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Hoverboard With Handle Segway

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Abstract: *In the present days we are dealing with a problem of increase in number of vehicles with ever-lasting demand of fuel to run them. If this situation remains with time it would be difficult for us to save our future from increasing pollution and fuel demand. With time the population on earth increases obviously; which cannot be controlled so to fulfill the demands of fuel or energy in future world, effective steps should be taken as soon as possible. Our dependence on fuel can be reduced with an alternative such as, use of battery operated vehicles. New technology should be implemented; use of eco-friendly vehicles should be encouraged. Segway is an electric scooter of future technology; it is often used to transport a user across mid-range distances in urban environments. It has more degrees of freedom than car or bike and is faster than pedestrian. They are more efficient than fuel powered vehicles for shorter distance and time of travelling. An electrical vehicle such as Segway, if widely used in the society would give a helping hand in reducing pollutions caused by two wheelers. It would save time and efforts in travelling short distances on barefoot for ages of people. This project is a step towards design, development and programming of an electric powered vehicle using simpler algorithm of control over motors via open source board. sensors and microcontroller. It also aims for study and analysis of stability of an electrical vehicle made using open source software and hardware.*

Keywords: Handle Segway

I. INTRODUCTION

The current transportation urban mobility model has negative impression on the society such as illnesses due to air pollution, road accidents, climate warming, congestion and dependence on fuel sources available which are limited. An estimated three million people in the world die every year because of diseases caused due to pollution. Children are the main victims of diseases related to pollution. Forty percent of diseases caused by the environment affect children under five, whereas these children make up only 10% of the worlds population. According to the World Health Organization 40% of the planets greenhouse gas emissions was due to automobile in the year 2010.Between the year 1950 to 1990, the number of motor vehicles in the world had multiplied to nine times, i.e. increase from 75 million to 675 million. According to the most conservative projections of the Organization for Economic Co-operation and Development, there will be 1.62 billion vehicles in 2030. In a resent search the number of vehicles in Jaipur. India has increased considerably in the past five years, resulting in increase in pollution too. According to regional transport office, every day 500 new non-commercial vehicles get registered including two wheelers and four wheelers. In the recently press released of the WHO report on pollution in India, the present situation of the city is not so encouraging when pollution in the air comes to picture. Due to increase in number of vehicles over the years, the city roads witness frequent traffic congestions, but above all, the vehicles emitting pollutants are affecting environment badly. "The air pollution consists of many pollutants, among other particulate matter. These particles are able to penetrate deeply into the respiratory tract and therefore constitute a risk for health by increasing mortality from respiratory infections and diseases, lung cancer, and selected cardiovascular diseases," says the WHO report. New patients with respiratory problems are constantly being

