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Fabrication of Exoskelton

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ABSTRACT

The exoskeleton based hydraulic support is basically a “chair” which is worn like an exoskeleton, allowing users to walk or run with the device while they work .this chair helps users to rest their leg muscles by directing their bodyweight towards a variable damper attached to the frame and directs the weight to the ground. It consists of two identical "chairs", one strapped to each of the wearer's legs. To use, simply bend your knees to a comfortable stance to activate its damper that supports your body weight. This exoskeleton based support would be useful to people whose current job requires them to stand for long hours. This new and modernized “chair” will ease the aches in the thighs and back. It is especially of great use to the elderly , workers in assembly line , trekkers and military who don’t always have the option of pulling a chair to rest themselves on the go ! It keeps your back straight and can reduce the occurrence of bad postures for both healthy workers and those recovering from muscle related injuries

INTRODUCTION

Exoskeletons contain rigid and resistant components that fulfil a set of functional roles including protection, excretion, sensing, and support, feeding and acting as a barrier against desiccation in terrestrial organisms. Exoskeletons have a role in defence from pests and predators, support, and in providing an attachment framework for musculature.

Exoskeletons can provide evidence of animal behaviour. The main usage of exoskeleton robots are for rehabilitation purposes.

The main function of a powered exoskeleton is to assist the wearer by boosting their strength and endurance. They are commonly designed for military use, to help soldiers carry heavy loads both in and out of combat. In civilian areas, similar exoskeletons could be used to help fire-fighters and other rescue workers survive dangerous environments. The medical field is another prime area for exoskeleton technology, where it can be used for enhanced precision during surgery, or as an assist to allow nurses to move heavy patients.

In general, an exoskeleton device refers to a device that is worn by a user to perform a particular function: augmenting human power, assisting walking, supporting heavy loads, and so on.

Exoskeletons and orthoses are defined as mechanical devices that are essentially anthropomorphic in nature, are 'worn' by an operator and fit closely to the body, and work in concert with the operator's movements. In general, the term 'exoskeleton' is used to describe a device that augments the performance of an able-bodied wearer, whereas the term 'orthosis' is typically used to describe a device that is used to assist a person with limb pathology.

It is perhaps worth noting that the term "exoskeleton" has come to describe systems that are comprised of more than just a passive protective and supporting shell, as its usage in biology would suggest. "Exoskeleton" within our research community is taken to include mechanical structures, as well as associated actuators, visco-elastic components, sensors and control elements.

Series-limb exoskeletons:

Elastic elements in the body, such as ligaments and tendons, have long been known to play a critical role in the economy and stability of movement. Humans and other animals use these tissues to reduce impact losses while storing substantial quantities of energy when striking the ground, and to provide propulsion during terminal stance in walking, running and jumping. Such biological strategies have inspired designers of running track surfaces and wearable devices such as shoes and exoskeletons.

Previous studies have shown that a compliant running track can improve performance by increasing running speed by a few percent and may also reduce the risk of injury. In another study on elastic running surfaces, the authors found a range of compliant ground surface stiffness’s that improved metabolic running economy. Similarly, previous studies have shown that wearable mechanisms in series with the biological leg can reduce the metabolic cost of running by lowering impact losses and by providing energy return. A running shoe called the Springbuck, designed with carbon composite elastic midsole, was shown to improve shock absorption and metabolic economy at moderate running speeds. Elastic exoskeletons in series with the human leg have been developed that store and release far greater strain energy than the running track surface of or the Springbuck shoe (~5 Joules/step for track and shoe versus ~80 Joules/step for elastic exoskeletons), and therefore it was believed that such exoskeletons would augment human running speed and economy. However, although these devices clearly augment jumping height, they have not been shown to improve peak running speed nor running economy.

Parallel-limb exoskeletons for load transfer:

Exoskeletons that act in parallel with the human lower limb for load transfer to the ground. Perhaps an in-series leg exoskeleton like the Spring Walker increases the metabolic cost of running because the limb length of the human plus machine is substantially increased, thereby increasing both the work at the hip to protract the leg during the aerial phase and the overall energetic demand to stabilize movement, overcoming any potential advantage of extending limb length. Additionally, with an in-series leg exoskeleton device, the ground reaction forces are still borne by the human leg. In contrast, with a parallel mechanism, body weight could be transferred through the exoskeleton directly to the ground, decreasing the loads borne by the biological limbs and lowering the metabolic demands to walk, run, and hop. Furthermore, such a parallel exoskeleton would not increase limb length, thereby not increasing the overall energetic demand to stabilize movement. Parallel-limb exoskeletons have also been advanced to augment the load-carrying capacity of humans. This type of leg exoskeleton could benefit people who engage in load carrying by increasing load capacity, lessening the likelihood of leg or back injury, improving metabolic locomotory economy, and/or reducing the perceived level of difficulty.

