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Design and Development Chairless Chair

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Abstract: It is very difficult to stand and work for overall shift in the company by a worker. This will reduce the efficiency of the worker. The solution to this problem is to have a portable device which has an ergonomic design, low cost exoskeletons. In this work a mechanical ergonomics device that is designed around the shape and function of the human body, with segments and joints corresponding to those of the person it is externally coupled with. It functions as a chair whenever it is needed and is coined as Chair less Chair. Worker in industrial can wear it on legs like an exoskeleton. It locks into place and you can sit down on it. The device never touches the ground, which makes it easier to wear: a belt secures it to the hips and it has straps that wrap around the thighs. These are specially designed and part of the mechanism, but an alternate version works with any footwear and touches the ground only when in a stationary position. The user just moves into the desired pose. It will fit closely to lower part of the body as an external body part on which maximum body forces act upon. It is a cost effective product and any error in design may fail the structure which creates loss. So, these forces should be carefully analyzed during the design of structure. The best way to predict these forces during pre-manufacturing stage is to make an analysis on the structure with the help of software. This helps in estimating the stresses induced on the structure which is one of the most important criteria for evaluation of the model.

I. INTRODUCTION

Exoskeletons are defined as standalone anthropomorphic active mechanical devices that are "worn" by an operator and work in concert with the operator's movements. Exoskeletons are mainly used to increase performance of able-bodied wearer. (e.g. for military applications), and to help disabled people to retrieve some motion abilities. (such exoskeletons are called "active orthoses" in the medical field).

As we know, the normal motor capability of legs is crucial and important for human-being's daily life. Legs, however, are apt to be injured in accident. And the Rehabilitation is essential for the patients to recover after leg operation. Additionally, diseases, stoke for instance, can also result in the loss of leg function. In order to regain the motor capability, the leg rehabilitation is a fundamental therapeutic approach. Basically Exoskeletons are of two types:

II. LITERATURE

In this paper we are very much interested in the wearable devices which help in increasing the efficiency of the human and decrease the rate of fatigue of human during work. The device discussed here is the passive device. This device is known as Chairless Chair which helps the wearer to work effectively at any location in a sitting posture.

H. Zurina and A. Fatinhas worked on the Design and Development of Lower Body Exoskeleton. In his paper an attempt has been made to evaluate the possibility of using the Chairless chair that will help in increasing the energy efficiency and offer weight support when the user feels tired rather than continuously taking on the weight[2].

Other than that, in term of ergonomics, and the objectives to give comfort to user has achieved by give choices to user to choose their comfort degree level from 45° to 90°.

Apart from the benefit of his experiment it can be conclude that his design still confront with some problems that need to fix in future so that the objective to give an ergonomic chair to user can be achieved. The experiment testing has been conducted for our prototype to our group member with weight of 80kg and height around 170cm. From the result of experiment testing, it can be observed that for height and weight, the Chair less chair doesn't give any effect in lack or over measure in its height dimension. It suit the user which prove that this chair can be wear by people from any height range. He tester were required to use the chair while do some work, it was observed that, he had difficulties in changing the degree level.

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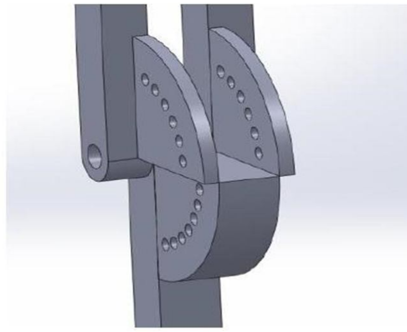

Figure 1: Knee locking mechanism developed by H. Zurina et.al.

Aditya Bhalerao and Sandesh Kamblehave worked on Pneu portable chair for employees to seat while working. By referring to human seating and walking characteristic a leg mechanism has been conceived with as kinematic structure whose mechanical design can be used by employees as an wearable exoskeleton. As per the Specified Design parameters the body can suitably carry around the 100Kg of Human Body weight. In the later part to reduce the cost, Oil was also brought in the weight sustaining mechanism thus providing better results. These type of device with ergonomical background can be easily upgraded with the use of more advanced technologies and culminating various facilities into one body and be constantly modified .A basic idea of how a exoskeleton using Pneumatic or Hydraulic Cylinder can be used to reduce the fatigue by using simple kinematic mechanisms. In this Particular Machine due to certain restrictions not much advancement has been made and it is similar to a tailor made clothing which is just suitable for one single person and may not fit properly to other user. Although as mentioned with advanced techniques it can be made more generalized for more no, of people to use it[6]. It has several major applications in real time scenario where it can be worn in the crowded trains or public places with space constrains. Also it can be worn by Traffic Police who work for long hours and are exposed to fatigue for a prolong period of time.

