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Design and Development of 3 Wheel Handicapped Steering Propulsion Cycle

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Abstract: *Mobility of physically disabled persons is a concerning social issue nowadays and Various hand driven tricycles, wheelchairs, retrofitted vehicles etc. Its commonly available for disabled people as a mode of transportation. This tricycle are three-wheeled design pedalled by disabled persons in the side and seat in the middle for sitting arrangement. The disabled persons use only one hand to steer the handle because other hand is used to rotate the pedal. This Paper Purpose is to design and fabricate a low cost tricycle for the handicap people to be propelled by the novel link mechanism attached to the steering column converting into cranking, using the advantage of leverage, with proper balance and distribution of mass and centre of gravity to crank the wheel shaft for propelling. The disabled persons can use both the hands on the steering, better control of the vehicle is ensured.*

Keywords: *Design, Cycle, Propulsion System, Handicapped Person*

I. INTRODUCTION

In general, manual wheelchair propulsion is an inefficient form of human locomotion. Hand-rim wheelchair propulsion will lead to a relatively high strain on the cardio respiratory and musculoskeletal systems, resulting in a high energy consumption, low mechanical efficiency, high heart rate and on the long term, to complaints related to anatomical structures of the upper limb. These factors, in combination with the general characteristics of the wheelchair-confined population (a physical disability, relatively high age, a sedentary life style untrained which may lead to a more pronounced sedentary lifestyle, which, in turn, may lead to health risks with respect to the cardio respiratory system. However, different cardio respiratory responses are seen when different wheelchair propulsion mechanisms are used. Traditionally, crank- and lever-propelled wheelchairs appear to be less straining forms of locomotion. The continuous motion, use of flexor and extensor muscles, and a less complex coupling of the hands seem the major contributing positive factors. More recently, the beneficial physiological characteristics of a so-called hub crank propulsion mechanism (a set of more or less traditional cranks fixed to the hubs of the rear wheels of a racing wheelchair) for track wheelchairs have been stressed. Indeed, lever-propelled wheelchairs lead to lower physical strain compared to hand-rim-propelled wheelchairs, as has been substantiated in previous studies Propulsion mechanism. The tricycle are general also is fairly practical: it is used in Europe and Northern America both in recreation and sports-oriented wheelchairs, as well as in wheelchairs for daily life. Indeed, significantly higher mechanical efficiency (ME) has been found using lever-propelled wheelchairs in comparison with hand-rim wheelchairs. The tricycle are implies that levers allow individuals to propel the wheelchair for a longer duration or at a higher mean velocity, thus increasing the social radius of action or freedom of mobility. The use of lever-propelled wheelchairs is increasing with the availability of lightweight materials and contemporary designs. Lever propulsion mechanisms further allow ergonomic optimization to individual physical characteristics on different mobility related design characteristics: not only with respect to the seat configuration, but also the lever design. One may think of lever length, grip form and orientation, and spatial orientation of the levers as well as the number of gears (thus varying the mechanical advantage). This allows fine tuning of the lever-propelled wheelchair to physical characteristics and aspects of different disabilities as well as to personal requirements and different task conditions.

II. LITERATURE REVIEW

A. Literature on "Handicapped Steering Cycle"

Ajit Tiwari, Rahul Mishra, Abhishek Sharma, Amitesh Sharma, Purushottem Mishra : Handicapped Steering Cycle

- 1) *Conclusion:* Traditional manual wheelchairs require considerable use and control of both arms for operation, thus adaptations are required for individuals with asymmetrical use of their arms. The Handicapped Steering Cycle Building upon previous projects the goal of this project was to create an accessory to be installed on a standard wheelchair, which allow full control of the wheelchair with only one Hand while addressing areas lacking in commercial products and previous designs, such as manufacture ability, attendant control, user comfort and ergonomics. After preliminary testing and analysis of three one-arm

propulsion designs, the project team developed a design for a removable, leveroperated accessory which could be adapted to fit a range of the most popular standard wheelchair models. The propulsion system, connected to the main lever by a coupler link, consists of a dual gearpawl assembly in which the desired direction of motion is chosen by moving a shifter to Joint one of the two gears press-fit around clutches, each of which allows motion in only one direction, either forward or reverse..

