

DESIGN AND FABRICATION OF BATTERY POWER OPERATED SEGWAY

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ABSTRACT- This paper describes the design and fabrication of battery power operated Segway. This is one of a several low speed human transportation device. The Segway currently in use is of high cost and a common person cannot afford it, so we have decided to design and fabricate it at low cost. The Segway has a disadvantage of lack of stability which causes injuries to many people, so we took this problem seriously and designed it with greater stability by adding castor wheels. The main objective is to build a vehicle capable of transporting a person weighing up to 70-80 kg to a considerable distance with varying speed. The materials are selected in such a way to withstand greater loads and at minimum cost. This kind of vehicle contains a lot of technology relevant to eco-friendly and energy efficient transportation. The Segway designed through SOLID WORKS and analyzed through ANSYS.

Keywords: Low speed transportation, Greater stability, Eco-friendly, Low cost.

INTRODUCTION

The Segway was introduced in the year 2001 by Dean Kamen and commercially manufactured by Segway Inc. of New Hampshire, USA. The word Segway is derived from the Italian word "segue" which means smooth transition. It is equipped with a stationary T-shaped hollow steel rod fitted into a platform that consists of a push button which is used to supply electric current from power source to the electrical components. The reference for base platform stress calculation is collected from "Future of Segway: Introduction to Segway". This transporter consist of two driving wheels with DC hub motors which is connected to the power source. The two castor wheels are attached to the base to increases the stability of the vehicle. Liu, .R. and Parthasarathy, R. "Segway human transporter (HT): Potential opportunities and challenges for transportation system, Washington, DC. (2003) describes research not only examine the design and marketing Aspect of Segway as a new potential mode of transportation, but also presents broader and long term view on transportation infrastructure improvement to accommodate diversified future transportation modes .The motion of the transporter

is controlled by two pressure pads and infrared sensor. All the above components are collectively connected to the circuit board for its proper functioning. Segway HT can travel 3 times faster than the average walker with a control speed and comfortable ride.

THEORITICAL CALCULATION

STRESS ON BASE:

Weight of user = 80 kg

Weight of Segway = 25 kg

Total Weight = 105 kg

Load acting = $105 \times 10 (g=10\text{m/s})$
= 1050 N

Area of base = 457.2×330.2
= 150967.44 mm²

Stress acting on base = $1050/150967.44$
= $6.95 \times 10^{-3} \text{ N/mm}^2$

YIELD STRESS:

Max weight on base = 130 kg

Yield stress

= Max weight * g / Area of the base

= $(130 \times 10) / 150967.44$

= $8.611 \times 10^{-3} \text{ N/mm}^2$

FACTOR OF SAFETY:

= Ultimate stress / Allowable stress

= 1300 / 1050

= 1.52 ~ 2

3D REPRESENTATION

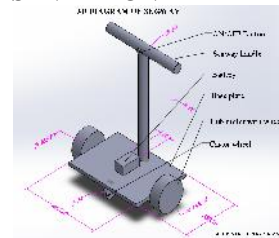


Fig 1 Solid works modelling
3D MODEL ANALYSIS

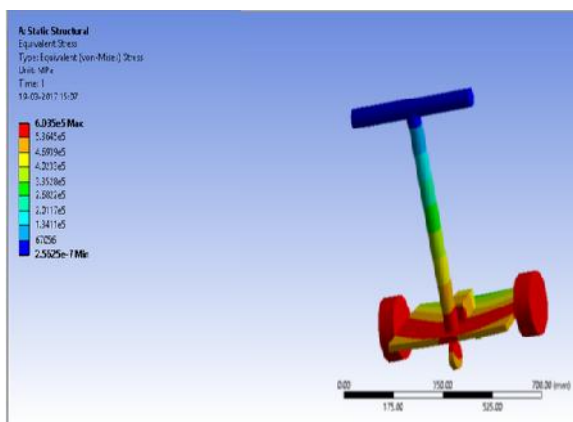


Fig 2 Stress analysis

3D modelling is done through Solid works and this is imported to ANSYS Workbench for analysis. From ANSYS result, it is inferred that stress is maximum at the base and wheel, minimum at handle. Maximum stress value obtained from analysis is less than the Ultimate strength of material, therefore the design is safe.

