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Design and Fabrication of a Pneumatically Operated Wheelchair Ambulated Stretcher

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Abstract: ***The transfer of a patient from a wheelchair to a stretcher or bed has become one of the most difficult tasks in hospitals and also at homes. Hence the proposed project aims at designing and fabricating a pneumatically operated wheelchair cum stretcher. This will overcome the drawback of patient transfer and reduce the physical exertion of the patient while being transferred. The proposed system consists of a compressor, two pneumatic cylinders, a 5/2 solenoid direction control valve and push buttons to operate the system. Initially, the required pressure for the compressor, which is from the range of 5 to 10 Bars is applied. From the compressor the air is sent to the 5/2 Solenoid Direction Control Valve which will direct the air from there towards the cylinder based on the type of the required conversion. The system will operate in three different modes, which will be, lifting of the wheelchair, conversion of the wheelchair to a stretcher and conversion of the stretcher back to the wheelchair. There are two push buttons placed at the hand rest portion. On pressing one button, the lifting mechanism takes place and on pressing the other button the wheelchair to be conversion will take place. On actuation, Cylinder C1 which is placed vertically will provide the movement for lifting of the wheelchair, and on actuation, the Cylinder C2 which is placed horizontally will provide the movement for the wheelchair to the stretcher conversion, or vice versa. This prototype can be used by the elderly people at homes and also for the patient transfer in hospitals.***
Key Words: ***Wheelchair, Stretcher, 5/2 Direction Control Valve.***

I. INTRODUCTION

According to the World Health Organization, 56.7 Billion People in the world depend on a wheelchair for their day to day tasks and mobility. Wheelchairs & stretchers are the most commonly used medical equipment for the transportation of patients. Over the decades, wheelchairs have evolved from manually operated to intelligently operated wheelchairs, which have faced more drawbacks such as, complete confinement to the wheelchair alone and cost on the higher side. Since the cost is high, it becomes highly difficult for the people below poverty line to afford these wheelchairs [2].

A. Proposed Work

Hence we have proposed to design an affordable multipurpose wheelchair which is Pneumatically Operated and can be converted into a Stretcher with the help of double for the required conversion, either into a wheelchair or into a stretcher. This will reduce the task of shifting the patient from a wheelchair to a stretcher by the care taker. This will also overcome all the drawbacks that the people faced on using the hydraulic system. The experimental setup of our project consists of a mild steel frame welded in the shape of a chair so that the disabled person can sit comfortably. Also a head rest is provided which can be used to place the head while resting. The seat setup is connected with the pneumatic cylinder and a solenoid valve. The solenoid valve is used to allow air from the compressor to the pneumatic cylinder in order to actuate the cylinder. The connections are given to the pneumatic cylinder in a suitable way such that when the cylinder is actuated, the wheel chair extends such that it converts into a bed. This product will thus prove to be novel medical equipment for the hospitals and for the patients with different aliments.

B. Existing Methodology

Wheelchair is one of the basic necessities in a hospital. It serves the purpose of transporting a person/patient from one location to another. These patients generally have restricted movements due to their diseases or the weakness caused due to their diseases. Such patients have to make use of a wheelchair to move from one place to another. Patients may require moving due to reasons such as, need of fresh air, needing to visit bathrooms and/or to clean themselves. Wheelchair serves this purpose as it is cheap and most efficient device available. The patient, who is incapable to move due to his/her diseases, needs to move himself from the wheelchair to bed or visa-versa. For this purpose they require external help. Also the translation, as proved by many studies, is detrimental to health of the helper as well as the patient. Hence to tackle this problem people have designed wheelchairs which could be converted into beds or visa-versa using mechanical linkages or electrical motor. These systems do not eliminate the need for an external help, as a ward boy or nurse is required

to lower or raise the wheelchair into bed. The implementation of hydraulics improves efficiency as well as eliminates the need of external help.

