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Design and Development of Self Balancing Bike

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Abstract: A two wheeler bike a basic need of every one. Everyone wishes to ride bike but some of them not able to balance it. In the present research work a concept of self balancing of bike has been proposed. There are various ways to balance the bike, in proposed concept a gyroscope based balancing has been presented. A self balancing bike has been designed using gyroscope. This can be applied for child bicycles as well. The proposed concept can be applicable for two wheelers including bicycle and motor bikes. There are numerous advantages of the proposed concept.

Key words: Self balancing; gyroscope; two wheeler; bike

1. INTRODUCTION

Now a day's many type of new bike are in market according to their feature and their work. Motorcycle construction is the engineering, manufacturing, and assembly of components and systems for a motorcycle which results in the performance, cost and Aesthetics desired by the designer. Customer want comfort and more function in bike so designer try to fulfill their desire. So, There are different type of bike like Standard, Cruiser, Sport bike, Touring, Sport touring, Dual-sport, Scooters, underbones and mopeds, Off-road bikes.
In new era rider want new type of bike, they want automation like self-drive, self- balancing, aerodynamics. In self-balancing bike there is very high technology used. Singla et al., (2015) represented a system for balanced bike sharing, similarly Gaspero et al., in 2013 worked on same concept but they also considered constraints. There are som many patents on the same concept (Yen et al., 2013; Chen, 2014; Hoffmann and Ozrelic, 2015; Hoffmann and Ozrelic, 2014; Kumar, et al., 2017). Mostly in this bike gyroscope, weight shifting technique and PID (Proportional, Integral, and Derivative) controller.
Here the authors are also going to manufacture a self-balancing bike using this technology. Which will help in easy and safe ride for riders. This bike ensures better stability. As this is an electric- bike there is no emission. Lam (2011) worked on stabilization of the bicycle for kids, they considered the concept of gyroscope for the purpose of balancing. In 2016, Gaspero et al., worked on constraint programming of balanced bike. Yang and Murakami (2015) worked on electric motor bike self balancing, their target was to run the bike on high speed. A survey was conducted by Govardhan et al., in 2017 on self balancing of the two wheeler bikes. Maximum of the researcher used gyroscope to balance the bike but Kooijman et al., (2011) balance the bike without the use of the gyroscope. Maddukuri,and Srikanth (2015) worked on I-cycle's design and fabrication,

Being a self -balanced electric bike it will help the specially challenged people, girls and kids to drive the vehicle safely without any serious issue of falling and

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slipping. And being an electric bike it covers many benefits over gas powered motor bikes. Benefits have been shown in Table 1.

Table 1: Benefits of proposed bike over conventional bikes

No need to change fuel filter
No need to check oil
No need to change oil or oil filters
No need to replace spark plugs
No need to replace clutch
No need to adjust clutch cables
No need to check clutch fluid levels
No need to replace timing belt
No need to sync throttle and idle speed

The proposed design has been made by keeping in mind few basic objective, as given below:

- To design a self-balancing for old people and learner.
- To improve the current concepts of technology in balancing.
- To make a light weight vehicle.
- Easy to handle and operate

From this "development of self- balancing bike using balancing technique project" the authors want an easy vehicle for unskilled or leaners to ride easily to their destination. In this project there is inclusion of machine parts with soft wares (solid works, creo) enhancing its efficiency. Expected goal of this project is to give a comfortable vehicle to current and upcoming generation. This project is also eco-friendly as it works on electrical power.

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2. EXISTING TECHNOLOGY

All the person who ride bike in the earlier days there always a risk to fall down. There are many companies which are already working on balancing of two wheeler. Figure 1 -3 represented the various self balancing bike

- Honda Riding Assist Motorcycle

Figure1 HONDA self-balancing bike

- BMW Bike Concept

Figure 2: BMW motor rad vision next

This company have various concept of bike according to road condition, man desire, weather condition, now at present near about 5 different concept of motorcycle. Those are sports, tour, roadster, heritage, adventure .These bike have different

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capabilities like high speed, high balancing capabilities.

