iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IV **Month of publication:** April 2018

DOI: http://doi.org/10.22214/ijraset.2018.4210

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Design of Tricycle to Reduce Driving Effort by Implementing New Gear Combination

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Abstract: ***Conventional tricycle required much used and manage by one arms for function, thus adjustment are required for handicap people with reducing effort of their arm. The objective of this project was to reduce driving effort by implementing a new gear combination. The price of vehicle may not be reasonable for a handicap people. So the focus is laid on the simplicity in design, high performance, easy maintenance & safety at very reasonable price. This paper provides detail designing parameters takes in consideration while designing the tricycle. This tricycle is very efficiently designed.***
Keywords: Nefforts, Gear ratio, Design, Cost, etc.

I. INTRODUCTION

Transportation is one of the important sources for increasing mobility of human. In transportation, vehicles play a very crucial role. Normal human being uses these vehicles very easily but for a disabled person it is very inconvenient. Nowadays various hand driven tricycles are available for them but these are designed primarily for the basic functional use for moving on road without considering many important aspects of safety, ergonomic aspects and aesthetics.

The design of tricycle is an improvement on the existing ones. It is carried out to benefit the user handily and physically such that when a little effort is exerted, a greater output (movement) is achieved as a result of the fast transmission generated by the chain drive mechanism. In this project, chain drive mechanism is using which allows the user much more efficient propulsion than would be provided by the hand pedal wheelchair. The project's goal is to provide a good living condition for people considered to be physically challenged (disabled), to transport themselves around their environment.

After our initial searches and inquiries the team adopted conventional tricycle as the most suitable means, because of it's:

1) Low cost, easy attainability and affordability by the disabled.
2) Small size, ease of movement and transportation ability.
3) Simplicity of parts and easy assembly.
4) Widespread usage by all age categories (children, youth and the elderly).

This project focuses on a specific disabled category, who are without legged people.

The process was initiated by searching for studies and research regarding developing regular tricycles with the purpose to suit the without legged person. We found many simple ideas to serve such category, however, they were personal endeavours not supported by states or organizations and not documented in scientific research.

II. PROBLEM DEFINITIONS

A. To develop a unique, cost-effective, purpose serving tricycle for disabled person.
B. To design and fabricate a tricycle for disabled person for allowing the disabled person to drive less effort while driving on ascent road conditions.

III. FIELD SURVEY

In order to get a basic idea of the day to day problems faced by disabled people for conveyance and transportation, Field Survey is carried out. Also a visit was conducted to ANANDWAN, WARORA, CHANDRAPUR (MAHARASHTRA) and some inputs regarding the project from the disabled people staying in the ANANDWAN were noted down in the field survey sheet. Following are the inputs gathered:

A. Vehicle should be cost effective.
B. Vehicle should be easy to operate.

C. Manual shifting of gears should not be there.
D. Efforts required to run the tricycle on ascent roads should be minimum.
E. A disabled should be able to climb up on the tricycle without getting help from other person.
F. Sufficient space should be provided so that hands or other body parts will not touch the vehicle body.
G. Functional controls of the vehicle should be within the reach.
H. Vehicle should be stable (should not move) at the time of climbing the person.

IV. MATERIAL SELECTION

While selecting the material for fabrication, prime motive is to select material that can provide high strength and reliability to the tricycle. Another consideration is to reduce material cost and overall weight of tricycle. Some desirable properties of material required for fabrication of model are [2]:-

1) Material must have high tensile strength.
2) Material should withstand torsional and shear stresses.
3) Material should be highly resistant to changing weather conditions.
4) Material should be light in weight.
5) Material should be cost-effective & cheap.

As the application includes various forces and moments on the fabricated model, the material selected must be either metal rods or tubes for safety and efficient working. Mild Steel provides high tensile and torsional strength (Refer Table No.1) required for the application. Hence, Mild Steel is selected.

