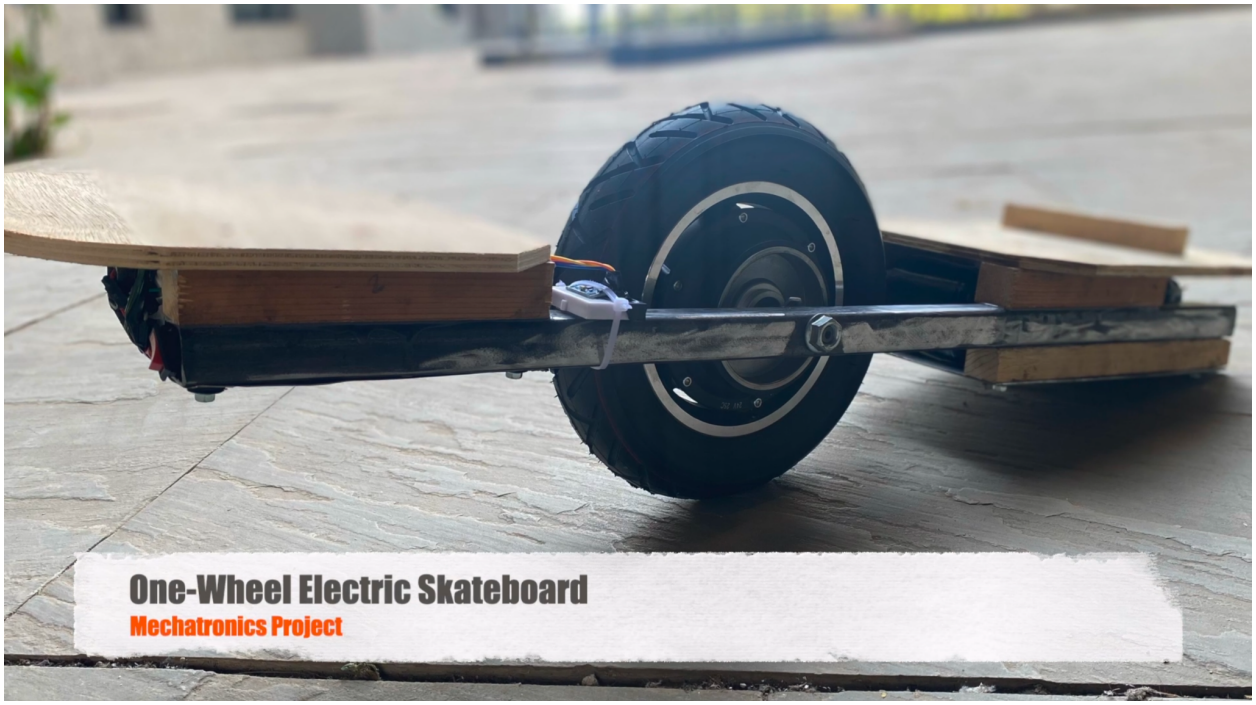
MECHATRONICS PROJECT
One-Wheel Electric Skateboard

Team Omega:
Tejendra Patel
Aryan Shah



As a part of the Mechatronics Course Project, we developed a one-wheel electric skateboard. This project inculcated concepts of electrical like sensor integration and the basics of the Hub BLDC motor, as well as the mechanical concept of designing the structure and using different machines to develop it.

How this works is that the IMU gives the Euler angle of the board and as the skater stands on it and tilts it, the motor starts rotating with the tilt.

For more detailed infomercial:
https://drive.google.com/file/d/1oFVugmqB5kUZnwSW6ttgWjtzxgXgsWD7/view?usp=share_link

Below are the technical details of the model

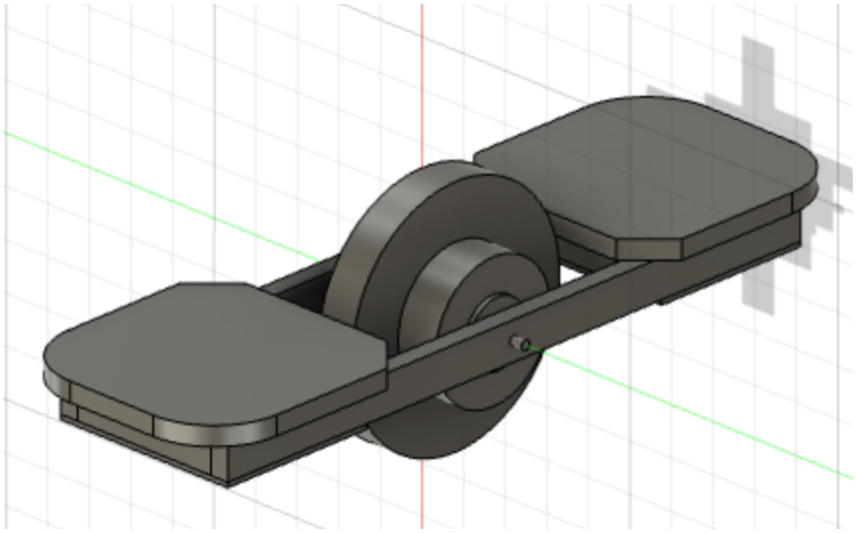
Procedure:

