Design and Fabrication of Self Balancing Two Wheeler
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Abstract:
This paper describes the design and fabrication of Self Balancing two wheeler. The Self balancing two wheeler is based on the principle of Segway knows when you are learning forward. To maintain balance, it turns the wheels at just the right speed, so you move forward. The Self balancing two wheeler is an intelligent vehicle which uses gyroscopic sensors detects the motion of rider, so that he can accelerate, brake or steer the vehicle. This self balancing is absolutely ecofriendly mode of transport which causes zero pollution.

Keywords: Fabrication, Gyroscopic, Self balancing ,Segway, Steer,Ecofriendly.

I. LITERATURE REVIEW
The Segway Personal Transportor(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 Segway PT was known by the names Ginger and IT before it was unveiled[1]. Reilly et al. describes Bicycles increase the distance that an individual can travel to the station, and some transit agencies improve access options with bike friendly policies, such as bike lockers and racks on transit vehicles. Shuttles, providing fixed route, fixed schedule services offer another method to increase transit station access [2]. Cervero et al. describes Access to transit stations from home, work, recreation centers and other destinations is often challenging, creating a barrier to transit ridership and overall system efficiency. At many transit stations, dedicated parking is limited and fills up early each workday. Transit stations in more urban settings have limited or no dedicated parking, so in this case two wheeler is useful[3].
Koopman et al. describes since its introduction, Segway HT has caused a good stir in the transportation community and general public. The operation of Segway HT has been legalized for sidewalk use in 24 states[4]; Meyer et al. describes segway HT is motorized and regulated by the Consumer Product Safety Commission instead of the National Highway Traffic Safety administration [5]. It is important to know the type and extent of trips that can be supplemented by Segway HT and potential market segmentation of such mode. On the other hand, this research also examines potential challenges to transportation systems by Segway HT. Those challenges may include, but not limited, to pavement types and slopes of the travel surface, lane usage, and safety issues. As claimed by its developer and manufacturer, Segway LLC [6].Moore et al. describes, HT is a self-balancing, personal transportation device that’s designed to operate in any pedestrian environment. Segway derived from the word “Squeeze” means “ to transition smoothly from one state to another”. Segway HT can travel three times faster than the average walker, empowering the pedestrian with speed and a comfortable ride. Majority of people who have tried Segway HT, express that Segway HT was easy to learn and maneuver in the traffic [7]. Rongfand liu and Rohini Parthasarthy describes research not only examines the design and marketing aspects of Segway HT as a new potential mode of transportation, but also presents a broader and long-term view on transportation infrastructure improvement to accommodate diversified future transportation modes[8]. Ambrose et al. unveiled in December 2001, the Segway Human Transport (HT) presented an innovative new commercial product for human mobility. The HT’s robustness, speed, and versatility make it an attractive transport option over moderate distances (a few kilometers). The two-wheel scooter provides a unique mode of transport due to its self-balancing mode of operation. In May 2003, Segway released the Segway Robot Mobility Platform (RMP) to a group of researchers (Nguyen et al. 2004a) [9]. Brett Browning et al. describes to adapt the segway RMP, a dynamically balancing robot base, to build robots capable of playing soccer autonomously,[10]. Brain G.R. huge that onboard computers regulate the power to the wheels to keep the forces balanced through the rider as shows balancing of Segway at different conditions that are accelerating, constant velocity and decelerating [11]. M.Thompson et al. describes the design and fabrication of Segway usinggyroscopic sensors, development board and battery powered electric motors. The design which we have come with will cost the Segway around 20,000 as compared to original Segway which costs around 3 lakhs plus tax, thus making the product cost effective [12]. Sadhna Pai et al. describes the Segway is based on the principle of inverted pendulum that will keep an angle of Zero degrees with vertical at all times[13]. Susan A. et al. describes This paper outlines a Segway HT pilot research project that explores safety and training issues and transit feeder service demand[14]. This research will provide answers about consumer acceptance, safety, land use, parking impacts, and market niche potential[15].

II. INTRODUCTION
At first glance, this device called the self balancing two wheeler basically we can call it a human transporter in some cases it also look as hi-tech , people who expedited it they praises the remarkable performance about it as it is different from other vehicles.

- A device consist of motors as motor-scooter
- Main power by motors
- Movement by changing weight.
- Dean Kamen design follows (150 patents)
- Max speed 10.0 - 12.5 mph
- Maximum distance 14 - 17 miles (single charge)
- It can bear near about 80kg
This two Wheeler is the personal transporter which is to move from one place to another place with a simple operation. Basically it is a look like scooter but the wheel display is parallel to each other that is both the wheels are positioned side by side.

The Segway is a personal transportation technology invented by Dean Kamen (DEKA, 2007). This technology can be used for relaxation or business-related purposes. It can be used by golfers on a golf course instead of gold carts, by policeman and security and also by individuals for sightseeing or to travel short distances. This two wheeler can be used on rough ground in remote farm areas or in the woods as well as on city pavements and streets. The company that manufactures this product has tried to develop different types of Segways to fit different needs. However, this technology is still in its early stages and society is going to play a huge role in the construction of a safe Segway. This paper is going to use Bijkers theory of the social construction of technology to look at the Segway in its current stage of development and the technology behind it, relevant social groups, problems and solutions, future Segway predictions, interpretative flexibility, closure and stability and the final safe Segway (Bjiker, 1997).