Parallel-limb exoskeletons for torque and work augmentation:

Exoskeletons that act in parallel with the human joint(s) for torque and work augmentation. Many parallel-limb exoskeletons have been developed to augment joint torque and work. In distinction to the load-carrying exoskeletons mentioned in the last section, this type of exoskeletal and orthotic device does not transfer substantial load to the ground, but simply augments joint torque and work. This type of leg exoskeleton could improve walking and running metabolic economy, or might be used to reduce joint pain or increase joint strength in paralyzed or weak joints.

Parallel-limb exoskeletons that increase human endurance:

Throughout the human body hundreds of muscles exert forces to stiffen and move the limbs and torso. During exhaustive exercise, only a small portion of these muscles fatigue. For a repetitive anaerobic activity, a parallel-limb exoskeleton could be designed to redistribute the cyclic work load over a greater number of muscles for the purpose of delaying the onset of fatigue. In such a strategy, springs within the exoskeleton could be stretched by muscles that would not normally fatigue if the exercise were conducted without the mechanism. The energy stored by the exoskeleton could then be used to assist those muscles that would typically fatigue, possibly improving endurance capacity.

LITERATURE SURVEY

Gupta, A. Dept. of Mech. Eng. & Mater. Sci., Rice Univ., Houston, TX, USA in his paper Design of a hepatic arm exoskeleton for training and rehabilitation present a detailed review of the requirements and constraints that are involved in the design of a high-quality hepatic arm exoskeleton. In this context, the design of a five-degree-of-freedom hepatic arm exoskeleton for training and rehabilitation in virtual environments is presented. The device is capable of providing kinaesthetic feedback to the joints of the lower arm and wrist of the operator, and will be used in future work for robot-assisted rehabilitation and training. Motivation for such applications is based on findings that show robot-assisted physical therapy aids in the rehabilitation process following neurological injuries. As a training tool, the device provides a means to implement flexible, repeatable, and safe training methodologies.

- Haruhiko Asada and Takeo Kanade in their paper Design of Direct-Drive Mechanical Arms describes the design concept of a new robot based on the direct-drive method using rare-earth d-c torque motors. Because these motors have high torque, light weight and compact size, we can construct robots with far better performance than those presently available. For example, we can eliminate all the transmission mechanisms, such as reducers and chain belts, between the motors and their loads, and construct a simple mechanism (direct-drive) where the arm links are directly coupled to the motor rotors. This elimination can lead to excellent performance: no backlash, low friction, low inertia, low compliance and high reliability, all of which are suited for high-speed, high-precision robots. First we propose a basic configuration of direct-drive robots. Second a general procedure for designing direct-drive robots is shown, and the feasibility of direct drive for robot actuation is discussed in terms of weights and torques of joints. One of the difficulties in designing direct-drive robots is that motors to drive wrist joints are loads for motors to drive elbow joints, and they are loads for motors at shoulders. To reduce this increasing series of loads is an essential issue for designing practical robots. We analyze the joint mass system for simplified kinematic model of the direct-drive robots, and show how the loads are reduced significantly by using rare-earth motors with light-weight and high torque. We also discuss optimum kinematic structures with minimum arm weight.

- Vidyavan sithiya in his paper Tactile Sensing—From Humans to Humanoid described that “sense of touch,” this paper 4 reviews the state of tactile sensing in humanoid robotics. The physiology, coding, and transferring tactile data and perceptual importance of the “sense of touch” in humans are discussed. Following 7 this, a number of design hints derived for robotic tactile sensing are 8 presented. Various technologies and transduction methods used to 9 improve the touch sense capability of robots are presented. Tactile sensing focused to fingertips and hands until past decade or so, has now been extended to whole body, even though many issues remain12 open. Trend and methods to develop tactile sensing arrays for various body sites are presented. Finally, various system issues that keep tactile sensing away from widespread utility are discussed.15 Index Terms—Cutaneous sensing, extrinsic sensing, humanoid robots, robotic skin, tactile sensing, touch sensing system.

