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Mono Wheel Transportation System for Commotion Areas

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Abstract: The project is about Mono-Wheel Bike. In this present economic statistics the cost of fossil fuel is increasing day by day and the time taken to reach the destination with existing bike is very time consuming because of the road traffic. To give solution Mono-Wheel Bike has developed with Portable design in weight parameters where is easy to carry along with us also it gives hassle free drive for the user when passing in commotion area or road traffic it moves rapidly faster rather than the existing bike. The bike is powered with BLDC motor and it is provided with secondary batteries.

KEY WORDS: Monowheel, BLDC Motor, Bike, Fossil Fuel

I. INTRODUCTION

A. MONOWHEEL BIKE

Early days horse drawn monowheel is a base model for this project. Single person can drive this wheel by using electric power[1].

B. ELECTRIC MONOWHEEL BIKE

An electric monowheel first tested in 1932 at lomdon and its is called Dynasphere. Later the very famous and well equipped RIOT wheel was introduced in 2003. It contains the travelers used to seated at the front of the wheel & it is well balanced with having heavy counterweight[2]. The mono vehicle is powered with sprocket and its having the spokes[3].

In 2007, Netherlands company started for customer service for monocycle it is called the Wheelsurf[4]. The diwheel also contructed in this period with having two wheel side by side. Sony launched the character axle of video games in 1971.

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C. ENGINE MONOWHEEL BIKE

Mono cycle introduced by American and his name is Mr.Kerry. Mr. McLean Rocket Roadster launched the vehicle in 2000, its working by Engine .

Later using this models, more number of designs introduced after 2000, with having larger wheels and high powered engine[5].

In 2011,a aircraft grade aluminum billet introduced in mono wheel for its high capability to run. It contains the travelers used to seated at the front of the wheel & it is well balanced with having heavy counterweight. Single person can drive this wheel by using engine power.

II. AIM AND OBJECTIVES

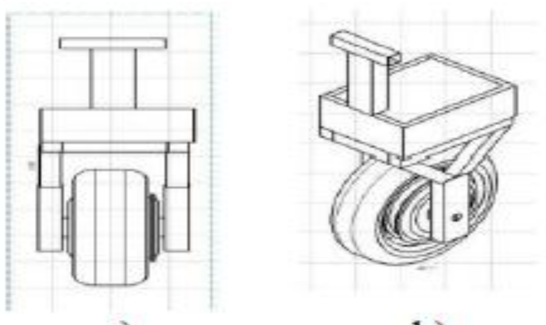
A. AIM AND OBJECTIVES

The important criteria to introduce this monowheel to have self balance with easy moving of reverse, forward working . Turning process can handled by handle bar and drivers balancing.

While traveling with required speed, its necessary to use the body balance for change of angle. One more important goal to design this bike to run less expensive.. The issue of balancing is reduced by using pendulum with but here we are using inverted pendulum. An inverted pendulum is which has its weight and its carry the form of simple mass and rod, to a full system. The normal pendulum was constant, then the inverted pendulum not in stable and should be evenhanded to remain standing

B. PRINCIPLE

This difficulty of balancing the monocycle is same as the 'inverted pendulum' issue. The inverted pendulum having its mass above its hinge. Fig.1 shows the Monocycle a)front view and b)sideview.



a)**Monocycle.a). Front View, b) Side View**

III. MATERIALS AND METHODS

A. TRANSMISSION SYSTEM

Design Criteria:

Desired top speed (Vmax) - 15km/hr.
Maximum driver weight –80 kg (extra 20 kg payload) Gross vehicle weight (GVW) - 25 kg. (assumed)
Radius of wheel/tire (Rw) – 0.381 m
Desired acceleration time (ta) - 05 seconds. Maximum incline angle (α) - 10 degree

To produce torque its needed to find out the total tractive effort (TTE) requirement for the vehicle:

TTE = RR + GR + FA

Where:

TTE = Total tractive effort [N]

= Force necessary to overcome rolling resistance [N] GR = force required to climb a grade [N]

FA = Force required to accelerate to final velocity [N]

B. DETERMINING GRADE RESISTANCE

The force which is needed to movie the vehicle up in slope it is called Grade Resistance – GR. So the calculation created by using angle and grade of the monocycle to climb in normal operation.

To convert incline angle, α, to grade resistance.

GR = WW × g ×sin(α) Where:

GR = grade resistance [N]
WW
= Weight on wheel [kg]
= maximum incline angle [degrees]

Solution

GR =25× g × sin(10)
= g × 4.31 N GR = 42.2811 N

Determining Acceleration Force

Acceleration Force (FA) is the force necessary to accelerate from a stop to maximum speed in desired time.

FA = WW × g ×Vmax / (g ×ta)

Where:

FA= acceleration force [N]
=Weight on wheel [kg]
Vmax = maximum speed [m/s]
Ta = Time required to achieve maximum speed [s]

C. DETERMINING TOTAL TRACTIVE EFFORT

The sum of the forces is calculated by step 1,2,3 and its called Total Tractive Effort – .

TTE = RR + GR + FA

Where:

TTE = Total Tractive Effort [N] GR
= Grade resistance [N]
FA= Acceleration force [N]
= Weight on wheel [kg]

Solution

TTE = (2.126 + 4.31 +0.05) × g
= 6.481× 9.81
TTE = 53.56 N

Determining Rolling Resistance

RR = WW×g×Crr

Where:

RR = Rolling Resistance [N]
WW = Weight on wheel [kg]
Crr = Rolling Friction Coefficient
RR = 25 × g × 0.002
(Crr value for bicycle tire on concrete)
=g×0.05N
RR= 0.4905 N

Tw = TTE ×Rw

Where, Tw= Wheel torque [Nm]
TTE= Total tractive effort [N]
Rw = Radius of the wheel/tire [m]

Solution

TTE Tw = 53.56× .381
= 20.4 Nm.

