International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 05, May-2019

DESIGN AND FABRICATION OF HUMAN ARM EXOSKELETON TO ACHIEVE EASE OF MOVEMENT

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Abstract: Hands are two of the imperative parts in the human body. Their regular engine abilities are pivotal for exercises of everyday living. They offer a broad variety of capacities. Despite the fact that, there are neuromuscular confusion or maturing that may prompt losing or debilitating of hand capacities. Around the world, stroke remains a main source of physical hindrances and useful inability. Henceforth, we make utilize different techniques to improve the development of the upper appendages. We in the ongoing past have seen numerous developments and advancements that have been built to help the developments of the human body. Such items have changed the general population's method for taking a gander at physical handicaps and disarranges. Huge numbers of these advances have for all intents and purposes empowered individuals in improving their physical state. In our task we utilize Pneumatic cylinders to help with the revolution of the joints in our arm. We will utilize one twofold acting Pneumatic cylinder to help turn the elbow joint and a littler twofold acting Pneumatic chamber to pivot the wrist joint with 1 level of opportunity and a stepper engine to twist the fingers. The Pneumatic barrels are worked by an air blower which utilizes high weight gas tanks. The stepper engine is associated with the fingers by strings and is worked by a microcontroller. The stepper engine can be run utilizing three stick flip changes to rotate the pole in clockwise and hostile to clockwise heading. These instruments help the patient's engine developments show signs of improvement and improve their anxious reaction. The present model made is controlled by a blower with low weight outlet. In future works, the model can be utilized as a kind of perspective to make exoskeletons a lot lighter. The tasks did later on can likewise have more prominent burden bearing ability to not just assistance with the recovery of patients with neuromuscular disarranges yet additionally help in helping individuals in conveying substantial loads in development fields, mining, and resistance. To accomplish higher burden bearing limit, the pneumatic blower utilized necessities to produce high measures of weight. The models made later on can likewise be totally compact. Rotating development in the elbow joint was accomplished with the assistance of pneumatic cylinder. The pneumatic cylinder is controlled by a blower, control supply and solenoid valve to deliver expansion and withdrawal. The arm experienced mechanical development making the muscles flex and broaden. The servo engine was useful in moving the fingers by interfacing them with strings.

Keywords: Exoskeleton, arm, suit, pneumatic, robot.

I. INTRODUCTION

In the present day and age, lives of people are made simple with the assistance of innovation. In each part of life innovation assumes a significant job in upgrading our day by day exercises. Consequently, we can create machines that help in the recovery of patients with neuromuscular scatters in the upper appendage. Neuromuscular clutters or loss of motion in the upper appendages can happen because of components like stroke, cerebral paralysis, polio and so forth. A standout amongst the best strategies to treat these illnesses is physiotherapy. Physiotherapy is the technique for invigorating the nerves in stun to work again by utilizing mechanical power and developments. In this way, we center around utilizing mechanical power and developments to advance portability and capacity in the upper appendages. The key pieces of the hand we have to concentrate on are the elbow joint, the wrist joint and the fingers. Previously, individuals have made exoskeletons for restoration which helped in the recovery of explicit pieces of the hand. A couple of aided the development of the wrist, a couple helped in the flexion and augmentation of the fingers and some assisted with the turning if the elbow joint. The instruments utilized in the past were enormous and complex in plan. The models in the past have a fixed base because of which there is no free development offered to the patient as he/she is to be situated. In different models the elbow development is empowered by outfitted engine.
Mechanical autonomy and Automation are gaining pivotal ground in the 21st century making a pathway for advancement of existing innovation in approaches to oblige our requests and to make new innovation to improve our method for living. Apply autonomy can be utilized in numerous fields and spaces to satisfy numerous reasons. Hardly any such fields can be fabricating, development, transportation, therapeutic and so forth. In the therapeutic field mechanical technology can be utilized to perform medical procedures and to treat patients post-medical procedure.

II. LITERATURE SURVEY

Andrew J. McDaid: - Anatomical Wrist Therapy Exoskeleton [1] the device automatically adjusts to the size of the wearer's wrist and is designed so it only applies torque about the wrist joint. The preliminary results are presented for healthy people and also those who have cerebral palsy. The members involved in the assignment analyzed the working of

a normal wrist and made a 3D simulation of the movements the human hand.
Rana Soltani-Zarrin, Amin Zeiaee, Challenges and opportunities in Exoskeleton based Rehabilitation [2] Robotic systems are increasingly used in rehabilitation to provide high intensity training for patients with motor impairment. The results of controlled trials involving human subjects confirm the effectiveness of robot-enhanced methods and prove them to be marginally superior over standard manual therapy in some cases.
Alan Siedd and Marcia K. O'Malley, Haptic arm Exoskeleton [3] in this project the model is heavier and less compact compared to other designs. However, the torque output is high helps in reducing human effort on the arm. A force-feedback exoskeleton is a haptic device worn by the user. Arm exoskeletons can simulate large forces at the hand or arm, like the weight of an object that is held. This is achieved by providing feedback to the various joints of the arm – the shoulder, elbow, and wrist.

III. SCOPE OF THE WORK

In this present focused world there is enormous shortage of labor, so there must be a choice to lessen this issue. Indeed, even in mechanical application it requires progressively HR for day by day work and burden conveying process is more. All these above work cannot do people. To defeat this circumstance pneumatic exoskeleton framework is embraced to facilitate the work and limit worry of prime zone for exoskeleton innovation, where it very well may be used for upgraded accuracy amid medical procedure or as a help to enable attendants to move substantial patients.