- Self-Balancing Scooter by Segway

Figure 3: Self-Balancing Scooter by Segway

In the very starting of the engineering the authors are introduced with the gyroscopes. A simple rotor wheel which in used in ships and the airplanes to give them a precision, stability and rigidity.
A gyroscope also possess auto pilot properties which strikes the mind and ask the mind where else can it be used after learning about it reading papers and research the authors got interested about making the self-balancing electric bike prototype. This report includes the information about the companies like Honda, BMW, which are working with gyroscopes in their upcoming bikes calling them as future bikes, and other than bikes the authors are already using the 2 wheel hover boards using the same technique.
The authors are going to manufacture a mid-size electric bike from scratch; our chassis design which will be fully balanced itself includes gyroscope which helps the vehicle to stay upright and avoids misbalancing at critical stopping conditions and a powerful motor for transmission.

3. PROPOSED BIKE SYSTEM

Our basic idea is different. What usually comes to mind is that balancing can be achieved through weight shifting and gyroscope that can be done by fixing rails perpendicular to the line of motion but in its plane, on which the weight can be made to move through an electric motor and by placing gyroscope on point of the centre of mass. But weight shifting is not a very efficient approach because once the authors approach nearer to the balancing point we'll have to shift weights more quickly, i.e. the response time should be good which cannot be done through weight-rail mechanism. Also in the weight-rail mechanism there is significant amount of jerks when the weights suddenly change their direction of motion.
So, the authors used one more mechanism known as the Reaction Wheel in which a

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flywheel is attached to an electric motor whose speed can be controlled, here the authors utilized the fact that when the motors apply torque to rotate the flywheel, they experience a rotatory torque themselves. There is a nice exhibition of it here. This will act as gyroscope. Many researchers focused on balancing of two wheelers (Kakar, 2018; Jadoun and Choudhary, 2014; Sunny, et al., 2016; Khan et al., 2018; Risodkar, et al., 2015)

The front wheel is attached through V-shaped fork so as to assist for the flywheel. Flywheel had to be attached in this manner so the Centre of Mass is low which would help in balancing it easily. As the bicycle had to be kept slight, with its centre of mass exactly in the plane of the bicycle and low, so the driving motor had to be attached parallel to the axis of the driven wheel and a transmission belt had to be used to drive it.
Here the authors may use gyro sensor and accelerometer for sense the tilting of bike .Tilt sensing is the core of this project and the most difficult part as well. The authors started off thinking that an accelerometer would be enough to measure angle as the authors can measure the direction of gravity w.r.t the accelerometer and get the tilt angle w.r.t the vertical. This perspective is correct, only for slow angular velocities but at high angular velocities the accelerometer tilt angle begins to giving wrong tilt data.

Subsequently the authors came over a technique of sensor fusion known as Kalman Filtering that the authors may use of both the sensors (accelerometer at low angular velocities and gyro sensor for high angular velocities) thereby giving correct tilt angle. Therefore if the above example is clear then it can be easily understood that the same method can be used here to balance the bike while keeping the oscillations minimum.

The prototype was created using following parts:

- Steel Frame
- Steel Base
- 12V DC Motor
- Mild steel disc
- Nuts and bolts
- Ball bearings
- Thrust bearing

4. PROPOSED DESIGN

A few of researchers worked on the design as well as fabrication of the self balance bike (Gopinath, et al., 2017; Prasad and Nirwana 2016; Gogoi et al., 2017; Bharani, et al., 2019)

The proposed bike has been designed using SOILDWORKS software. Figure 4 to figure 7 shows the various design stages of various parts.

