MECHANICAL ARM FOR AMPUTEE

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Abstract - *Special Exoskeleton have evolved as leading tools for augmenting able-bodied performance which is assisting human mobility and restoring lost limb function exploiting biomimetic design, the device may be worn in close proximity to the body and transmits torques via powered revolute joints and structural limbs. In the present work a comprehensive design and fabrication of hand exoskeleton technologies for rehabilitation and assistive engineering were made from the basic hand biomechanics to actuator technology with the involvement of mechanical power. The designed suit reviews the state of the art of active hand exoskeletons for the applications in the areas of rehabilitation and assistive robots.*

Keywords: Amputee person, Exoskeleton Arm, lightweight mechanism.

1. Introduction

Mechanical arm is an external mechanical structure that allows for the transfer of mechanical power from the exoskeleton structure to the human arm. Excelsior's exoskeleton suit is a mobile machine consisting primarily of an outer framework worn by a person, and a powered system of mechanical muscles that delivers energy for limb movement. This helps the bearer of the suit to lift heavy weight regularly, continuously for longer duration of time without getting injured, fatigued and loosing efficiency. Recyclable, light and enduring materials are used in this project in order to fulfill safety and environmental concerns. The main function of the exoskeleton suit is to assist the wearer by boosting their strength, endurance and durability.

The same concept could be applied in case of an amputee person. Let it be any simple task such as walking, lifting objects or any such task, these people have to continuously depend on someone else. Such small little things might not affect a fully abled person but does matter a lot for an amputee. This reduces their independence, self-confidence. At first place they have to face a huge loss of losing a limb, being teased or taunted might be a regular affair for them but above all of this being dependent makes life miserable.

1.1 Motivation

People who go under the knife to get their limb amputated for any reason be it Medical, Accidental etc. have the right to spend their life independent. As all the objects we see around are designed in a way that keeping in mind that the user will be a fully abled person it becomes hard to manage the things. This project could make such person life a bit more bearable.

1.2 Problem Statement

To design an electrically operated mechanical arm based on the lead screw mechanism to achieve basic movements to aid an amputee in his/her day to day life.

1.3 Objectives

1. To develop simple in design, easy to maintain and light weight exoskeleton arm.
2. To develop a working model using electrically operated lead screw of load capacity up to 2 kg.
3. To develop cheap alternative for existing prosthetic arm present in the market.

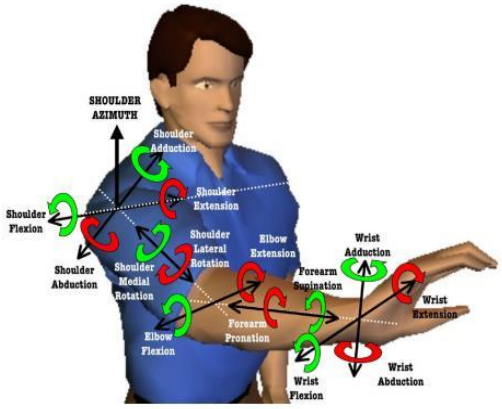


Fig. Model showing different motions human hand can achieve.

1.4 Scope of project

1. The use of lead screw mechanism instead of hydraulic actuator, which reduces the weight of the system, to achieve the required motion.
2. Based on analysis, replacement of aluminum parts with hard plastics wherever necessary.
3. The project focused only on the right arm but the construction could be modified to fit the left arm.
4. The structure, needed to be non-invasive so that the structure was easy to mount on and off the arm.

2. LITERATURE REVIEW

Luis et..al [1] It is well known that the application of advanced nonlinear control techniques enable more efficient and precise tracking than linear ones in real models. However, for some critical applications nonlinear schemes

are not an option but a requirement. In this paper, they deal with the nonlinear control design of an exoskeleton performing arm rehabilitation on patients with poor neural and motor capabilities.

Rahul et..al [2] This research paper deals with design solutions for aiding limb module of a powered limb exoskeleton used for handling heavy work load in work-place. This paper focuses on the various issues with human-centered approach and addressing the problems of physical human–exoskeleton interactions and dealing with everyday scenarios.

