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# A Review Paper on -E-Bike Motor Speed Controller

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**Abstract:** *Speed control is not a prevalent feature found in electric bicycles. Many electric bicycles implement a pseudo speed controller that does not include feedback based on sensing speed. As with automobiles, speed control can be desirable for driver comfort and safety. Additionally, accurate speed control is also very helpful when validating dynamic models of single-track vehicles, which is our motivation. This paper describes a low cost feedback speed controller for an instrumented electric bicycle. To achieve this, we used gear box system identification to fit a second order linear model of the longitudinal dynamics of the bicycle to a measured step time response. The resulting fitted plant model was used to design a robust PID controller. We implemented the controller with a custom Arduino-based micro-controller.*

**Keywords:** bicycle, electric, control, speed, mechatronics

## I. INTRODUCTION

The system makes use of an STM32 controller along with a throttle input, speed sensor for tyre speed, switch, motor driver, ebike motor, battery and OLED display to develop the system. We will hereby focus on throttling and speed display part of ebikes while developing this controller.

The STM controller constantly monitors the throttle values. The throttle consists of a throttle position sensor (TPS). Non contact type TPS work on the principle of Hall effect or inductive sensors, or magnetoresistive technologies, wherein by and large the magnet or inductive circle is the unique part which is mounted on the butterfly valve choke spindle/shaft gear and the sensor and sign handling circuit board is mounted inside the ETC gear box cover and is stationary. At the point when the magnet/inductive circle mounted on the spindle which is rotated from the lower mechanical stop to WOT, there is an adjustment of the magnetic field for the sensor. The adjustment of the magnetic field is detected by the sensor and the voltage created is given as the input to the ECU.

The Throttle signal is processed by the controller and it then operates the motor through motor driver. The motor voltage is varied as per throttle values in order to control its power and speed. Also the controller constantly monitor speed sensor values. The peed sensor works on hall effect principle to constantly transmit the wheel RPM. This RPM value is displayed on the LCD display by the controller. The motor speed and sensor monitoring is turned off when the main switch s turned off. The complete process restarts as soon as the switch is turned on. Thus we successfully develop and test our own Ebike controller using STM32.

Most E-Bikes being sold today use brushless motor controllers, though some do still use brushed motor controllers. In simplest terms, a controller is the brain of the E-Bike. It receives information from the parts and translates that information in real-time to relay signals to the different components of an E-Bike. Some controllers may only be responsible for the acceleration of the E-bike, or when using the pedal assist system. Other more advanced controllers, such as the one inside the Delfast Top 3.0i, that have more processing power, can control a wide array of features using inputs and outputs and complex algorithms.

To understand controllers, it's also helpful to understand the motors that they are used to control. The two main types of motors in use for electric bicycles are brushed motors and brushless motors. Both are DC motors. Both motors use a set of positively and negatively charged magnets, though they do so in different ways.

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The brushed motor uses electromagnetically charged coils of wire on a rotor. When current is applied it is alternately attracted and repelled by the opposing fixed magnets (the stator) to make the rotor turn as brushes keep contact and conduct the current that keeps the rotor spinning. This was the DC motor in use for many years and is still in use for numerous applications, including power tools like impact drills and electric screwdrivers, as well as various smaller motors inside appliances. It was among the first types of motor used in electric bikes.

The main drawback of the brushed motor can be seen in its name. The brushes must have a contact point which creates friction that over time causes the brushes and surfaces to wear out and need maintenance. Brushed motors also tend to be heavier than newer brushless motors.

Brushless motors are not only much lighter, but because they don't have brushes creating constant friction, which causes slowing and heat buildup, they tend to last much longer and require much less maintenance.

### 1.1 Objective

The objective of the e-bike motor speed controller is to precisely and efficiently regulate the speed of the electric motor in response to user input, ensuring a safe, smooth, and customizable riding experience while optimizing energy consumption and extending battery life. This entails designing a controller that offers seamless acceleration and deceleration, maintains consistent speed across varying terrains, and incorporates advanced features such as regenerative braking and intelligent speed limits to enhance user comfort, safety, and overall satisfaction. The controller should strike a balance between performance and eco-friendliness, aligning with the principles of sustainability and electric mobility.