- Hugh Herr in his paper Exoskeletons and orthoses: classification, design challenge For over a century, technologists and scientists have actively sought the development of exoskeletons and orthoses designed to augment human economy, strength, and endurance. While there are still many challenges associated with exoskeletal and orthotic design that have yet to be perfected, the advances in the field have been truly impressive. In this commentary, I first classify exoskeletons and orthoses into devices that act in series and in parallel to a human limb, providing a few examples within each category. This classification is then followed by a discussion of major design challenges and future research directions critical to the field of exoskeletons and orthoses. The current series of the Journal of Neuro Engineering and Rehabilitation (JNER) is dedicated to recent advances in robotic exoskeletons and powered orthoses. The articles in this special issue cover a broad spectrum of embodiments, from orthotic devices to assist individuals suffering from limb pathology to limb exoskeletons designed to augment normal, intact limb function.

- Jung-Hoon Kim in his paper Design of a Walking Assistance Lower Limb Exoskeleton for Paraplegic Patients and Hardware Validation Using described that the design of an assistive lower limb exoskeleton robot for paraplegic patients that can measure the centre of pressure is presented. In contrast with most biped walking robots, the centre of pressure (CoP) or zero moment point (ZMP) has not been actively used in the operation of exoskeleton robots. In order to measure CoP in our exoskeleton robot, two kinds of force sensor units are installed in the exoskeleton: low profile force sensors in foot modules to measure the human weight transferred to the ground and a load cell at the shank frame to measure the supporting force. The CoP of the exoskeleton robotics calculated from the above force sensors, an inclinometer at the waist, and the positions of 14 DoF exoskeleton joint with an algorithm to change the fixed pivot using a foot contact sensor. Experiments on an able-bodied person wearing the designed exoskeleton and walking on the ground are performed to validate the designed hardware system. Through the experiments, the trajectories of the CoP of the exoskeleton with a wearer are calculated based on the proposed algorithm and it is compared with the value measured by a commercial pressure measurement system.

METHODOLOGY

The method used in the project work is prototype analysis method.

For this method we will make study on the method of making prototype and then start to fabricate. The considerations of the weight and strength will be taken. The system will be prepared by using Chanel materials of steel, then other project work will be done. This part of report contains three parts:

- Assembly parts
- Working of the system
- Flow diagram of working

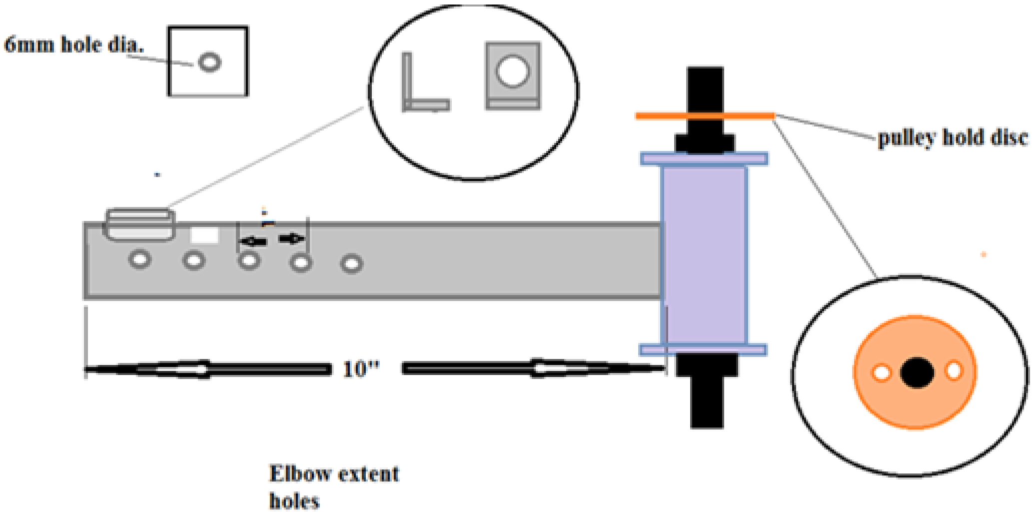
Assembly parts

There are five parts that have been prepared in our project.