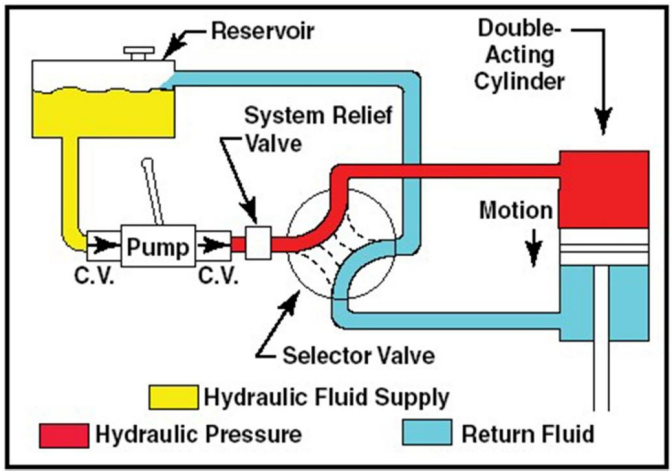

Fig -1: Block diagram of the existing system

Figure 3 explains about the working of a hydraulic system. The yellow coloured fluid is a zero pressured Hydraulic fluid, which acts as the supply. C.V represents the control valve which is present before and after the place where the pump is placed. The function of the pump is to provide the required flow to the operation from the reservoir. The System Relief Valve is used to provide the required amount of pressure for the system. The selector valve acts as the fluid selector which reaches the upper and the lower portion of the double acting cylinder. The blue colour represents the return fluid which provides ease to the movement of the piston. Similarly, the Red coloured fluid is the hydraulic fluid which is the output from the Pump. Based on the pressure of this fluid, the cylinder movement will take place.

C. Proposed Methodology

The wheel chair which is recognized as one of the one most important mobility aid for the physically injured people. The proposed project is developed for mobilizing the patient without external efforts. It is a wheelchair cum stretcher, which is operated pneumatically. Figure 4.1 is the block diagram of the proposed methodology which explains about the work flow of the process. From the air compressor, the supply is given to the FRL unit. The prime function of the FRL unit is to Filter the impurities from the air, Regulate the supply of the air and then to Lubricate it in order avoid the friction during the process. From the FRL, the air passes via flow control valve which controls the flow of the air, which is then made to pass through the 5/2 Solenoid DCV. The function of the DCV is to direct the air towards the pneumatic cylinders for the conversion to take place. Two Double acting pneumatic cylinders are placed below the seating portion. On actuation i.e. on pressing the yellow coloured push button, the cylinder that is placed vertically will operate and the lifting mechanism will take place. Similarly, on pressing the red coloured push button, the horizontally placed cylinder will operate, and the bed to wheelchair conversion or vice-versa operation will take place.

II. BLOCK DIAGRAM

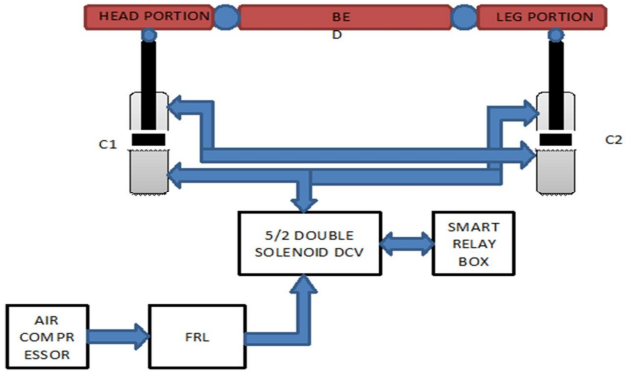

Fig -2: Block diagram of the proposed system

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III. COMPONENTS

The various components used for the lifting and conversion of the wheelchair and vice-versa, is done by using the following components.