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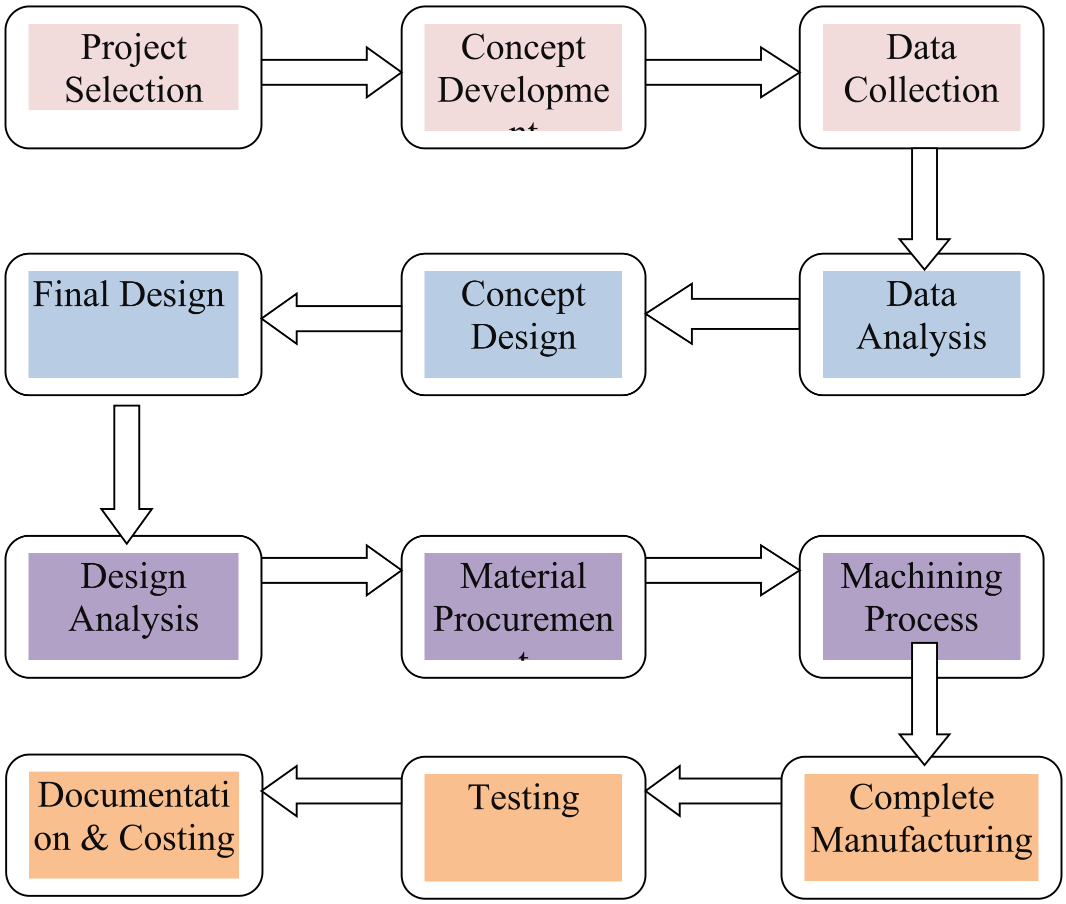
reported in hospitals. The two wheelers are the major contributors of vehicular air pollution followed by four-wheeler (e.g., car, jeep, taxi etc.), trucks and buses in decreasing order of magnitude.

II. METHODOLOGY



III. OBJECTIVE

The device's width and length could not exceed shoulder length as it could not be concealed beneath the costume otherwise. Its height from the ground could not be more than a few inches for the same reason. It was important for the user to have good balance while standing on the device.

The device was to move using motorized wheels and would be able to turn using swivel caster wheels. The batteries were to be mounted on the device underneath the device next to the wheels and off the ground, or otherwise concealed from the audience. The device was to be controlled via either remote control by another person or via switches by the user.

The device must allow the user to move forward and turn in both directions all while balancing. It is not necessary for it to go backwards. It must also be considerably quiet, as the audience is only a few feet away from the performers and loud motor noise would give away the "magic" of the angel's smooth and every movement.

Principal

The device must allow the user to move forward and turn in both directions all while balancing. It is not necessary for it to go backwards. It must also be considerably quiet, as the audience is only a few feet away from the performers and loud motor noise would give away the "magic" of the angel's smooth and every movement.

An Electric DC motor is a machine which converts electric energy into mechanical energy. The working of DC motor is based on the principle that when a current carrying conductor is placed in a magnetic field, it experiences a mechanical force.

The Electric motors give the necessary torque to the wheels and then it is controlled with the help of switches. As the whole idea of hoverboard cart is based on the people related to disabilities, the switches used at the hand positions so that anyone can able to navigate the vehicle easily.

Problem Statement

Air pollution is a major environmental problem in cities where most people are exposed to poor air quality. Rapid urbanization in India has led to significant growth in the number of ICE vehicles. As vehicle traffic continues to grow and congestion increases, vehicles have become the primary source of air pollution in urban India. The country has taken several measures to improve its quality in cities. These include improving fuel quality, drafting the necessary legislation and applying vehicle emission standards, improving traffic planning and management, etc.

Shortage of fossil fuel and the expansion of pollution and fuel rate makes electric vehicles (EV) more popular on transportation. Compact electric vehicles are gaining some attention from the urban public, personal transporters include all types of bicycles, Segway, hoverboard, e - scooter, e-bikes, etc... are widely used. But the main disadvantage of these electric vehicles is their high cost. A Hoverboard with 3 wheels, which is powered by two engines mounted as part of the Hoverboard. The DPDT switches control the board's direction and movement. The vehicle has battery-operated electric motors. It is balanced through a small bearing wheel. No micro-controller, gyroscope, or sensor is used. The rider accelerates or decelerates by using Speed governor.

