



Design of Technical Support for Stand-up

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Design of technical support for stand-up

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Abstract— This article contains the design of a technical aid for stand-up in patients with lower limb immobilization syndrome. The methodology applied consists of the definition of the design, design of parts, electronic design and final design, using the Inventor software, it was possible to simulate each of the parts that make up the structure of the technical aid. The final result of the design will allow the ascent and descent of the patient in a controlled and safe way.

Keywords— Technical assistance, stand-up, design, linear actuated.

I. INTRODUCTION

Elderly adults suffer a deterioration of their motor skills due to bone decalcification and muscle deterioration, in addition to other diseases that develop primarily with age. According to the WHO (World Health Organization), more than one billion people worldwide are elderly adults with disabilities who need technical assistance [1].

These physical conditions confine elderly adults to places and spaces with little movement, increasing deterioration due to lack of exercise leading to restrictions that affect the performance of daily activities, such as getting up from a chair, walking, or moving heavy objects, which reduces the quality of life of an elderly adult.

WHO defines technical aids as devices, instruments or programs that provide their users with greater independence [2], to move beyond the advantages offered by assistive technology, there is a difference between need, demand and supply, that needs technical assistance does not mean that it is easy to find in the market. Currently only 10% of people with these needs have access to them [1].

In 1999 Liljedahl Gunnar, presented the design of a system of technical aids for standing up, This consisted a mobile lifting crane that held the patient in a wave-type sling. In 2009, Hunzikier Kurt developed a prototype with hydraulic action and parallelogram mechanism used in physical rehabilitation therapies, which consists of changing the patient's position from sitting to standing.

In the same year Perk Heinrich, presented a standing design that was adapted to a wheelchair with a parallelogram mechanism. consisting of an actuator from the base to the

backrest joint, causing a necessary force that displaces the chair, placing the person in a standing position. [3].

For the management of immobility syndrome, occupational therapy is currently used. occupational therapy is used, which proposes an intervention that does not change the psychological characteristics, but improves the performance of activities of daily living, by activating them through various methods that compensate for appropriate equipment and assistance.

It is important to emphasize that, in order to carry out a good management of these treatments in the elderly, prevention and therapeutic aspects must be taken into account, rehabilitation and palliative care without neglecting social and family aspects. [3].

Today, the sololift crane allows patients, guardians and health care personnel in institutions to transfer to a wheelchair, beds or chairs in a safe, fast and risk-free manner for patients with reduced mobility [4].

According to the registry of localization and characterization of persons with disabilities (RLCPD), the following is indicated, established that in Colombia 22% of people in 2018 suffered from lower limb disabilities, also recognized the need for the use of a technical aid such as a lift, standing frame (crane, stander, etc.), cane, walker or crutch) and 81% reported that they were already using one of these aids [2]. However, these people require a greater effort from the user to reach a full standing position, in the case of cranes, they require higher structural conditions because of their dimensions [5].

This study proposes the development of a technical aid that allows patients to stand upright in order to facilitate their mobility, this assistive technology is currently in the design phase and has not been tested on patients, consists of a linear actuator that raises and lowers the upper arms, which contain the supports that hold the patient, is easy to handle and is indicated for patients with immobilization syndrome. Designed in 6061 aluminum, capable of supporting 150 kg of weight, is easy to maintain and clean.

II. MATERIALS AND METHODS

This section describes the design process of the standing aid, which is made up of 4 stages, as shown in figure 1.

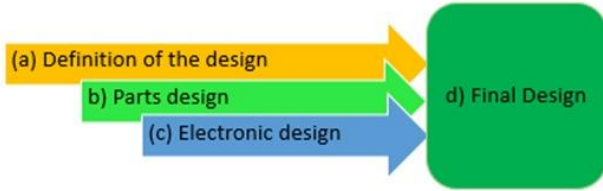


Fig. 1 Stages of the design process. Own source.

A. Design definition

To determine the final design of the technical aid, the following features were taken into account: patient safety, used technology and ergonomics, anthropometric characteristics of the patient were also taken into account, weight and height, in this phase, the complete structure of the final technical aid was drafted, in which it was sectioned by parts (described in stage b) to facilitate its elaboration and final assembly in software.