COMPONENTS

HUB MOTOR: The hub motor is an electrical motor that is incorporated into the hub of a wheel and drives it directly. Hub motor electromagnetic fields are supplied to the stationary winding of the wheel. The outer part of the motor follows, or tries, to follow those fields, turning the attached wheels. Energy is transferred in a brushless motor electronically, eliminating physical contact between stationary and moving parts. Although brushless motor technology is more expensive, most are efficient and longer – lasting than brushed motor systems.

BATTERY: A Lithium ion battery or Li-ion battery is a type of rechargeable battery in which lithium ions move from negative electrode to positive electrode during discharge and back while charging. It uses an intercalated lithium compound as one electrode material, compared to the metallic lithium used in a non-rechargeable lithium battery. The electrolyte, which allows for ionic movement, and the two electrodes are the constituent components of lithium ion battery cell. Lithium-ion batteries are common in home electronics. They are one of the popular rechargeable batteries for portable electronics, with a high energy density.

LOGIC BOARD: Logic board computes the real time data. It computes and controls the two aspects such as speed and direction of wheel spin. It houses and controls infrared sensors with the help of pressure pads. It also controls the power

management of the transporter based on the type of raider.

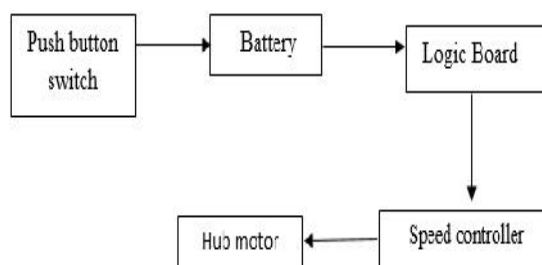
INFRARED SENSORS: These sensors make it possible for the user to control the wheels, the pressure pads are mounted over a pair of switches. When the raiders apply pressure on the pads, the switches are pushed down, which controls the light transmitted from the infrared LED to the sensors. Depending upon the pressure of the pressure pads the wheels rotate.

PUSH BUTTON: A push button is a simple switch mechanism for controlling some aspects of the device. Push buttons are typically made out of hard materials, usually plastics or metal.

S.NO	Component	SPECIFICATION
1	Motor	350W*2(Nos)
2	Battery	36V, 4.4Ah
3	Wheel Dia	165.1 mm
4	Base	457.2*330.2*18(mm)
5	Ground clearance	30mm
6	Wire	1.5sq.mm auto grade
7	Cable connectors	6(Nos)

Table 1 Component Specification

WORKING



The wheels with hub motor, logic board, pressure pads with infrared sensors, battery and handle bar with push button are mounted on base plate with the help of bolts and nuts. Initially the push button is in off condition. When it is switched on the electric current and DC source passes through the logic board. Force exerted on the pressure pad due to human weight, breaks the infrared rays passing through the sensor leading to the rotation of the wheel in a controlled speed. For turning the transporter is controlled in such a way that the one

side of the motor is rotated and the other is maintained at the stationary position. The riding of this transporter requires a special skill for driving as it is controlled by sensors.

EXPERIMENTAL RESULT

We have completed fabrication of a battery power operated Segway by designing it in solid works and stress analysis in ANSYS software that resulted in greater stability of the vehicle with smooth transition.

FABRICATED MODEL OF SEGWAY



Fig 3 Side View



Fig 4 Front View

CONCLUSION

The design and fabrication of Segway personal transporter is aimed at providing a zero pollution environment to a considerable distance at lower cost. To overcome toppling caster wheels are attached to the base thereby increasing stability. In future solar panels can also be installed to recharge the battery, thereby making the power source renewable.

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