IJAET International Journal of Application of Engineering and Technology ISSN: 2395-3594

Vol-2 No.-1

DESIGN, ANALYSIS AND FABRICATION OF HUMAN TRANSPORTER SEGWAY VEHICLE

Antim Rewapati, Akshay Sangamnerkar, A.P.Singh and O.P. Singh
Department of Mechanical Engg. , IIST, Indore (M.P.), INDIA

ABSTRACT

The Segway PT is a two-wheeled, self-balancing, battery-powered electric vehicle invented by Dean Kamen. It is produced by Segway Inc. of New Hampshire. The starting price of any type of Segway is above Rs 2, 00,000/-. It is suitable only for high class people. In a country like India where high class people are short in number compared to middle class and low class people, it is not preferable. If it available for low cost it will be preferred by all. That is the ultimate aim of our project. To make a Segway with a cost around of Rs 6000/-. We named it as Segwheels or human transporter or homemade Segway.

Keywords: - *Segway vehicle, battery powered*

I. INTRODUCTION

The Segway PT is a two-wheeled, self-balancing, battery-powered electric vehicle invented by Dean Kamen. It is produced by Segway Inc. of New Hampshire. The name Segway is derived from the word segue, meaning smooth transition. PT is an abbreviation for personal transporter. Computers and motors in the base of the device keep the Segway PT upright when powered on with balancing enabled. A user commands the Segway to go forward by shifting their weight forward on the platform and backward by shifting their weight backward. The Segway detects, as it balances, the change in its centre of mass, and first establishes and then maintains a corresponding speed, forward or backward. Gyroscopic sensors and fluid-based levelling sensors detect the weight shift. To turn, the user presses the handlebar to the left or the right.

Segway PTs are driven by electric motors and can reach a speed of 12.5 miles per hour (20.1 km/h). The first problem with the Segway is the price. This technology is not affordable to low-income individuals. The biggest market for the Segway would be college students; however, this market has not been tapped into. University campuses are usually big and getting from one class to the next and back to dormitories can be a long distance when one has to walk, but college students cannot afford to buy the Segway for their use. The solution to this problem is for manufacturers to use cheaper but safe technology in order to decrease the price. A second problem is lack of advertising; few people know about Segway dealerships, the cost and the great invention that it is, the solution would be to advertise more. The Segway is not only a great innovation, but it is also environmental friendly since it is fully electrical and does not release any emissions and this would appeal to a lot of people if they knew it existed. The final problem with the Segway is that the technology is so new and when it breaks down the manufacturers are forced to recall all Segways and this can be costly. Unlike cars where there is an abundant of mechanics to fix them when

ISSN 2395-3594

they break down, the Segway does not enjoy the same benefit, the solution to this problem would be to provide users with very simplified manuals and an excellent technical support team that can be easily reached by dialing a toll free number.The Segway has a bright future, because after most of the problems are taken care of, it will eventually be widely used and accepted as a form of transportation that is better than the bicycle. Some of the improvements in the future would be the addition of an umbrella that is attached to the handlebars and can be opened at a touch of a button. Segways will be modified to transport more than one person; there will be room for a passenger. Also, the manufacturers will make smaller Segways for young kids, Segways with retractable covers to shield the user from bad weather and proper nightlights so it can be safely used twenty four hours a day. Lastly, when the Segway is widely used there will have to be Segway lanes for the riders.

The Segway is still in the stage of interpretative flexibility, as per Bjiker's theory of Social Construction of Technology (Bjiker, 1995). Society is going to play a major role in creating the best and safe Segway.
In conclusion, it is only after the Segway passes this phasing of interpretative flexibility will it reach closure and stability. It is after this last stage that the diffusion of this technology will take place in a big way. The best way for this diffusion to take place is by using opinion leaders via the wide range of media available to us (Rogers, 1995).

II. WORKING OF SEGWAY

The Segway does pretty much the same thing, except it has wheels instead of legs, a motor instead of muscles, a collection of microprocessors instead of a brain and a set of sophisticated tilt sensors instead of an inner-ear balancing system. Like your brain, the Segway knows when you are leaning forward. To maintain balance, it turns the wheels at just the right speed, so you move forward. At its most basic, the Segway is a combination of a series of sensors, a control system and a motor system. In this section, we'll look at each of these elements.

