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Chairless Chair with Kneumatic

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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 body weight 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.

I. INTRODUCTION

The world is getting compact day by day. With the development in technology it has become very important to ensure that the most used devices are also compact and small in size , so it is the need of the hour to manufacture something like "Exoskeleton based hydraulic support" or "Wearable Chair" or "Chairless Chair".

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 !

The prime requirements of an effective project organization therefore are:-

1) Autonomy
2) Group functional integration
3) Small group size
4) Common work location for all project members
5) Team spirit among group members

All the foregoing requirements are mutually reinforcing, and conjoin together towards effective implementation of this innovative and time-bound project.

Factors in consideration of project:-

a) Compatibility with the objective, plan.
b) Availability of needed scientific and engineering skills in R & D.
c) Critical technical problems likely to emerge.
d) Market prospects and potential of the proposed new product.
e) Availability of production skills needed.
f) Financial return expected.

II. OBJECTIVE

The objective of our project is to enable the worker to have the ability to move around with absolute ease, with the use of a chairless chair.

A. *Salient Features of the Project*

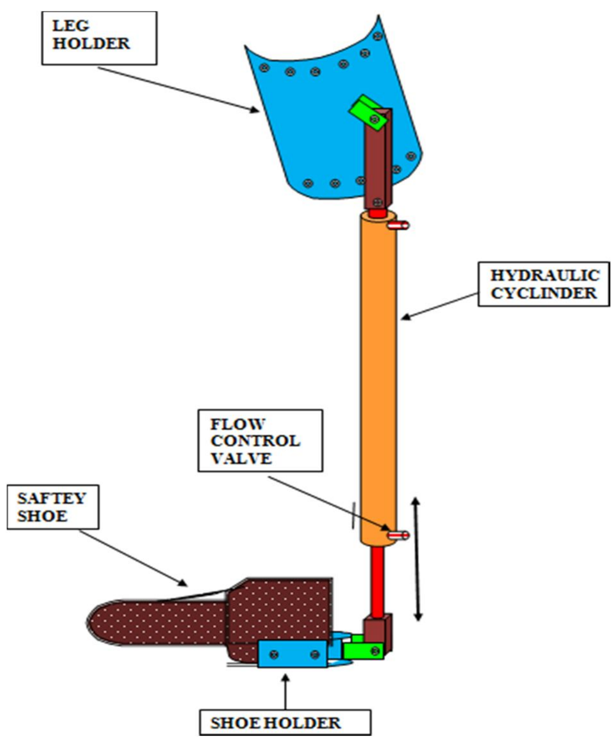
1) Pneumatic cylinder is used for smooth suspension which make comfort to operator
2) It is light in weight.
3) It is easy to wear
4) Low cost

III. NOVELTY

1) Makes use of Hydraulic System as compared to the software and electrically controlled unit used by AUDI.
2) Cheaper than the control system based unit.
3) Variety of Applications.

Following is a Control System based unit used by AUDI :-

Schematic Diagram of our Hydraulic System:-



Raw material & standard material:-

SR NO	PART NAME	MAT	QTY
1	Cylinder 25 bore 250 stroke	STD	2
2	Pad	MS	2
3	Belt	NY	4
4	Shoe	LE	2
5	Pivot joint	MS	2
6	Shoe holder	MS	2
7	Rivet	AL	24
8	Nut bolt	MS	4
9	Spring	MS	2

IV. METHADOLOGY

A. Firstly procurement of a leather safety shoe for which we will make a frame, which will hold the shoe (shoe holder) is done. The shoe holder is fixed to the heel of the shoe.
B. Now a small square block one end of which is pivoted to shoe holder and another end is fixed to the bottom end of Piston connecting rod is used.
C. Here we will use 10 bar pressure cylinder half filled with air and half with oil, depends upon the weight of user. The cylinder has 25 mm bore diameter, 250 mm stroke length and is provided with two flow control valves.
D. Now, a leg holder is made which will hold the thigh and is made by taking 2mm MS sheet bended to the shape of thighs.
E. Two nylon laces are fixed to the thigh holder with the help of pop rivet so that it can hold the leg.
F. The leg holder is pivoted to square block and square block is fixed to cylinder.

