International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

# BASICS OF EXOSKELETON

**Vijay Kumar Singh[1], Prakash Kushwah[2], Arpit Kumar Vishwakarma[3], Vishal Mandal[4]**

**Prof. Sumeet Kumar Singh[5]**

*[1-5]Mechanical Engineering, Madhav Institute of Technology and Science, Gwalior (474005)*

---

**Abstract -** From A Greek word "Exo" define external and "Skeletons" define skeleton, "Exoskeleton" began Exoskeleton is next generation of machine which help in many industry and ways in the future. It multipurpose and various varieties we can also use artificial intelligence which can be very useful for the industry and country depending on application. Example it can be weaponries, medical sector and reduce human effort wok etc. it can be made for protesters limbs as well as entire skeleton also can be used robotics purposes.

***Key Words***: suit, pneumatic, robots, exoskeleton frame

## 1. INTRODUCTION

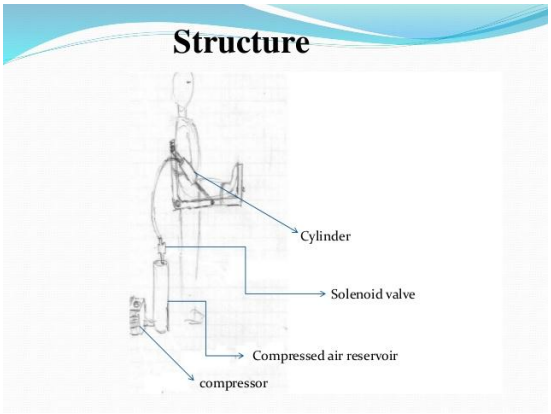


**Fig – 1: Structure**

Exoskeleton arm is external mechanical structure those transfer the mechanical motion to working power it can be compared alongside electrical commutation and programming as well as artificial intelligence so that the accuracy and function can be improved for uses.

The fictional example can be in various cinematic programs for example the suit of iron. We can also program it as unman machine for example robot which we see for heavy lifting (machinery). the main function of this project is to boost the power in minimum effort of the wearer also enhances the strength and endurance there mainly used to defense research purposes mainly used as weapons we can also use in medical areas as it can in enhance the precision in any kind of surgery due which programming and electronic system.

Exoskeleton are unpopular and rarely seen in our everyday comminute because of requirement of especially precise motor, sensors and sustainable and moveable power source. From last decade funda of exoskeleton is the bases of many robotics achievement. Because it allows grate degree of freedom weight size ratio to power as compare to other motor. At the same time this technology is showing great vision in neuromuscular sciences as it is giving compactable result those who has lost their limbs.

Today many researcher and research organization are working for on a complete human like exoskeleton this can grasp , grip and move the joint as we human it can be great achievement for human kind as it can reduces the burden of small works it can move, show can be manipulated as the machine of mass destruction. It has many field to expand in to for example heavy industry, military, logistic, instruction medical and self-defense.

The most importance requirement of any machinery is safety of the user exoskeleton work very close to the user body practically touching it so exoskeleton must be design by keeping user safety in mind. Which safety in every aspect including mechanical error, motor error, mal function, power source lost, all this mal function we must have protocol for every type of error and a way to user safe.

## 2. Working

Firstly we design and connect alloy pipes in exoskeleton frame, then we will connect the entire frame with metal wire through hollow pipes. After the completion of exoskeleton frame we will do the wiring and electric and machinery connection we will make a holding the motor, compressor and battery.

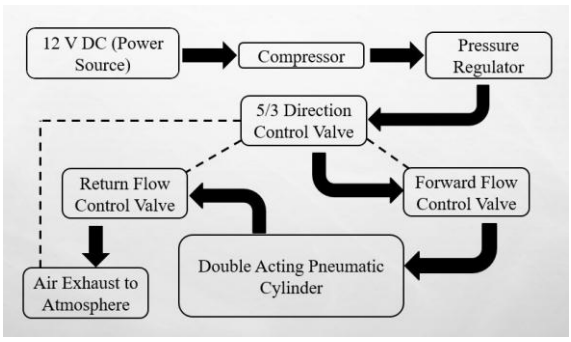


**Fig – 2: Circuit process**

The next step will be the connection of electronics power source and machinery, with help of soldering we will give connections to the battery/power source and compressor.

After this which connect the switch between power source and compressor, now will connect pneumatic motor with compressor after that the output end of the motor will connect to the metal wire which are vowed into our entire frame.

The connection are done and our exoskeleton is almost ready, but before putting in test we must consider all the safety feature we have to put the insulated thermal plate between and the motor and power supply to prevent from access heat generation by motor and battery causing damage to the user. Next will have to pad the entire structure with insulated pads to prevent from shocks and minimize the vibration.

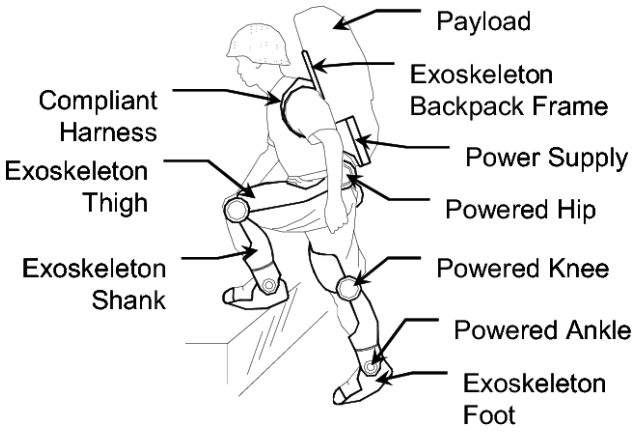


**Fig – 3: Exoskelton Suit**

Now our exoskeleton is safe and ready for user.

