Segway – Self Balancing Human Transporter

Glen Victor Menezes[1] Kalpesh Shankar Jamsandekar[2] Dattatray Natha Girhe[3]
[1,2,3]Department of Mechanical Engineering
[1,2,3]Dilkap Research Institute of Engineering and Management Studies, Neral, Maharashtra, India

Abstract— In this project work, two large wheeled and two small supporting wheel, self-balancing as well as manually balancing Segway vehicle is prepared which is also known as a personal transporter Segway. The system is able to operate in transporter mode and robotic mode. The first goal is to maintain stabilization in pitch dynamic. This project focuses on to manufactured Segway without using any type programming & Sensors a state feedback to stabilize system on transporter mode. Small wheel is used so that there is no need of gyroscope for balancing purpose. The aim of this project work is to build up at a very low cost, highly efficient rate and easy to handle and operating also. The tests are performed on Segway confirm that also.

Keywords: Segway, Hoverboard, Human Transporter

I. INTRODUCTION

In this project, "SEGWAY" has been built as a part of the course applied control and mechanical and electronics fusion. The goal of this project to everyone know about the Segway how is to manufactured or fabrication and how is the working system of the Segway and another one is the how is to ride and balance of the Segway. The project aimed at making a two wheeled and two small wheel balancing electric vehicle. Two electric motors in the base of the device keep the vehicle right and left. By using switch and electric supply go forward and go backward direction easily with the help of switch. The vehicle has electric motors powered by dry batteries. It balances with the help of small wheel there is no used of Microcontroller, gyroscope and any type of sensors. The rider accelerates or decelerates by using push up switch go forward and backwards in the direction he or she wishes to travel. Handle is providing by simply Manual-balance and operated two motors with the help of switches. The Segway Human Transporter is one of several low-speed transportation devices (e.g., bikes, scooters, wheelchairs) that, under certain circumstances, travel on sidewalks, roadways, and other shared-use paths. To plan the main objective was to build a vehicle capable of transporting a person weighing up to 70-80 kg and required to ride the vehicle. This thesis also takes into consideration the material used with minimum possible cost. The design of Segway Human Transporter is such that it covers less space and comfort to the user.

II. CONSTRUCTION

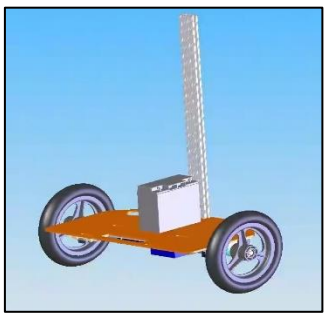

Fig. 1:

A. Support Frame

The frame structure of Segway is made as simplest as possible. It has been designed to keep in mind that it has to withstand the weight of motor, battery and major weight of rider. We have used a plywood which is easy to available and cheaper rate, also they are having less weight and high strength, so it is best suitable for this purpose. The measurement in the structure is taken on the basis of position of motors and tires, as shown in figure. The dimensions of chassis, support frame is, 45 cm × 36 cm × 5 cm. The handle is attached to the upper frame which is couple by triangle plates, and bolted by nut-bolts. The handle is attached to the upper supporting frame, the dimensions is 70 cm high and 6 cm wide.

Fig. 2:

B. Motor Foundation

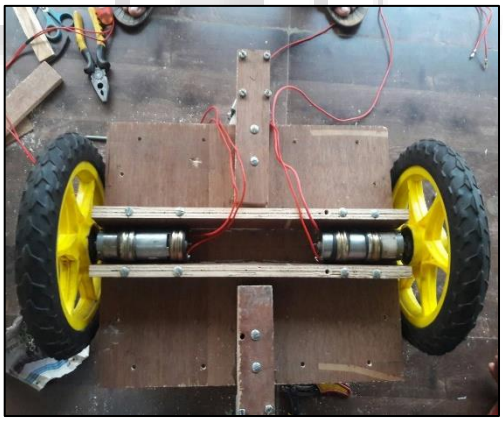

Fig. 3

The two DC motors is fixed apposite to each other in parallel with each other, for the proper foundation it is clapped by CLIPS which are bolted by nut-bolts. Also getting support by two plywood plates shown on figure, which covers the motors and fixed motors in its position. The motors are gear motor having shaft in centre of the motor making balance in the centre of gravity for motor. They are place in the centre of the frame giving exact alignment of two wheels.

C. Shaft

The shaft is made from a single aluminum rod connecting motor shaft at one end and another end is couple with wheel coupling. The coupling offers the transmission from motor shaft to wheel. The coupling is rigid type.

III. COMPONENTS USED

A. Motor

Fig. 4:

Motor is fixing with the chassis through screwed bolt and it is the main source of power with is to drive the vehicle. There are two motors, each for one wheel. Each motor is driven by a separate 12v battery.

B. Wheels

Fig. 5:

In SEGWAY two large tyres is used in both the sides, and two small wheels for direction. Scooter, or cycle wheels are used in Segway reason behind that cost is less, easy to available and friction property is also less. Also, higher amount of weight gaining capacity and movements is also very smooth.

C. DPDT Switch (Double Pole Double Throw)

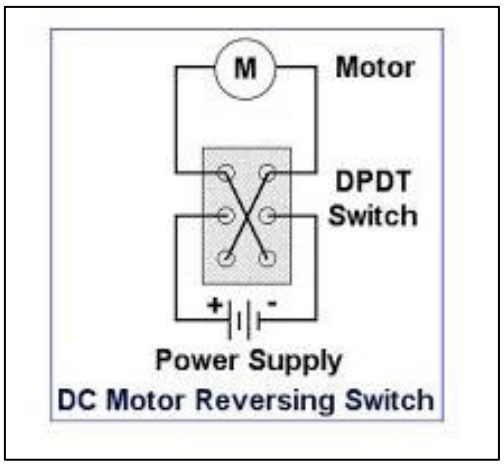

Fig. 6:

Double Pole Double Throw (DPDT) switch. It is used to guide the direction of rotation of motor shaft. By operating the switch, the direction of vehicle can be controlled. Connecting wires are used to connect switch with motor.