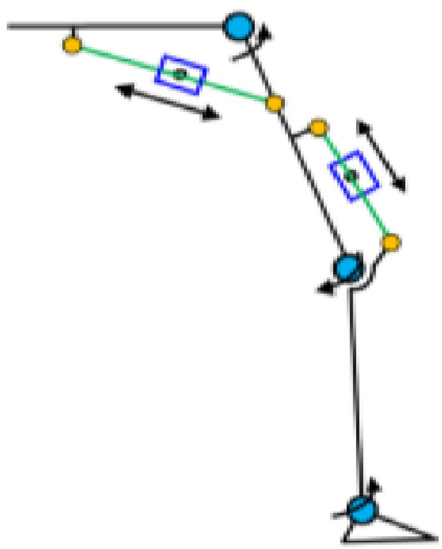

Figure 2: Mechanism of Pneu Portable Chair

Cyril Varghese and Vedaksha Joshi has worked on the Exoskeleton Based Hydraulic Support was successfully fabricated and it was found to be suitably safe [3]. 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) 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. 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 . The EBHS being extremely light in weight causes very little hindrance while walking and the user can easily get used to it.

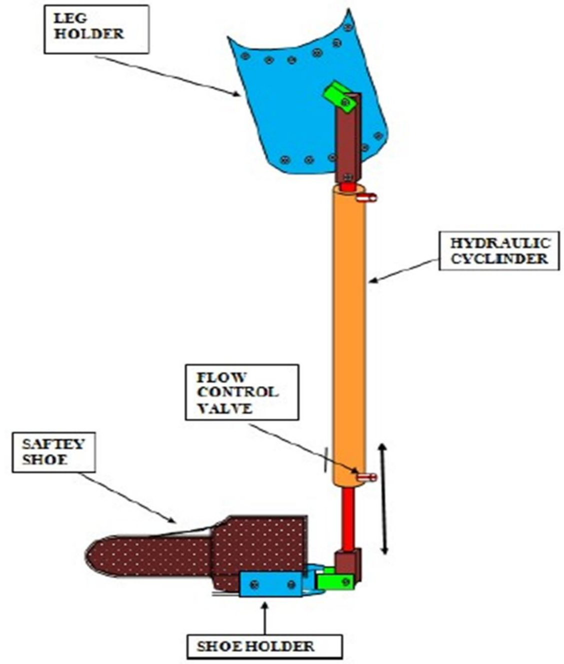

Figure 3: Schematic Diagram of Hydraulic Mechanism

Noone has worked on the lower limb exoskeletons called Chair less Chair. This product is also known as a "mechatronic device" worn on the legs, which allows the user to walk or run when not activated [4]. Once the device is activated, it uses a portable variable damper to engage and hold the person's body weight, relieving the stress on leg muscles and joints. The user just needs to move into the desired pose, this activates the device. This device is based on research from the Bio-Inspired Robotics laboratory at ETH Zurich. A belt secures the wearable to the hips and its straps wrap around the thigh. Since it is the chair that can carry the person's body weight, the stress on leg muscles and joints is relieved. The device runs for about 24 hours on a single 6V battery and an aluminum and carbon fiber frame keeps the overall weight of the Chair less Chair at just two kilograms, so it doesn't burden the wearer with too much excess weight. Production-line trials started in Germany with BMW in September and with Audi later in the year 2015. The user can sit comfort in the places where the people are densely crowded using this device. This device is totally controlled by a mechatronic system.

Figure 4: Noone Chairless Chair

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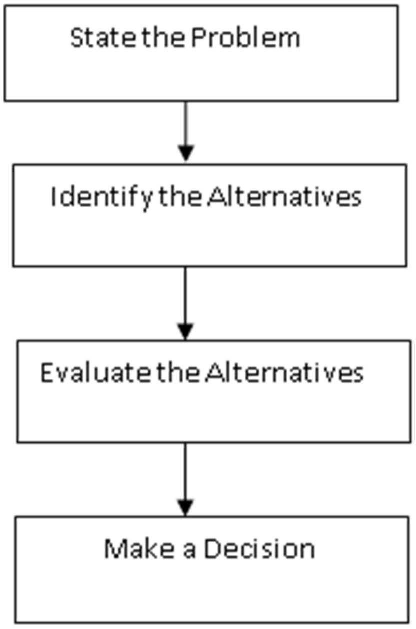
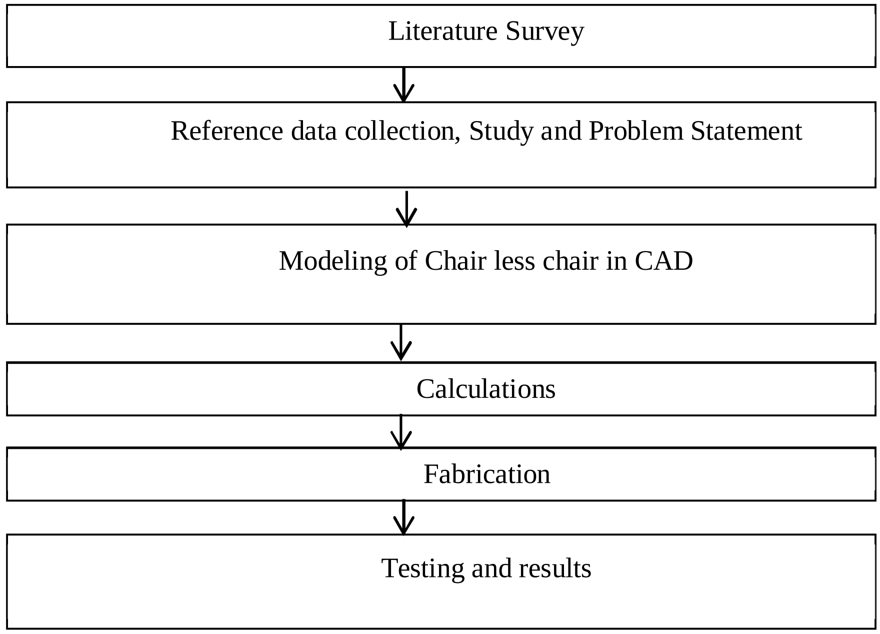
III. METROLOGLY