- Fore arm link
- Extent of fore arm
- Arm links and joint
- Extent of fore arm
- Shoulder attachments
- Sensor attachment

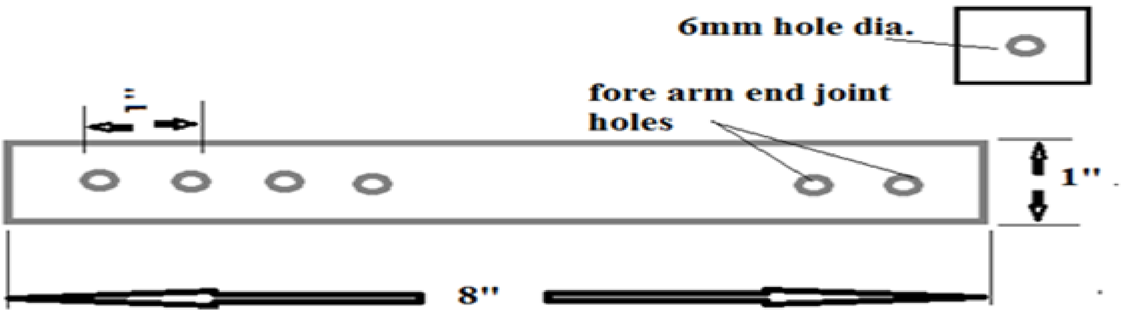
Forearm link:

- It is a 10" link with a revolute shaft on its end.
- It has 4 holes on its end to provide a joint link to the another half side of the fore arm.
- A clamping system of motor is welded to attach motor.
- A pulley hold disc is also attached to hold the transmission pulley.

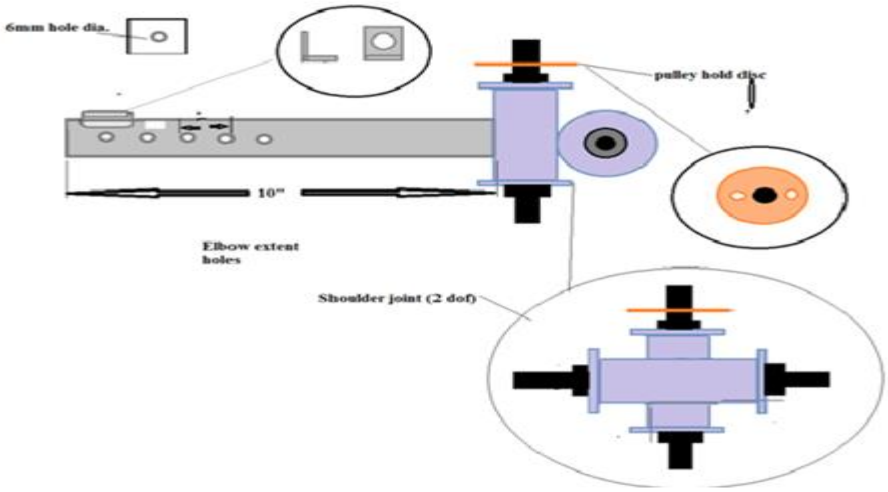


Extent of fore arm:

- The fore arm has two links with holes on them with distance 1" each so that the arm length can be adjusted according to the arm length of particular.
- The fore arm also has end joints to attach the gripper part assembly on it.
- Over all due to adjustment the fore arm can be set on the length range of 1 ft to 1.5 ft in a minimum extent increment of 1".