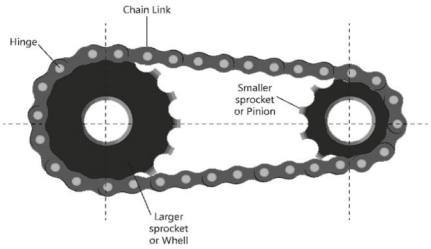
Properties of Mild Steel:-

Properties	Values
Density	7.7- 8.03 gm/cm3
Elastic modulus	190-210 GPa
Poisson's ratio	0.27-0.3
Tensile strength	615.4 MPa
Yield strength	400 MPa
Hardness	179 HB
Impact strength	6.1 J

Table No.1 Material Specifications

V. CONSTRUCTION

Below is the detailed outline of the construction process we used. Each section is accompanied by a detailed schematic diagram detailing the dimensions of the materials used as well as pictures taken during construction.

Fig. No	Name of the components	Components	Specifications
5.1.	FRAMEWORK		Dimensions: Overall length - 0.813 m Overall width - 0.762 m Overall height - 0.457 m
5.2.	WHEEL RIM		• Wheel rims for the tricycle shall be of size 28 inch x 1.5 inch. • The spokes shall be of 2.00 mm normal dia. • There shall be 32 spokes in the front wheel and 40 spokes in each of the rear wheels. • When assembled the spokes shall cross without touching each other.
5.3.	DRIVE CHAIN		The power transmission from hand driven lever to the rear gear is done with the help of drive chain mechanism. In which, the driver gear contain 18 teeth on it's periphery and the driven gear contain 24 teeth on it's periphery. The total number of links are used to drive the wheel are 62.
5.4.	REAR GEAR		The rear gear contains 24 teeth as shown in figure. It is directly fitted on the axle of the wheel for parallel motion transfer from hand lever to the wheel. As it is bigger than the drive gear for transmitting less speed but at the same for transmitting more power to the driven gear by applying less torque .
5.5.	TYRES AND TUBES		Tyres and tubes of required dimension for the rim of 28” and 1.5”
5.6.	MUDGUARDS		The mudguards of minimum 0.45 mm thick MS sheets shall be provided with beaded edges.
5.7.	SEAT AND BACKREST	The whole seat is of fiber for reducing it's weight.	
5.8.	ACCESSORIES	Following items can be additionally added as normal accessories: a) Bell/ Horn. b) Red reflectors.	

VI. PRINCIPLE

This type of tricycle usage all handicapped person which is contain hand lever propulsion and in direct back wheel connecting and single hand drive system. This type of tricycle drive to easy and economical purpose based design in this wheel chair. The hand lever connecting on direct back wheel in drive chain mechanism, when your drive to the hand lever rotating in back wheel acting on forward motion then which is contain single hand bar drive system.

VII. WORKING

A. Since it is hand powered tricycle, the power is given by pedaling the sprocket with the help of the hand.
B. As it is pedaled, there is a chain drive link between the gears at the hand the forward wheel.
C. This initiates the movement in the rear wheel.
D. Initially, more force is required to pull the vehicle from rest position.
E. As the vehicle is in motion, the force required will be less to continue the motion.
F. Acceleration can be done as per the rider's stamina and ability.
G. Steering the vehicle can be done with the help of the handle of tricycle.

VIII. OBJECTIVES

A. Reduce the physical burden on disabled person and be appropriate for use
B. Top limit speed to 10 Km/ph
C. Total cost of the power train and power supply will not exceed Rs 7000.

IX. CALCULATIONS

1) Mass on a wheel= m = 35 kg
2) Radius of wheel = R = 0.3 m
3) Teeth on driven = 24 teeth
4) Teeth on driver = 18 teeth
5) Initial speed of driver = 100 rpm
6) Time consider = 10 sec

A.For early cycle

Teeth on driver = 18 teeth
Teeth on driven = 18 teeth
Speed of driver = 100 rpm (∴assume)
Diameter of wheel = 0.6 m
We have,
Gear ratio = Teeth on driven/teeth on driver
= speed on driver/speed on driven
» 18/18 = 100/speed of driven
∴ speed of driven = 100 rpm