IV. METHODOLOGY

Preparations

The entire arm is supported by a frame made of Aluminum. The frame is light in weight. The sponge cushion holds on to the arm with a firm grip and prevents the sharp parts of the metal from harming the wearer.
One end of the Pneumatic cylinder is fixed to the upper arm and the piston end is fixed to the extension of the frame near the elbow. When the piston is in TDC (top dead center), the arm is extended. When the cylinder is filled with air and the piston reaches BDC (bottom dead center), the arm is flexed. In addition to the arm movement, a gripper is attached to the wrist which is operated with the help of two servo motors.

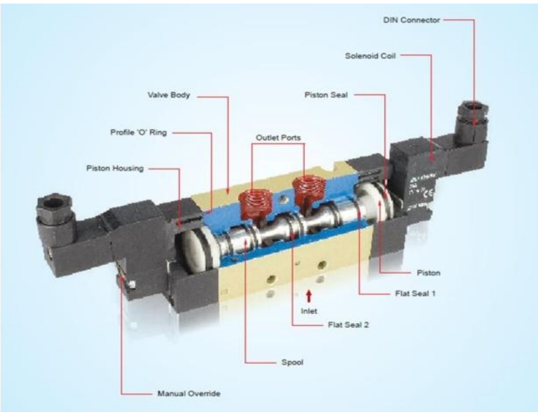

Fig: Solenoid valve

Fig: Double acting pneumatic piston

Fig: Arm frame work

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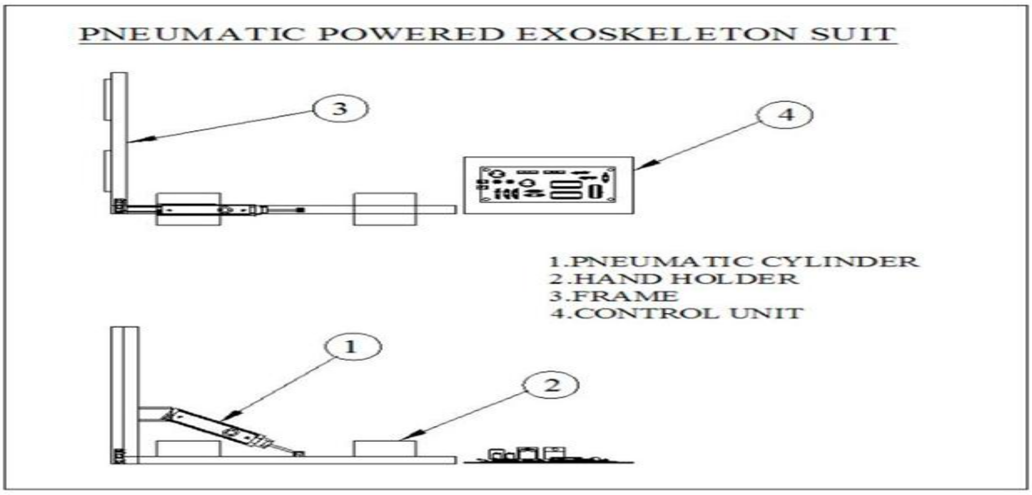

Fig: 2D diagram of the suit

Calculations

Pneumatic cylinder

Diameter of the Piston (d) = 25 mm
Pressure acting (p) = 0.63kpa
Material used for rod = Mild Steel
Yield stress (σy) = 36 kgf/mm²
Assuming factor of safety = 2
Force acting on the rod (P) = Pressure x Area
= p x (Πd² / 4)
= 0.4×490.87
P = 196.3N

Double acting pneumatic cylinder

Stroke length : 120 mm Quantity: 4
Seals : Nitride (Buna-N) Elastomer
End cones: mild steel Piston : EN – 8 Media: Air
Temperature : 0-80 º C
Max pressure range : 8×105 N/m^2

Solenoid Valve

Max pressure range : 0-8 x 10^5 N/m²
Quantity : 1

Connectors

Max working pressure : 8 x 105 N/m²
Temperature : 0-100 º C
Fluid media : Air Material: Brass

Hoses

Max pressure : 8 x 105 N/m²
Outer diameter : 6 mm
Inner diameter : 4 mm

The important parts of pneumatic exo-skeleton suit are:-

1. Compressor unit
2. Solenoid valve (direction control valve)
3. Double acting cylinders

1. **Compressor unit :** It is one of the significant piece of exoskeleton suit. The limit of blower is 4-8 bars. It gives the vital pressurized air required to work the framework. Our blower has capacity to lift up to 5-20 kgs burden.
2. **Solenoid valve (direction control valve):-** It is utilized to control the bearing of the pressurized air in this pneumatic framework utilizing 5/2 heading control valve. It requires two valves.
3. **Double acting cylinders:-** These barrels are incited by packed air which can lift the heap. This venture requires four barrels for task (120mm stroke length)

The working of the exoskeleton is totally founded on the systems of the pneumatic chambers and solenoid valves and the joints which will give various degrees of opportunity for each part to get simple movement for the human wearing it. At the point when air from blower makes chamber to impel and helps in lifting weight which will be associated with snare through arm outline the power required to lift weight will be all the more so to lessen the exertion of barrel and to build the limit we are utilizing one chamber were the weight will be exchanged to single arm and bears and the pressure on chamber will diminishes to higher degree. For our situation lifting vitality will be created by compacted air which will incites the twofold acting barrel and the total setup of blower and actuators will deliver more power than the stationary weight.

V. CONCLUSION

The model is made easy to wear by the patient. The model is fitted well onto the wearer and supports the entire arm thoroughly. Effective movement is achieved from the model by the wearer. It helps in rehabilitation for patients with very less or no neuromuscular functions and helps them in gaining back their muscle strength and nervous function.

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