Source Of Problems

1. Loose cables

Whether the cables themselves are loose or their connections are bad, you need to reconnect them. Start by unscrewing the bottom of the board, then remove the lower part of the body. Locate the main circuit board and start disconnecting and reconnecting the wires. If this does not work, you might need to buy a new motherboard.

2. Wheel motors

These are tiny little devices that wire from the motherboard feed into the wheels. The red light will blink four times for the motherboard side and five times for the battery side. Fixing this problem requires buying a new motor for the bad wheel then replacing it disconnecting the old motor and reattaching the new one. They come pre-assembled making this an easy project.

3. Faulty battery

Every battery goes bad eventually, including the ones in a hoverboard. When yours finally kicks the bucket, all you need to do is purchase a new one and replace it.Make sure to pick up the battery that works with your model or a UL -2271. The ULs are made by Samsung and considered the safest in the market.

4. Hoverboard not turning off

When your hoverboard keeps on beeping and won't turn off, you need to take the matters in your own hands. You should flip it and unscrew it and slowly remove the battery this will stop the noisy beeping sound. Then you need to buy a hoverboard repair kit and fix the problem on your own.

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IV. COMPONENTS USED

Components	Quantity
1. Wooden frame (Base)	1
2. Motors	2
3.DC Batteries	2
4. Driving wheels	2
5. Supporting wheels	2
6. Handle	2
7. Switches	1
8. Bush	2
9.Other Electrical components	2
	-

Construction

Once the plywood was acquired, the 15”x12” platform was created using a table saw. The edges were sanded in order to prevent wood splinters, as the device was to be picked up from its sides and moved during blackout scenes in the production. In order to find the best placement of the switches, I stood on the platform with my feet slightly pointed outwards. I marked the location of my big toes on the platform. A rotary tool was used to drill a half inch hole through the wood on the marked locations. The switches were then fitted through the holes, with the button poking out of the surface and the terminals on the underside of the platform. The switches were then attached to the platform with super glue. The channel was attached by connecting it with three 90° brackets which were then screwed onto the underside of the platform on the opposite edge of the casters. The casters were attached to the device by screwing the attached metal plate onto the underside of the platform, half an inch from the edges. The motors were attached to the channel with clamping mounts, which were then screwed into the channel. The motor’s shaft was connected to a 1/4” shaft with a coupler. The 1/4” shaft was attached to the channel with two pillow block bearings. The shaft was finally connected to the heavy duty wheel with a clamping hub. Figures 14 and 15 below help visualize this process. The batteries were attached to the underside of the platform with duct tape. Wire was soldered onto the terminals of the motors and switches, and bullet connectors were used to connect it to the batteries. The wire was then taped onto the platform in order to prevent it from dragging along the floor and potentially getting stuck under a wheel. Figures 16 and 17 below help visualize the circuitry.

Design Details

This section describes each component’s geometry and material selection. The design consists of a platform for the user to stand on with two switches near the toes to control movement. Attached to the underside of the platform are the batteries, motors, wheels, and all necessary wiring. The selected parts are detailed in Table 1 below. Further explanations and reasoning is explained in the subsequent sections.

Component	Selection
Platform	23/32”x15”x12” Plywood
Motor	300 RPM Gear Motor
Wheel	4” Diameter Heavy Duty Wheel
Casters wheel	2” Diameter Swivel Plate Caster
Batteries	3700 mAh 12V Battery Pack
Switches	Single-Pole Momentary Contact Push-Button Switch

Calculation

Weight to be carried = 100kg Diameter of the tyre = 0.1651m Radius of the tyre = 0.08255m

Required speed = 12kmph (normal speed of a hub rotor hoverboard is 6 to 7 miles/hour) [7 miles = 11.2654 km]

(max: speed of hover board is 10 miles/hour) [10 miles = 16.0934 km]

Total reaction on each tyre normal reaction of each tyre = W/2 W = Weight = 100/2 = 50 kg = 50 x 9.81 = 490.5 N

Static friction Considering it as u, u = 0.025 Dynamic friction v = 0.002 then, Static frictional force, F(u) = 0.025 x 490.5 = 12.2025 N Dynamic frictional force, F(v) = 0.002 x 490.5 = 0.981 N