For linear speed-
v = (3.14*diameter of gear*speed of driven)/60
= (3.14*75*100)/60
= 0.39 m/s
For angular speed-
ω_2 = (2*3.14*speed of driven)/60
= (2*3.14*100)/60
= 10.47 rad/s
Mass moment of Inertia-
I= (1/2)*m*R^2

where,
m=mass of wheel
R=radius of wheel
Torque is given by-

$T=I*\dot{\alpha}$

For initial angular speed = ω_1 = 0 rad/sec
And initial time = 0 sec

$\dot{\alpha} = \omega_2/t_2$
$= 10.47/10$ …….(assume t_2 =10 sec)
$= 1.047$ rad/s^2

$T = \{(1/2)*m*R^2\}*\dot{\alpha}$
$= \{(1/2)*35*0.3^2\}*1.047$
$= 1.64$ Nm

Power is given by-

$P = (2*3.14*\text{speed of driven}*T)/60$
$= (2*3.14*100*1.64)/60$
$P = 17.17$ Nm/s

B. For modified cycle

Teeth on driver = 18 teeth
Teeth on driven = 24 teeth
Speed of driver = 100 rpm (∴assume)
Diameter of wheel = 0.6 m
We have,
Gear ratio = Teeth on driven/teeth on driver
= speed on driver/speed on driven
24/18 = 100/speed of driven
∴ speed of driven = 75 rpm
For linear speed-
v = (3.14* diameter of gear *speed of driven)/60
= (3.14*100*75)/60
= 0.39 m/s
For angular speed-

$\omega_2 = (2*3.14*\text{speed of driven})/60$
$= (2*3.14*75)/60$
$= 7.85$ rad/s

Mass moment of Inertia-
$I= (1/2)*m*R^2$
where,
m = mass of wheel
R =r adius of wheel
Torque is given by-

$T=I*\dot{\alpha}$

For initial angular speed = ω_1 = 0 rad/sec
And initial time = 0 sec

$\dot{\alpha}= \omega_2/t_2$
$=7.85/10$ …….(assume t_2 =10 sec)
$=0.785$ rad/s^2

$T = \{(1/2)*m*R^2\}*\dot{\alpha}$
$= \{(1/2)*35*0.3^2\}*0.785$

= 1.236 Nm

Power is given by-

P = (2*3.14*speed of driven*T)/60

= (2*3.14*75*1.236)/60

P = 9.71 Nm/

C. Comparison of powers

For early cycle	For Modified cycle
P=17.17 Nm/s	P=9.71 Nm/s

Final Model

Fig. 10.1 Final Assembly

Cad Model

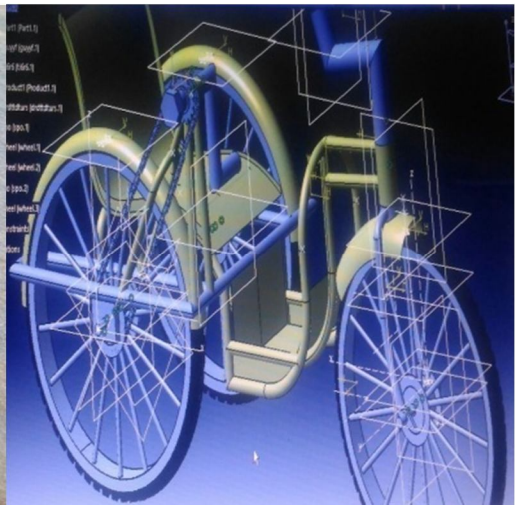


Fig. 10.2 CAD MODEL

X. CONCLUSIONS

A. A model is designed and fabricated that will be effective in providing mobility for persons who have disabilities.

B. One of the major lessons we have learned is that designing an appropriate technology is a huge challenge. Appropriate is more than just availability for replication, it considers longevity, reliability, and efficiency.

C. The model which we have fabricated seems to be appropriate considering the results obtained.

D. This project provides scope to add advancement in various aspects of working and mechanism for future development.

E. It is simple in design and easy to operate. The efforts made for operating tricycle is less this is an advantages of this tricycle.