The primary sensor system is an assembly of gyroscopes. A basic gyroscope is a spinning wheel inside a stable frame. A spinning object resists changes to its axis of rotation, because an applied force moves along with the object itself. If you push on a point at the top of a spinning wheel, for example, that point moves around to the front of the wheel while it is still feeling the force you applied. As the point of force keeps moving, it ends up applying force on opposite ends of the wheel the force balances itself out. Because of its resistance to outside force, a gyroscope wheel will maintain its position in space (relative to the ground), even if you tilt it. But the gyroscope's frame will move freely in space. By measuring the position of the gyroscope's spinning wheel relative to the frame, a precise sensor can tell the pitch of an object (how much it is tilting away from an upright position) as well as its pitch rate (how quickly it is tilting). A conventional gyroscope would be cumbersome and difficult to maintain in this sort of vehicle, so the Segway gets the same effect with a different sort of mechanism. Segways use special solid-state angular rate sensor constructed using silicon. This sort of gyroscope determines an object's rotation using the

Coriolis Effect on a very small scale. Simply put, the Coriolis effect is the apparent turning of an object moving in relation to another rotating object. For example, an airplane traveling in a straight line appears to turn because the Earth is rotating underneath it. A typical solid-state silicon gyroscope consists of a tiny silicon plate mounted on a support frame. The silicon particles are moved by an electrostatic current applied across the plate. The particles move in a particular way, which causes the plate to vibrate in a predictable manner. But when the plate is rotated around its axis (that is, when the Segway rotates in that

particular plane), the particles suddenly shift in relation to the plate. This alters the vibration, and the change is in proportion to the degree of rotation. The gyroscope system measures the change in vibration, and passes this information on to the computer. In this way, the computer can figure out when the Segway is rotating along particular axes. The Segway HT has five gyroscopic sensors, though it only needs three to detect forward and backward pitch as well as leaning to the left or right (termed "roll"). The extra sensors add redundancy, to make the vehicle more reliable. Additionally, the Segway has two tilt sensors filled with electrolyte fluid. Like your inner ear, this system figures out its own position relative to the ground based on the tilt of the fluid surface. All of the tilt information is passed on to the "brain" of the vehicle, two electronic controller circuit boards comprising a cluster of microprocessors. The Segway has a total of 10 onboard microprocessors, which boast, in total, about three times the power of a typical PC. Normally, both boards work together, but if one board breaks down, the other will take over all functions so that the system can notify the rider of a failure and shut down gracefully.bThe Segway requires this much brain power because it needs to make extremely precise adjustments to keep from falling over. In normal operation, the controller boards check the position sensors about 100 times per second. The microprocessors run an advanced piece of software that monitors all of the stability information and adjusts the speed of several electric motors accordingly. The electric motors, which are powered by a pair of rechargeable nickel metal hydride (NIMH) or Lithium-ion (Li-ion) batteries, can turn each of the wheels independently at variable speeds. When the vehicle leans forward, the motors spin both wheels forward to keep from tilting over. When the vehicle leans backward, the motors spin both wheels backward. When the rider operates the handlebar control to turn left or right, the motors spin one wheel faster than the other, or spin the wheels in opposite directions, so that the vehicle rotates.

III. OBJECTIVE

The starting price of any type of Segway is above Rs 2, 00,000/-. It is suitable only for high class people. In a country like India where high class people are short in number compared to middle class and low class people, it is not preferable. If it available for low cost it will be preferred by all. That is the ultimate aim of our project. To make a Segway with a cost around of Rs 6000/-. We named it as Segwheels or human transporter or homemade Segway.

IV. PROPOSED METHOD

1) Calculation of wooden base frame vehicle including (wheel)

a) Force
b) Torque
c) Wheel Rpm
d) Power Requirement for wheels
e) Wind power Calculation

2) Design of transporter on Creo- Parametric 2.0

3) Analysis of Design on Solid Work including Stress and Displacement on Wooden frame.

4) Purchase the entire component that is required to run our vehicle.

5) Assemble all the components

V. CALCULATION

First calculate the force on the wheel, torque and rpm of wheel

For vehicle (wheels)

1) Force = Mass * Acceleration

F = 100 * 10 * 5/18

F = 277.7 N (For two wheel)

F = 138.85N (For single wheel)