Firstly battery will transfer the power to air compressor, then the air compressor will create the high pressure air flow through the pneumatic motor, then pneumatic motor will create the mechanical energy to support our exoskeleton to make it work, to direct the force to a particular limbs, the sensor to be connected at source of mechanical power/pneumatic motor so that the efficiency and power generated can be used to its maximum potential.

## 3. Parts of Exoskeleton

**3.1 - Alloy Pipes -** It will give Liberace and extra support to the bones of the user as well as became the base and provides strength to the structure.

**3.2 - Metal Wire -** These wires will go through connection to the hollow alloy pipes to gives flexibility and exoskeleton as well as they will be connected to the motor to provides need force for heavy lifting and the working.

**3.3 - Joint Connectors and Locks -** These will help a structure to stay connected and proper functioning as well as they will provides rigidity so that structure that can stand on its own.

**3.4 - Pneumatics Motor -** It will give the required power and degree of freedom show that structure can work properly power source.

**3.5 - Power Source -** AC / DC rechargeable batteries to provide required energy for air compressor to work.

**3.6 - Air Compressor -** Air compressor will convert surrounding low pressure to high pressure to make the pneumatics motor.

## 4. Calculation

Assuming

$F_c$ = force acting on the cylinder (newton)

$M_a$ = mass of the arms

$L_g$ = distance of center of gravity of the for arms

$M_g$ = mass of load lifting

Diameter of piston rod = d = 30 mm

Material used for rod = Mild Steel

Factor of safety = 3

Force acting on the rod (P) = pressure × area

Force (P) = 0.5 × $\frac{\pi}{4}$× (30) ^2

Force (P) = 353.42 N

Length arm = 12 inch (0.3048 m)

Table to be calculate for assumption

| Weight (kg) | Time (sec) | Pressure (bar) |
|---|---|---|
| 5 | 1.5 | 5 |
| 15 | 2.5 | 5 |
| 25 | 3.5 | 5 |

Power = $\frac{work}{time}$ = $\frac{force \times distance}{time}$

(Taken g = 10)

1st calculation

= $\frac{5\times10\times0.3048}{1.5}$ = 10.16 (Nm/sec)

2nd calculation

$= \frac{15 \times 10 \times 0.3048}{2.5} = 18.28$ (Nm/sec)

3rd calculation

$= \frac{25 \times 10 \times 0.3048}{3.5} = 21.79$ (Nm/sec)

## 5. Future scope

Today we don't see any robotic or any exoskeleton machinery due to lap of suitable resource if research rate keeps on the same track we will see the robotics future which will be consisting of robots in every corner of the street.

### 5.1 - In Defense Field

Many defense organization surrounding the world are working on the prototype of weaponries as well as unmanned exoskeleton/robots for the defense of their country and also minimize loss of human lives.

In modern world and modern welfare many robotics and mechanical devices are used throughout the world to detect underground mines and explosive, device are also used for heavy lifting and manufacturing of military infrastructure in future such task carried out by 5-6 month can be done by single soldiers.

### 5.2 - Medical field

In medical field we use machinery for many successful operation with great precision and accuracy with great technology and tough programming we can make medical exoskeleton which will gave doctor/operator the perfect precision and accuracy to perform any complicated operation and minimize the human power and effort.

Some exoskeleton can be produce to go out in war zone to extract the wounded solider without any extra loss of human lives.

Those there limbs can also be held by exoskeleton technology to provide them with protesit limbs as that good as new.

### 5.3 - Rescue Operations

In some natural disorders such as Flood, Earth quake, landslides, etc. the Exoskeleton are under the action for rescue people on the place where Rescue team not easily reach.

### 5.4 - Space operation

The exoskeleton has been intended to be a transportable and wearable framework. require no connection to outside structures during activity in NASA the current X1 Exoskeleton is being customized for in-space its likely applications on Earth are tremendous. For instance, the X1 can go about as a versatility help gadget for people.

### 5.5 - Everyday purpose

With such technology and continues working on it might see robots more than human which can do and can we programmer do basic stuff such as driving the car giving extra strength, household work an such thing.

## 6. Advantage

- Reducing human efforts
- Saving human lives in war zones and medical research
- Giving strength of handicapped people
- Defense system
- Everyday work
- Weaponzation of modern war fear
- It will give perfect precision and accuracy in medical field and operation

## 7. Limitation

- Technology is not available today
- The programming required will be different as per need
- It will be exhausting carry the machinery
- It will make human less active
- Such technology is very far as compared to reached
- It will required fire source and different type of battery as further requirement

## 8. Conclusions

The idea behind this project to develop not much expansive and eco- friendly. This project simple construction, design and cheaper. While maintaining simplicity, ease to access, implementation and maintenance.

Our project not used only lift weight or push/pull the object but they have also used to rescue operation, military, industry. It has also help the physically disabled people to carry weight or push/pull the object in daily life.

## 9. References

- Wikipedia
- Quora
- Help of faculty and senrious
- Research paper publish by Karnataka engineering college student