Torque required in static friction,

T = Fxr F = force, r = radius of wheel T = 12.2025 x0.08255 = 1.0122 Nm

Torque required in dynamic friction, T = F x r T = 0.981 x 0.08255 = 0.0081 Nm

Internal force required for the motion, F = ma m = 100 Kg a = dv/dt = [(16000/3600) /10] = 0.444 m/s

F = 100 x 0.444 = 44.4 N

Torque required for moving the vehicle,

T = F x r = 44.4 x 0.08255 = 3.665 Nm

Total power required to move the vehicle,

P = T x w T = Torque w = Angular velocity

=2 rps

60 x rpm = rps , 16 kmph = 514.1286 from reference 1 rpm = 6 (angular velocity)

So, w = 514.1286 x 6 = 3084.7716 Power required to move vehicle,

P = T x w w in rad/sec Rad/sec to degree =

So, = 53.839 rad / sec

P = 3.665 x 53.839 = 197.3199 = 198

Platform Details

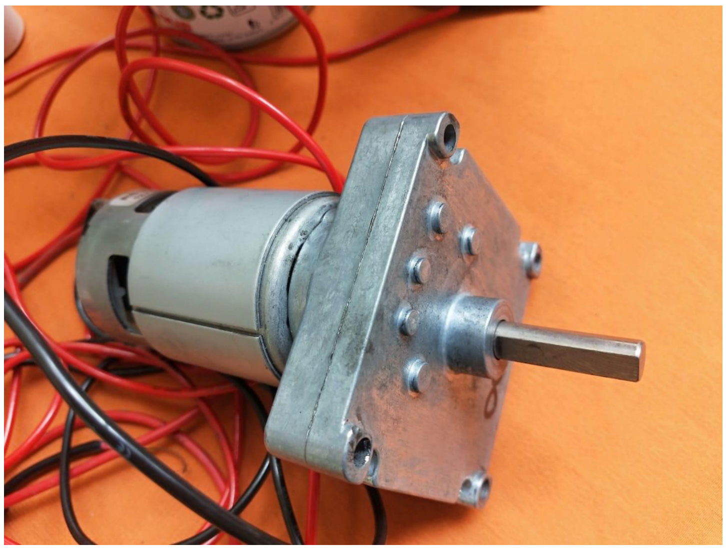
Seeing as the device would use four wheels in total, it made sense for the platform to be rectangular. The chosen dimensions were 15”x12”. The 15” width allowed for comfortable feet placement on the platform, with the user placing their heels together and pointing their feet slightly outward. The 12” length allowed for more room on the underside of the platform for electrical and other structural components.

As for the material, simple plywood was selected due to its high strength and resistance to cracking and bending. Its light weight was also a positive factor as it helped exert a lower load on the wheels. A 23/32” plywood height was selected.

Plywood Platform

DC Gear Motor

Two 12 volt dc gear hub motors are used. They have been selected over normal Dc motors as they have a better power/weight ratio, greater efficiency and hence are more compact, robust and reliable. The absence of a commutator and carbon brushes (which are subjected to mechanical wear and tear due to friction) enables this type of motor to have a longer life. The armature is the stationary part and has three coils, while the rotor is a permanent magnet. Each motor has three hall sensors used to detect the position of the rotor. The stator speed Ns and the rotor speed Nr are both the same at steady state as this is a synchronous motor. The rotor speed Nr is measured by taking feedback from the hall sensors while the stator speed Ns is the frequency at which you alternately switch the coils. By taking feedback Nr and Ns are kept the same.



DC Gear Motor

Structural Details

The motor and motorized wheels were attached to the underside of the platform by connecting them with an aluminum channel. This channel ran alongside the width of the platform. It was connected to 90° brackets and attaching those to the underside of the plywood with wood screws.

The total height of the device had to be considered. It should be kept as low as possible due to costume concerns. Increasing the height would make it more difficult to conceal the device using the angelic cloth costume. 4” diameter wheels were selected for the motorized wheels. 3” diameter swivel casters were selected. The casters were directly attached to the underside of the platform by screwing the attached metal plate to the plywood.

As stated earlier, the switches’ height had to be considered due to it being controlled by the toes. Small SPST momentary switcher were selected, mountable on half-inch holes which were to be drilled into the plywood platform.

The switches were default off, momentary on in order for the user to press down with their toes in order to move forward. Two of these switches were purchased, one for each circuit. The electrical components were connected with 14 AWG wires taped on the underside of the platform. The wiring formed two circuits, one for each motor (left and right).

