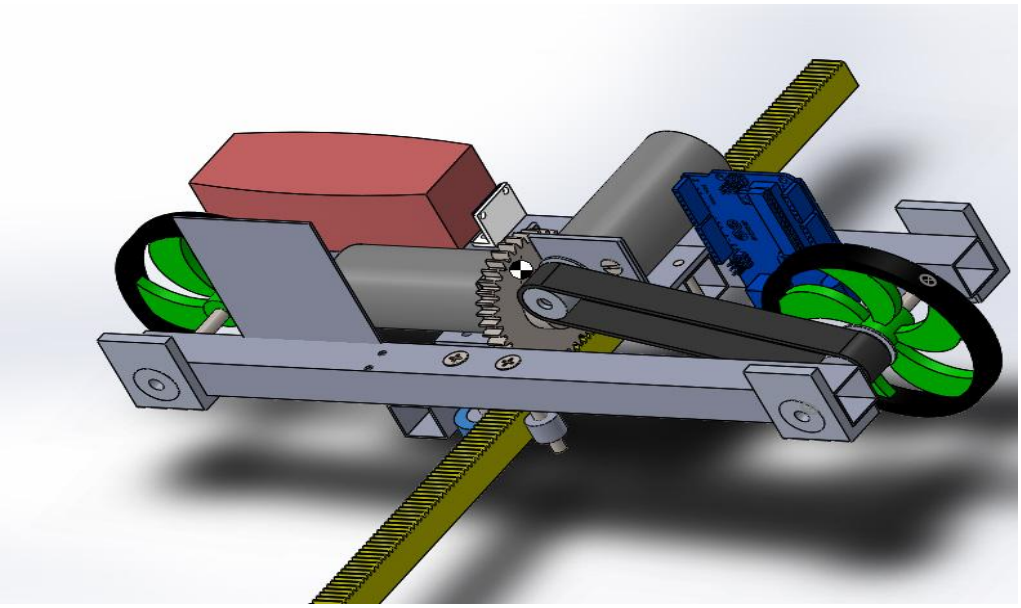


Self Balancing Bike

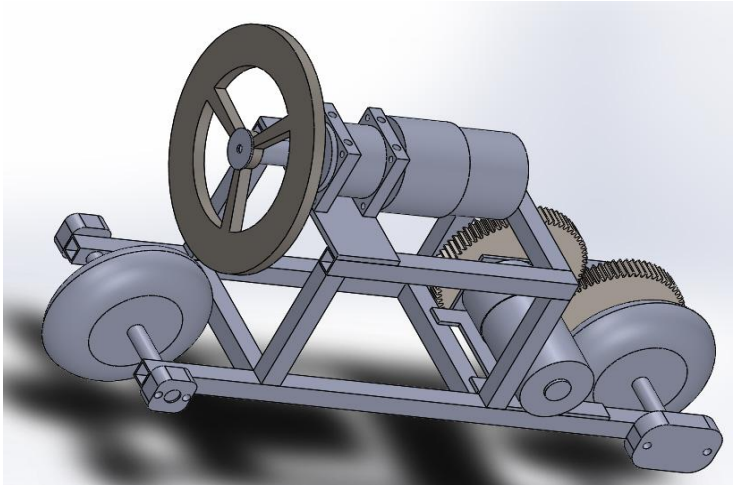
January 2019 - March 2019

Team Members:

Aman Saini

Nisarg Suthar Manishbhai

Venkata Sai Mukesh Thota



Abstract

In the world automation is becoming a common practice, and we are searching for it in almost every product which we use. Our project is a miniature of self-balancing bike.Our goal was to design and fabricate a 2 wheeled automobile which could move forward by balancing on its own.We have designed and manufactured two prototypes, one using the mass balance technique to balance and the other prototype using the Reaction wheel mechanism to balance.

Motivation

In this fast moving world technology has become a part of our lives and automation of the products in particular.We are experiencing new automations like the self driving car,automatic dishwasher,washing machine etc. And the self balancing bikes are emerging to be one of the best automated products. In recent times Honda has presented their Self balancing bike as the future motorcycle.
This kind of a future motorcycle makes riding comfortable and effortless.To present a miniature of such a motorcycle which is the future of automation has been our main motivation.