B. V. B. Vaidya: *Design and Fabrication of Wheelchair cum Tricycle for Physically Challenged and Elder People* (2016)

1) *Conclusion:* This paper is about the development of traditional manual operated wheelchair cum tricycle is rear wheel drive in which chain drive mechanism replaced with single slider drive mechanism Design and Fabrication of Wheelchair cum Tricycle for Physically Challenged and Elder People concept of this model is taken from manually operated tricycle and railroad car. This wheelchair cum tricycle is useful for handicapped person and modified tricycle gives the both advantages of wheelchair (for short distance or in-door use) as well as tricycle (for long distance use) in one machine.. The Design and Fabrication of Wheelchair cum Tricycle for Physically Challenged and Elder People paper provides the details of components used & designing parameters takes in consideration while designing tricycle. The wheelchair cum tricycle is very efficiently design and can be proved as better replacement for tricycle having chain drive mechanism.

C. P.R. Jawale, Mr.A.R.Gabhane, Ms.K.G.Baje, Mr.D.B.Lakade, Mr.D.N.Patil: *Modern Hybrid Tricycle for Handicapped Person*(April 2017)

1) *Conclusion:* In rural and city areas, tricycle is cheap for transporting purpose for short distance. Tricycle is generally propelled by human energy. The disabled person generally used the Hand Powered Tricycles in this community, but some most of the hand powered tricycles do not have the physical strength or coordination to propel themselves on the tricycles with their arms and hands. The design factors of all are considered by analyzing the problems of handicapped persons. This paper gives the idea about the research papers related various technologies of tricycle. Various kinds of technology of tricycles are here discussed as well as compared also.

III. WORK PLAN AND OJECTIVE OF WORK

A. Working Principle

When the apply force on steering in forward and backward direction liver and crank provide the motion to wheel chair by converting the sliding motion into rotary motion. The direction of motion of wheelchair is controlled by steering. The device is operated by to and from motion of steering which help to rotate the wheel, the turning action takes place by tilting the steering forward and backward direction.

B. Components

Table: 1 Components

COMPONENT	MATERIAL
Steering Actuator	Mild Steel
Steering Wheel	Standard
Support Frame	Mild Steel Tube
Steering Arm	Mild Steel
Seat	Standard
Cranking Offset Assembly	C30 Steel And Mild Steel
Steering Column Rod	C30 Steel

- 1) *Working:* This is a single seated three wheeled vehicle with front wheels being steered by the steering column. The steering column has the outer tube which is hinged at the base and the other side extension of the steering column is pulling and pushing the cranking mechanism of the rear wheel. The internal rod of the steering column are hinged to the link mechanism to the front wheel to steer the wheel as the steering handle is being rotated which are held at the top side of the steering column. The steering column is holding the steering rod within the bearings. The rear wheel axle is on one of cranking mechanism. The rear wheels are held on two different axles. The steering column when pulled or pushed, the steering column pivoted at the base from a distance. This is termed as a lever that pivots on a fulcrum attached to the fixed frame. The lever operates by applying force at the steering handle, at distance from the fulcrum or pivot. As the lever pivots on the fulcrum, points further from this pivot move faster than points closer to the pivot out of the lever and the power into must be the same so forces applied to points farther from the pivot must be less than when applied to points closer in. If a and b are distances from the fulcrum to points A and B and let the force F_a applied at A is the input and the force F_b at B applied the output the ratio of the velocities of points A and B is given by a/b so we have the ratio of the output force to force the input or mechanical advantage is given by

