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REDESIGNING OF VEHICLE FOR PHYSICALLY CHALLENGED PERSON

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Abstract - *This paper addresses a feasible design solution in form of a user friendly three wheeler vehicle, which allows physically challenged people to commute on their own and perform their activities without anyone's assistance, has been proposed. The activity was started with customer survey and market study .The finalized model was analyzed to validate for stiffness and Ergonomics. On finalizing the design, prototype building activity was initiated. A full scale working prototype model was manufactured for physical validation of the design function. Outcome of this project is the solution of transport for physically challenged community using which they can communicate and lead an independent and normal life.*

Key Words: **Design, Survey, Model, Stiffness, Ergonomics, Prototype**

1. INTRODUCTION

The term Disability covers impairments, activity Limitations, and participation restrictions. Impairment is a problem in body function or structure. An activity limitation is a difficulty encountered by an individual in executing a task or action. However participation restriction is a problem experienced by individual involvement in life situations. Disability is caused by impairments to various subsystems of the body – these can be broadly classified under the following categories. Any impairment which limits physical function of limbs or damage of limbs or organs is a physical disability. Mobility impairment is a category of disability that includes people with varying types of physical disabilities. This type of disability includes upper limb disability, lower limb disability, manual dexterity and disability in co-ordination with different organs of the body. Disability in mobility can either be a congenital or acquired with age problem. This problem could also be the consequence of some disease [7].

2. LITERATURE REVIEW

Since the liberation war of Bangladesh in 1971, a large number of people have become disabled and vulnerable to the country. The prevalence of disability is believed to be high for basic reasons relating to over population, extreme poverty, illiteracy, social security, lack of awareness of traffic rules and above all lack of medical/health car e and services. By latest, the number s of disabled people is increasing rapidly due to increasing rate of road accidents and other relevant diseases [1].

At present patients are facing problem while defecating. Patients' needs to be lifted up and helped to remove the dress and make them defecate, which is discomforting to the patients in emergency condition. The design of back rest in the existing wheel chair creates repetitive stress injury if the patient is sitting for a long time.

3. PRESENT SCENARIO

Presently available wheel chairs are basically for indoor use or short distance movement and the manual three-wheelers for outdoor use. But those are not very suitable for use and having lot of technical drawbacks [4].The numbers of crippled/ disabled people are quite alarming but the numbers of wheel chair or three-wheeler users are not big and mostly found them in hospitals and residents, especially in urban areas. It happens because the presently available wheel chairs or three-wheelers are manual and not very suitable for outdoors use or for the roads around the country. The roads even in the cities are not very smooth or there is no lane for wheel chairs/ three-wheelers. Most of the cases the roads are very rough and narrows with some other limitations [2].

Fig -1: Wheel Chair

4. PROBLEM IDENTIFICATION

Market study is done to understand the product market segment, to know the competitors in the market, to study their product capacitance and market strategy, to bench mark the product. Observation shows that there is difficulty in shifting the patient from wheel chair to auto rickshaw and other vehicles due to bad braking system provided identified

problem is as shown [3]. Shortage of the height of the back rest, no adjustable and cushioned back rest, no head rest in the existing design, some wheelchairs, such as the IBOT incorporate gyroscopic technology and other advances, enabling the chair to balance and run on only two of its four wheels on some surfaces, thus raising the user to a height comparable to a standing person [11].

Fig -2: Problem Identification

5. DESIGN CONSIDERATION

5.1 Design analyses and calculations Shaft design

The combined bending moment of the most critical section of the shaft is given by

Mb=(Mbv^2+Mbh^2)1/2

Where,

Mbv= the bending moment due to vertical loading;

Mbh= the bending moment due to horizontal loading.

The shaft diameter can be determined by

D^3=16/3.14*Ss((KbMb)^2+(ktmt)^2)

Where,

Mb = bending moment (NM);

Kb = combined shock and fatigue factor applied to bending moment;

Kt= combined shock and fatigue factor applied to torsional moment;

Ss= Allowable stress for shaft without keyway, MN/m2.

Torsional moment can be determined by

Mt=9550*kw/(rev/min)

Where,

Kw = power output of the engine;

Rev/min is speed of the shaft.

5.2 Determination of required Power

The required power for the tricycle to move over rough terrain is given as:

P=WV/3.733

Where,

P = power (W);

W = weight of the tricycle (N);

5.3 Determination of Driving Torque (Manual)

The driving torque is given by

T=p/ω.

