Design and Fabrication of Mobility Scooter

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ABSTRACT

The basic aim behind our project is to make an environmentally friendly portable automobile which would be easy to handle by both the sexes and would emit 0% emission. We have used D.C motor as our main power source due to which there is no emission at all and also the problem of fuel consumption is solved. Also keeping in mind, the parking problems now days, we decided to make a tri-scooter which can be folded easily, so after the use one can fold the tri-scooter and can carry it along with him/her. Our design allows users to easily transport the tri-scooter using less space when it is "folded" into a compact size. We have made this design with our own innovative ideas and by referring some books and websites. The versatility of a folding mobile scooter is also appropriate for air travel and inadequate storage and at places where bike theft is a significant concern. While designing we have concentrated on power, economy, ease and comfort of riding and low maintenance cost. Also, we have concentrated on ergonomics factor to give the user a comfortable ride.

1. INTRODUCTION:

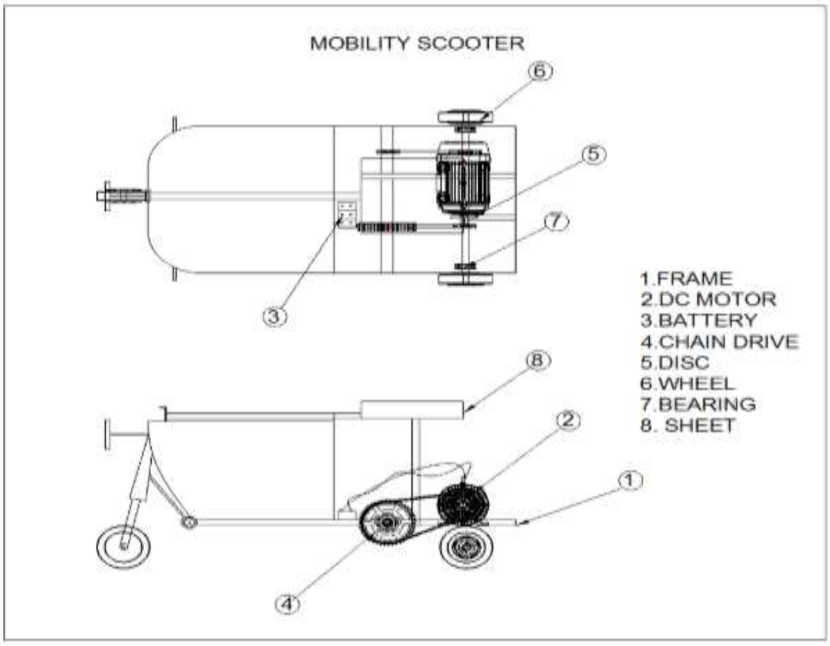
All developed countries in the world show an increase in the number of older people. As older people start to have difficulty in walking many choose to use a mobility scooter to help them move around. Benefitting from improved design, mobility scooters are becoming an increasingly popular mobility device and are a common sight on many streets. Many older people have difficulty in walking and the percentage of people in this group rises with age [1]. Depending on the reasons behind the difficulty, as people begin to struggle to walk, they have a range of options open to them which can be used alone or in combination.

They can walk less often, walk less far, take more frequent rest breaks while walking, use public or private transport, use mobility aid for stability such as a walker or a cane, or use a mobility device instead of walking such as a wheel chair or a mobility scooter. In developed countries with an ageing population, mobility is one of the major concerns for older adults who are unable to drive their cars anymore. Some may be healthy seniors who are semi-ambulatory or they may be persons with disabilities [3]. Research indicates that the use of mobility scooters become a preferred mode choice to maintain 'automobility'. Along with increasing age, decreasing mobility, increasing muscle weakness and impaired reflexes often follow.

As a result, older people can find themselves both with poorer walking skills, but also unable to drive a standard car. Fortunately, many different vehicles are available to resolve these situations, allowing those unable to drive a standard car to participate in routine activities and transport themselves around regardless. These vehicles include mobility scooters, also known as motorized mobility scooters (MMS), powered wheelchairs and electric bicycles, and are all primarily used by older people as an instrument to increase their mobility. Mobility scooters are three- or four-wheeled vehicles, powered by an electric motor.

2. DESIGN AND SELECTION OF MATERIAL:

Fig 2.1 shows the steps included to identify the need, research the problem, develop possible solutions, select the most promising solution, construct a prototype, test and evaluate the prototype, communicate the design, and redesign.



- CR5 MS square pipes and sheet for frame.
- 48-volt DC motor.
- 4 12-volt battery.
- 3 -polymer wheels.

3. DESIGN CALCULATION:

3.1 DESIGN OF DC MOTOR:

In order to choose the required DC motor that can do the job, we conducted a theoretical study that aims to help us choose the optimal type and size of DC motors.