D. Battery-

Fig. 7

Battery is a main power source. One or may be Two 12V DC batteries are used in Segway. Each battery connected with each motor. Battery supplies power to each motor to run the wheels. Battery is rechargeable in both ways electric socket and solar plates.

WORKING

In this SEGWAY , the balancing of the vehicle is depend upon the wheels, which is two small and two large wheel is for supporting and carry a load of all body and person weight and is located to the side of the frame, the motor is connected to the wheel which gives the moment to the vehicle, two small wheels are connected to the frame which is located at front and back side of the vehicle, and with the help of this wheel we give the direction to the vehicle, because it rotation is 360 degree.

The working process is depending on the switches. The wheels are connected to the motor and the motor is connected to the switch, which is DPDT switch, it works as a forward and backward direction. Motor is connected to the battery which gives power to run and give moment to the wheel. The switch has 6 terminals. There are two switches connected separately to both motors. When pushing the switch button in forward direction the vehicle is moves on forward direction, when push the button in backward direction the vehicle is moves in reverse direction. When we have to give left turn, we must push right switch. When we have to take turn right, we have push left button and when we have to take reverse direction then press both backward buttons.

IV. CALCULATIONS

A. Design Considerations

Speed = 500 rpm
Torque = 82
Maximum weight of rider = 80kg
Chassis weight including batteries = 15kg
Therefore,
The total weight = 35kg (approximate)
Coefficient of friction between road and tyre + 0.3

B. Torque Required

Torque required = friction force × radius of wheel
T = 95×0.3× 15024

T = 4034 kg/m
Motor shaft length = 0.8
Motor shaft breadth = 0.4
The two motors are used.
Therefore, torque required by each,
Motor = 4 kg/m (approximate)
Standard wheel dimension = 12 inch
= 30.48 cm

In order to generate this extra pressure, air has to be pumped under the board through the circles. We can estimate the speed of air flowing through the circles using Bernoulli's equation.

C. Velocity

Velocity = [2 (pressure) / (air density)]1/2
= [2 (48150/ (102 kg/m3)] ½
= [8025]1/2
= 90m/s

In previous problem, we estimated the power absorbed by wind turbine. The Segway is basically the same process in reverse. So, we can use the same formula to estimate the power it takes to run the Segway.

D. Power

Power = (air density) × (area swept by motor) × (air speed)2 / 2
= [(1.2) × (2×l×b) × (30)] / (2)
= (1.3) × (2× 0.8× 0.4) × (30) / 2
= 2800 W

V. ADVANTAGES & APPLICATIONS

A. Advantages

1) Reduces time for travelling foot distance.
2) A clean, green, eco-friendly machine (zero emission).
3) Require less space for riding, parking.
4) Riders stand an additional eight inches off the ground, allowing you to be better seen and giving the rider better sight lines, over cars in a parking lot or boxes in a warehouse
5) Low operating cost: no need for gas and inexpensive battery charging (A complete cycle charge will take eight to ten hours).

B. Applications

1) Our target is for college, school, malls and office use where required longer distance to travel on footsteps.
2) In some NGO for handicap people. It is meant for those people having difficulty to walk.
3) In government departments where most of the officers are aged and have long corridors.
4) For amusements parks, our Segway would be so simpler that even kids can drive safely.

VI. CONCLUSION

Basically, this investigation is successful achieved the objective with the acceptable outcome. The main goal of this project was a build a functional two wheels and one supporting wheels transporter and this goal has been fulfilled. The overall functionality and performance of the vehicle has been evaluated thoroughly by a number of test drives. The vehicle has been tested by a number of different weights. This project is implementing with an idea to find an effective solution to transportation problem.

REFERENCES

[1] J. Sea rock, B. Browning and M. Veloso, 2004, "Turning Segway's into Robust Human-Scale Dynamically Balanced Soccer Robots", in Proceedings of the Eighth RoboCup International Symposium, July, 2004.
[2] S. C. Lin, C. C. Tsai and W. L. Lou, 2007, "Adaptive Neural Network Control of a Self-balancing Two-wheeled Scooter", The 33rd Annual Conference of the IEEE Industrial Electronics Society (IECON), Nov. 5-8 2007, pp. 868-873, Taipei, Taiwan.
[3] M. Burkert, T. Groll, T. Lai, T. McCoy and D. Smith, 2004,
[4] "Segway Design Project", Project Report, Grand Valley State University the Padnos School of Engineering, USA.
[5] M. Sasaki, N. Yanagihara, O. Matsumoto and K. Komoriya, 2005, "Steering Control of the Personal Riding-type Wheeled Mobile Platform (PMP)", 2005. IEEE/RSJ International Conference on Intelligent Robots and Systems, pp.1697-1702.
[6] K. M. Goher and M. O. Tokhi, 2010, "Development, Modeling and Control of a Novel Design of Two-Wheeled Machines", Cyber Journals Multidisciplinary Journals in Science and Technology, Journal of Selected Areas in Robotics and Control (JSRC), December Edition.
[7] H. J. Jean and C. K. Wang, 2009, "Design and Implementation of a Balancing Controller for Two-Wheeled Vehicles Using A Cost-Effective MCU", Proceedings of the Eighth International Conference on Machine Learning and Cybernetics, July 12-15 2009, pp. 3329-3334, Baoding, China.

