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Self-Balancing One Wheel Vehicle (skids)

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Abstract - This paper covers all the designing and self-balancing mechanism. This vehicle works on the principle of inverted pendulum. It includes the designing of PID controller to combine the results from the sensors, designing motor speed controller and implementation of the self-balancing mechanism. The battery is used to provide supply to the vehicle. And it has further been planned to the simple design procedure and enhance driver comfort and safety, and to increase the performance of the vehicle. The aim to design and develop of this vehicle to make you connect with the people, not take you away from them. It lets you mix and mingle into the crowd, naturally. This paper also consists of driver navigation system which will guide the driver to be in the neutral position.

I. INTRODUCTION

Well, it's less than a motorcycle (in some ways), but in other ways, it's so much more. One-wheeled, electric-powered. A one-wheeled vehicle includes vehicles electric motors, a self-balancing system, and steering mechanism, wherein the electric motors and self-balancing system are disposed within the wheel of the one-wheeled vehicle. Side stirrup legs, which with respect to the wheel forks, such as that the stirrup legs may be rotated backwards and act as a kickstand for the on-wheeled vehicle. The side stirrup legs may be weighted with for example, one or more batteries may be attached to the side stirrup legs to provide a weight distribution such that one-wheeled vehicle does not fall forward when parked.

A computational resource such as microcontroller, or microprocessor-based controller, receives input signals indicative of operation of the twist throttle and brake, and responsive thereto produces signals to adjust the tilt angle relative to the acceleration and thereby reduce the need for a rider to lean forward or backwards.

II. DESIGN OF SKIDS (Self Balanced one-wheel vehicle)

The following design methodology was used in design:

1. Requirements
2. Design Calculations and analysis
3. Considerations
4. Testing
5. Acceptance

Based on the overall design objectives of durability, performance, and light- weight design, the component is evaluated by the design team and must meet all of the criteria to become an overall part of successful design. Alternatives were also considered during each process and testing commenced once the chosen design met the design objective.

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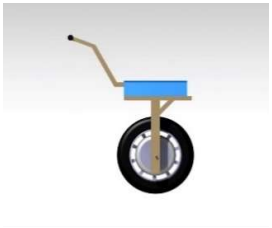
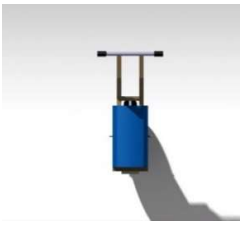
a. DIFFERENT VIEWS OF THE VEHICLE

Isometric view of the vehicle

Front view of the vehicle



Side view of the vehicle



Top view of the vehicle

III. SELF - BALANCING MECHANISM

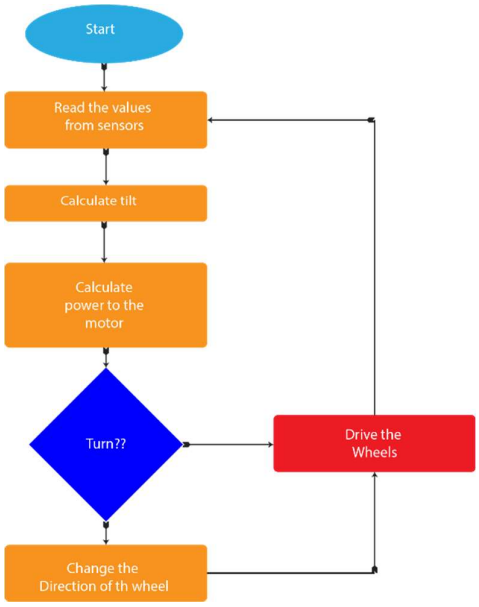
a. CONTROL THEORY OF THE SELF-BALANCING UNICYCLE

Creating a self-powered unicycle that balances itself in three dimensions is a robotics and control theory problem.

