamps placed to fix the crutches fixed with two M5x0.8 screws, two washers, and two nuts 2b). The support setting support will be attached to the main plate using two M5x0.8 screws, two nuts, and two washers and on the plate positioned behind the driver's seat through four rivets, preventing the device from rotating when placing the crutches on the support according to figures and 2d).

At the bottom of the vehicle occurs the positioning of the support for the crutches. The centers of the recesses are concentric with the centers of the clamps. This element set to the baluster through an omega clamp with two screws M5x0.8 together with two washers Fig. 2e) and 2f).

After dimensioning the components, occurred a stress analysis in Inventor, using the forces calculated according to the dimensioning. The first piece to be analyzed was the support for crutches, using aluminum as a material.

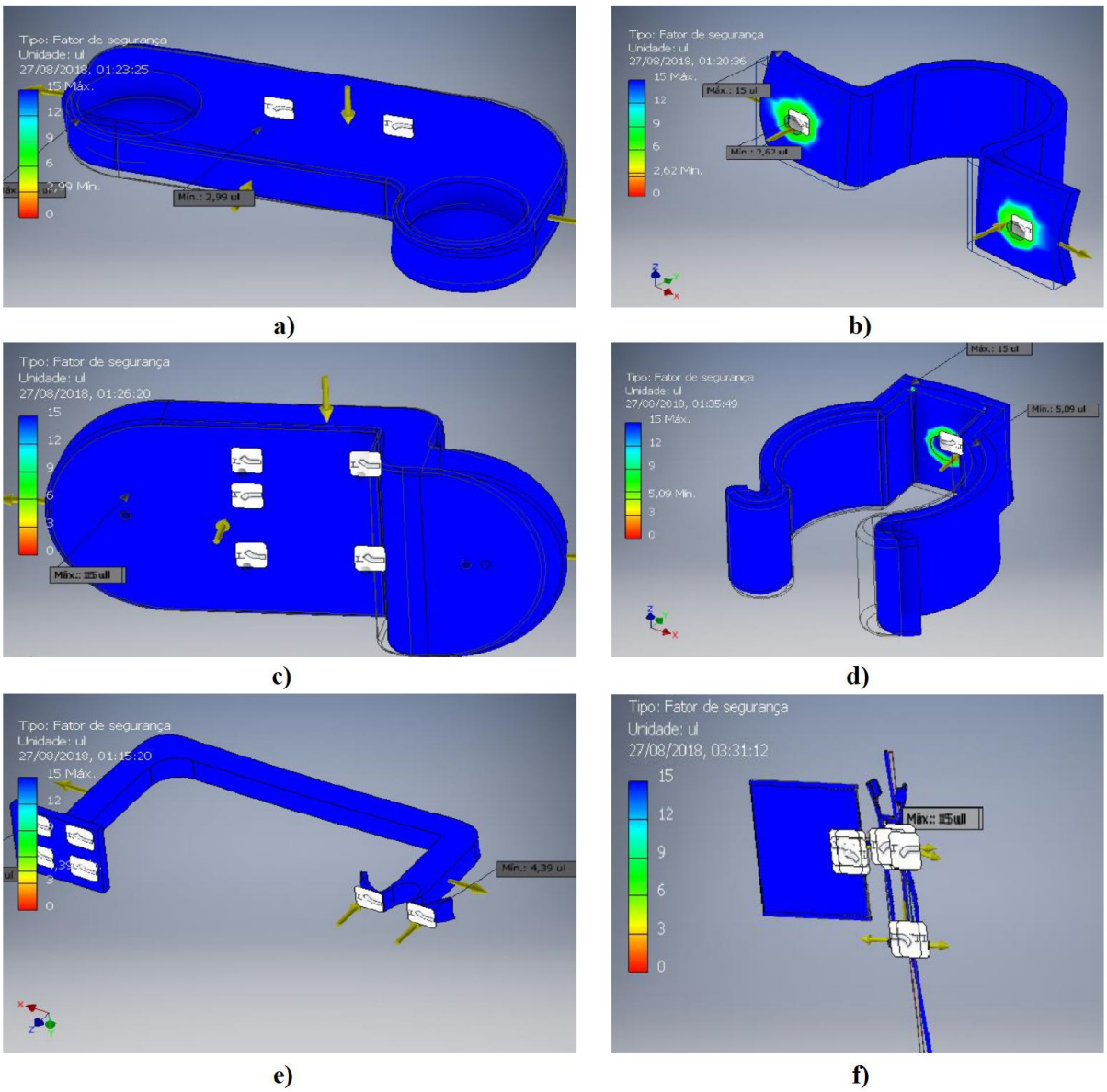

Fig. 2. Project stress analysis. a) Tension analysis in support for crutches; b) Stress analysis on the clamp; c) Stress analysis on the main plate; d) analysis of the clamp for the crutch; e) Support support; f) Analysis of stresses in the assembly.

IV. RESULTS AND DISCUSSION

From the application of the questionnaires, the people interviewed complain about the lack of accessibility of public urban buses. The drivers are not ready to help disabled people. The other people who use buses do not respect the disabled and often ignore their existence, making it very difficult for them to use public transport. Another question is whether crutches end up creating discomfort for both users and other people when using public urban buses. Another problem is whether crutches end up creating trouble for users and other people who use buses. The users of crutches generate the disruption because they hinder the movement of passengers and therefore put their crutches or between the legs, next to the body.

The safety coefficient defined by the inventor's stress analysis related to the design calculations made by the group, establishing K = 2.62 for omega clamp, K = 2.99 for the crutch support, K = 15 for the main plate, k = 5.09 for the brace, K = 4.39 for the support of the crutches, these being the minimum values for the support and finally establishing for the entire assembly the K = 15.

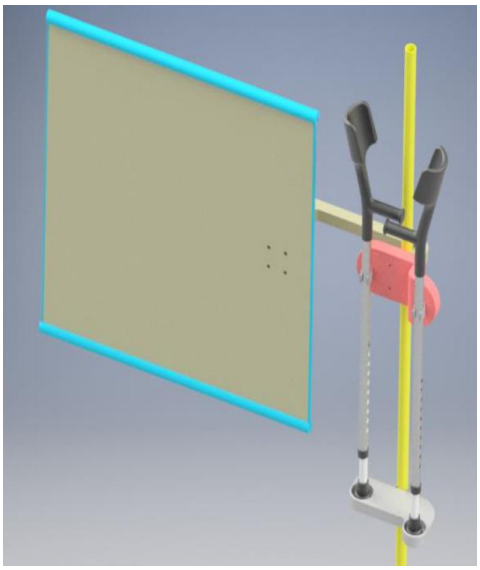

Fig. 4 – Final assembly.

V. CONCLUSION

With the application of the questionnaires, we can conclude that there will be greater accessibility for users of crutches because when sharing the bank with other people, it will be more conformable for both besides reducing the risk of crutches injuring someone in an accident. So the device turns out to be viable both for users of crutches using public urban buses and for other passengers on the bus. In this way, we can conclude that the work will withstand all the necessary forces since it is oversized with a very high safety coefficient with K = 15.

We also concluded that it was possible to design the support for crutches inside urban buses and that it can work according to the dimensioning and stress analysis.

And finally, the study achieved all the objectives established by the members, complying with all the rules and parameters stipulated throughout the research.

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