6. SOLUTION

6.1 Three-wheel mobility scooter

3-wheel scooters provide great outdoor functionality while a tighter turning radius still allows them to navigate indoors[5].Longer battery life, higher top speeds and larger tires will give you the added edge to maneuver safely outdoors over relatively smooth terrain. While the pieces will be heavier, 3-wheel scooters can usually be disassembled and transported inside a vehicle [6].

Fig -3: Scooter

6.2 Wheelchair seating

In normal conditions the person sitting in the wheel chair cannot able to enter in to the vehicle. Because of the height level of the wheelchair. For the comfort entry into the vehicle the wheel chair sitting height is increased 11cm from the normal range. By this increasing of the height the normal seat position is changed into a new position. The Welding is done to change the seat position [9].

6.3 Motorized wheelchair for disabled people

Motorized wheel chair enables the person to move easily. This makes the journey more comfort. The use of powered wheelchairs with high navigational intelligence is one of the great steps towards the integration of severely physically disabled and mentally handicapped people [12]. A wiper motor having speed 70 RPM and current 35 Amps are chosen for the execution.

Fig -4: Motorized wheelchair

6.4 Slope arrangements

The slop was made to make the entry of the person who sitting in the wheelchair. The ramp was made about 45 degree angle. This ensures the safe entry to the vehicle. It is welded to the rear side of the vehicle with the dimensions. The calculations for the strip made accurately and welded accurately to the vehicle. This makes the smooth movement of the wheelchair person to the vehicle. The importance of the slop is that it should be of accurate angle to make the entry in a safe manner. Otherwise the person will fall down and increase the accident rates. So it finally concluded to an angle of 45 degree.

Fig -5: Slope

7. DESIGN CALCULATIONS

7.1 Available data

Total height of the vehicl =71cm
Distance between ground and tray=19cm
Vehicle height from tray to position of wheel chair seat =52cm
Wheel chair height from ground to seat =53cm
Width of the vehicle =37cm
Width of the wheel chair =70cm
Length of the wheel chair =77cm
Length of the tray =84cm
Width of the tray =80cm
Rim radius = 13cm
Length between directional wheel to wheel =77cm
Wheel chair inner wheel distance =70cm
Voltage =12 volt
Current =35 amps
Speed =70 rpm

7.2 Power Calculation

POWER (P) =V*I
POWER=12*35 =420 WATT

7.3 Torque calculation

TORQUE (T) =60 P/2*3.14*N
TORQUE =60*420/2*3.14*70 = 343.77 N-M

7.4 Motor type:

WIPER MOTOR [12]
SPEED =70 RPM
CURRENT=35 AMPS

7.5 Power source

1 DC BATTERY, 12 VOLT

7.6 Slop details

ANGLE =15DEGREE
VEHICLE WHEEL (Dia.) = 40 cm
IDLE WHEEL (Dia.) =46cm
For avoiding the shocks and easy movement, the idle wheels are taken as in big size [8].

8. BRAKING AND LOCKING MECHANISMS

The mechanism which is used to slow and stop the vehicle is known as braking system .It is used to keep the vehicle in desired position even in rest. It should have less weight.in this system, the kinetic energy is converted in to heat energy due to friction between two mating surfaces of brake lining and brake drum. The heat is dissipated in to the atmosphere. Need for brakes are to stop or slow down the vehicle at will of the operator. To control the vehicle descending a hill, to keep the vehicle in desired position even in rest. Requirements of braking system are it should be consistent with safety, a better cooling system, good anti fades characteristics, less weight, and it should be reliable [10]. Types of brakes are two wheel brakes, four wheel brake, hand brake, foot brake, power brake, rum brake, disc brake, wheel brake, transmission brake, air brakes, and electric brake. Heavy magnet are used for locking .The use of four magnet will give the exact position for the vehicle. Easy and cost effective method is adopted and that makes the overall cost as less. The braking and locking mechanisms help to ensure safety and comfortness to the person during the journey. It will helps to avoid accidents.

Fig -6: Simple locking system

9. CONCLUSIONS

The physically challenged person will get a comfort drive through the vehicle that we developed. The person sitting in the wheel chair can enter in to the vehicle through slope. Test drive is made with a person and he get the maximum comfort by our vehicle.

The cost of the vehicle is kept low as possible, which will attract the customer to buy this vehicle. This new concept of making the wheel chair inside the vehicle will give a great impact on the market.

Fig -7: Redesigned vehicle

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