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Claw device adjustable to walking sticks for objects handling

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Abstract: *The following article presents a prototype for an electrical claw system attachable to Canadian canes. This project occurs at the Fundação Escola Técnica Liberato Salzano Vieira da Cunha in Novo Hamburgo with the intent of figuring out if there was a way of developing a device attachable to Canadian canes to help users with motor deficiency on the leg retrieve belonging on the floor. The knowledge necessary for this project was based on mechanical engineering knowledge of pulleys and electronic knowledge of motors and the prototyping platform Arduino. The research had two phases: the software prototyping and planning and the construction of the prototype. We were able to conclude the prototype, although there remains a big space for improvement soon.*

Keywords: *Claw, Cane, Motor Deficiency.*

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I. INTRODUCTION

Auxiliary walking devices are used by the elderly or people affected by problems with bones and joints, such as fractures and arthrosis [1]. The best known are the cane, the crutches, and the walker. They are used to provide greater freedom of movement and independence while helping to balance. Studies show that these devices increase the confidence and the feeling of security in the elderly [2]. The cane is the most popular, but there are several types of canes, one of which is the Canadian cane [3].

The project described here starts with the idea of creating a device that helps the user to collect belongings on the floor with the help of a claw. Without any effort from the user beyond the push of a button, taking into account that the object pickers currently in the market are all mechanical grabbers that are uncomfortable and occupy the only hand out of use by the walking aid, which can cause accidents if the user loses his balance and is not available to support himself due to the grabber occupying his vacant hand [4].

The assistive devices for locomotion used in the routine of walking disabled people such as the cane, walker, crutches, among others, have the sole function of helping the balance and locomotion of the user in question [3]. Assistive devices increase users' confidence and sense of security. Besides, the load on the joints of the lower limb can reduce, relieving joint pain, and compensating for weaknesses or injuries. The possible increase in this autonomy would have a tremendous psychological impact on users, and could drastically improve the quality of life for anyone. However, when said user drops some belongings such as the wallet, the cell phone, and any other small belonging present in everyone's day-to-day, the simple task of recovering this belonging, for someone with motor difficulties, becomes too complicated a job [5]. With a system that can be attached to a cane, this work would is more simples. Reducing unnecessary efforts, bringing more autonomy to the user, a higher level of confidence and self-esteem, improving the individual's quality of life [6].

Projects developed using 3D modeling software, simulation, and computational support are suitable for Assistive Technology (AT) [6] or improvements in hospital devices and devices and to support people with disabilities [7-8].

Assistive Technology (AT) is an interdisciplinary area of knowledge. AT encompasses products, resources, methodologies, strategies, practices, and services that aim to promote functionality, related to the activity and participation of people with disabilities, disabilities or reduced mobility, aiming at their autonomy, independence, quality of life and social inclusion [9-10].

This project has as its principal objective to discover a solution to these problems, creating a prototype initially in software and, in the end, making it. For this, the Autodesk Inventor Professional 2018 CAD software was used. To make the prototype, worked and molded aluminum sheets used with pulleys, motors, prototyping platforms, and various electro-electronic elements.

The principal purpose of the project here is an electrical claw system that can be attached to a Canadian cane so that the individual using the device can collect their belongings on the floor effortlessly and with a free hand, just needing to press a button.

Finally, in this paper, the current progress of the project was reported, informing the necessary knowledge for its realization, the methods and materials used in each area, and the results obtained during the development, showing how the prototype is currently and its stages until the end-current point..

II. MATERIALS AND METHODS

The structure of the prototype is its main supporting part composed of an aluminum “U” profile with dimensions of 2x670x54 mm(flat), which then had its width folded in a center with 20 mm and two sides with 17 mm forming a profile in "U". The body has a five mm diameter hole located at the bottom of the structure.

For the realization of the stepper motor support, another aluminum plate used to make the main structure. However, this plate to serve as the motor support has measures 2x43x71 mm (flat) that had its length doubled, dividing the plate into two sections, one 28 mm and another 43 mm long.

Then, for fixing the motor on the support, four holes were drilled.