R: Incline reaction to cycle weight.

Ƒx: friction force.

W: cycle weight

Predefined parameters

Maximum mass of cycle with person = 110 Kg (This mass accounts for both the mass of the cycle approximated to be equal to 35 Kg, and the mass of a standard user which is about 75 Kg.)

• Acceleration due to gravity, g = 9.81m/s2

• Maximum angle of inclination: αmax = 37°. According to the international laws for transportation the maximum slope angle should not exceed 37°.

• Coefficient of friction: μ = 0.5 – 0.7, we will assume the value μmax = 0.7, to account for the worst possible conditions.

• Wheel Radius: R = 10cm = 0.10 m

• Wheel perimeter: P wheel = πd =0.62 m.

• Assuming the required acceleration: ax = 1 m/s2

• The average velocity of the cycle is: V avg = 5 km/h = 1.39 m/s

- Weight of the Cycle W= M × g = 110 × 9.81 = 1079 N
- Reaction of the incline R = W cos (37°) = 861 N
- Friction force Ƒx = μmax × R = 0.7 × 861 = 602 N
- Weight in the direction of the movement Wx = W sin (α)

= 1079 sin (37°) = 649 N

At equilibrium condition (Σ FX = F - ƒx - Wx = 0)

Hence F = ƒx + Wx = 602 + 649 = 1251 N

Propulsion force (initial force), F = 1251 N

Torque at the wheel, T = F × R = 1251× 100 = 1251 Nm

3.1.2 CALCULATION OF RPM:

V = 20 km/hr. = 5.5m/sec

V= πdN/60

N= 60 x v/πd

N= 525 rpm

T = 1251 Nmm

Available DC motor in market 250W & 2500 rpm so we have to design transmission to achieve torque of 1251 Nmm at 525 rpm:

To find new torque Tactual

Tactual =P x 60/2Πn = 250 x 60/2π x 2500

Tactual= 0.95 N-m = 950 N mm

Transmission ratio=5

Final torque = 950 x 5= 4750 N-mm

& new rpm = 2500/5 = 500 rpm

Hence final speed v = π x 0.20 x 500/60 V=5.23 m/sec = 18.28 = 20 km/hr.

As generated torque and speed is more than required value so design of motor is safe.

3.2 DESIGN OF SHAFT:

Shaft subjected to bending movement

M=WL/4 = (1251 x 700)/4 = 218925 N-mm

Bending stress for shaft material, fb = 620 N/mm2

Hence fb = M/Z

Fb = M/ ((π/32) xd3

Hence, d = 15.33 mm i.e. 16 mm (approx. for standard design)

So, we selected bigger size for shaft i.e. 16 mm.

4. EXPERIMENTALS ANALYSIS:

4.1 Initial test conditions:

Road condition: 1 km plain surface with no turns

Battery condition: fully charged

Weight of driver: 75kg

Motor rpm: 2500

Output rpm: 454

4.2 Observations:

Initial time = 00:00:00

Final time = 00:02:34.

So, Time required for 1 km run = 2 minutes 34 sec

=154 sec.

4.3 Calculations:

Speed = distance/time = 1/154

= 0.006493 km/sec

= 23km/hr.

4.4 Speed test results:

The theoretical speed and the practical speed were found to be nearly equal.

Theoretical speed=20km/hr.

Practical speed =23km/hr.

5. SCOPE OF IMPROVEMENT:

The present mobility scooter requires accessories and mountings for its better safety and improved performance as follows:

1. Need speedometer for safety and economical operating range with respect to battery discharge characteristics.
2. Need accelerator mechanism for speed control.
3. Rear mirrors and headlamps can be used.
4. Optimization of boot space.

The present design of mobility vehicle is made up of mild steel frame, hence the weight can be reduced by incorporating suitable non-ferrous material. Cost of the vehicle needs to be optimized for better affordability for the target group of old aged community.

6. CONCLUSION:

In formulating the recommendations for a mobility scooter definition, it became obvious that flexibility for future developments should be incorporated. New technologies, a change in user demographics and new energy sources may influence new designs. Definitions should be based on performance specifications rather than prescriptive specifications to keep the door open for future developments. In terms of user experience most users felt their scooter has had a positive impact upon their lives and perceive their scooter in a positive light. Their scooter meets their needs by enabling them to independently achieve their desired activities.

It is clear that matching the mobility device to the individual and training the individual to use their mobility device is important. However, neither of these occur regularly. The impacts of scooter usage on functional health is less clear. The relationships between frequency length of use to physical functionality and capabilities has not been investigated. Where mobility scooter data does exist, it is most often inseparable from wheelchair data, particularly electronic wheelchair data. Given the different physical capabilities of their users this is unhelpful. The two works that focus solely on mobility scooters and physical health impacts investigate different aspects of physical health have different limitations and reach different conclusions.

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