A. Air Compressor

An air compressor is a gadget that believers control (utilizing an electric engine, diesel or fuel motor, and so forth.) into potential vitality put away in pressurized air (i.e., compacted air). By one of a few techniques, an air compressor powers increasingly air into a capacity tank, expanding the weight. At the point when tank weight achieves its maximum breaking point the air compressor close off. The compacted air, at that point, is held in the tank until called into utilization. Air compressors have many utilizations, including: providing high-weight clean air to fill gas chambers, giving moderate-weight clean air to a submerged surface provided jumper, providing moderate-weight clean air for driving some office and school building pneumatic HVAC control framework valves, providing a lot of direct weight air to control pneumatic apparatuses, for example, jackhammers, filling high weight air tanks (HPA), for filling of tires, and furthermore to deliver huge volumes of direct weight air for vast scale mechanical procedures, (for example, oxidation for oil coking or bond plant sack house cleanse frameworks).

B. 5/2 Solenoid Direction Control Valve

The directional valve is one of the essential parts of a pneumatic framework. Generally known as DCV, this valve is utilized to control the course of wind stream in the pneumatic framework. The directional valve does this by changing the position of its inner versatile parts. The valve was chosen for fast operation and to diminish the manual exertion and furthermore for the alteration of the machine into programmed machine by methods for utilizing a solenoid valve. A solenoid is an electrical gadget that proselytes electrical vitality into straight line movement and power. These are additionally used for a mechanical operation which thus works as the valve component. Solenoids might be push sort or draw sort. The push sort solenoid is one in which the plunger is pushed when the solenoid is stimulated electrically. The draw sort solenoid is one in which the plunger is pulled when the solenoid is empowered.

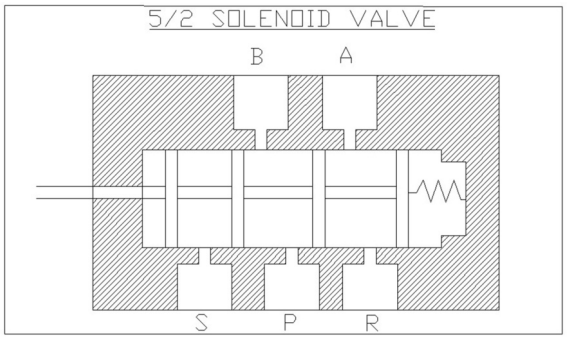

Fig -3: 5/2 Solenoid Direction Control Valve

C. Pneumatic Cylinder

Automation is comprehensively characterized as the substitution of manual exertion by mechanical power. Pneumatics is an alluring medium for minimal effort automation especially for successive or dull operations. Numerous production lines and plants as of now have a packed air framework, which is fit for giving both the power or vitality necessities and the control framework (albeit similarly pneumatic control frameworks might be monetary and can be beneficially connected to different types of energy).

Fig -4: Double Acting Pneumatic Cylinder

IV. CONCLUSION

The implementation of the wheelchair cum stretcher was done by using the Pneumatic Cylinders and the DCV. It has overcome the drawback of patient transfer and reduce the physical exertion of the patient while being transferred. The proposed system consists of a compressor, two pneumatic cylinders, a 5/2 solenoid direction control valve and push buttons to operate the system. Initially, the required pressure for the compressor, which is from the range of 5 to 10 Bars is applied. From the compressor the air is sent to the 5/2 Solenoid Direction Control Valve which will direct the air from there towards the cylinder based on the type of the required conversion. The system will operate in three different modes, which will be, lifting of the wheelchair, conversion of the wheelchair to a stretcher and conversion of the stretcher back to the wheelchair. There are two push buttons placed at the hand rest portion. On pressing one button, the lifting mechanism takes place and on pressing the other button the wheelchair to be conversion will take place. On actuation, Cylinder C1 which is placed vertically will provide the movement for lifting of the wheelchair, and on actuation, the Cylinder C2 which is placed horizontally will provide the movement for the wheelchair to the stretcher conversion, or vice versa. This prototype can be not only be used for also for the patient transfer in hospitals but it can be used by the elderly people at homes.

