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Design and Fabrication of Segway Urban Commuter

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Abstract: Cycles have been around since 1800's and they have been used for personal transportation ever since. Their use is however limited when it comes to being used indoors or for senior citizens to go up hill outside. Furthermore we need to reduce the mechanical effort of humans to make the ride effortless but also green enough to not damage the environment. The purpose of the paper is to design, fabricate and analyse the Segway Urban Commuter (SUC). The vehicle comprises of two wheels on either side of a frame. The user stands on the platform and changes his centre of gravity by shifting his weight forward or backward on the platform. This tends to make the platform tilt with the user, this tilt is read by the accelerometer and the wheels are set in motion by the Arduino to help balance the user. Hence more the tilt, greater is the speed achieved to keep the user balanced. This setup is designed to provide a zero pollution vehicle on campus that is fabricated with cost reduction in mind, without compromising on the safety and other necessary features of the original Segway. This project also includes additions that greatly enhance the usability of the vehicle.

Keywords: Segway Urban Commuter, electric vehicle, self-balancing, green vehicle, personal commuter.

I. INTRODUCTION

The aim of the paper is to design, fabricate and analyse the SUC. The original Segway is expensive for a college campus or even a mall for that case. Buying individual vehicles and giving them out for rent or for personal use of the faculty or visitors is not feasible. Hence we have come up with a proposal to create a vehicle that is easily affordable, is equally safe and yet eco-friendly. We follow the same methodology of operation, but we have innovated its principle of work to make it totally cost effective and efficient. With the addition of an Android motherboard, the entire process becomes extremely simple. An Android mother board comes inbuilt with a gyroscope/accelerometer sensor, proximity sensor, GPS, digital compass, barometer etc. all of these inputs to the phone can also be forwarded through any of the output means, namely, Bluetooth, audio, video, Wi-Fi, Infrared ports etc. With these options and the Android operating system on board, the SUC now has incredible potential for third party and native applications.

II. FRAME

The frame is the most important part of the Segway. It is made up of iron angles that form a rectangle of 22"x20". The platform will be made up of a perforated metal sheet welded to the frame as shown in Fig.1.The motors and the wheels will also be attached to the frame below. The top part of the frame holds the handle bar and the battery container. The handlebar is made of metal bar that is at optimal average height, designed to be held comfortably.

The base of the handlebar is firmly attached to the frame and the handlebar freely rotates in one plane about its axis. The battery container is designed to move back and forth to help balance the Segway at Stand by. This helps the user to begin at the neutral axis to the ground that the Segway will stand on. The frame also constitutes a set of small tyres that will be placed at the front end and the back end of the Segway to prevent the user to bend more than the Segway can handle, this adds a safety feature that helps the user to not fall during his commute.

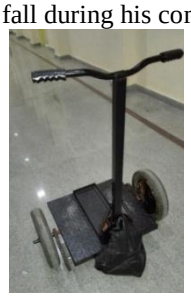

Fig 1. Frame of the SUC, including the handle and wheels

III.MOTORS

The motors used in this project are actual second hand motors that are used in a power steering mechanism to help the driver to turn the wheels of the car. They are DC motors that have a gear attached to them as shown in Fig.2. From 2500 RPM, they are brought down to 120 rpm. Hence the torque generated by these motors is easily sufficient to move a person and the frame with it. The specifications of the motor comprise of a 12Volt DC motor, drawing current at 5 Amps on no load and up to a maximum of 12 Amps on full load. The motors are currently at 120 RPM but with a chain drive we have been able to increase it to 400 RPM. The motors are placed o opposite diagonals of the frame to help balance the Segway.

Fig 2. The geared motor of the Segway

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IV. ELECTRONIC COMPONENTS

The Segway constitutes an electronic system that helps it to operate smoothly. The brain of the Segway is the Arduino Uno motherboard which is shown in Fig.3. This motherboard is used to process the input and take the required decision accordingly. The Uno board is connected to the batteries, the motor controller and the Android Phone. The Android Phone sends the orientation in real time to the Arduino and it accordingly sends the required input to the motor controllers which control the motors to turn or accelerate as required.