2) Torque = Force * Distance

Wheel radius = 15cm

T = 138.85 * 0.15

T = 20.82 N-M

3) Wheel Rpm

Wheel Diam. = 0.30m

Wheel Circumference = 3.14* 0.30

W.C = 0.942

Required speed = 2.77 m/s

Speed m/s = Rps* Circumference

2.77m/s = Rps* 0.942

Rps = 2.20

Rpm = 132

4) Power = T * W

P = 20.82 * 2*3.14* 132/60

P = 288 w

VI. DESIGN

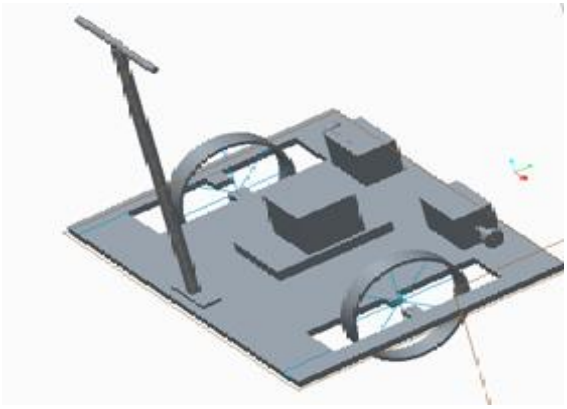

Figure 1 Vehicle design on Creo parametric 2.0

VII. ANALYSIS

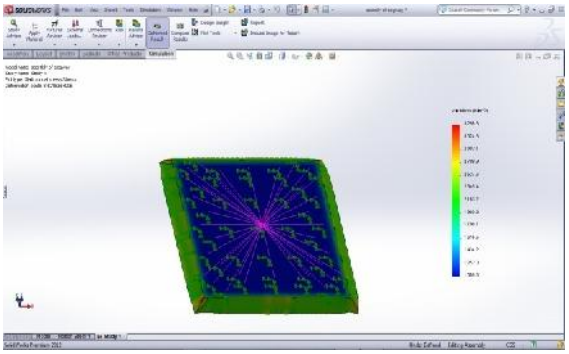

Figure 2 Static nodal stresses

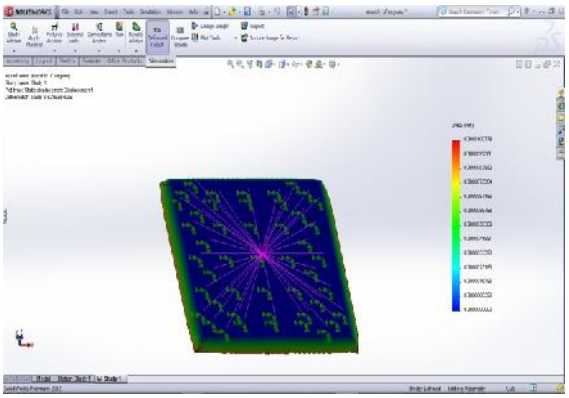

Figure 3 Static displacement

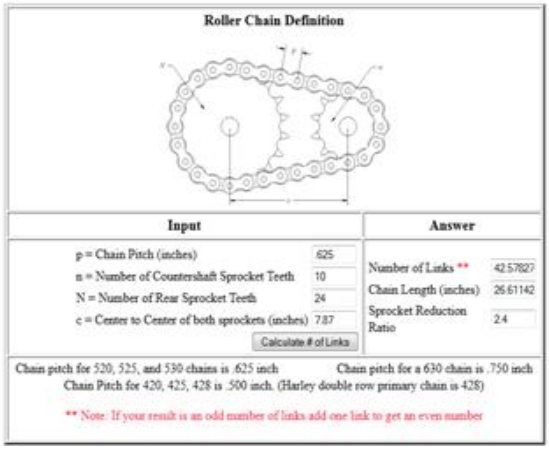

Figure 4 Chain length calculation

Figure 5 Final Design

IX. CONCLUSION, LIMITATION AND FUTURE WORK

CONCLUSION

In the course of this project, the design, analysis and fabrication of segwheels was done. The attempt to change the existing design of hi-tech Segway was successfully completed. This project was implemented with an idea to find an effective solution to transportation problem. The main objective is to achive space utilization and minimise the fuel consuption especially for commuting over shortest distance.

LIMITATION

1) It was difficult to run the vehicle by starter because of high rpm.

2) Power consume by starter was high

FUTURE WORK

Vehicle may be more innovative by using the solar penal and dc wind fan by which energy is recovered and this energy will utilize to run the vehicle. Cost of our project was only 5460/- Rs and we find a successfully solution to run the vehicle in cheapest cost.

4.3 RESULT

The main objective of our project to make cheapest vehicle like Segway because cost of Segway is high, which is not affordable by all. Finally we find a successfully solution to run the vehicle in cheapest cost. We keep cost around 6000/-Rs for our project but we completed our project within 5500/- Rs.

REFERENCES

1. Injuries Associated with Motorless Scooters (as of May 2001). Database of the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP). September 2001.
2. Lajoie, Y., Teasdale, N., Bard, C. & Fleury, M. “Attentional Demands for Walking: Age-Related Changes”. Changes in Sensory Motor Behavior in Aging. A. Ferrandez & N. Teasdale (eds.). 1996.
3. Lajoie, Y., Teasdale, N., Cole, J., Malcolm, B., Bard, C., Fleury, M., Forget, R., Paillard, J. & Lamarre, Y. “Gait behavior in a patient without large myelinated sensory fibers below the neck”. Neurology. 47: 109-115, 1996.
4. Motorized Personal Transportation Devices (MPTDs). Literature Review: Projects, Regulatory Frameworks and Safety Aspects. CEVEQ. December 2003.
5. Motorized scooters, skateboards and the SegwayTM. Info update. Insurance Corporation of British Columbia.
6. Shaheen, S.A. & Finson, R. Bridging the Last Mile: A Study of the Behavioural, Institutional and Economic Potential of the Segway Human Transporter. ITS-Davis & Partners for Advanced Transit & Highways (PATH) and Center for Commercialization of ITS Technology (CCIT). August 2002