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## DEVELOPMENT OF A TRANSFORMABLE ELECTRICALLY POWERED WHEEL CHAIR INTO A MEDICAL EMERGENCY STRETCHER

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### Abstract

The movement of a physically disabled person from one place to another during his/her unhealthy conditions becomes a tedious task. It is required to move the patient within the hospital campus for the basic necessities, physicians health check-up, medical tests etc. It causes inconvenience to both the patient and helping staff. For that purpose, wheelchairs are provided to the patients for the easy handling of above discussed tasks. One helping staff is needed always to be with patient for all these transitions. Sometimes it becomes a tough work when the patient is too heavy to be lifted by two or three members and also when the transition has to be done twice or thrice in a day. Now-a-days automated wheelchairs have also come in some hospitals that reduce the need of nursing/attending staff. The patient can move themselves by their own hands with the help of some mechanism that is used to move the wheelchair which are having their own advantages and disadvantages. Somehow if the problem of transition of patient is solved then it will be a helping hand for both the patient as well as the nursing staff. It is thought to combine the concept of wheelchair and stretcher and design a system which serves the both purposes and hence in order to meet the patient requirement this paper aims at designing an electric wheelchair that can be converted into a bed/stretcher with variable adjustable positions with the help of electric motor.

**Keywords:** Automatic wheel chair, Electric wheelchair, nursing staff, stretcher, Wheelchair.

### I. Introduction

For a physically disabled person in their movement from place to other remains a tedious task. A wheelchair serves for this purpose as it is very cheap and most commonly available. Moreover a wheelchair is one of the easiest modes which serves the purpose of transportation for a patient and is considered as one of the basic necessities in a hospital. It serves the purpose of transporting a person from one location to another. The patients who use these chairs are the

people who are unable to move completely due to their physical disability/injury in an accident or the weakness caused due to their diseases. These people must alternatively use a wheelchair to move from one place to another. Patients may require movement due to reasons such as to fulfil the basic amenities needs like refreshment, search of fresh air, etc. The patient who is incapable to move due to their diseases needs to move themselves from the wheelchair to the bed or visa-versa for which they require external help.

Many studies showed that 40% of the helpers who helped a physically changed person for their translation from bed to chair and vice-versa and the nursing staff in hospital who helped in shifting the patients are suffering from the back pain and joint pains. Transferring the people from one place to other remains a little easier as long as the patient weighs not too heavy or else it becomes much difficult task. Sometimes there may come a situation in which the patient is kept on the floors in order to change their position so as to carry them again. To tackle this problem many people have designed wheelchairs with various applications which could be converted into a bed or visa-versa using mechanical linkages or with the help of an electrical motor. A slipping mechanism or pulling mechanism is used for lowering the back portion. The safety of these systems depends on the helping hand that how the attendant handles the patient and operates the chair. These systems did not eliminate the need for an external help as an attending staff or nurse is required to lower or raise the wheelchair into bed. Then the implementation of hydraulics and pneumatics improved the efficiency as well as eliminated the need of external help.

The hydraulic system requires oil for the operation and proper care was required to store the liquid and also to handle it. Liquid replacement should be done in regular intervals and there comes a chance of making the surrounding places untidy. The pneumatics will need to carry air cylinder which creates noise by heavy air flow though it was proved to be the safest one but due to the bulkiness and heaviness it was dropped.

To overcome the above mentioned problem, the proposed work uses an electrically driven conversion system for the disabled patients. This is even helpful when the patient want to take a nap/sleep by converting the wheelchair to an easy-chair where the person can stop the chair at a particular position where they would feel comfortable. The driving and conversion mechanism is both based on the electric motors. In driving part the motor is put with the gear arrangement to make the speed slow and to give more torque.

### **Patient Handling:**

The present method of patient handling is discussed here from an accident spot to various stages.

- Transferring the patient from the accident spot to stretcher.

- From the stretcher to the ambulance vehicle.
- From the ambulance vehicle to the hospital stretcher.
- Stretcher to bed at Out Patient Department(OPD).
- OPD to (Intensive Care Unit) ICU ward bed.
- OPD to health check-up/test centres/lab.
- Again back to hospital bed with the help of hospital stretcher.

## **II. Literature Review**

Shubhangi Gondane and M. K. Sonpimple [1] stated that the conversion system should be taken into consideration first and then the other things and hence apart from the hydraulic and any other system, pneumatic system has been employed for the conversion of chair into bed. This work mainly stressed on the comfortability of the patients in the wheel chair either during transportation or at stand still condition. Here the wheelchair seat design was done by the synthesis of mechanism. Also provisions have been made for housing additional accessories that may be helpful for the patients in the case of a medical emergency.