$$MA = \frac{F_B}{F_A} = \frac{a}{b}$$

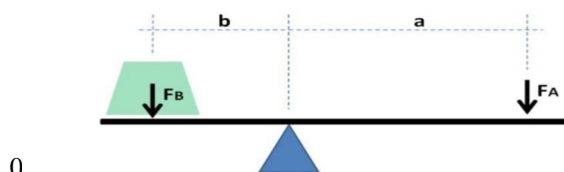


Fig-1. Working

Where: a & b distances from pivot point

M_1 & M_2 masses

F_a & F_b are forces

The working law of the lever which was proven by Archimedes using geometric reasoning. If the distance a from the fulcrum to where (point A) the input force is applied is greater than the distance b from fulcrum to where the output force is applied (point B) then the lever amplifies the input force. With the help of above principle, we are using the steering column as lever to get the mechanical advantage by using the pivot and use the smaller distance from the fulcrum to connect the crank link of the wheel to propel the wheel to affect the drive.

- 2) *Market Survey:* For making the best product which will satisfy the customers need and overcome the problems arriving in the existing product the market survey is necessary, so in order to make convenient product we took a market survey through the various resources such as visiting the various industry, we referred various article, books, magazine, newspapers related to our field of invention and we found many problems arising in our field.

After analyzing all the things, we come to our conclusion to make a product that overcomes all the problems and difficulty of previous product and we are inspired to make the “Design and Development of 3 wheel handicapped steering propulsion cycle” which will be more convenient and economical.

IV. DESIGN AND MODELLING

A. Sketches on Papers

For better understanding of different parts of our project first we made sketches on paper so we can understand different components of our project and get idea to how we will make project model.

B. Designing in Parametric Software

- 1) For final product designing we made 3D model in SOLIDWORKS Software, in which we made different individual components and finally we made assembly of different components.
- 2) For manufacturing of any machine, it requires to firstly making individual parts with desired shape and dimensions containing in whole machine and then we need to assemble every individual parts with each other to make final machine.
- 3) Here, different view of parts and the materials with dimensions of the parts are shown for manufacture / machining them in workshop. They are as follow

Table-2.Design Parts

Sr.No	Part Name
1	2D Design of the model
2	Base of seat
3	Front Wheel
4	Back Wheel
5	Steering
6	Base Frame Part
7	Bearing Shaft
8	Bottom Strip For Steering
9	Cam Shaft
10	Final Assembly