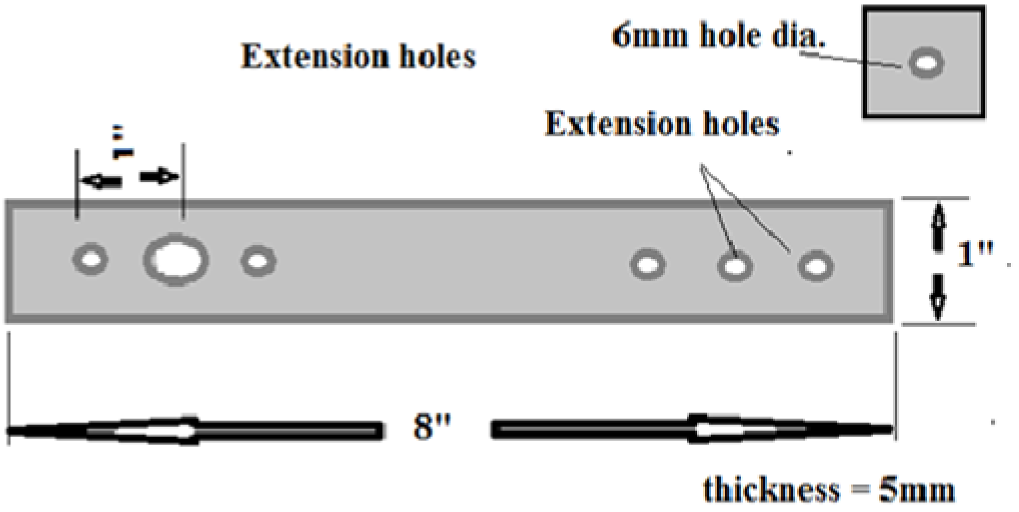


Arm links and joints :



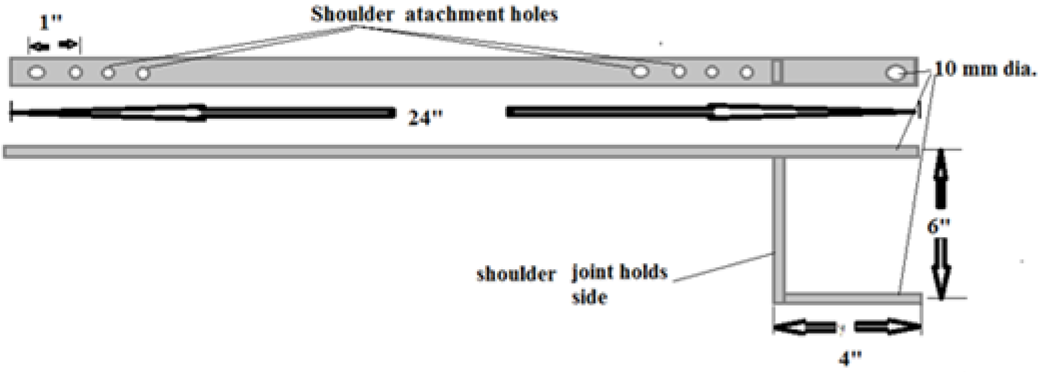
Arm link extent:

- The arm extent is also the other half part of the arm link. This has three holes to for extent and the coupling holes on the other side to couple with shoulder joint.
- This allows the arm to adjust the length from maximum 12” to minimum 8”.



Shoulder attachments:

- The shoulder attachment is the assembly for maintaining the load of whole arm to be distributed on shoulder and ultimately to the human body.
- It has four holes on the both end so that any possible attachment for holding can be adjusted by 6".
- The shoulder joint side is the extent for holding the arm body couple.



CONCLUSION AND FUTURE SCOPE

- ➢ The timing for actuation is appropriate as for heavy weight lifting as it is 6 seconds the controlling will be non – critical for the work.
- ➢ The transmission ratio matches the movement of the parts of exoskeleton.
- ➢ The skeleton weight is 6 kgs. The system should be light weight so this structure should be made of light weight material like aluminium.
- ➢ The weight increment due to battery exceeds 10 kgs so the balancing improvement can overcome this issue.

- ➢ The project work can be done by taking some material consideration and design software help. This provides a rapid forecasting of the system possibilities.
- ➢ Android system can be added on the actuation part of the circuitry, this operating system is designed to work as the human behavior of using devices.
- ➢ A brain–computer interface (BCI), sometimes called a mind-machine interface (MMI), direct neural interface (DNI), synthetic telepathy interface (STI) or brain–machine interface (BMI), is a direct communication pathway between the brain and an external device.
- ➢ BCIs are often directed at assisting, augmenting, or repairing human cognitive or sensory-motor functions. This brain computer interface makes its operation simple and easy.

- It seems likely that in the 21st century more investments will be made to drive innovation in this important area. The fact that large automobile companies, such as Honda and Toyota, have recently begun exoskeletal research programs is an indication of this technological shift.

REFERENCES

[1] Mechatronics, IEEE/ASME Transactions on (Volume:11 , Issue: 3), 19 June 2006.

[2] Journal of Vibration and Acoustics | Volume 105 | Issue 3 |

[3]"Tactile sensing and control of robotic manipulation," J. 1444 Adv. Robot., vol. , no. 3, pp. 245–261, 1994.

[4] Journal of Neuro Engineering and Rehabilitation 2009, 6:21 doi:10.1186/1743-0003-6-21

[5] International Journal of Advanced Robotic Systems 21 Aug 2012; Accepted 30