Sreeraag C S et al.[2] mentioned about the concept validation of a wheelchair cum stretcher The main objective was to save the space by using this design. It has an ergonomically designed arm rest and handle for patients' comfortable operation of the wheelchair. Some additional features have also been added for the patients comfort. The priority is also given to the cushioning part and the base on which it is fitted. The comfortability should be given to the patients by using a better cushion and base should be used in such a way that easy folding can be done.

According to Joshi Mohit et al.[3] importance has been given to the driving part of wheelchair and the wheels are powered by dc batteries for its automatic movement. Here focus has been made only on the driving part and hence it required enough powered batteries. The selection of the chair wheel was also given importance as the movement depends a lot on wheels and hence a caster wheel was approached for that.

Conversion system is not made completely automatic. Someone is always needed to help in getting converted into the bed or stretcher and therefore slipping system is used in which back portion is pulled slowly for easy conversion.

Rashid Ahmed et al.[4] stated that safety and cost effectiveness is the main factor that should be taken into account and therefore pneumatic system is used instead of dc batteries and hydraulic system. Apart from all the disadvantages that a pneumatic system have like bulkiness, noise generation it assured for the safety issues which are also important and hence proper fabrications of the joints are done with quality material selection.

SV Karankoti et al[5] prioritized the comfort level during the conversion system. A patient when being in a very critical condition, any type of small jerk can lead to many problems and hence they have proposed a hydraulic system for the easy and smooth running of wheelchair. It have the benefit over the pneumatic system as for pneumatic it is always necessary to carry the pressure chamber and also in this system there is so much noise generation. Amos Winter[8] stated that mechanical principles helped for better design understanding the centre of gravity location which was very important in designing the wheelchair. The design and construction part has been given more importance. The height and weight of the chair should be in a ratio of 1:1.5 and so called the golden ratio. It is very essential for the proper balance of the chair.

Motorised wheel chair-cum-stretcher done by Rajeev.V.R[6] et al. used joystick used for driving of the wheelchair. This work lacks its application in a particular case when dealing with the paralysed people or disabled people. Here a 26 watt powered dc motor is used in the back and front positions.

Ravikumar Kandasamy[7] et al designed a solar tricycle for handicapped persons by installing the solar panels on the top so that they can use the generated power for driving. This system operation lacks in the situation in the absence of sunlight and also it adds a cost effect to the wheelchair. Addition of the solar plates slightly increments the occupied space and weight of chair.

Ehsanullah Khan et al [9] designed a low cost trolley cum wheel chair and also gave importance to the patient's safety as well as reduced care takers stress in transporting the patients. A wheel chair is stretched into a chair and a trolley is placed adjacent to it with the same height so that easier transferring can be done.

### **III. Existing System**

In the present situation the wheelchairs are driven automatically by using an electric motor, the wheelchair to stretcher conversion system is done by using hydraulic system or by pneumatic system. In hydraulic driven wheelchair to stretcher conversion system and vice-versa the conversion is done by the hydraulic piston and for this it is required to use hydraulic fluids which are capable of lifting heavy weights and the whole setup looks stingy, large and untidy. For providing automation transducers have to be added, which will convert one signal to the other and thereby this will make the setup more complicated and costly. In pneumatic driven wheel chair to stretcher conversion system and vice-versa, the conversion is done by using pneumatic pressure where the required pressure is supplied with the help of cylinder which contains pressurised gas in it. In this pneumatic system it is always required to carry the cylinder along with the chair-stretcher setup and while in operation, this will create noise due to drop in

pressure. Also and for making this system automatic, there is a need for conversion system which will convert the given signal to the pneumatic signal and thereby making system complex and increasing the cost.

#### IV. Proposed System

In the proposed System the wheelchair to stretcher conversion system is done by using electrical motors. There will be two motors which will convert the given wheelchair to stretcher and vice-versa. One motor is for the foot part and the other is for providing the back support flat such that the wheelchair is converted into a stretcher and the same motors are used for converting this into wheelchair. In this the person may stop the conversion system at any position where the comfortability is felt so that this can also be made altered as an easy-chair.

#### V. Block Diagram

The block diagram of the proposed system is shown in Fig.1.

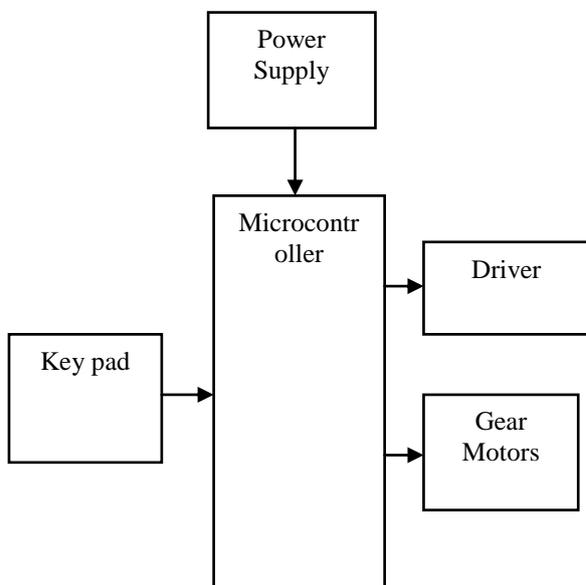


Fig-1:Block diagram of the proposed system.