B. Design of parts

The design of the technical aid for stand-up upright, consists of 8 pieces, which were created independently to be later assembled and assembled, as shown in figure 2, these parts were designed using Autodesk Inventor software, anthropometric measurements of a patient weighing 90 kilograms were also taken into account, parts are designed in 6061 aluminum, which has good resistance to weight and is easy to weld.

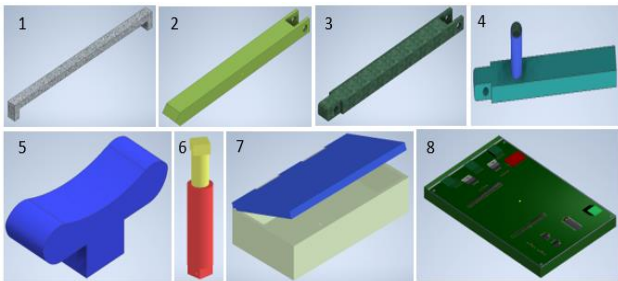


Fig. 2 Individual design of each part

The following are the 8 pieces that were designed to achieve the final assembly:

1. Chassis base: Supports the structure of the technical aid.
2. Arm 2 and 3: serves as a support for arm 3.
3. Arm 4: this is where the pushbuttons used to control the vertical movement of the technical aid are located.

4. Axillary support: offers comfort and supports the weight of the patient.
5. Linear actuator: its function is to raise and lower the structure that allows the patient to stand upright.
6. Electronic card storage box: serves to protect the electronic card.
7. Electronic board: contains the electronic components used for the operation of the technical aid.

C. Electronic design

In this stage, the study of the electronic design phases was carried out, as shown in figure 3, The electrical circuit was then designed in Proteus software (Figure 4).

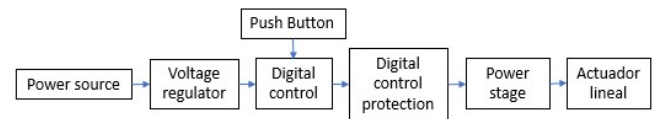


Fig. 3 Electronic schematic design phases.

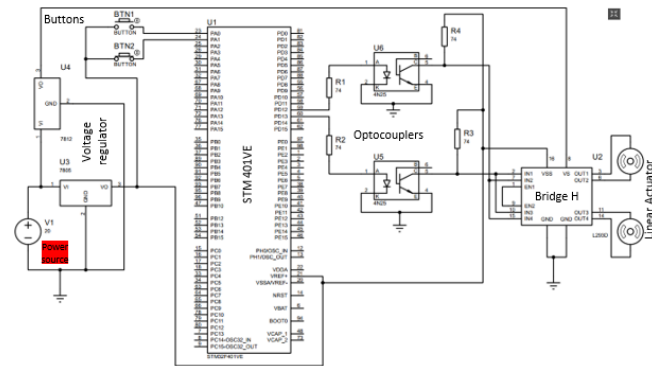


Fig. 4 Electronic design of the technical aid. Own source.

D. Final assembly

The stand-up aid consists of a linear actuator that ascends and descends supporting the structure that holds the patient. This aid is easy to use and is indicated for patients with immobilization syndrome, its parts are designed in 6061 aluminum, which is capable of supporting up to 150 kilograms of weight, being in this way easy to maintain and clean.

The assembly was performed using Autodesk Inventor software, in which the parts described in the first stage were taken and the respective couplings between the parts were made, resulting in the final assembly shown in Figure 5.

The following is a description of each of the parts listed in Figure 5.

1. Structure.
2. Axillary supports.
3. Push button for lowering and raising the technical aid.
4. Linear actuator.
5. Housing and electrical circuit.