A self-balancing unicycle can be considered as a non-linear control system similar to that of a two-dimensional inverted pendulum with a unicycle cart at its base. There are many higher-order effects involved in modelling the full system. Rotation of the drive wheel itself can provide control in only one dimension, forwards and backwards. Control in other dimensions generally requires other actuators, such as auxiliary pendulums, reaction wheels, or control moment gyroscopes attached to the main unicycle pendulum.

b. CONTROL MECHANISM

As all the the commands that to give in input and output to the system are controlled by the on-board microcontroller in the system. The commands that are being feeded into microcontroller by using C language. The software running in the controller is embedded C. The embedded C programs is a set of language extensions for the C programming language.



Above figure shows the control program structure of the self-balancing personal transporter. In this program structure, the readings from both the accelerometer and gyroscope sensors are sent to the controller. These are fused to get the exact tilt of the vehicle. To remove the high frequency distortion in the reading of the accelerometer it is passed through a low pass filter. The angular velocity obtained from gyroscope is integrated to obtain the angle and then passed through a high pass filter to remove the low frequency distortions. The result obtained from low pass and high pass filter are then summed to find the estimated angle. Controller receives commands from rider and controls the vehicle motion its direction. User can control the vehicle motion in 4 directions: Forward, Backward, Left and Right.

c. RIDING MECHANISM

Ready to accelerate? It's simple. A suitable forward shift of your body weight and the SKIDS gently begins to move in the direction you want to go. A SKID doesn't do anything more or less than you want it to do. A gyro sensor tells the SKIDS'S RYDE-EX control system to drive the wheel forwards or backwards to stay under the centre of gravity. Lean forward, and the gyro tells the processor that the bike is falling forward. As a result, it will roll forward until the rider allows the bike to come back to zero.

IV. DRIVER NAVIGATION SYSTEM (DNS)

- This system will guide the driver to remain in a neutral position.
- It will tell whether a driver has to lean forward or to go backword during motion.
- This system is very good to sense the position of the vehicle to make it and calibrate as per requirement.

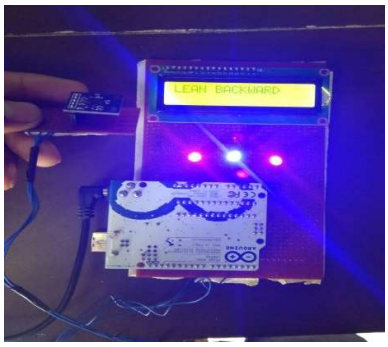


Fig. 4.1 When a driver will lean forward it will show a indication to move backward as shown in fig.

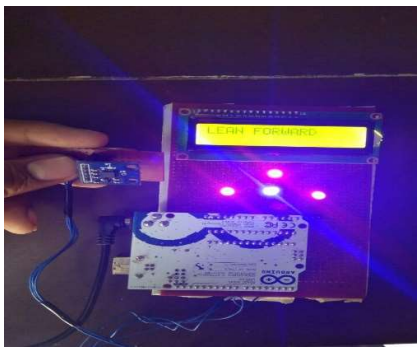


Fig. 4.2 Similarly in case of backword motion it will show to move forward.

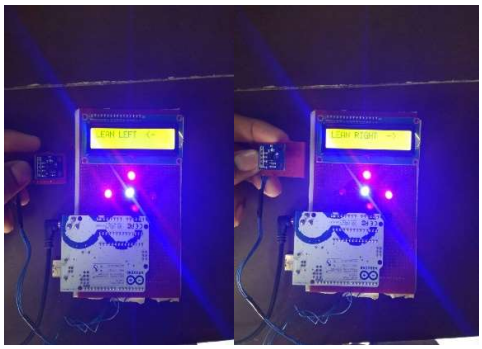


Fig 4.3 Side to side motion indication

CONCLUSION

This paper presents design and the development of the self-balancing personal transporter which is capable of carrying single person to move from one place to anotherwithin the premises of large campus. The vehicle balances itself by moving the motors in clockwise or anti-clockwise direction base on the readings from sensors. Thus the proposed system can be much helpful in the large campuses like airports, universities etc. This system reduces the work of humans as well as provides eco-friendly environment.

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