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Structure

Battery

A VRLA battery (valve-regulated lead-acid battery), more commonly known as a sealed battery (SLA) or maintenance free battery, is a type of lead-acid rechargeable battery. Due to their construction, they can be mounted in any orientation, and do not require constant maintenance. The term "maintenance free" is a misnomer as VRLA batteries still require cleaning and regular functional testing. They are widely used in large portable electrical devices, off- grid power systems and similar roles, where large amounts of storage are needed at a lower cost than other low-maintenance technologies like lithium-ion.

There are two primary types of VRLA batteries, gel cells and AGM. Gel cells add silica dust to the electrolyte, forming a thick putty-like gel. These are sometimes referred to as "silicone batteries". AGM (absorbed glass mat) batteries feature fiberglass mesh between the battery plates which serves to contain the electrolyte. Both designs offer advantages and disadvantages compared to conventional batteries, as well as each other. CHARGING VIA THE ELECTRICITY “Y“TEM’“ INBUILT GENERATOR A 7.2V control voltage is used for 6V systems.

12 Volt DC battery

Wheel

Two Scotty ES wheels are used. The outer diameter of the motor almost matches the rim size and hence mounting the motor in these wheels is considerably easier. By using a circular 10mm thick plate of mild steel the motor is mounted between the wheels.

Wheel

V. ELECTRICAL SYSTEM

It was important to determine whether each motor would have its own circuit (and battery), or whether one circuit would include both motors and one or more batteries would power the motors.

With two separate circuits, each motor would require its own battery to run, allowing for the user to control each motor independently. This simplifies turning, as it would require the controller of the device to simply close one circuit and short the other. However, two batteries would be required as opposed to one. This further increases the weight of the device and the load supported by the wheels, as well as the total cost of the device.

Having one circuit for the device restricts it to one component, eliminating a previous structural concept . Having one battery as opposed to two would reduce the total weight 3 and cost of the device. The motors would be configured in parallel with each other in order to retain the voltage output of the battery. Controlling the device would also be more complicated, especially when turning.

Advantages

1. Become more productive: more work can be done by using the product versus walking.
2. Become more recognizable: 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.
3. Low operating costs: no need for gas and inexpensive battery charging (A complete cycle charge will take eight to ten hours)
4. Reduce fatigue caused by walking.
5. A clean, green, eco-friendly machine! (Zero emission).

Disadvantage

1. Slow, having a max speed of 12.5 mph.
2. Does not exactly say how far the Segway will go with riders of different masses.
3. Heavy, weighing around 100lbs.

4. Unlike bicycles, a drained Segway cannot be pedaled home or a charger.
5. Expensive, this costs around 30,000-50,000.

Application

In such advanced technologies, Hoverboards are one of the best examples that which decreases the cost of living. These hoverboards and Self balancing scooter run through the rechargeable battery and which can use travel anywhere in your city such as shopping, park while going to the gym or to your workspace etc.

hover board can use travel anywhere in your city such as shopping, park while going to the gym or to your workspace etc.

Future Development

1. Motors and computers in the base of the device keep the Segway upright, and as an individual leans forward, the device moves forward.
2. User can travel to nearby distance easily without any problem.
3. Segway is very useful for patrolling in an area.
4. Main Development is that it is emission free/green vehicle.

VI. CONCLUSION

From this project, we successfully make out the model having its capacity that user can stand and it sustain its load. Also we identify the model beyond its limit capacity. As well as we also came to know about electrical& computer engineering field.

This project was assigned to me by Prof. Antonio Barata of the Cal Poly Music Department. He wished for a device to smoothly and eerily allow one to move without using their legs. The device was to be used by a myself performing as an angel in RSVP, a yearly student-produced production led and overseen by Dr. Barata.

The project began with exploring ideas for the design inspired by similar devices in the market. Ultimately, a rectangular platform with two motor-powered wheels and two casters was chosen. Parts were purchased and connected, and the device was built and tested.

During testing, it was found that the device did not perform as well as expected. A motor would frequently stall and cause me to become immobile or move in a jittery fashion, which was not desired. The project was eventually chosen to not be included in the show, and I would go on to successfully perform in the show without the need of a device. Recommendations for the product can be found in Section 5.2 Recommendations for Future Manufacturing

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