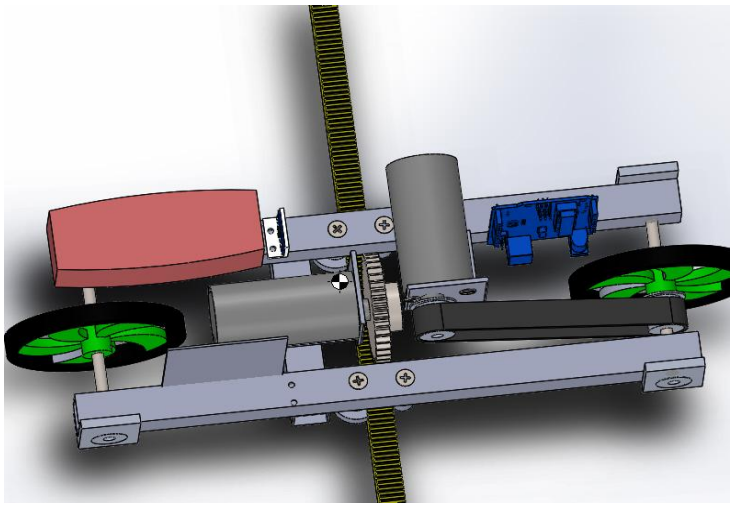
Mechanical Aspect of Design

1. **First Prototype**

   This was our working prototype.

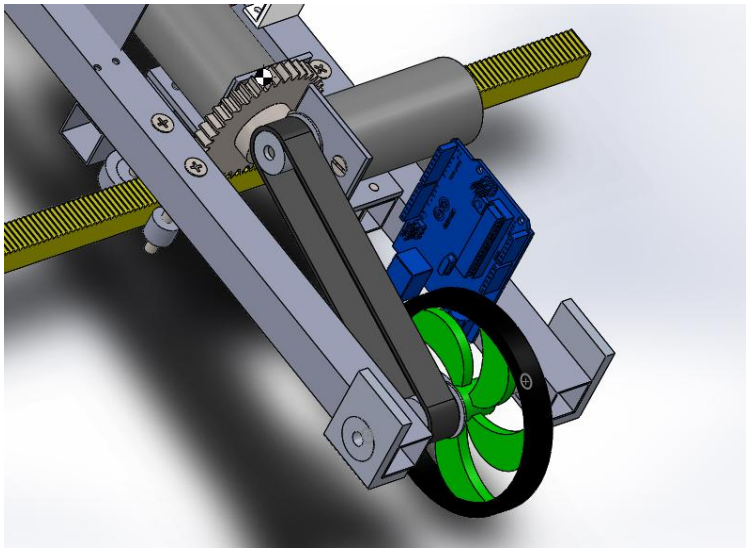
   Balancing Mechanism Used:

   We used a rack and pinion mechanism to shift mass on either sides.The pinion was powered by a cytron motor. We have mounted the motor on an aluminum channel using a suitable L plate to hold the motor firmly.To ensure smooth sliding of the rack we have used 4 bearings.2 bearings on the straight side of the rack and the other two on the grooved side of it.



Driving Mechanism Used:

We used pulley and belt drive. We haven't connected the motor directly to the wheel in order to decrease the width of the whole assembly.One pulley was connected to the shaft which goes through the wheel and the other to the motor which was mounted on one of the body channels. A belt is connected to both the pulleys to run the wheel. We have mounted the motor on an aluminum channel using a suitable L plate to hold the motor firmly.Two bearing blocks with bearings are present on either sides of the wheel shaft to ensure its smooth rotation, and similarly the front wheel is also assembled.

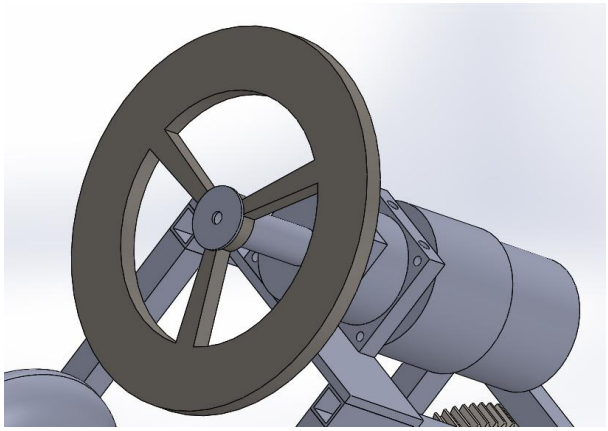


2. Second Prototype

This prototype was still under development.

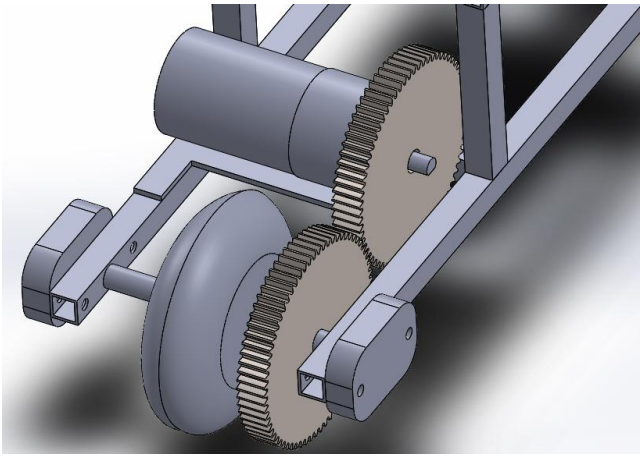
Balancing Mechanism Used:

We have used a reaction wheel to produce reaction torque (opposite to the direction of tilt of the bike) which helps in balancing the bike.The reaction wheel was powered by using a 12V bainbot motor coupled to a 11:1 gearbox.