The Android Phone has inbuilt sensors of various kinds. Accelerometer, proximity sensor, GPS, Magnetometer, Heart rate sensor, Light Sensor etc. and all of this information can be forwarded through the multiple output options like Bluetooth, Wi-Fi, Infrared, Audio-Video outputs etc. This can be used to control the Segway, to fine tune it and create unimaginable possibilities with this much information flowing just below the hood. The potential is huge for third party and native applications on the Android platform and the new application genre that will be customized for the Segway alone. The accelerometer sensors used in this Segway are shown in Fig.4 and Fig.5.

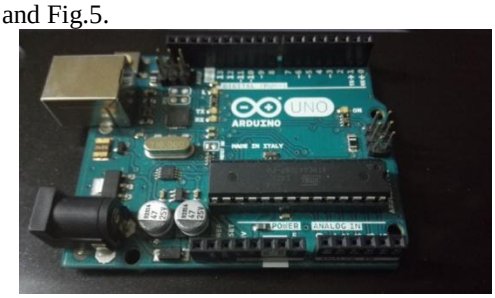

Fig 3. The Arduino used in this Segway

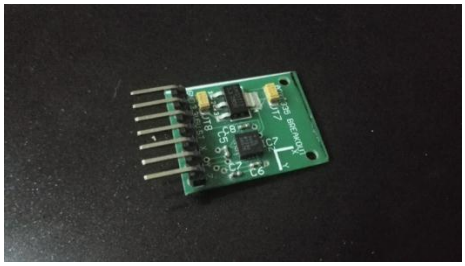

Fig 4. The Accelerometer sensor used in this Segway

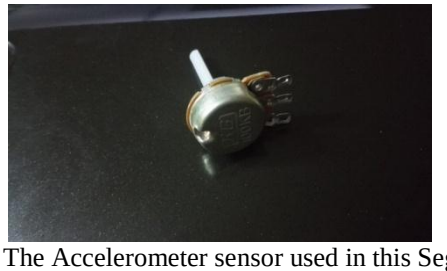

Fig 5. The Accelerometer sensor used in this Segway

V. POWER SOURCE

The Segway is powered by a 12Volt, 42 Ampere Hour battery that is used to power cars is shown in Fig.6. One battery is sufficient enough to take the Segway for a minimum of 2 hours. The battery will be placed on the top side of the frame between th leg space area. It has been given the freedom to move back and forth to help balance the Segway as a whole. There is provision to add another battery in this space if more battery life is required.

Fig. 6. The Lead –Acid battery used in the SUC

VI. CONCLUSION

In conclusion, the Segway urban commuter is an excellent option for people of all ages. It is green, efficient, fast and a cost effective way to commute short distances. The vehicle uses electricity to power both of its motors, hence there is zero pollution. The vehicle is able to carry a person easily and with an added luggage too if necessary for the commute for at least two hours. With an added battery pack, we can increase the duration to four or even 8 hours. The vehicle is able to travel for up to 30 kmph, which is more than enough speed for people to commute in. It is also very safe as there is a foot switch acting as a dead man's switch to avoid any accidental movement and there is also the two set of wheels that help prevent excess tilting of the user. Lastly, but most importantly, the Segway is just a fraction of its cost. The original Segway is 5, 00,000 INR but the model we've made took only 25,000 INR, hence this allows for easier purchasing at schools and other campuses or even for a common man to commute in.

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BIOGRAPHIES

Pal Pandian P, Associate Professor of Mechanical Engineering, completed his BE (Mechanical Engineering) from Madurai Kamaraj University, MTech (Industrial Engineering) from National Institute of Technology, Trichy and MBA from Alagappa University. Currently he is pursuing PhD (Mechanical Engineering) in Anna University, Chennai. He has 14 years of experience in Academic. He has been an enthusiastic participant at various International and National Conferences/Seminars/Workshops around the World and also presented his research work at the same. He has published more than three dozen papers in the various National, International journals and Conferences. He has also guided a number of undergraduate, post-graduate projects.

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