

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 9, Issue 2, February 2020

Sit To Stand Mobility Assistance for Handicapped Person

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ABSTRACT: This project describes the preliminary design of a light, high stability, robotic system for handicapped person and elderly assistance. Robotic technologies have been investigated in the recent past to prevent falls by a postural control of patients and to promote safe mobility. The mechanisms used for such assisting devices must exhibit complex mechanical functions that may change during the use. The aim of a robotic walker to help paralyzed patient regain the ability during sit to stand and walk.

KEYWORDS: robotic walker, sit to stand, safe mobility, paralyzed patient

I. INTRODUCTION

One-fifth of the estimated global population, i.e. (between 110 million and 190 million people), experience significant disabilities. Disabilities of various parts such as eye, ear, hand, leg etc. Limb disability is one of the disabilities which are caused due to various reasons such as deformation by birth, war, disorders such as diabetes. Lower limb of sports person also suffers huge blows while playing and are always at the risk of suffering severe injuries. These injuries sometimes may be a permanent disability. For an individual with mobility impairment, the first major obstacle in his/her daily physical activities is the challenge of standing up from a seated position. Sit-to-stand (SiSt) is a highly demanding process that requires significant joint torque to lift the body center of mass. Thus, there is a need for a standing mechanism so that the disabled users can boost their confidence level and gain the associated health benefits. For example, standing maintains leg muscles in reasonable physical condition, improves blood circulation, urinary health, and bowel function, and reduces spasticity and pressure sores efficiently. Many paraplegics utilize walker type and exoskeleton devices as assistive devices using robot technology. For example, braces and crutches have been widely used by people with spinal cord injury to provide the opportunity to stand and move. A standing-up robotic supportive device has been used to raise the human from sitting to standing posture. The device is driven by a pneumatic servo system.

II. OBJECTIVES

Sit-to-stand is one of the most common daily activities that can be performed with no effort by healthy subjects, but if the health situation is impaired a different scenario since the action requires a sufficient level of strength and balance. The main objective of the proposed experimental is to help the handicapped person during sit to stand and walk.

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III. WORKING PRINCIPLE

The compressed air goes to the flow control valve. The flow control valve is used to control the flow of air. It is adjustable one. We have to adjust the lever, so that the required pressurized air goes to the Solenoid Valve. In our project, the solenoid valve is used as a direction control valve. The function of solenoid valve is used to move the double acting cylinder forward/reverse depends upon the valve position. In one position air enters into the cylinder and pushes the piston, so that the handle moves upward. The next position air enters to the other side of cylinder and pushes the piston return back, so that the releasing stroke is obtained. In that time the handle moves downward. The speed of the releasing stroke is varied by the directional control valve manually.

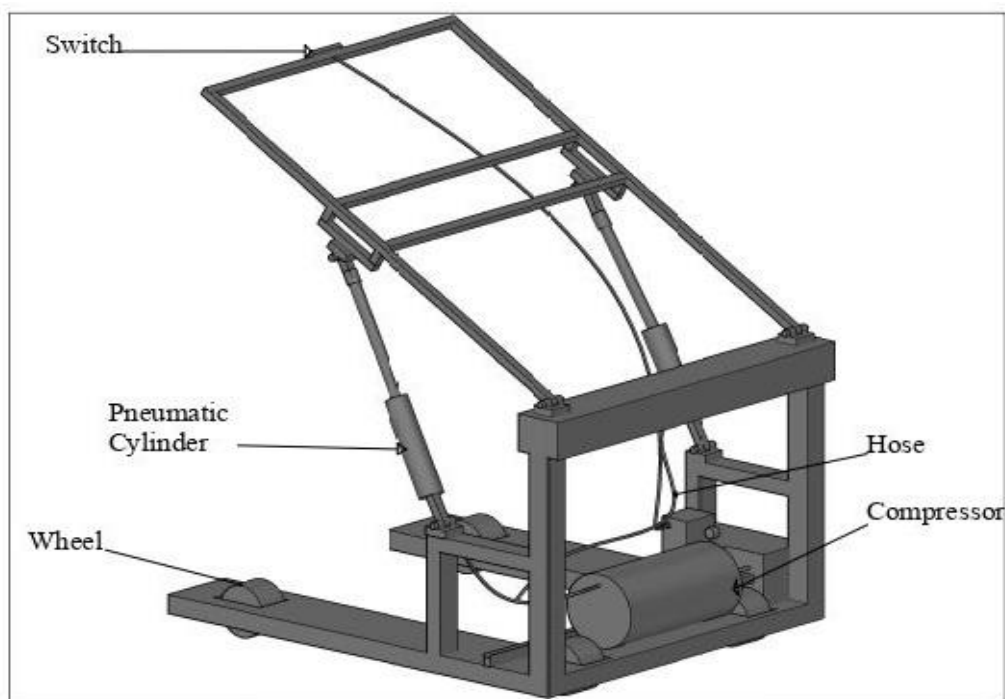


Figure 1. Robotic walker for STS

IV. MATERIALS USED

SI.NO	MATERIALS	QUANTITY
1.	Pneumatic cylinder 50*200 mm	2
2.	Solenoid valve	2
3.	Flow control valve	4
4.	Compressor	1
5.	Hoses	-
6.	Wheel	4
7.	Tube connector	-
8.	Switch	1
9.	Frame stand	-

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V. DESIGN CALCULATION

Specifications:

Selecting cylinder = 50 * 200 mm
Diameter of piston, D = 50 mm
Diameter of piston rod, d = 20 mm
Operating pressure, P = 5 bar = 0.5 N/mm²
Stroke length, L = 200 mm

Force calculations:

Double acting in forward stroke,

Force = Area * Pressure
Area = $\pi/4 * D^2$
Area = $\pi/4 * 50^2$
Area = 1963.4 mm²
F = 1963.4 * 0.5
F = 981.7 N

Double acting in return stroke,

Force, F = Area * Pressure
Area = $\pi/4 * (D^2 - d^2)$
Area = $\pi/4 * (50^2 - 20^2)$
Area = 1649.34 mm²
F = 1649.34 * 0.5
F = 824.67 N

Theoretical air consumption calculations:

Free air consumption in litres for forward stroke,

$C = \{\pi/4 * D^2 * (P+1) * L\} / 1000$
 $C = \{3.14 * 5^2 * 6 * 20\} / 1000$
C = 9.42 ltrs.

Free air consumption in litres for return stroke,

$C = \{\pi/4 * (D-d)^2 * (P+1) * L\} / 1000$
 $C = \{3.14 * (5-2)^2 * 6 * 20\} / 1000$
C = 3.39 ltrs.

VI. ADVANTAGES

- Simple in construction.
- Easy to fabricate.
- Easily portable.
- The weight of the system is less.
- Compact in size.
- The components used for the fabrication are simple and easily available.

VII. APPLICATIONS

- It is highly suitable for stroke patients.
- It can be used in Hospitals

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- It can also be used for paralyzed patients.
- It can be used in home, office and institutions.

VIII. CONCLUSION

In this study, a robotic walker was developed to provide sit to stand mechanism and mobility assistance for handicapped person and elderly people. The design of the robotic walker is compact and hence is able to use in institutions, offices, industries and also at hospitals. The design is made very safe and there is no chance of failure of the frame and wheels under normal conditions.

IX. ACKNOWLEDGEMENT

I am thankful to and fortunate enough to get constant encouragement, support and guidance from teaching staffs which helped us in successfully completing our project work. Also, I would like to extend our sincere esteems to all staff in laboratory for their timely support.

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