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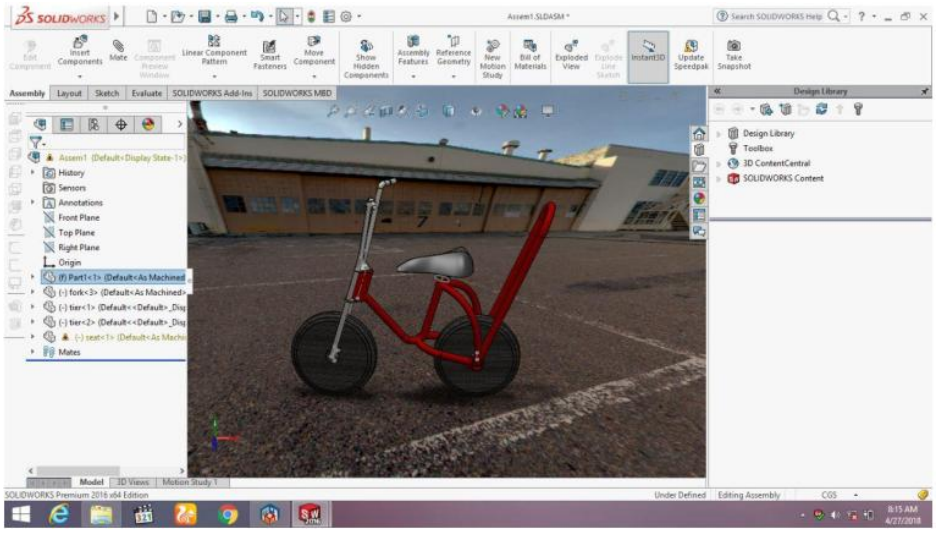