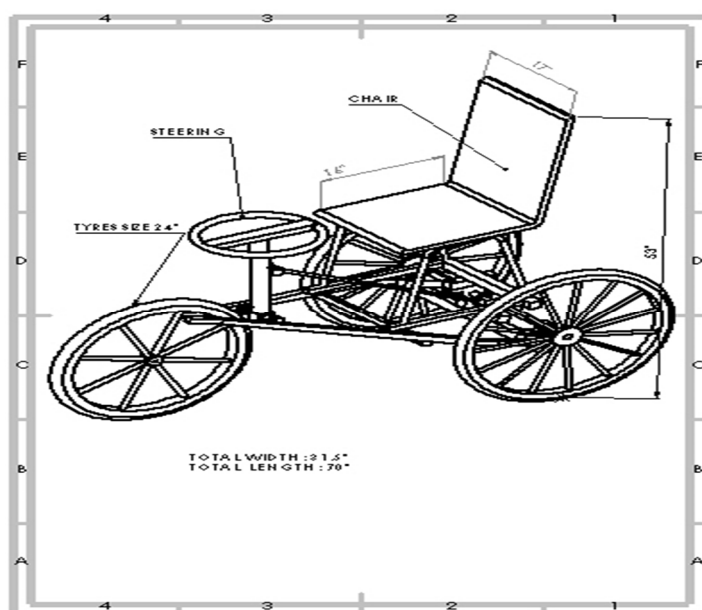


Fig-2.Design of the model

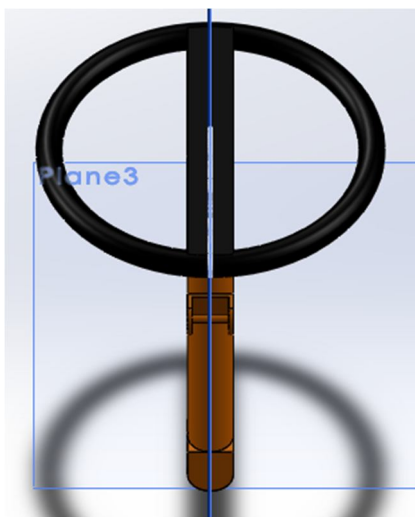


Fig-3.Steering



Fig.-4. Back Wheel

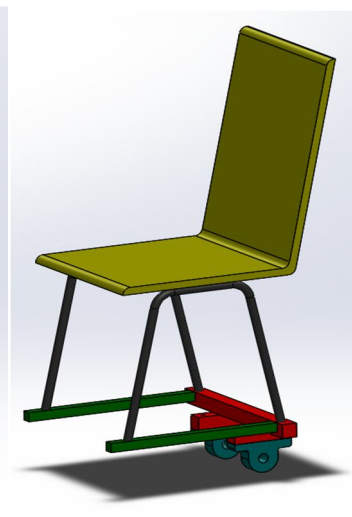


Fig.5. Base of seat

V. TECHNICAL OVERVIEW

A. Spoke

The spoke is one of some number of rods radiating from the center of a wheel connecting the hub with the round traction surface. This term originally referred to portions of a log that had been split length wise into 4 or 6 sections. The Spoke radial members of a wagon wheel were made by carving a spoke (from a log) into their finished shape.



Fig-6.Spoke

B. Steering

The Steering is collection of linkages, components etc and which allows any vehicle to follow the desired course. The Steering basic aim of steering is to ensure that the wheels are pointing in the desired directions. Steering is typically achieved by a series of rods, linkages, gears and pivots.



Fig-7.Steering

C. Flywheel

The flywheel is a mechanical device specifically designed to efficiently store rotational energy. This resists changes in rotational speed by their moment of inertia and The amount of energy stored in a flywheel is proportional to the square of its rotational speed. A flywheel's stored energy is changed by increasing or decreasing its rotational speed by applying a torque aligned with its axis of symmetry.

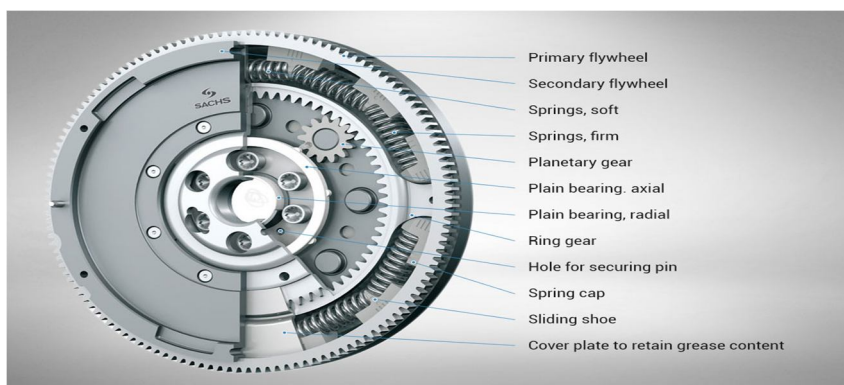


Fig-8.Flywheel

D. Rim

This is commonly a metal extrusion that is butted into itself to form a hoop though may also be a structure of carbon fiber composite and was historically made of wood. The rim Some wheels use both an aerodynamic carbon hoop bonded to an aluminum rim on which to mount conventional bicycle tires. The metallic bicycle rims are now generally made of aluminum alloy. The rim designed for use with rim brakes provide a smooth parallel braking surface while rims meant for use with disc brakes.

VI. CONCLUSION

After completing the project, we conclude that our project is simple in construction and compact in size for use. Manufacturing of project model is easy and cost of the model is economical. The tricycle prototype can be built to carry out to determine the working and efficiency of the tricycle over existing wheel chair hence the experiment over the prototype gives the result of effortless operations of vehicle for physically disabled persons. For the propulsion of the wheel chair with tiller mechanism which can be provided the easy movement of wheel chair over an existing vehicle with the help of different mechanism and combination of technology which can have greater advantage to the physically disabled persons to propel the vehicle.

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