V. NEED OF OUR PROJECT / APPLICATIONS

The following are the benefits of our project to the society:-

1) With the growth of technology many companies like Audi have optimized factory floor plans designed to maximize efficiency, with little room, literally or figuratively, for chairs. The EBHS effectively lets employees carry a seat with them at all times. This enables them to take micro-breaks of 3 to 10 seconds while working thereby reducing muscle fatigue.
2) This invisible chair would prove helpful to hunters, farmers, surgeons, retail workers, etc i.e. anyone who needs to stand for long hours at stretch.
3) This chair would be helpful to the elderly as they need rest a while after walking some distance.
4) Our project can be developed further to suit the needs of the handicap , by acting as a walking assistance.
5) Once into mass production , an organisation can completely give up the usage of conventional chairs and make use of EBHS to save floor space and maximize efficiency.
6) It can be used by commuters standing in a crowded train or metro to relax themselves without occupying much space.
7) Used my military and trekkers while trekking difficult terrains.

VI. DESIGN CALCULATIONS

A. Design of Cylinder

Material : Al. fs= 210kg/cm2
Bolt material : M.S. Ft = 280 kg/cm2

Design a cylinder of internal diameter for Di=2.5cm,Internal air pressure P= 25 kg/cm² Max. ft=210kg/cm² and max. ftb= 280 kg/cm². For this information we have to find the thickness. That is we have to find „t" Using the relation,

$$\text{Thickness} = \frac{D}{2}\left(\sqrt{\frac{210+25}{210-25}} - 1\right)$$

$$t = \frac{2.5}{2}\left(\sqrt{\frac{235}{185}} - 1\right)$$

$$t = 1.25\left(\sqrt{1.2} - 1\right)$$

$$t = 0.11$$

$$t = 0.11\text{mm}$$

For safety purpose we will design the cylinder using factor of safety as '4'

Therefore $t = 4\text{x}\ 0.11 = 0.44 = 0.5$ mm

To find the outer diameter of the cylinder,

$$\text{Outer diameter } Do = Di + 2\,(t)$$

$$= 25 + 2\,(0.5)$$

$$= 26 \text{ mm}$$

The minimum outside dia of cylinder is 26 mm

B. Design of lever

t = thickness of arm in cm. Fb = 160 N/mm^2 B = width of arm in cm = 4.5 x t

Bending moment at 25 mm from center of shaft, W = maximum force applied by human = 30 kg M = W x L

M = 300 x 25 =7500 Nmm

And section modulus = Z = 1/6 Bt^2

Z = 1/6 x 4.5 x t x t^2 Z = 1/6 x 4.5 t^3

Z = 0.75 t^3 mm^3.

Now using the relation,

Fb = M / Z

160= 7500/ (0.75 t^3)

t = 3.9 mm.= 4 mm

B = 4.5 x 4 = 18 mm

So we select section 18 x 4 mm for pivote lin

C. *Design of Welded Joint*

Checking the strength of the welded joints for safety.

The transverse fillet weld welds the side plate and the edge stiffness plates, The maximum load which the plate can carry for transverse fillet weld is

P = 0.707 x S x L x ft

Where, S = size of weld, L = contact length = 30mm

The load of shear along with the friction is 60 kg = 600N Hence,

600 = 0.707 x 3.15 x 30 x ft

Hence let us find the safe value of „ft"

$$\text{Therefore ft} = \frac{600}{0.707 \times 3.15 \times 30}$$

ft = 8.9 N/mm^2

Since the calculated value of the tensile load is very smaller than The permissible value as ft=21 N/mm^2. Hence welded joint is safe.

D. *Design of Bolts*

For Bolted Joint we used M10 Bolts do = 10mm

dc = do x 0.84 dc = 8.4mm

Shear Area A = ∏ / 4 X (8.4) ^{2}

A = 55 mm^2

τ = F A

$$\tau = \frac{500}{55}$$

τ = 9.09 N/ mm^2

τ on bolt < τ i.e. 9.09 N/ mm^2 < 80 N/ mm^2 Design is Safe.

VII. ADVANTAGES

1) It is automatic.
2) It is power less
3) Provides maximum comfort.
4) It will light in weight
5) Compact in size and portable.

VIII. DISADVANTAGES

1) It is not adjustable to other people.

IX. CONCLUSION

1) The Exoskeleton Based Hydraulic Support was successfully fabricated and it was found to be suitably safe under Fluctuating Load during walking as well as under Dead Load when the user sits/rests on it. (Tested the Extra Large Size Variant for a user weighting 116 kgs for a span of 43 days)
2) The entire cost of making the EBHS is Rs 8540 ($ 126.84) thereby making is very economical for the general public as well as for Industrial use and also for the Military.
3) When in full scale production , the EBHS will be available in three sizes , From 5ft to 5"5" : Regular Size
   From 5"5" to 6ft : Large Size From 6ft to
   6"5" : Extra Large Size
4) The EBHS being extremely light in weight causes very little hindrance while walking and the user can easily get used to it.