Figure 4: 3D Side view of bike

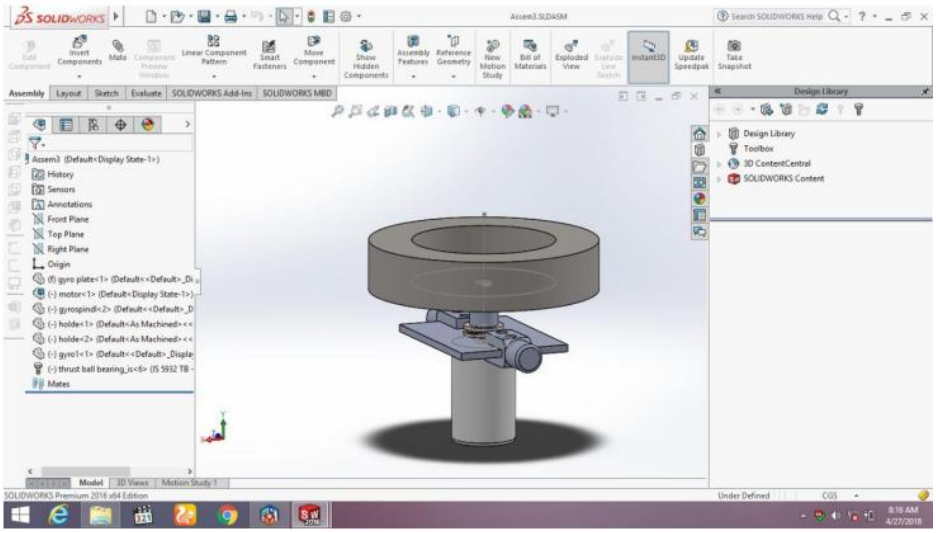

Figure 5: 3D Side view of Gyroscope

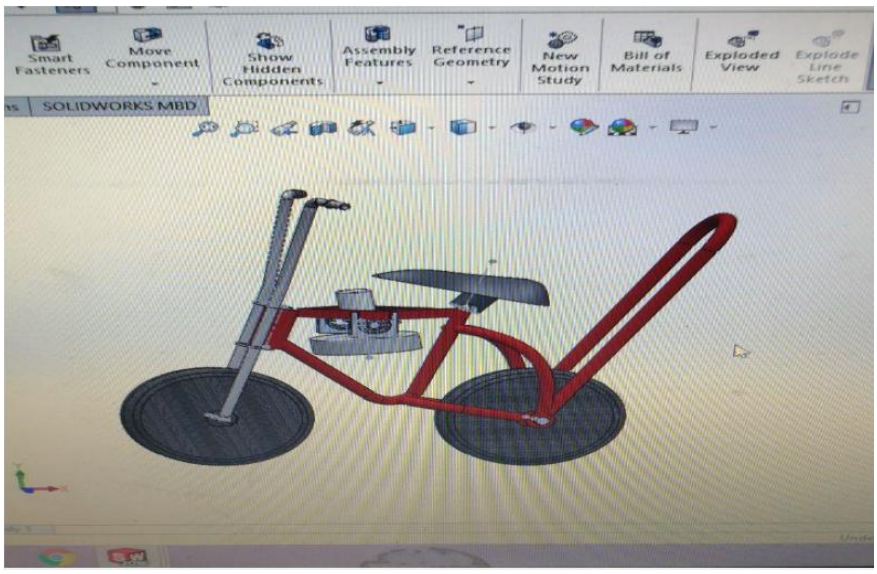

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Figure 6: 2D side view of bike

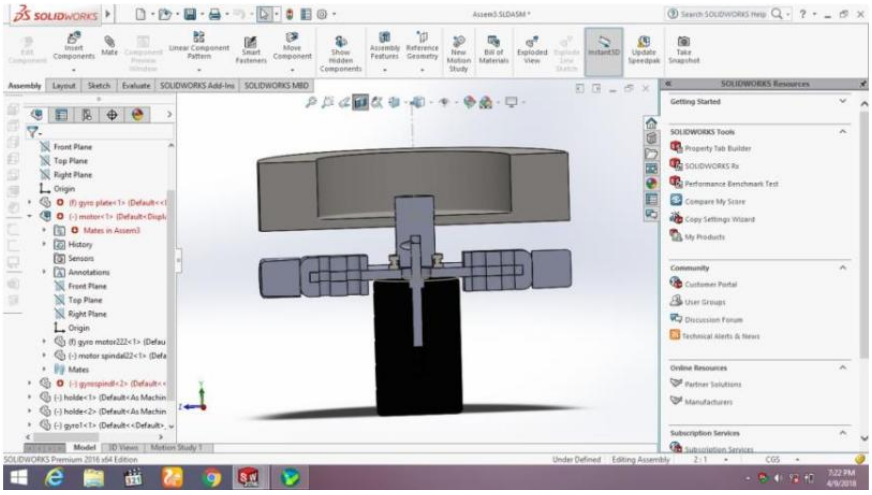

Figure 7: Gyroscope details

3.2: Dimensions of Assembly Parts

Following figures showing proper dimensions of the designed parts: Figure 8 to figure 11 represents the dimensions of various parts

