

Ergonomic Design and Development of Stair Climbing Wheel Chair

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Abstract:- Currently autonomy in the area of mobility is accepted to be of high value which may be occasionally hampered due to some form of disability. Hence, wheelchairs continue to play a vital part to allow for mobility of the impaired people. But this autonomy isn't applicable in surroundings having steep pitches or staircase. Therefore, a wheelchair having staircase climbing capability could be the remedy. A new stair climbing wheelchair was designed in this paper which can work in three modes stair-climbing mode, powered wheelchair mode and mode. It helps physically impaired and senior people to move more flexibly and comfortably. The walking medium was first designed in this paper, as well as the theoretical design and computation which were used to decide the structure and dimension; also transmission system design was followed. Theoretical Dynamic analysis on stir of wheelchair is also carried out to bring a better view at the transmissibility of wheelchair. The design of a stair climbing all terrain wheelchairs is tried and critical factors of wheelchair are modeled also, such a wheelchair could also give an easy means of transport for cases in hospitals. The different mechanisms have been anatomized and compared to elect the most suitable medium. The medium therefore chosen has been modeled and anatomized using SOLIDWORKS computer software. The end of this paper is to present a medium for staircase climbing of wheelchair and to dissect the effectiveness of the same. After making the necessary design changes, a prototype of the wheelchair is developed..

Keywords: *Wheelchair, Transmissibility, All terrain, Modelling, Optimization Design.*

INTRODUCTION

According to the first official report, "the Global Disabled Persons Report," there are 650 million people, or nearly 10% of the world's population, who are disabled in the United States. 1970s, and the percentage has now risen to 15%. The proportion of disabled people is growing due to the ageing population and increase in chronic diseases. Over a many decades there's no great change in the vacuity of sophisticated wheelchairs to the common people. The profitable or below profitable classes of India are suffering with the extravagant prices for sophisticated or the dependable models of wheelchairs. The introductory issue, which is set up these days is the incapability of the wheelchairs to pass through different terrains. likewise, the common wheelchairs aren't manufactured with purposes of climbing the stairs. The elaboration of wheelchair has been governed by a notion of comforting diversified druggies and their availability. numerous figures of associations have ventured into the transmittable systems. The traditional wheelchairs and powered wheelchairs

continue to play a vital part in mobility. still wheelchairs to date give a high position of mobility only in artificial or hedge free surroundings. therefore, there remains a significant gap between the handicap negotiating capability of a wheelchair and that of the average suitable person. This aspect is maybe most apparent when considering stair-climbing. The planetary bus medium is optimized to extend the life of the gear for the transmission system and ameliorate the security of the wheelchair; the seat backrest adaptation system is added which is used to acclimate the centre of graveness of the wheelchair and keep the seat always in position with the ground while climbing up and down stairs.

Two abecedarian means of stair concession are provision of a stepping medium, or adding the wheel's footmark(periphery) so that the step is bridged. Provision of a stepping medium requires fairly complex mechanical operation and must be linked to knowledge of the position of the stair edge. Murray John[1] has presented recent advances for mobility assistive bias and comparison of different check assistive mechanisms along with their advantages and disadvantages. KanYoneda et al[2] have reported the use of greasepaint filled belt for stair climbing straggler which helps to increase the disunion measure. The belt was also experimentally tested

The wheelchair will be used for medical operations and so the medium should be largely stable under worst conditions. The wheelchair needs to be accessible to utmost number of people in developing country like India and so the cost mustn't be too high. The medium will have to give nonstop positive lift to lift or descend in reasonable time this is dependent on number of connections

1.DEVELOPMENT OF STAIRCLIMBING AND ALL TERRAIN WHEEL CHAIR

The development proposed for all terrain wheelchair is originally carried out with a abstract solid model using solid modeling software. Abstract model is further modified considering the dynamic stability of tracked medium for all- terrain wheelchair. Elaborate analysis is carried out, considering the following.

1. Most importantly, the tracked medium not only helps in climbing stairs, but also most suitable for all the different terrains.
2. The medium must maintain the stability while climbing any grade.
3. Climbing stairs comfortably without any possibility of tripping.

4. It should help in transmissibility through any different standard of stairs irrespective of their confines. In tracked medium there are two major types those are single section tracked and double section tracked. Double section tracked medium is more suitable for climbing of stairs with no discomfort and lesser stability considering the center of graveness of system. Although, double section tracked medium is complex, objectification of some sophisticated technologies with better assessments can break the complexity.