Fig -5**:** Implemented Work

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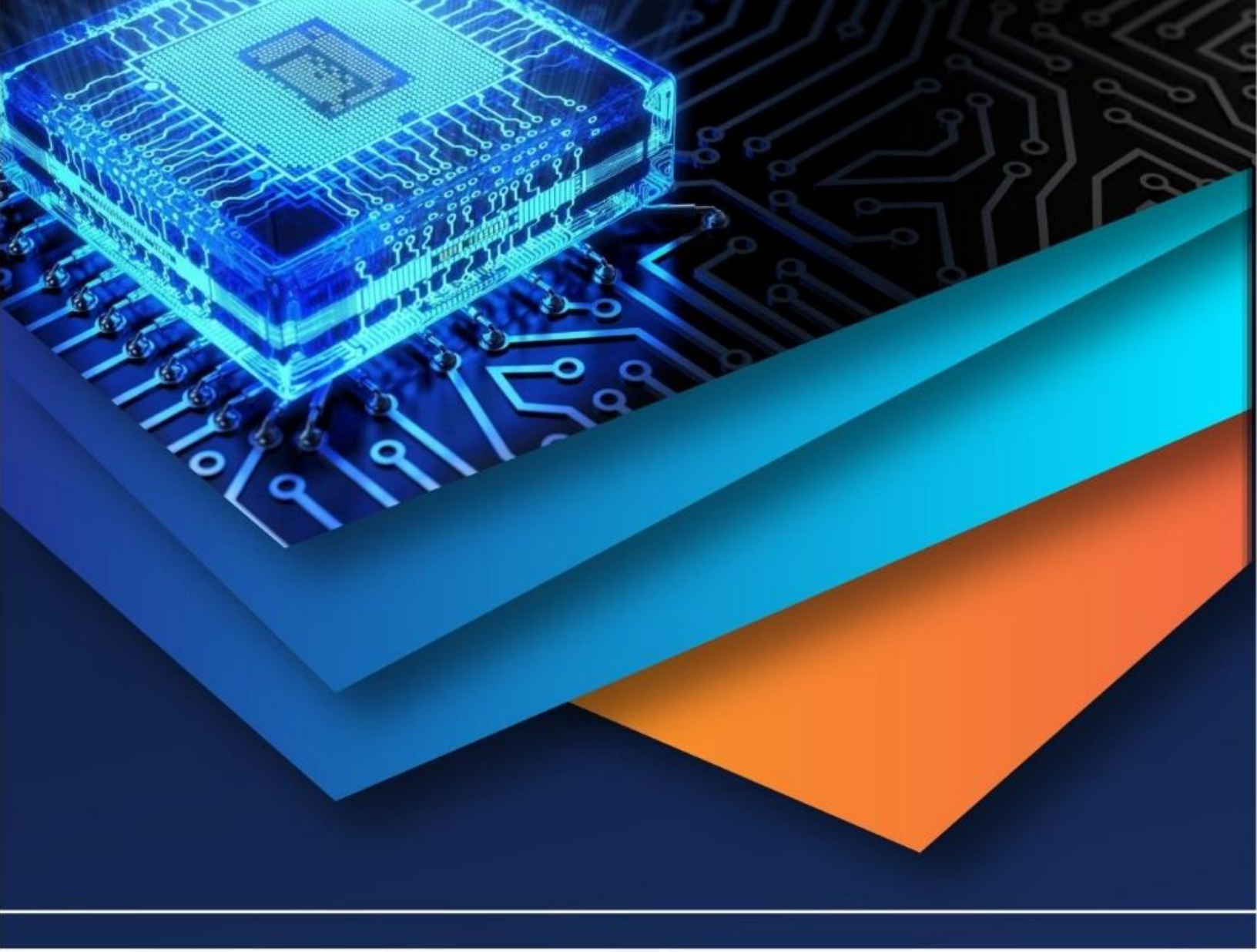

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