##### A. Microcontroller

In this proposed work it is planned to perform the control of wheel chair by using a microcontroller.

A microcontroller is a small low cost computer built on a single IC chip which contains a processor, memory, and programmable input/output peripherals. Normally 8 or 16 bit microcontrollers are being employed as it is commonly available in the market. It has the program memory available in the form of ROM. The ROM and a little portion of RAM are contained on the microcontroller chip. Microcontrollers are the processors that are designed for specific tasks and they find their applications in many automation and other embedded systems. Microcontrollers are used to control many devices economically.

**B. Gear motor**

A gear motor is a specific type of electrical motor that is designed to produce high output torque while maintaining a low speed. Gear motors can be found in many different applications and are most commonly used. The gear motors can find its applications in various areas like hospital beds, commercial jacks, cranes etc. In this proposed work a dc gear motor is to be used for raising or lowering the patients' bed.

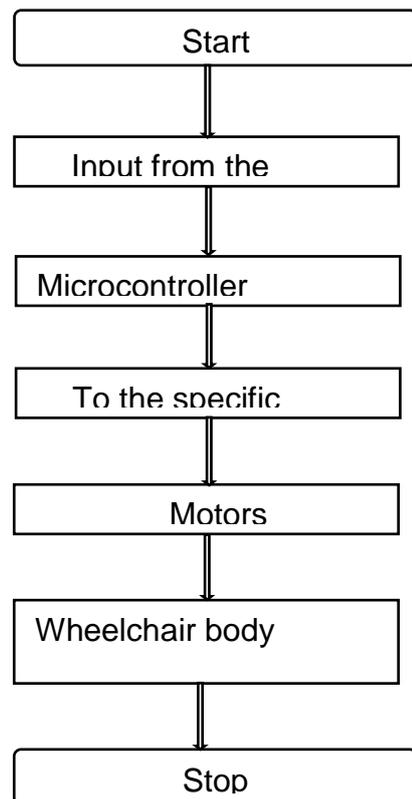
**C. Working Mechanism**

For navigating the wheel chair there will be a direction key provided which gives the signal to the microcontroller after pressing it. This in turn generates the signal which makes the gear motor to rotate the gears attached to the motor are also attached to the back resting support and to the leg support portion which slowly rotates in the clock wise direction and simultaneously the foot part will rise up after reaching the prescribed position it will stop.

For converting from stretcher to bed the mechanism is similar but the portion of back will move in anti-clock wise direction and the foot will move down wards to make wheel chair position as shown in figure 2. This process of conversion can be stopped anywhere if the patient feels that it is the comfortable position. The whole process works only with the help of gear motors. A reasonable number of gears are used here in order to increase the gear reduction ratio. Increasing the gear has the advantages that its speed reduces so that the conversion system can be done slowly. It also increases the torque of the shaft so that a heavy load can be easily carried. The working sequence is shown in figure 3



**Fir-2: Conversion Mechanism.**



**Figure 3.Flow chart of working.**

## **VI. Advantges**

In this proposed system there is no requirement for signal conversion system like electrical to pneumatic or hydraulic actuators/converters. Also this system has an advantage of not having any bulky equipment like piston and cylinder arrangement operating either on air or fluid otherwise it would become a little difficult in handling and storage of the liquid. The more complexity is the system it would require a regular maintenance. This system will provide the attending person an easy handling for the patient and the person can stop the process where the patient could feel that is their comfortable position. This system is very simple as it uses only electric motors for both movement and conversion system which also cost less than those pneumatic and electric systems.

## **VII. Conclusion and Future Expansion**

The proposed system has overcome the drawback of the existing system and this can be extended by using android app control. The above system can be easily upgraded to monitor the patient's health condition with the addition of bio- sensors. The above system can be easily upgraded to monitor the patient's health condition. Many real-time applications can be used for the patient. A number of bio sensors can be implemented to monitor the patient condition regularly. Blood pressure, heart beat, sugar level, pulse rate etc are the parameters that can be measured. This application can also be extended to the blind patients. For them it will be a difficult task to drive this automated chair. Hence some provision can be made so that using the image processing technique the obstacles in the travelling path can be identified and thus avoided.

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