2. ANALYSIS OF DESIGN PARAMETERS

Mortal and other creatures elect walking patterns that appear to minimize energetic cost. They tend to move at a speed near that minimizes the metabolic energy cost per unit distance travelled(5). And at a given speed the nervous system selects a combination of step frequency and step length that coincides with the minimal rate of metabolic energy expenditure. By considering comfortable staircase ascent speed to be one step per second we get the direct speed of the wheelchair. After opting the chain, the coming step is the selection of sprocket. This is done using the pitch of the chain. The tooth correction factor is suitably modified.

Shaft: Shafts is handed with way for the underpinning of the compartments and sprockets at proper distances

Tensioner : Tensioner is a element that's present for ease of assembly of chain drive. For proper functioning of the chains they must be under proper pressure.

Finite Element Analysis : For proper traction and stability on the staircase, it's assumed that the wheelchair should be resting at four contact points on each side. Lin Zhang and Xi Feihong[11] have used the Autodesk Inventor for modeling and simulation of stair climbing wheelchair. For easy ascent, the stiltis given an angle.

It's necessary to validate the results through factual trial and to be sure that the medium will actually serve as it's anticipated, before pacing with factual manufacture of prototype. For this purpose a model is developed with reduced scale and variety of trials in colorful conditions are performed to validate the medium

3. OPTIMIZATION DESIGN

Figure 1: Stair structure

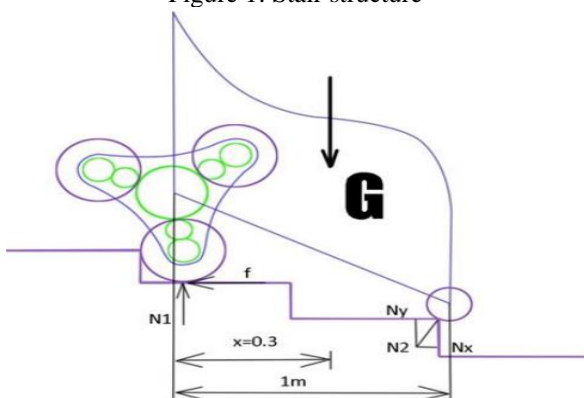
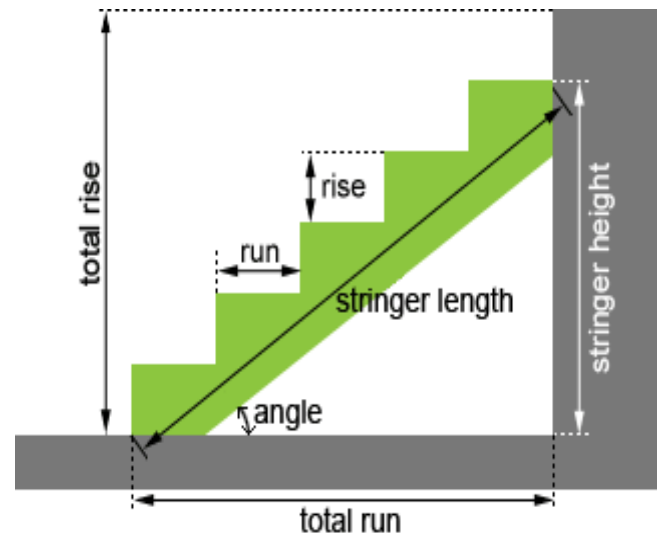


Figure 2: The condition of slip.

The operating principle of the wheelchair that can climb



stairs is as follows: one input is provided by twomotors that drive solar gears of planetary wheels, and the other degree of freedom is controlled by the terrain. When the ground has low friction, the planet carrier (i.e., the other input) can adjust in true adaptive response to the road conditions; when the wheelchair is climbing stairs, one of the degrees of freedom is constrained by the stairs, the wheels cluster can develop into a planetary wheel system, and the planet carrier drives the other two wheels around the constrained wheel to achieve the function of climbing stairs. In order to ameliorate our wheelchair, the following optimizations are designed planetary bus medium optimization, seat backrest conforming medium, locking system and enhancement the comfort and convenience grounded on the ergonomics proposition. M.A. Saliba, D. Zammit[6]

1. Planetary bus system optimization-Ordinary planetary wheel structure is when the central shaft drives the central gear; the central gear will drive the planetary gear and the planetarybus to make the wheelchair go forward

2. The same drive system through simple

Metamorphosis has two driving modes – move on the ground and climbing stairs which have compact structure and accessible operation.

4. ERGONOMICS DESIGN

Along with society's unremitting progress, the rapid-fire development of the product technology and the Internet, the product of mortal design has reached into a new stage. Design of the " mortal- machine- terrain" collective concinnity and the " mortal- centered" design conception has come the important foundation for the ultramodern society.