Driving Mechanism Used:

Rear wheel had the drive. It was done by using 2 spur gears one attached to the motor and the other to the shaft of the wheel. Two bearing blocks with bearings were present on either side of the wheel shaft to ensure its smooth rotation. Front wheel was driven and to ensure its rotation we used similar bearing blocks with bearings as used in the rear wheel.



Electronics Aspect of Design

1. **First Prototype:**
    - This model as mentioned is a miniature form of a self balancing bike aiming to balance itself on the two wheels automatically. So to check if it is in a balanced position or an inclined position with respect to ground/road/surface we have used 'MPU-9250 accelerometer+gyroscope' which determines the inclination of the bike with respect to the ground/gravity.
    - This mpu-9250 is controlled and used by microprocessor 'arduino-nano' and its readings are also interpreted by the microprocessor. Hence net mass is shifted in the opposite direction of the initial inclination of the bike with respect to ground.
    - To shift the extra mass so that net mass balances perpendicular to the ground,the extra mass was shifted using a rack and pinion mechanism.
    - The rack and pinion was controlled as well as moved using a 'cytron motor' and 'l298 motor driver using the same microprocessor which interprets the inclination .
    - The bike is moved forward using a cytron motor and a l298 motor driver controlled by the same microprocessor.

    In this way both balancing and movement was ensured.

2. **Second Prototype:**
    - This model as mentioned is a miniature form of a self balancing bike aiming to balance itself on the two wheels automatically.
    - So to check if it is in a balanced position or an inclined position with respect to ground/road/surface we have used the 'MPU-9250 accelerometer+gyroscope' which determines the inclination of the bike with respect to the ground/gravity.
    - This mpu-9250 is controlled and used by microprocessor 'arduino-nano' and its readings are also interpreted by the microprocessor.
    - This prototype works on the principle of torque due to the change in angular velocity of a rotating object.
    - The reaction wheel serves the purpose of producing the torque which balances the torque produced by the gravity on the inclined bike.
    - The balancing torque is produced by the reaction wheel whose angular velocity is given by a motor controlled by a 'l298 motor driver'.

- The motor driver is controlled by the same microprocessor which is interpreting the inclination using the mpu-9250 gyroscope+accelerometer .
- The bike is moved forward using a cytron motor and a l298 motor driver controlled by the same microprocessor.

In this way both balancing and movement was ensured.

Applications

1.It can replace normal two wheeled automobiles.

2.Reduced chance of accident.

3.Beginners can easily learn how to drive.

4.Can be made automated vehicle as main task of balancing is done.

5.It can also run in hilly areas or regions having inclination.

Limitations

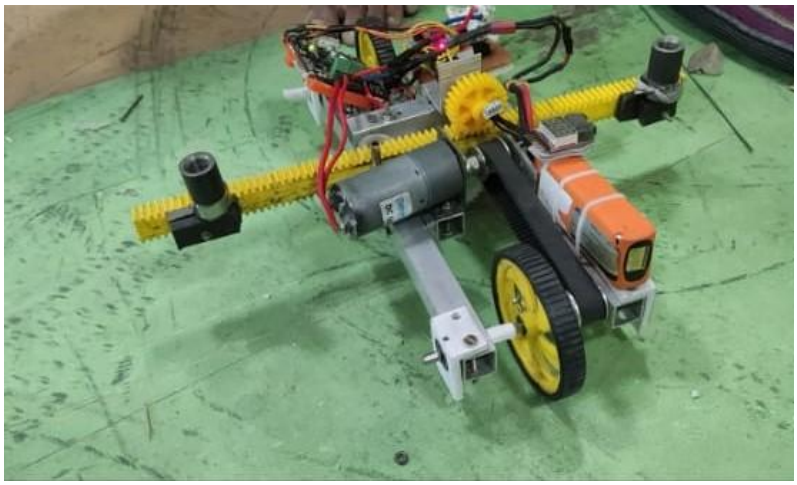
There is a time lag between the actuation of the balancing mechanism and actual balancing of the bike.

Bike can travel only straight.

At fast speed, balancing mechanism becomes uncertain.

Future Improvements

1. Balance mechanism has to be made more quick.
2. Front wheel should have drive so that it is able to rotate about one of its diametrical axis.



Demonstration of balancing