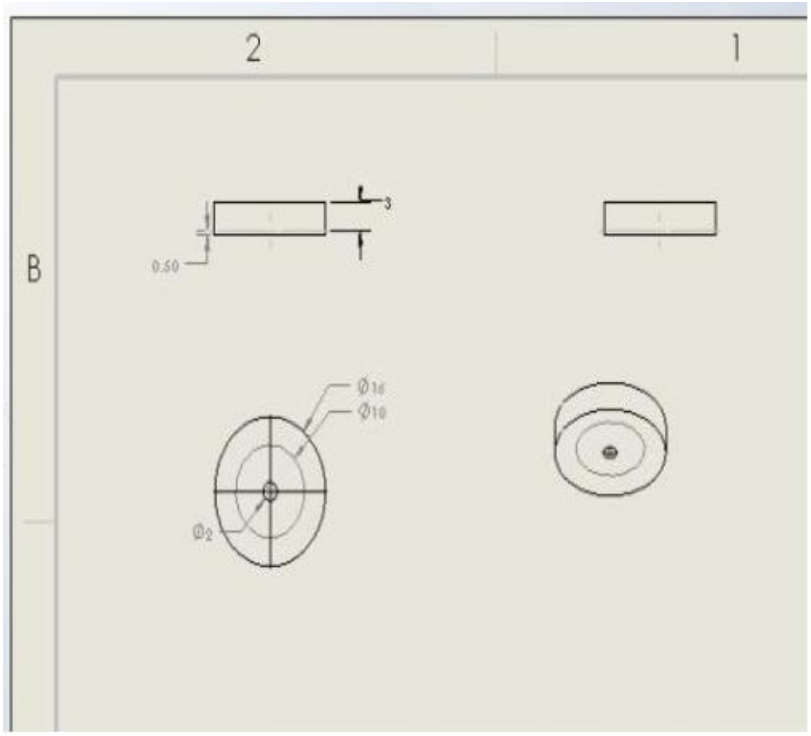

Figure 8: Dimensions of Gyroscope Wheel

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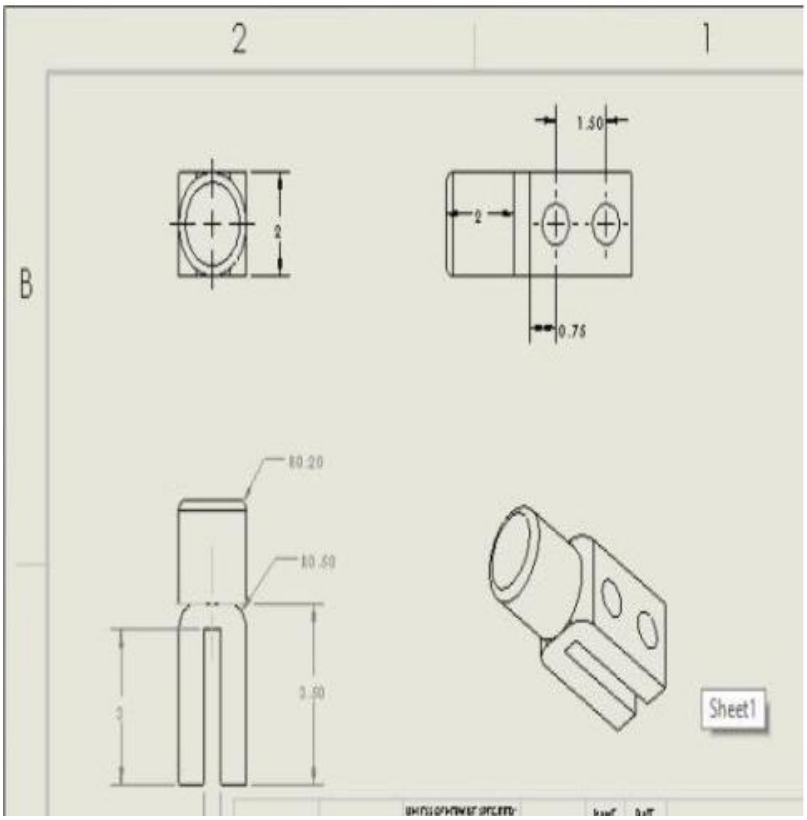

