HYDRAULIC EXOSKELETON

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Nagpur, India***Abstract :*** With improvements in actuation technology and sensory systems, it is becoming increasingly feasible to create powered exoskeletal garments that can assist with the movement of human limbs. This class of robotics referred to as human-machine interfaces will one day be used for the rehabilitation of paralysed, damaged or weak upper and lower extremities. The focus of this project was the development of an exoskeletal interface for the rehabilitation of the hands and in the improvements in the defence services.

In addition, the sensor introduces an elastic element between the actuator and its corresponding knee joint. This will allow series elastic actuation (SEA) to improve control and safely of the system. The Leg Rehabilitation Device requires multiple actuators. To stay within volume and weight constraints, it is therefore imperative to reduce the size, mass and efficiency of each actuator without losing power. A method was devised that allows small efficient actuating subunits to work together and produce a combined collective output.

This is a very unique equipment in our country which helps uniquely in defence services and to cope up with the handicapped people to do their work in a easier manner. Furthermore, the developments in this project may one day be used for other parts of the body helping bring human-machine interface technology into the fields of rehabilitation and therapy.

Introduction

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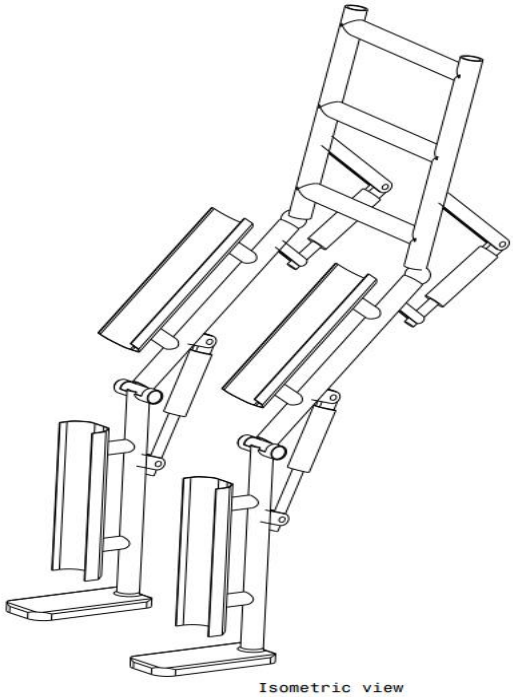
I. WORKING

The main concept is to lift and trasmit the load with the help of pneumatic power by the action of human motion .
As the name suggest the project is powered by pneumatic supply, We are using a small 12V air compressor which will provide a compressed air upto 100-150 psi. The air will be stored in a small tank,from there it will be supplied to pneumatic cylinders via electromechanical actuator, the actuator will be controlled by a microprocessor which will be programmed accordingly.
The actuation of pneumatic cylinders will be synchronized as the human leg muscle works while walking,the main purpose of pneumatic cylinders are to carry the load and pass it on the solid frame on which it is mounted.
The bottom of exoskeleton will be mounted by curved plates supported by helical spring which will provide comfort during walking.

II. METHODOLOGY



1.Methodology

1) Introduction:-This project starts with the existing problem of fatigue and excessive burden on the human body while carrying heavy loads on the shoulders or on the whole body.

The prototype of our idea will help us the functionality of our design and its benefits will help human body to a greater extent.

2). Methodology steps:-

Step-1. : - Problem Identification

It has been observed that human carry heavy load on their shoulders, it cost them a lot of effort and fatigue which results in the lack of concentration in their work and this also cost them a lot of health related issues.

Our idea will help them to reduce it to a greater extent.

Step-2 :- Problem statement

Considering the above discussion there are many disadvantages of this fatigue, and there are no such muchines available in the market to solve this problem, to increase the efficiency of humans.

Step-3:-Objectives and Scope

The main objective is to make a multiutility system/machine which can be helpful to human in carrying the heavy load from their shoulders is a very simple and efficient way, by the use of compressed air.

This can be used by our Arm forces as they have to carry heavy loads most of the time on their shoulders this causes fatigue and reduces their work efficiency and energy. Our product will carry the load directly from their back to the ground, hence reducing the fatigue.

This product can also be modified for people who lost their legs, arms and sometimes it also provide support to the backbone, with this they can also live their life like normal people and capable of doing the same as normal human in context of load carrying.

Further, this product will also be modified for special defence Services by the use of robotics and electromechanical technologies.

Step -4 :- Design Parameters

For designing our project we are considering the loads which carried by humans on their back, we are considering a maximum limit to 100kg, the various types of load human can carry on their back , and the maximum ability of humans to carry loads.

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Step-5:- Design model

By considering all the parameters, data which were obtained , we made a model of our design on a designing software named "CATIA", and based on which all other calculations were made.

Step-6 :-Revised design

The final design was created by doing some changes which were done in order to make the model more effective and user friendly.

Step-7:- Fabrication

Fabrication process were carried out at our college workshop taking all the standard consideration and safety precautions, for fabrication, the raw material was purchased from the local market at cheaper price.

Step-8 :- Testing

Testing was carried out at different locations to get the suitable results, based on which the report is made.

III. COMPONENTS REQUIRED

Stainless steel pipe
Pneumatic cylinders(4)
Pneumatic actuator
Electromechanical valve
Linear flex sensor
Mild steel pipe
Straps to hold suit
Aurdino (2) uno

IV. CALCULATION

Material of pipe – Stainless steel AISI 304
Strength (MPa) = 215MPa
Axial load on the pipe
Assuming load to be carried by human to be 150 kg
Assuming thickness of pipe to be 2 mm
Therefore Di = Do – 0.002
Pressure = Force/Area
205×105 = (150×9.81) / (π/4 × Do2) – (π/4 × Di2)
205×105 = (150×9.81) / (π/4 × Do2) – (π/4 × (Do - 0.002)2)
(π/4 × Do2) – (π/4 × (Do - 0.002)2) = 7.178×10-5
Therefore, Do = 0.02384828 m
Assuming Factor of safety = 1.3
Therefore, Do = 0.0238482 × 1.3
Do = 0.0310026 m
Do = 31.0026 mm
Taking standard outside outer diameter = 32 mm
Therefore Di = 30 mm

V. RESULTS AND DISCUSSION

I.Particulars	I.MIN	I.MAX	C.MEAN
C.Pressure	50	150	100
I.Load(applied)	60	76	68
I.Weight of the system	9	12	11.5

VII. Advantages over conventional exoskeleton

1. Simple mechanical components
2. Economical
3. Simple in design
4. Light in weight than conventional exoskeleton
5. Reliable

VIII. CONCLUSIONS

The basic idea for developing this project is to build an economical and simple and reliable system to carry heavy loads. The project is simple in construction, design and is very economical. It is flexible compared to its predecessors with rigid frame and relies less on electronic systems. All these benefits can be achieved without compromising ease in use, simplicity and easy maintenance.
Our project is not only used to lift weights but also is applicable in rescue operations, military, industries.

IX. REFERENCES

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