The ergonomics is one of the disciplines of collaboration on technology and mortal relations; study of mortal deconstruction, physiology and psychology of colorful factors in some kind of work terrain; study the relations of mortal and machine and terrain; study of how to have unified consideration of working effectiveness, mortal health, safety and comfort when people work and serve in

family life and leaves **ShikhaOram, 2014[8]**. Thus, in order to make the design of the wheelchair be more mature, in order to make the driver more accessible. Therefore, in order to make the design of the wheelchair be more mature, in order to make the operator more convenient and comfortable, the element of ergonomics has been added in our design. Based on the principles and methods of ergonomics,

5. DEVELOPMENT OF PROTOTYPE

The prototype is developed. The rubber track of single side is prepared for testing the feasibility of the medium. There were many design variations for assembly purpose. Trials are conducted on the test model using factual staircase. The ascent, descent and ease of rolling of the test model are tested. It was observed that the rolling of the medium needed inordinate quantum of necklace and also there was a problem of the bulging of belt. This problem was answered by cutting the belt into lower corridor. This gave fresh stability to the medium on the staircase. It was also observed that there was slight bending at critical points in pipe. Hence, it was concluded that pipes of larger periphery should be used. It was concluded by observation that the classes for lower sprockets could be made lower and the length of medium could be kept constant by adding the lengths of pipes. Test model was made using pipes of 16 mm external periphery. The pipe was set up to bend at critical points during testing. Hence, the final stilt was made using pipes of 22 mm external periphery. The deportations at ends of the axle are made zero. The cargo that which acts on the axle is considered, to be outside the stepped figure. The type of cargo that which happens to develop over the axle while it's static is a slightly distributed cargo throughout the twisted face of the ends of the solid axle. The cargo is considered, to be one fourth of the cargo due to weight on each side of the axle. The element type used is 3D tetrahedron

DESIGN OF STAIR CLIMBING WHEELCHAIR:

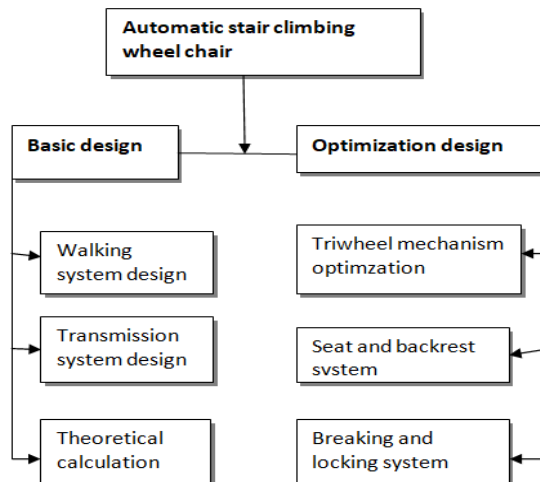


Figure3: Modeling and design

The object of the design of the wheel chair as mentioned in this paper includes to reduce the cost by implementing a

new mechanism, functions dependably in a variety of operational circumstances, to conserve space and prevent the disabled person from exerting themselves. Some of their notable design modifications includes,

1. Front wheels are kept simple with a belt drive that uses an electric motor, and the back wheels are powered by it. A triangle frame has three identical wheels mounted on each corner that are connected by a belt system. However, the wheelchair's weight was a problem because it was so heavy with the battery and motor.

2. Each back wheel in the gear system has seven gears. Three pinions are attached to the one gear in the center, and then three other gears are attached to those pinions. The majority of gears outside the wheel are coupled, ensuring smooth operation. Additionally, an electric motor is linked to the shaft. After researching various spring, lever, and pneumatic damping systems. For dampening, a spring coil was utilized on the back wheel.

6. CONCLUSION

In this design, designed a new kind of stair-climbing wheelchair, which has compact structure, can manage with flat or inclined terrain, stairs and obstacles. The different mechanisms were reviewed and the most applicable were studied in detail. Their relative advantages and limitations were compared and the tank medium was set up to be most suitable to fulfill the colorful conditions. Modeling and analysis of the tank medium was carried out using SOLIDWORKS software and the results achieved were encouraging. The maximum deviation occurs at a non-critical point. therefore, from the SOLIDWORKS SIMULATION analysis the design is stable under the needed conditions and hence it's used. A test model was developed and variations were made for design for manufacturing and assembly(DFMA) after thorough trial on the model. Grounded on these variations, the factual prototype was developed. The president tipping medium and the electrical controls were also mounted. The prototype was tested on position face as well as on staircase. It's seen that the tank medium works effectively as it was anticipated

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