Gopal et..al [3] In this a comprehensive design and fabrication of hand exoskeleton technologies for rehabilitation and assistive engineering were made from the basic hand biomechanics to actuator technology with the involvement of pneumatic power

Kai et..al [4] In this paper, the reaching movements of human arm are analyzed by the principal component analysis method and two most significant synergies of the joints of human arm, which can account for more than 80% of the variation, are extracted.

Abdul et..al [5] This research paper presents the design of a low-cost and easy-to-use 2 degree of freedom (DOF) robotic exoskeleton for arm rehabilitation

3. COMPONENT SELECTION

- **Arm material selection**

Cantilever Beams are members that are supported from a single point only; typically, with a Fixed Support. In order to ensure the structure is static, the support must be fixed; meaning it is able to support forces and moments in all directions.

4. DESIGN OF ARM

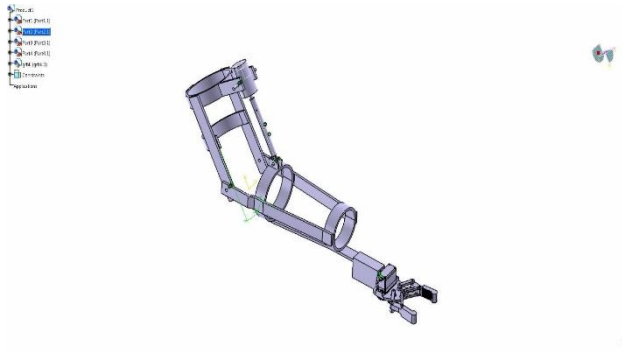
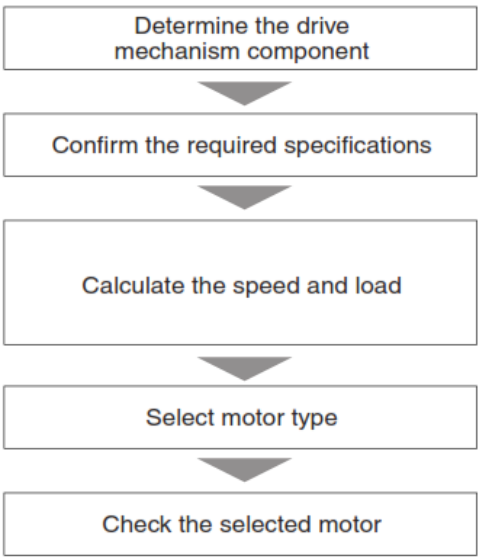


Fig. Model showing arm assembly with gripper attached

- **Motor selection**

This section describes certain items that must be calculated to find the optimum motor for a particular application. Selection procedures and examples are given.



Components:

- Aluminium Flat Bar
- Battery 12Volt 8Amp
- High Torque Motor
- Lead Screw M8
- Griper
- Servo controller
- PWM motor controller