D. DETERMINING WHEEL TORQUE

To check the vehicle performance towards to tractive effort and speed, it is need to find the appropriate wheel torque –Tw

E. ACCELEROMETER

It is device to measure acceleration of the vehicles and to measure the tilt and vibration in numerous devices. Fig.2 shows the accelerometer.

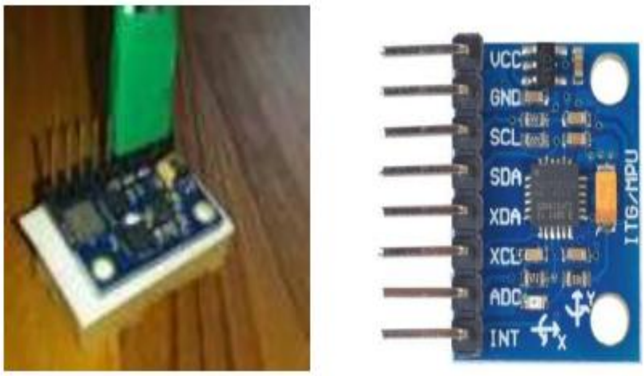
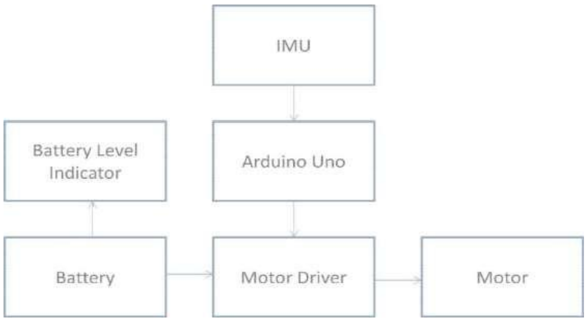


Fig. 1. Accelerometer.

F. BLOCK DIAGRAM



G. SMOOTHENING OF IMU OUTPUTS

The telemetry of the IMU sensor was disturbed by the mechanical vibrations, which led the IMU to produce noisier responses to the microcontroller. The IMU was padded with absorptive materials, like sponge and rubber pads. These IMU was fixed onto the sponge padding and fixed on the frame to absorb vibrations.

The response of the IMU improved.Fig.3.shows the smoothening of IMU outputs.

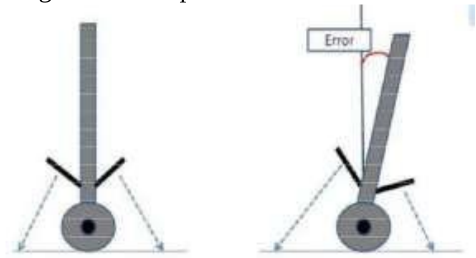


Fig. 2.Smoothening of IMU outputs .

The second solution which we applied was on the program. The program for reading the values from the sensor was tweaked and coded to take average of over 20 values for increasing accuracy of the response from the sensor.

H. PID ALGORITHM

The PID algorithm accepts the real time values from the imu sensor, namely the acceleration and gyro-rates, and computes the steady state error with reference to a set point, in our case 180o. The PID controller then applies its control on the PWM values to the motor in order to correct the error and hence balance the platform. The response of the PID controller is all dependent on the weightage we assert on certain computing variables. The weightages are called as PID constants, namely Kp, Kd and Ki. The Fig 4 shows a PID algorithm.

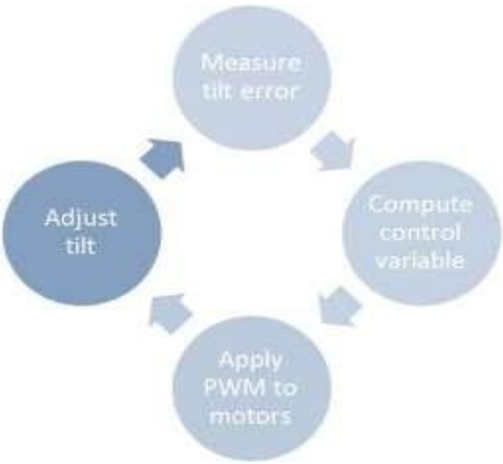


Fig. 3.PID algorithm.

I. FABRICATED MODEL

The Result outcome of the fabricated Mono-Wheel Bike is shom in following Figures with all three views (i.e.) Front, Side, and Isometric View.The Result outcome of the fabricated Mono-Wheel Bike is shom in following Fig. 5 shows the with all two views (i.e.) Front, Side, and Isometric View .

Fig. 4.Fabricated Model.

IV. CONCLUSION

With the thought of innovation, the difficult journey of fabricating Mono- Wheel vehicle started. we've got finally designed the drivers that square measure capable of commanding the motors to balance the vehicle in line with the driver's moment. we've got additionally unreal the vehicle and assembled all the elements. The vehicle is capable of helpful itself in forward and backward directions. The driver's square measure designed to draw 600-800 amperes of current in an exceedingly single direction. we've got additionally taken care of the security that the drivers square measure designed with tilt protection and electronic breaking.It is know that we have done the design and implementation of conceptual prototype in going forward, self-balancing mechanism of the vehicle can be enhanced using the available technologies in mechatronics Also, The vehicle can be made portable by the usage of light weight alloys and portability techniques.

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