Modelling and Fabricating Gyro Self Balancing DIY Wheel

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Abstract: The project is about the designing of a single wheeler self balanced car. The single wheeler vehicle would be able to balance itself and can be stabilized against any impact and in zero velocity as well. We used single heavy rotating disks with hub motors at the chassis to compensate the tilt of the vehicle and get it stabilized. An android device is used to measure the tilt angle of the chassis using orientation sensor. The data then is sent to a Bluetooth receiver that is connected with an arduino. An android application is developed which takes the angle of tilt of the vehicle as data input from the phone and sends a control signal to the arduino accordingly. Using the signals the vehicle is balanced by controlling the motor from the arduino which determines the tilt direction of the rotating disks. This vehicle is designed to provide the safety that single wheeler vehicle does not have during an impact. Our aim is to design a safe, cost effective and fuel efficient vehicle

Index Terms – Gyroscope, DC Motor operated, Compact Disc wheel, Arduino,

I. INTRODUCTION

Motorbike is a very popular transport around the globe. It has been very popular due to its energy efficiency, compact design, convenience and attractive look. Many youngsters consider it as fashionable ride while people in the developing country often use it as a low priced vehicle with better fuel efficiency. However, despite of the features and popularity motorbike has lack of safety and is very risky. Therefore, motorbike accidents are fatal. An injury is must while death is more frequent scenario. The major lacking in motorbike addressing the safety features are the passenger's body is exposed during ride time which allows the passengers to get off the vehicle and exposes him to impact with roadside elements and the chance of damage is limitless. The project is about designing a self balanced two wheeler vehicle and developing the circuits. The vehicle balances on its own when it has its engine on while there is stand to keep it standing when the engine is not running.

The vehicle will be balancing on the using counterforce to it when it tilts beyond the accepted angle. The objective of building a self balanced two wheeler vehicle is mainly to ensure safety of the rider. We have considered the scenario of our country, Bangladesh in this manner. Enormous numbers of people become victim of fatal accidents. Moreover, the cars in the cities are increasing day by day but the roads are not increasing. So if a vehicle that can serve like a car and just takes the small amount of place like a motorbike whether for parking or running on roads, would be a better solution for people.
On the other hand many people does not consider it as a transport as it does not have the comfort features like the car while two wheel vehicle can save energy and space. We designed a vehicle which has both the cabin comfort of a car and the compactness of a motorbike. It has the safety features which can minimize the damage during an impact. The vehicle also has luxury features and still cost effective

II. COMPONENTS/ MATERIALS REQUIRED

- COMPACT DISC
- BATTERY
- DC-MOTOR
- HARD DISC
- CONNECTING WIRES

A gyroscope is a wheel mounted in two or three gimbals, which are a pivoted supports that allow the rotation of the wheel about a single axis. A set of three gimbals, one mounted on the other with orthogonal pivot axes, may be used to allow a wheel mounted on the innermost gimbal to have an orientation remaining independent of the orientation, in space, of its support. In the case of a gyroscope with two gimbals, the **outer gimbal**, which is the gyroscope frame, is mounted so as to pivot about an axis in its own plane determined by the support. This outer gimbal possesses one degree of rotational freedom and its axis possesses none. The **inner gimbal** is mounted in the gyroscope frame (outer gimbal) so as to pivot about an axis in its own plane that is always perpendicular to the pivotal axis of the gyroscope frame (outer gimbal). This inner gimbal has two degrees of rotational freedom.

The axle of the spinning wheel defines the spin axis. The rotor is constrained to spin about an axis, which is always perpendicular to the axis of the inner gimbal. So the rotor possesses three degrees of rotational freedom and its axis possesses two. The wheel responds to a force applied to the input axis by a reaction force to the output axis.

The behaviour of a gyroscope can be most easily appreciated by consideration of the front wheel of a bicycle. If the wheel is leaned away from the vertical so that the top of the wheel moves to the left, the forward rim of the wheel also turns to the left. In other words, rotation on one axis of the turning wheel produces rotation of the third axis.

A **gyroscope flywheel** will roll or resist about the output axis depending upon whether the output gimbals are of a free or fixed configuration. Examples of some free-output-gimbal devices would be the attitude reference gyroscopes used to sense or measure the pitch, roll and yaw attitude angles in a spacecraft or aircraft.

III.MANUFACTURING PROCESS

1. The gimbals and gimbal frames are machined from aluminum bar stock using tools developed as part of the design process. They are polished and cleaned and stored in bins until assembly. For assembly, the bins are moved to appropriate locations along the assembly line.
2. Gyroscopes are manufactured in a straight-forward assembly line process that emphasizes the importance of "touch labor" over automation. Gyroscopes are assembled from the inside out. The motor is the heart of the gyroscope and is installed first. A "typical" gyroscope motor is synchronized to spin at 24,000 revolutions per minute (rpm). It must be perfectly synchronized, and the motor is typically bench-tested before assembly. Electrical connections are added to the motor.
3. The gimbals and frames are assembled next, beginning with the inner gimbal and ending with the outer gimbal frame. Bearings are put into place. The "end play" of the bearings (the looseness of fit) typically has a very small tolerance of 0.0002-0.0008 in (0.006-0.024 mm).
4. The outermost electrical connections are attached on the assembly line, and circuit cards are added. Finally, the gyroscope is calibrated at the end of the assembly process. The suspension of the bearings and calibration are hand checked; manufacturers have found that, for even calibration, human observation, testing, and correction are more trustworthy than automated methods. The gyroscope is an elegant example of an application of simple principles of physics. Because it is simple, manufacturers closely guard any proprietary techniques. Because the gyroscope is a simple device with wide ranging uses, some require more manufacturing processes. The manufacturing steps described above take about 10 hours and result in a free gyroscope for an application such as missile guidance. A more exotic gyroscope may require 40 hours of assembly time.