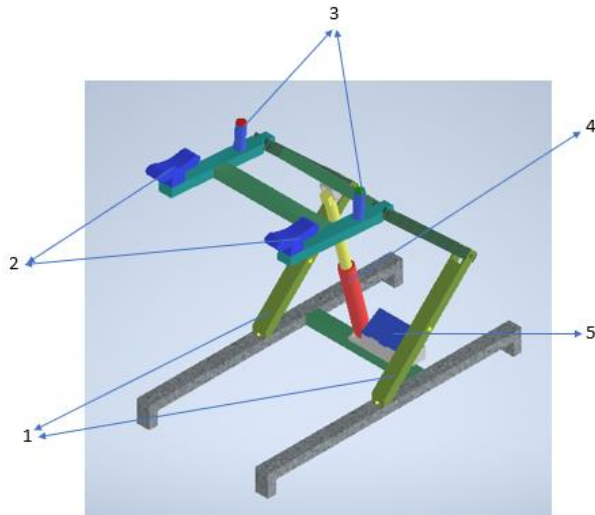


Fig. 5 Identification of parts in the final assembly. Own source.

III. RESULTS

A heavy-duty electric linear actuator with good thrust and pull characteristics was used, withstanding a maximum load of 1500 N, works with a travel speed of 14 mm/s, a duty cycle of 25% and operating frequency of 20%, is powered by 12 VDC and a maximum load current of 3 A.

Figure 6, we can observe that the technical aid has a vertical displacement, has a linear actuator that has a length of 20 cm and an angle of 30° with respect to arm 2 in its initial position and the final position of the linear actuator reaches a length of 95 cm and an angle of 60° with respect to arm 2.

The technical aid has a red pushbutton for activating the lowering of the linear actuator and a green push button for activating the raising of the linear actuator the patient can be verticalized.

To start the assistive device, make sure that the actuator is in its initial position (lowered) and position the patient in front of the assistive device, making sure that the patient is attached to the axillary supports and safety harness, after this press the ascent button until the patient is fully verticalized.

This technical aid will allow the user greater mobility and independence to carry out daily activities, It also seeks to satisfy the medical and social needs of the user and, above all, to offer safety and security, affordability and quality for good performance, as well as practical maintenance.

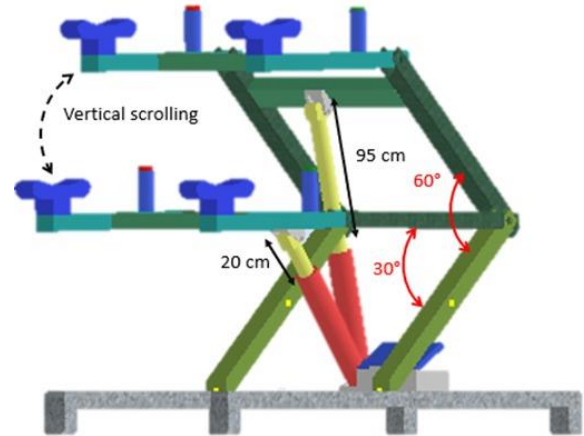


Fig. 6 Simulation of technical assistance operation. Own source.

IV. CONCLUSIONS

The technical aid proposed in this article presents robust properties that will allow it to be used in people weighing up to 150 kilograms, with electronic operation that facilitates controlled ascent and descent, minimizing the effort made by the patient, thanks to its axillary supports it offers greater safety and comfort, compared to the article (Design of a standing equipment) published in the UC engineering magazine on April 1, 2013 [6], where a mechanical operation based on levers and pedals is described.

There are currently many technologies that offer similar features, However, these require complex pre-installation conditions, as well as ample space for its proper operation, their acquisition implies a high cost since they require a specialized and frequent maintenance service.

Although this prototype offers many benefits for its users, has not yet been tested in patients because it is still in the design phase.

The development of this technical aid is intended to achieve greater patient autonomy, as standing up will require less effort, improving their quality of life and making it easier for their caregivers to work.

The design and simulation of the structure and electronic card of the technical aid for stand-up was achieved, taking into account the need to verticalize the patient with reduced immobilization syndrome in a simple and safe manner.

The design of this technical aid will support up to 150 kg, this will enable a wider range of users of this support product to be reached. However, prior evaluation is required for the use of the equipment in case the user exceeds the established characteristics for safe operation.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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