We have to design following main component: -

1) *Damper:* The function of damper to carry the load of worker. We have designed it for 100 kg load.
2) *Sheet:* Mild-sheet sheet required to give support to the worker and to fascinate the sitting position.
3) *Tie Belt:* Belt is used for strapping of exoskeleton to human body. Belt will be taken as standard material available in market to wrap the model as waist and thighs.
4) *Safety Shoes:* Shoes are the last of model, which is attached at bottom place and to be wear at the time of working. Shoes are selected as standard size of number.

IV. CALCULATION

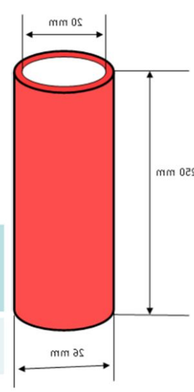
Area x Pressure = Force Output

F= P X A

Consider the weight of human sitting on chair = 100 kg. = 981 N

$981 = P \times \pi r^2$

Material	Yield strength (MPa)	Ultimate tensile strength (MPa)
Aluminium alloy 6061-T6	241	300



$P = 981/\pi\, 10^2$

$P = 3.12\ N/mm^2$

A. Design Of Cylinder

Now for thickness of wall of cylinder,
Hooks law
We have, t = pd/2 σtensile
where p = internal pressure= 3.12N/mm2 , & d = diameter of cylinder=20 mm selected, ft1 = permissible stress.
We have ultimate stress for cylinder material $\sigma_{ultimate}$ = 300 N/mm^2 aluminium alloy
Considering factor of safety as 4.
We get permissible stress = ultimate stress/factor of safety
$\therefore \sigma_{tensile}$ =300/4
$\sigma_{tensile}$ = 75 N/mm^2
Inputting these value in thickness formula,
We get, t = 3.12 x 20/2 x 75
= 62.4/150= 0.416 mm.
t = 0.5 mm (say)

but standard available cylinder in the market is 3 mm thick, so our design is safe.
Outer Dia. of cylinder = 20 + (2 x 3) = 26 mm
The minimum outside dia of cylinder is 26 mm

V. METRIAL SLECTION

For the exoskeleton leg we selected a lighter stronger and flexible material. Here we have selected aluminum alloy give good characteristic machinability brazeability and corrosion resistance.

VI. CONCLUSION

The exoskeleton does not consumes any power for its operation. This device is eco-friendly as it does not pollute the environment. This Chairless is light in weight, mobile & reliable, easy to carry and does not require any extra space. The future work will concentrate more on making it lighter in weight and more compact.

REFERENCES

[1] DESIGN AND FABRICATION OF EXOSKELETON BASED HYDRAULIC SUPPORT. Cyril Varghese, Vedaksha Joshi, Vinayak Waghmare, Ajal Nair, Albey David, International Journal of Advanced Research (2016), page no.22
[2] AISI 4140 Alloy Steel (UNS G41400), http://www.azom.com/article.aspx?ArticleID=6769, page no 2
[3] Design and Implementation of Chair Less Seating Arrangement for Industrial Workers and Farmers, Rushikesh M. Magdum Sachin M. Jadhav, GRD Journals-Global Research and Development Journal for Engineering | Volume 3 | Issue 8 | July 2018, page no-5
[4] A Review on Chairless Chair, Jaiswal Pradeepkumar, Ankit chaudhary, Gurmeet Singh, IRJET, April 2020, page no6343
[5] Design and Analysis of Lower Limb Exoskeleton, N. Siva Nagamani, V. Mohan Srikanth, IJIRST –International Journal for Innovative Research in Science & Technology| Volume 3 | Issue 12 | May 2017, ISSN (online): 2349-6010, page no 61.