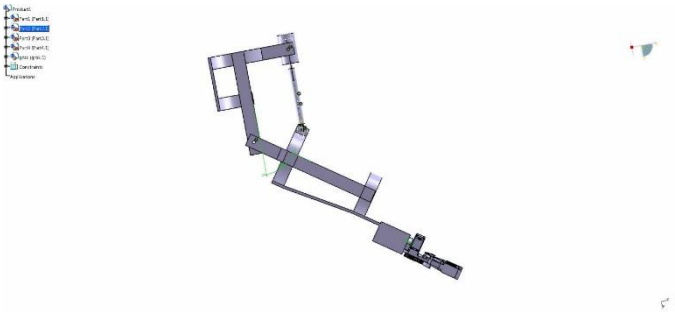


Fig. Model showing side view of arm with gripper attached

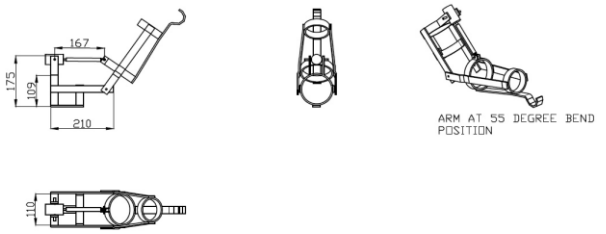
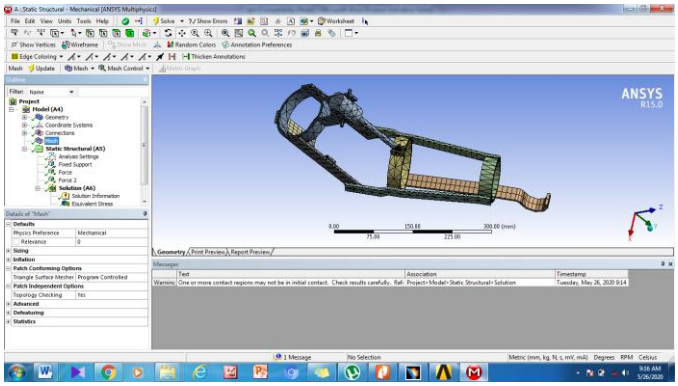
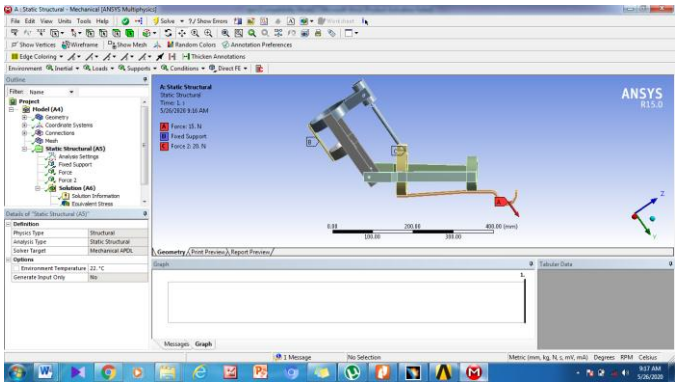
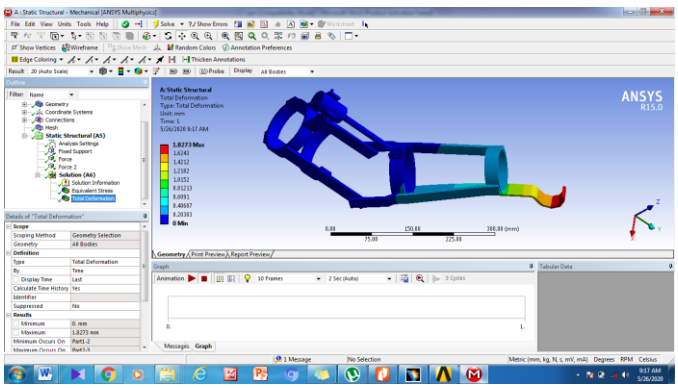


Fig. Arm drawings in different views is shown.

5. ANALYSIS RESULT







6. SAFETY PRECAUTIONS

The following points should be considered for the safe operation of machine and to avoid accidents: -

1. All the parts of the arm should be checked to be in perfect alignment.
2. All the nuts and bolts should be perfectly tightened.
3. The operating switch should be located at convenient location to the operator so as to control the arm easily.
4. The inspection and maintenance of the arm should be done from time to time

7. FUTURE SCOPE

- Brain Computer Interface (BCI) is an immerging field of research. BCI can be used to acquire signals from the human brain and control the arm.
- Imagination is the limit for its future applications. It can be a real boon for handicapped people, who are paralyzed or lost their hands in some accident.
- The system can work in the same way as human arm.
- A Precise gesture controlled system is also possible.
- Mechanical Arms has a wide scope of development. In the near future the arms will be able to perform every task as humans and in much better way.
- A person who may have lost his hand in any accident can resume his life like previous by such artificial arms.

8. CONCLUSION

The idea behind this project is to develop an inexpensive and user-friendly system. This project shows that it is simple in construction, design and cheaper. It gives quick response and flexible compared to hydraulic and electrical type exoskeleton. This can be achieved while maintaining simplicity, ease of use, implementation and maintenance.

9. ACKNOWLEDGMENT

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