The prototype mechanism consists of a set of GT2 aluminum toothed pulleys with space for a 7 mm belt generally used in CNC printers, as well as a toothed belt making the connection between the two pulleys. Part of the mechanism is the robotic claw composed of several mobile gears connected to a servomotor that rotates 90º opens and closes the claw.

Finally, the mechanism also has a stepper motor connected to the motor pulley that transmits the movement and torque to the driven pulley.

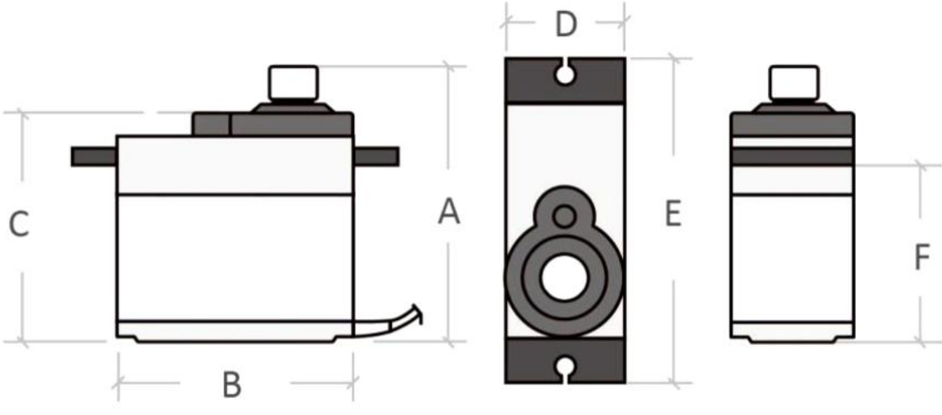
The project requiring motors and ways to control them relied on the use of electronic boards such as Arduino, a protoboard, jumpers, resistors, pushbuttons, and drivers.

Arduino, as previously stated, is an open-source prototyping platform using a mixed C++ programming language, among others, based on ATmega328. The driver is an extension of the Arduino, enabling new prototyping possibilities; in this case, the Arduino Shield allows the use of stepper motors.

The protoboard was used in conjunction with the jumpers, which are no more than cables with a male connection at one end and another female at the other, to make the connection between the buttons to operate the system and the Arduino. Just like the 10 kΩ resistors used for the electrical energy to go to earth. The stepper motor used to move the system is the CYMA 17HS2408, with approximately 12 N/cm holding torque. The engine has a shaft with a diameter of 5 mm as well as a body 28 x 42.5 x 42.5.

The motor is model MG995 TowerPro and has a torque of 11 kgf.cm when receiving voltage of 6 V. The motor has measures according to the following drawing provided by the manufacturer (Fig. 1).

Figure 1. Servomotor measurements (mm).



A	B	C	D	E	F
42.7	40.9	37.0	20.0	54.4	26.8

In addition to these elements, the main part of the mechanism that carried out the act of grabbing objects is the robotic claw, in this case, using the Robocore V2 Robotic Claw from Robocore.

The claw has a 124 mm opening and measures according to the drawing provided by the manufacturer Fig. 2 and 3.

Figure 2. CROW V2 Robotic Claw (Open).