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X. FUTURE SCOPE

A. A small oil vessel and a battery operated motor could be incorporated in the system so as to lock the EBHS at various sitting positions as per the user‟s comfort.

B. Could be of great use for people facing difficulty in walking.

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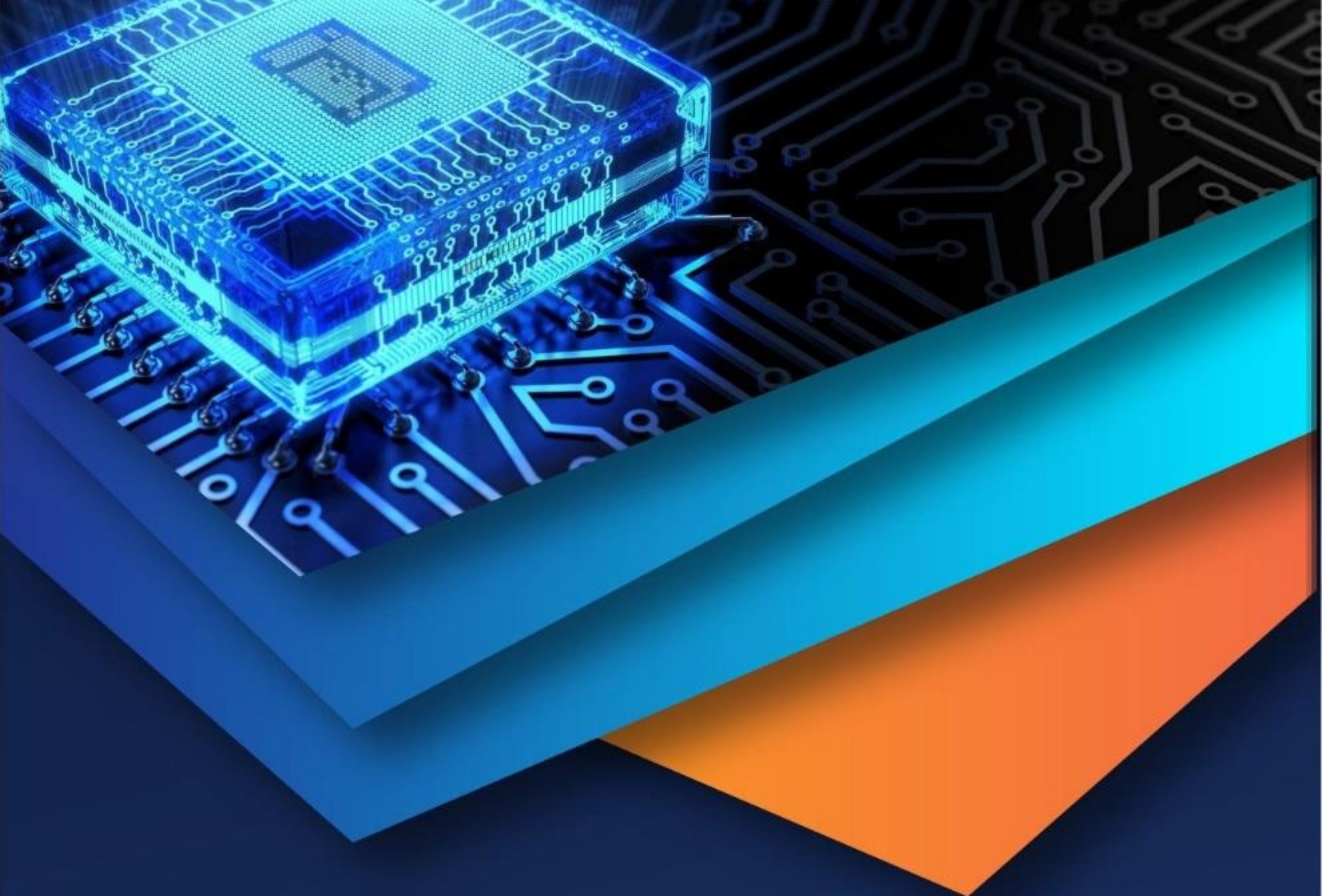

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