IV. WORKING PRINCIPLE

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Instead of a complete rim, four point masses, A, B, C, D, represent the areas of the rim that are most important in visualizing how a gyro works. The bottom axis is held stationary but can pivot in all directions. When a tilting force is applied to the top axis, point A is sent in an upward direction and C goes in a downward direction. Since this gyro is rotating in a clockwise direction, point A will be where point B was when the gyro has rotated 90 degrees. The same goes for point C and D. Point A is still traveling in the upward direction when it is at the 90 degrees position, and point C will be traveling in the downward direction. The combined motion of A and C cause the axis to rotate in the "precession plane" to the right. This is called precession. A gyro's axis will move at a right angle to a rotating motion. If the gyro were rotating counterclockwise, the axis would move in the precession plane to the left.

If in the clockwise example the tilting force was a pull instead of a push, the precession would be to the left. When the gyro has rotated another 90 degrees, point C is where point A was when the tilting force was first applied. The downward motion of point C is now countered by the tilting force and the axis does not rotate in the "tilting force" plane. The more the tilting force pushes the axis, the more the rim on the other side pushes the axis back when the rim revolves around 180 degrees. Actually, the axis will rotate in the tilting force plane in this example. The axis will rotate because some of the energy in the upward and downward motion of A and C is used up in causing the axis to rotate in the precession plane. Then when points A and C finally make it around to the opposite sides, the tilting force (being constant) is more than the upward and downward counter acting forces. The property of precession of a gyroscope is used to keep monorail trains straight up and down as it turns corners. A hydraulic cylinder pushes or pulls, as needed, on one axis of a heavy gyro. Sometimes precession is unwanted so two counter rotating gyros on the same axis are used. Also a gimbal can be used.

V. CONCLUSION

The piezoelectric plate gyroscope is a feasible alternative to traditional MEMS gyroscopes. One of its advantages is a lower required drive voltage. However, the sensitivity is only about 38 micro volts, whereas the sensitivity of a ring gyroscope is around 200 micro volts. Also, when there is no rotation, traditional gyroscopes come much closer to the ideal zero volts output than the piezoelectric plate gyroscope, which still outputs up to 100 millivolts. A major advantage and the one that could prove most practical is the versatility of the piezoelectric plate gyroscope. It can measure rotation in two directions. In addition, if the driving voltage direction is switched, the same device can measure rotation in the third direction, although with much less sensitivity. Since this device is easily incorporated into other IC chips, it could be controlled to do more things than a ring or tuning fork gyroscope, which require three gyroscopes to measure three rotation directions. However many campus environments also experience traffic congestion, parking difficulties and pollution from fossil-fuelled vehicles. It appears that pedal power alone has not been sufficient to supplant the use of petrol and diesel vehicles to date, and therefore it is opportune to investigate both the reasons behind the continual use of environmentally unfriendly transport, and consider potential solutions. This paper presents the results from a year-long study into electric bicycle effectiveness for a large tropical campus, identifying barriers to bicycle use that can be overcome through the availability of public use electric bicycles.

REFERENCES

[1] Narong Aphiratsakun, Kittipan Techakittirioj, “Autonomous AU Bicycle: Self-Balancing and Tracking Control”, Proceeding of the IEEE International Conference on Robotics and Biomimetics (ROBIO) Shenzhen, China, December 2013.

[2] Pom Yuam Lam, “Gyroscopic stabilization of a Kid-Size Bicycle”, IEEE 5th International Conference on Cybernetics and Intelligent Systems (CIS)Pages:247-252, DOI: 10.1109/ICCIS.2011.6070336, 2011.

[3] Mukeshkumar Prasad, Nilesh W. Nirwan, “Design and Fabrication of Automatic Balancing Cycle”, International Journal of Science, Engineering and Technology Research (IJSETR), Volume 5, Issue 2, February 2016.

[4] J.D.G. Kooijman, J.P. Meijaard, Jim M. Papadopoulos, Andy Ruina, A.L. Schwab, “A bicycle can be self-stable without gyroscopic or caster effects”, Science Magazine, Volume 332, 6027 pp, 339-342, April 15, 2011.

[5] R.S. Khurmi, J. K. Gupta, “Theory of Machines”, Volume 5, S. Chand Publications, 1062 pp, 480-513. [14] C. J. L. Balsas, “Sustainable Transportation Planning on College Campuses,” Transport Policy, Vol. 10, No. 1, 2003, pp. 35-49. doi:10.1016/S0967-070X(02)00028-8.

[6] W. Toor, “Transportation & Sustainable Campus Commu- nities: Issues, Examples, Solutions,” Island Press, Wash- ington DC, 2004. [16] J. Rouwendal, “An Economic Analysis of Fuel Use per Kilometre by Private Cars,” Journal of Transport Economics and Policy, Vol. 30, No. 1, 1996, pp. 3-14.