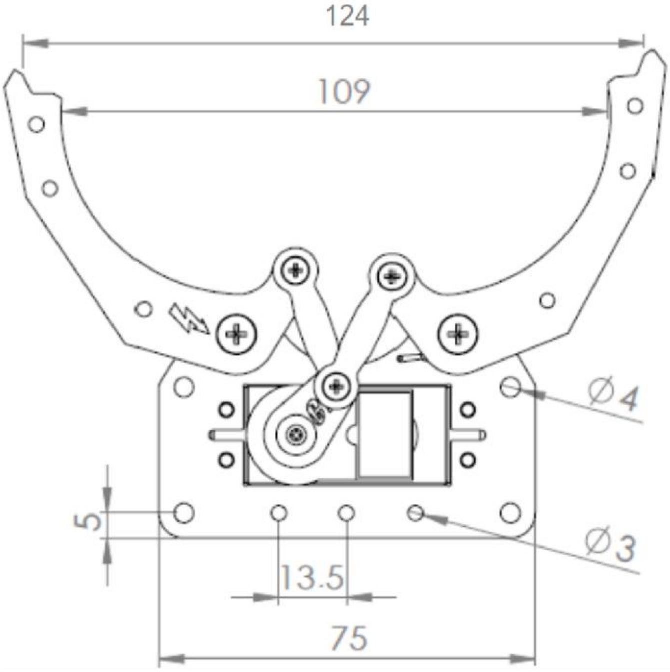
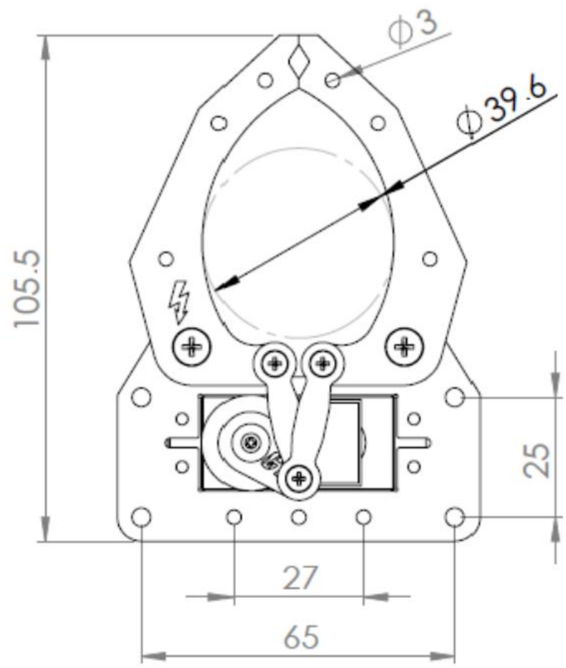


Figure 3. CROW V2 Robotic Claw (Closed).



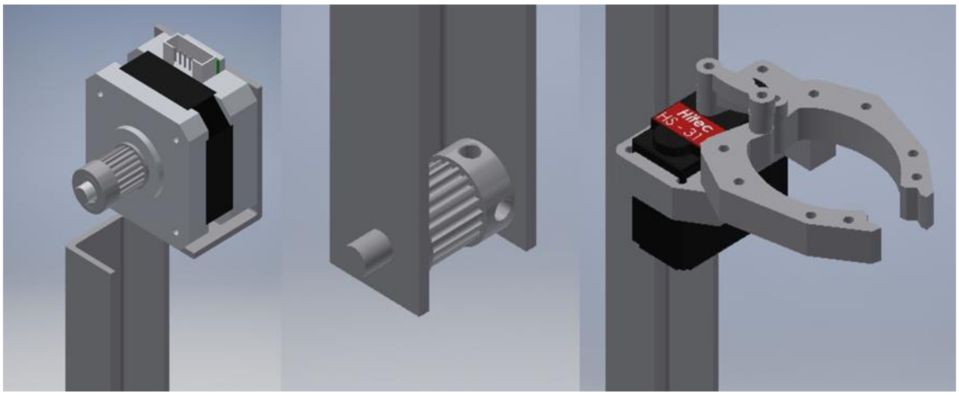
III. RESULTS AND DISCUSSIONS

A prototype of the project's basic idea was generated throughout the project's development. The prototype has a total height of approximately 721 mm. The final prototype has two motors, one being a stepper and the other motor. Also, it uses a protoboard, an Arduino, an Arduino Shield, and a robotic claw.

The project needs to emphasize that all measurements were obtained using the Canadian reference cane.

The prototype, in its most early phase, was planned using CAD software Autodesk Inventor Professional 2018 (Fig. 4).