1. First we started with procuring the hub motor and driver. The part is listed below.
2. Then, the CAD model of the design was made using Fusion 360. Also, attached below.
3. Mechanical structure was made, and simultaneously, electrical circuits were developed.
4. Integrating all as a system.

Parts List:

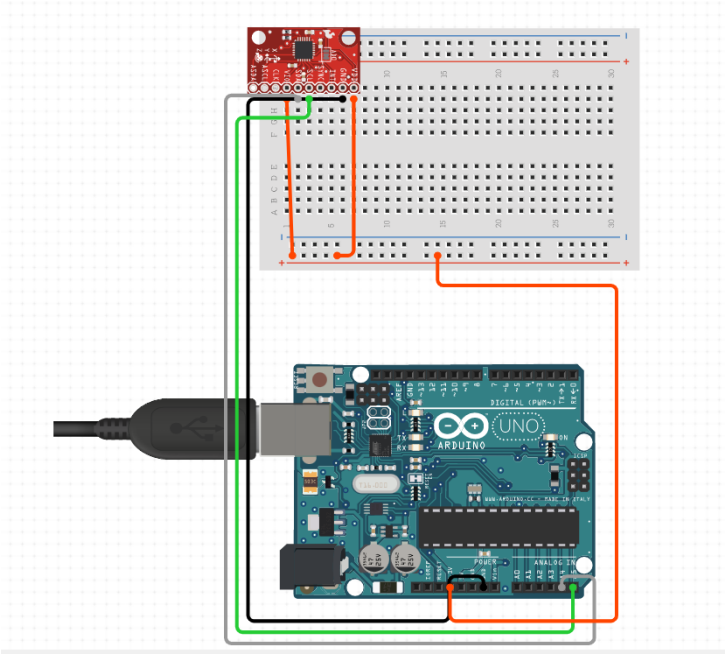
S.NO.	Parts	Specifications
1	Hollow Iron Rods	Dimensions in the CAD file
2	Aluminum Sheets	
3	Wooden bars	
4	Wooden plates	
5	Battery	LIFEPO4 Rechargeable E-Vehicle Battery 24V 12000MAH (8S2P) 22.5V TO 29.2V
6	IMU sensor	MPU9250 9-Axis Gyro Accelerometer Module
7	Micro-controller	Arduino Uno
8	Hub motor + motor controller	10inch BLDC hub motor with 24V 350W motor controller
9	Switch	Single pole, Single throw (SPST)

CAD Model:



Here you can find the CAD model with parts(ipt) and assemblies(apt) files of the model. It is the exact replica of our model with hub motor dimensions included.
https://github.com/Tejendra00/One-Wheel-Electric-Skateboard

Electrical Circuit:



This shows the connection of imu with the Arduino Uno microcontroller.
The connection of the hub motor and the motor driver is different for different motors, so it's provided by the vendor.
Other than that, a switch and battery were connected, which has a trivial circuit.

PWM is given using Arduino pin6 analogWrite() to the motor driver signal pin. One thing to remember is to connect the common ground of Arduino Uno and the motor driver.

Code:

Code is pretty self-explanatory. We have used an algorithm that gives IMU output as an Euler angle and then mapped it to the PWM range of the motor driver.
Link: https://github.com/Tejendra00/One-Wheel-Electric-Skateboard

Challenges faced and What could be done better?:

The major challenge of this skateboard is that it doesn't balance itself, so it required some practice to use it. Initially, we wanted to make a skateboard that could balance itself once connected to the power supply and would be able to move in both directions depending on the tilt provided by the driver.
For that, we needed a controller that was capable of frequently changing the PWM directions in order to maintain the imu sensor angle to zero essentially meaning the axis of the skateboard would remain horizontal. But because of the hardware constraints, we were just able to procure a simple controller. The controller we had was not capable of changing the direction of motion of the motor, and to do so, we had to add an additional relay module to the controller that increased the time of response thus we were unable to balance the skateboard and make it move either ways.
The above issue can be solved if one uses **VESC- Variable Electronic Speed Controller**. This controller is capable of rotating the hub motor in both directions at a high frequency so that this feature can be used to balance the skateboard using the same strategy as an inverted pendulum. This will make it more user-friendly.