III. BLOCK DIAGRAM

Figure 2. Control System Block Diagram

CHASIS

Chasis is made of wooden block and four wooden blocks are used to make the frame. To make chasis to be balanced, four wooden blocks of equal weights are used. It is engaged firmly with the help of stud. Stud is to connect the wooden block together with the nut. Wheels are attached to the middle of frame in order to withstand the load capacity. Handle is also made of same wood to which DPDT switch is fixed.

MOTOR

Motor is fixed with the chasis 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.

CHAIN DRIVE

Chain drives are used to transmit power between motor and wheel. Type of chain used is Power transmitting chains (Bush Roller Type).

Chain drives are used because it has the following advantages:
- No slip
- Occupy less space
- High transmission efficiency
- Highly preferable for small shaft distance

STUD & NUT

A stud is a round bar threaded at both ends. Stud is a screwed rod to connect the wooden block together in order to make the chasis.

POWER SUPPLY

20A Continous 12 V input power supply.

DPDT SWITCH

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.

WOOD

The type of wood used to make frame is “COUNTRY WOOD”. Four wooden blocks are jointed with the help of stud and screwed with bolts. Motor and battery are mounted on frame with help of screws.

IV. DESIGN CONSIDERATION

A. Torque Calculations

Maximum weight of rider = 80 kg
Chassis weight including batteries = 7 kg
Therefore, Total weight = 87 kg (approx.)
Coefficient of friction between road and tyre = 0.3
Torque required = Coefficient of friction * Friction Force * Radius of Wheel
T = 0.3 * 87 (kg) * 7.5 (cm)
T = 1.95 kgf-m (Approx.)
As two motor are used. Therefore torque required by each motor = 0.97 kgf-m (Approx.)
TABLE 1:

<table>
<thead>
<tr>
<th>MOTOR</th>
<th>375 RPM, 20V, 46 LINKS, 552 MM LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAIN DRIVE</td>
<td>76 CM LENGTH, DIAMETER 9 MM, PITCH 1.25 MM</td>
</tr>
<tr>
<td>WOODEN BLOCK</td>
<td>500 MM LENGTH, 60MM WIDTH</td>
</tr>
<tr>
<td>INPUT VOLTAGE</td>
<td>12 V(RECOMMENDED )</td>
</tr>
<tr>
<td>OUTPUT VOLTAGE</td>
<td>12V , O/P CURRENT 5A PER CHANNEL</td>
</tr>
</tbody>
</table>

B. Circuit Diagram

Figure 3(A). Control System Circuit Diagram

![Circuit diagram of control system]

Circuit diagram is as shown in above fig. It consists of 2 switches used for controlling the operation of Segway named as engage switch & Series connected 12v supply & a constant current source. It is used to adjust the gain & potentiometer is used to control the steer/direction values.

C. Variation between Current input and RPM

Output voltage: 12V
Output Current: 5A per channel

![Graph of RPM vs Current Input]

D. Cost Analysis

<table>
<thead>
<tr>
<th>Components</th>
<th>Cost</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gear Head Motors</td>
<td>4000</td>
<td>Blue</td>
</tr>
<tr>
<td>Wheels</td>
<td>600</td>
<td>Pink</td>
</tr>
<tr>
<td>Frame</td>
<td>600</td>
<td>Green</td>
</tr>
<tr>
<td>Batteries /Adaptors</td>
<td>1000</td>
<td>Purple</td>
</tr>
<tr>
<td>Chain Drive</td>
<td>200</td>
<td>Sky blue</td>
</tr>
<tr>
<td>Sprocket</td>
<td>500</td>
<td>Orange</td>
</tr>
<tr>
<td>Stud</td>
<td>100</td>
<td>Dark blue</td>
</tr>
<tr>
<td>Miscelanios</td>
<td>100</td>
<td>Rot red</td>
</tr>
<tr>
<td>Fabrication</td>
<td>400</td>
<td>Dark green</td>
</tr>
</tbody>
</table>

V. MECHANICAL SYSTEM:
The best suitable material for base plate is iron due to its high strength. As a very high load acting on base plate, we use angle plates to avoid bending. For handle we use 1 inch diameter steel pipe. The pipe is threaded to form a ‘T’ joint. When the rider tilts forward the platform along with the handle tilts forward. The motors are bolted to the base plate from bottom. For transmitting the torque produced by motor to wheels we have designed coupling. It is made up of MS rod with chain sprockets. This design will help to improve the torque of the motors. In this we have made cycle like structure by using bearing, Rod & sprockets. The batteries are mounted on the platform and control circuit below platform and rider is ready to ride.

VI. RESULT
The desired objective of low cost self balancing two wheeler has been obtained.

VII. CONCLUSION
In the course of this project, the design and fabrication of two wheeler 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 achieve space...
utilization and minimize the fuel consumption especially for commuting over shortest distance.

VIII. SCOPE

1. Parts which is used can be minimized so that weight can be minimized.

2. Improvisation of model can done by aligning the axis of board and motor and wheel.

IX. REFERENCES