XI. ACKNOWLEDGEMENT

This work is sponsored by ANANDWAN, WARORA, CHANDRAPUR (MAHARASHTRA). Authors are thankful to the RTMNU for giving us the opportunity to work on such an innovative project which is having great social cause.

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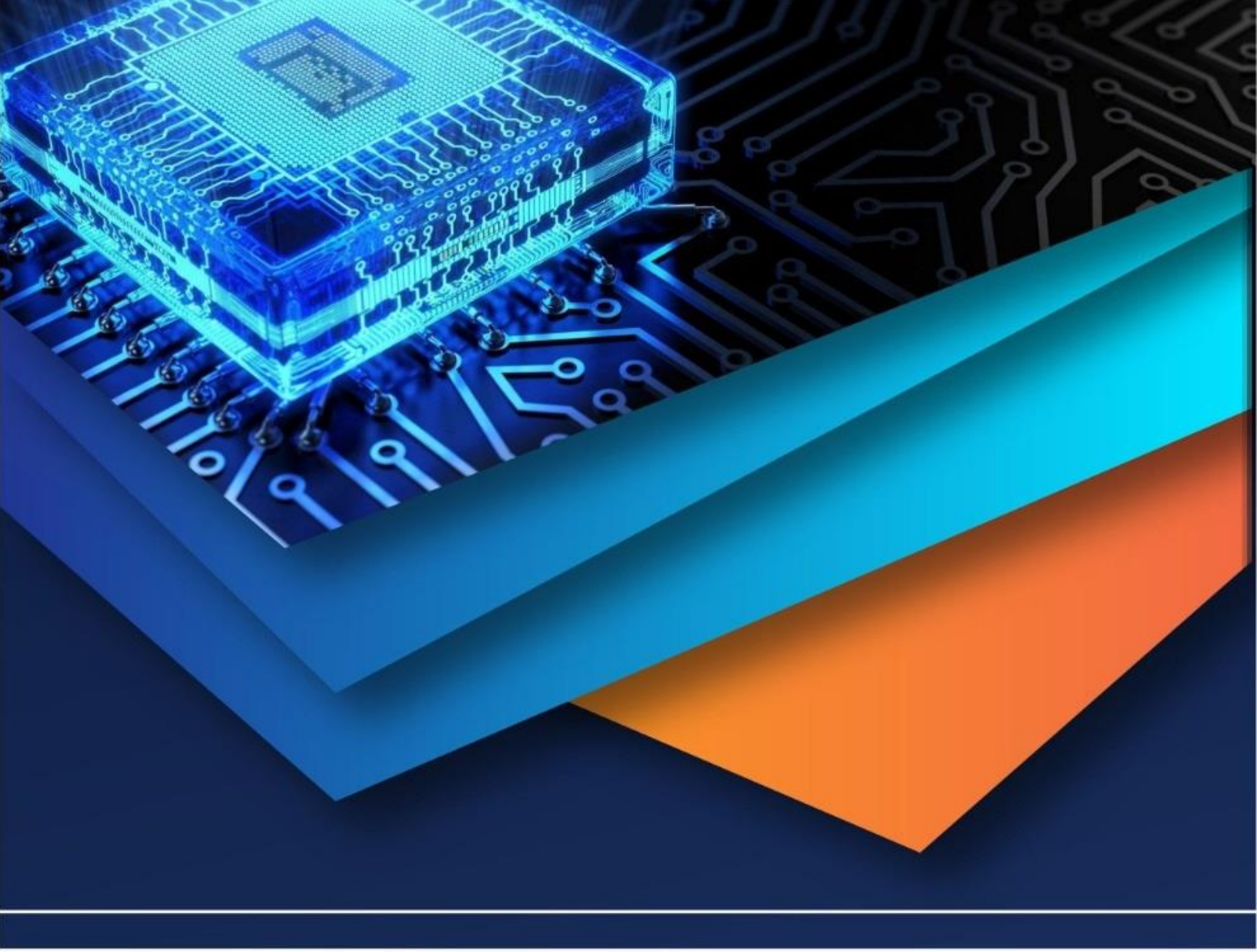

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