### 1.2 Working

E-bikes are the transport medium of our future. We are moving towards the electric vehicles era leaving behind the fuel based mechanisms. Well in case of e-bikes there are 3 major components required.

- E-bike Motor
- E-bike Battery
- E-bike Controller

We here propose to develop and test a working ebike controller. The ebike controller will be performing the following operations:

- Getting throttle inputs
- Controlling motor speed as per throttle
- Getting Speed Value's and displaying on display
- Starting and shutting down bike as per start switch

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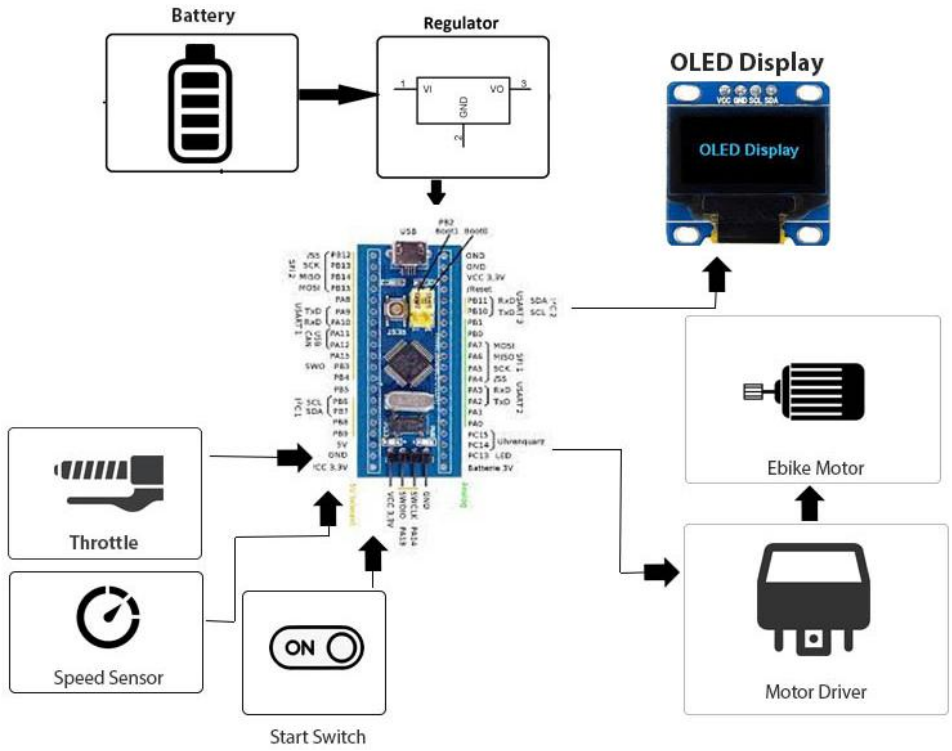
## II. COMPONENTS

- Stm32 Controller
- Battery
- Throttle
- Speed Sensor
- OLED Display
- Ebike Motor
- Motor Driver
- Buzzer
- LED's
- PCB Board
- Resistors
- Capacitors
- Transistors
- Cables and Connectors
- Buoy Body Frame

## III. BLOCK DIAGRAM




## IV. CONCLUSION

This work presented the design, implementation and testing of a PID based cruise control for an electric bicycle. A PID controller was tuned using a linearized model of an electric bicycle identified from measured data. This PID controller was implemented digitally on a consumer 10 microcontroller integrated into the powertrain of an electric bicycle. Initial testing of this implementation showed the speed controller performed in accordance with our goals for the project. Further testing is required to tune and improve the performance of the controller. Improvements to the cruise control system should include simpler integration into the existing electric bicycle platform, smoother speed modulation and improvement over the precision error in the existing controller.

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