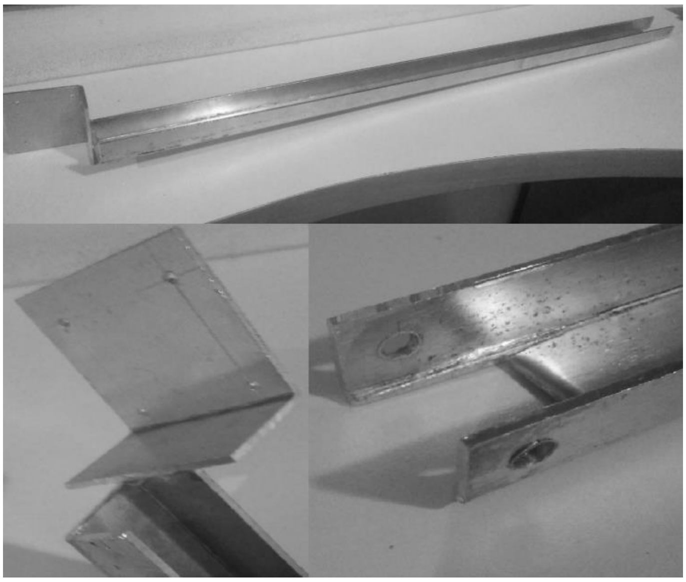
Figure 4. Software prototype, upper, lower and grapple.



The complete mechanism that performs all the movement of the prototype is composed of two toothed pulleys with a distance between the center of 700 mm, a toothed belt that makes the connection between the two, a stepper motor that moves the assembly and a robotic claw ran through a motor.

The structure has the shape of a "U" profile with flat dimensions of 54 mm divided into three parts, the part that was in the center is 20 mm long, and the sides are 17 mm each. At the base of the structure, there are two holes with a diameter of 5 mm each to fit the axis of the moving pulley. Due to a bending problem, it was necessary to cut at the end of the structure to comfort the pulley in its place.

Figure 5. Metal structure without mechanism.



The entire structure is approximately 690 mm high. Together with this structure is the support platform for the motor.

The support platform consists of another aluminum plate but with dimensions of 2 x 46 x 71 (mm) and a negligible weight that was glued with the use of super glue on the top of the structure (opposite to the 5mm diameter holes). There are four equidistant holes in this platform, all located 31 mm apart. The top holes have a 7.5 mm spacing from the sides and 9 mm from the top of the platform.

The complete mechanism that performs all the movement of the prototype is composed of two toothed pulleys with a distance between the center of 700 mm, a toothed belt that makes the connection between the two, a stepper motor that moves the assembly and a robotic claw ran through a servomotor. To carry out the transmission of the engine rotation to the system, it was necessary to use a pair of toothed pulleys connected through a toothed belt.

The toothed pulleys used in the project are the GT2 pulleys commonly used in CNC systems or 3D printers. The pulleys had a distance between the center of approximately 700 mm. Both pulleys have the same diameter because this prototype does not intend to perform a transmission that increases the transmitted torque and requires equal rotations. Both pulleys have a 2 mm pitch as well as 20 teeth.

Figure 6. Pulley GT2.

To accommodate the driven pulley, it was necessary to machine an axle. The raw material used was a 10 mm diameter rectified alloy steel shaft. The shaft was inserted into the 5 mm holes located at the bottom of the structure.

To perform the mechanical part's movement, it was necessary to perform an electrical system with a stepper motor, a servomotor Arduino, an Arduino Shield, a protoboard, jumpers, and resistors and buttons.

The servomotor was connected to the Arduin and connected to the protoboard together with the button and the 5 V power input in the same row and with the ground wire, which is connected to the Arduino, and a ten resistor together in the same row.

The programming on the Arduino platform was performed so that when the button is pressed, the servo motor, connected to the claw, rotates 90º to close the claw. When the servo is released, it returns to its original position, closing the nail and grabbing the object.

IV. CONCLUSION

This work brought as a theme the idea of a prototype for an electrical claw system that can be attached to Canadian walking sticks to help people with motor disabilities in their legs. With this defined theme, a prototype initially planned in software, and then it was made together with electronics and programming. After making the prototype as the final phase of this project, it opens up space for future validation as well as the improvement of the project, standardizing it according to safety standards, replacing the protoboard and Arduino with an individual board with the sole purpose of carrying out the necessary functions avoiding excessive jumpers and unnecessary pollution of the prototype, also the making of a more intuitive interface for the buttons to facilitate the use of the prototype.

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