Figure 9: Dimensions of Holder

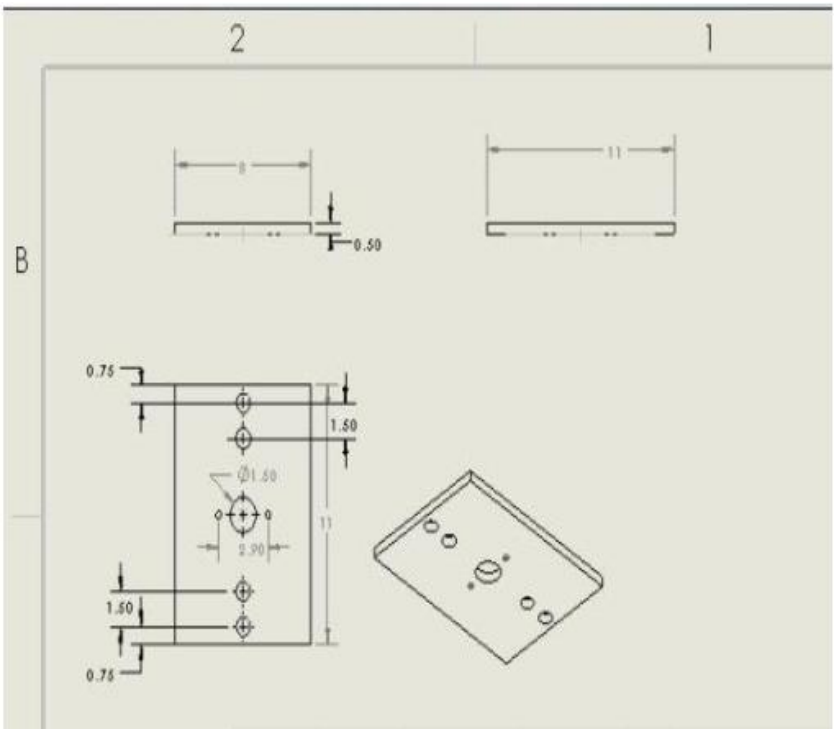

Figure 10: Dimensions of Gyroscope Plate

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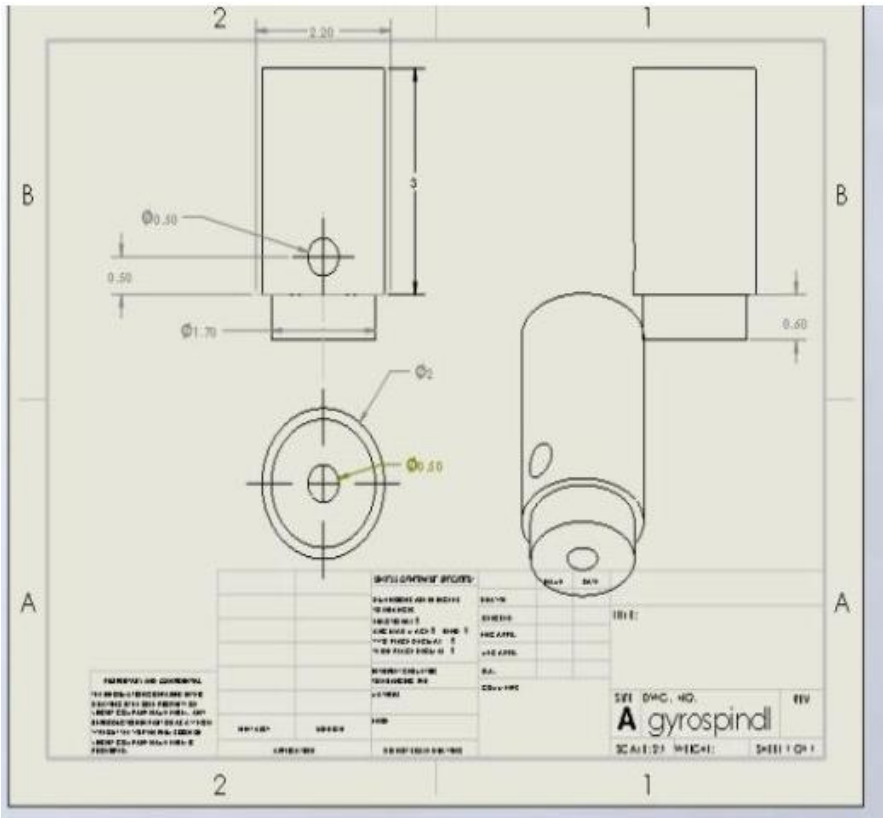

Figure 11: Dimensions of Plate Spindle

Advantages of Self-Balancing Proposed Bike

- Easy to ride for starters
- No fear of falling
- Less maintenance cost
- Can work on electricity
- This bike is easy to operate and are also safe.
- Environmental-friendly
- A removable battery that can be recharged at any time.
- Handy and portable battery
- Its lightweight provides an effortless parking

5. CONCLUSIONS

Our project is focused on future of transportation and future of riders etc. From this project the authors have demonstrated the balancing technique for safety and better ride. A self balancing bike has been designed using gyroscope. This can be applied for child bicycles as well. This bike makes easy driving for the beginners. everybody wishes to ride bike but some of them not able to balance it. In the present research work a concept of self balancing of bike has been proposed. There are various ways to balance the bike, in proposed

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concept a gyroscope based balancing has been presented. . The proposed concept can be applicable for two wheelers including bicycle and motor bikes.
Our concept can make following changes for the betterment in the bike that can be observed in demonstration presented by us. So after study this project the outcomes are:-

- No need balance the bike by rider
- zero-emissions bike
- No need to change fuel filter
- No need to check oil
- No need to change oil or oil filters
- No need to replace spark plugs

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