Design and Fabrication of Stair Climbing Wheelchair

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***Abstract*- One of the basic problems of user on manual wheelchair is overcoming architectural barriers (kerbs, stairs etc.) on its way. Even though many research studies have been reported indifferent fields to increase the independence of wheelchair users, the question of overcoming obstacles by a wheelchair always remains as topic of discussion for many researchers. In our project a motor operated stair climbing wheelchair concept which can overcome the architectural barriers to a considerable extent has been developed. This project involves the design of an ergonomically designed battery powered wheel chair for multipurpose use. Stair climbing functionality is embedded in the design through its structure and mechanism. All the design parameters of wheelchair were based on the standard design of the stairs in India. Major part of the project focuses on the proposed design concept and concludes by discussing upon the physical working model developed for the proposed design solution.**

Index Terms- Architectural barriers, motor operated, stair climbing.

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 injures sometimes may be a permanent disability.

MANUSCRIPT BODY

- Methodology :-

The method we followed to complete the project is as follows

SELECTION: - Selection of project

SURVEY: - Existing product = Scope for improvement

DESIGN: - Design of frame and wheel = Analysis of frame and wheel > calculations

FABRICATION: - Procurement of material = Machining

ASSEMBLY: - Fitting all the parts = Wiring

TESTING: - Testing of the wheelchair

RESULT: - Tabulation of result obtained from testing.

PRINCIPLE PARTS

The wheel chair consists of following principle part wheel

1. Frame
2. Lobe wheels
3. Chair
4. Gear motor and Reduction box
5. Transmission system

1. Frame :-

A frame is a structural system that supports other components of a physical construction or steel frame that limits the construction's extent. This frame was fabricated using MS pipe of outer diameter 25.4 mm and wall thickness of 1.67mm. The frame can be divided into two parts rectangular part and leg part. The rectangular part is used to hold the chair along with the tilting mechanism, drive shaft and gear motor. The leg part is mainly used to hold the planetary wheels and driven shaft. The dimensions of the rectangular part were chosen by considering the

space required for a normal person to sit comfortably and taking other ergonomic considerations.

2. Lobe wheels :-

The stair climbing lobe wheel was designed by imitating the continuous foot movement in a human gait cycle. The discontinuous wheel or stair climbing lobe wheel is designed to produce similar phase cycle as stance and swing phase of human gait cycle. The stair climbing lobe wheel is designed by considering foot size of human so that each spoke shoe will adjust to the tread size automatically. The size between each shoe is designed to negotiate maximum height of the riser in public building. It can negotiate the step riser of range 75 – 185mm and tread width range 230 – 350mm which enables it to access almost all the stairs in public areas. A light weight wheel with drum brakes was also developed to control the movement of the shaft during ascending and descending process.

3. Chair :-

The chair is one of the main parts of the wheelchair. The chair is fitted on to the frame of the wheelchair. There is a tilting mechanism which connects the chair to the frame. There is need for the tilting mechanism because the person sitting on the wheelchair may feel like slipping from the seat because of the inclination of the stairs. The more the inclination of the stairs the more he feels to slip from the chair. So with help of the seat tilting mechanism the person sitting on the wheelchair can adjust the seat to the higher angle making the seat nearest to parallel to the ground so that he may sit comfortably on the wheelchair while it is climbing stairs. The seat tilting mechanism where the knob is rotated to tilt the seat to the higher position. The person sitting on the wheelchair can rotate the knob to change the position of the seat when he wants to climb the stairs. With this the CG of the wheelchair will

4. Gear motor :-

A gear motor is used as locomotion unit and this motion is transmitted to the wheels through shafts. This motor is mounted on a support provided by the shaft. The dimensions and specifications of gear motor are obtained from standard motors available. The battery availability in the market is of 12V, so to provide the required voltage for the motor two batteries are connected in series to make 24V. The connection for the motor. The motor and the battery is connected in series and the circuit is closed by connecting a reverse switch. The reverse switch is used to change the direction of the motor so that the person can either climb up or climb down the stairs.

5. Transmission system :-

The transmission component of the wheelchair design is responsible for allowing the operator to change gears between forward, neutral, and reverse movement. The transmission system consists of the motor and chain-sprocket system. The motor with the reduction box is directly mounted on the centre shaft with the help of mountings from the frame to hold the motor in place. Therefore the motor is mounted rigidly, so that all the torque produced is completely transferred to the wheels. Now the drive from the centre shaft is transferred to the front and back shafts with the help of the chain arrangement. The front and back shafts drive the wheels which climbs the stairs.

CONCLUSION

The design of the wheelchair is compact and hence is able to move about in almost all the stairs that we find at institutions, offices, industries and also at some homes. The design is made very safe and there is no chance of failure of the frame and wheels under normal conditions According to the tests conducted, the stair climbing wheelchair has a capacity of carrying a load of 100kgs on flat surface. It has the ability to ascend a flight of stairs of 35-degree elevation carrying a weight of 55kgs.

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