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E-BIKE MOTOR SPEED CONTROLLER SYSTEM

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ABSTRACT: The velocity controller of the electric bike motor regulates the vehicle's speed. In order to effectively manage the speed of the electric motor, it basically uses a microprocessor to transform the manually operated throttle's incoming input into an electrical signal. Here, the controller is used for the crucially important efficient energy transfer, preventing losses in the system and so working together to extend the electric bicycle's battery life and range. The MOSFETs are used as drivers in the circuit to crucially drive the power to the motor without delay. The contemplation done for selecting such a powerful microcontroller is due to the additional features such as GPS, Display, Monitoring and healthcare, etcetera. The overall performance is critically determined by the design and implementation of an electric bike motor speed controller. The motor delivered expected speed control without any delay.

I. INTRODUCTION

Bicycles have been used by people as a practical form of transportation for ages. Future technological developments have created a demand for more advanced, comfortable options that take less time and effort. Converting a regular bicycle to an electric one is also the answer in this case. This electric bike motor speed controller can be used on bicycles and bikes alike. The main objective of the project is to primarily control the speed of the electric motor by measuring the variance in the input derived manually by the throttle. Utilizing electric motorcycles has the primary benefit of having zero carbon emissions, or no carbon footprint, which supports India's goal of being carbon free by 2070 as well as the worldwide goal of becoming carbon free, significantly lowering pollution levels overall. Along with being environment friendly this is also pocket friendly which makes it one of the most effective choices to be made in dense populated cities, huge college campuses, parks etcetera. This can be used in conjunction with normal cycling wherein if the rider is exhausted then there is an option to switch to battery mode to propagate the vehicle using battery and thus be an electric vehicle. Regenerative braking and peddling generation are few of the techniques which can be used to simultaneously recharge the batteries.

II. LITERATURE SURVEY

Mehrdad Asadi, Mahmood Fathy ,Hamidreza Mahini , Amir Masoud Rahmani, "A systematic literature evaluate of car velocity assistance in sensible transportation system", extent 15,Issue 8.

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The authors' goal in this study was to analyze common speed harmonization procedures that rely solely on ramp metering (RM) and variable speed limit (VSL) strategies. Taking into account speed harmonization techniques, mechanisms, and the effects of developing technology, the authors reviewed the literature. They drew attention to the lack of velocity harmonization for visitors' flow dynamics and the study's failure to use cutting-edge technological knowledge.

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Sheu, K. B., Hsu, T. H., & Hsu, Y. Y.A novel parallel hybrid motorcycle transmission.In Materials science forum.Trans Tech Publications.

In 1999, AVL Company introduced a hybrid system featuring a 50 cc carbeuretted lean-burn two-stroke engine combined with a

0.75 kW electric motor, strategically positioned on the engine crankshaft primarily to enhance torque during acceleration.[2] **Hsu,**

SuHau., Hsu, D. W., Fu, L. C., & Hsu, Y. P. (2004, June). Novel integrated management system design of electric motorcycles. In American Control Conference, 2004.Proceedings of the 2004.IEEE.

Su-Hau et al (2004) directed their attention towards optimizing the utilization of battery energy and put forth a comprehensive management system for the electric motor with a strong emphasis on energy efficiency..[3]

Huang, K. David.,&Tzeng, Sheng Chung. (2004). A new parallel-type hybrid electric-vehicle. Applied Energy, 79(1), 51-

64.

A novel parallel-type hybrid-electric power system, comprising an engine's energy distribution and a torque-integrated mechanism, was introduced by David and Sheng-Chung in 2004. This system specifically included an engine, a motor/alternator, a CVT device, PCM, and a 3-helical gear set.

III. EXISTING SYSTEM

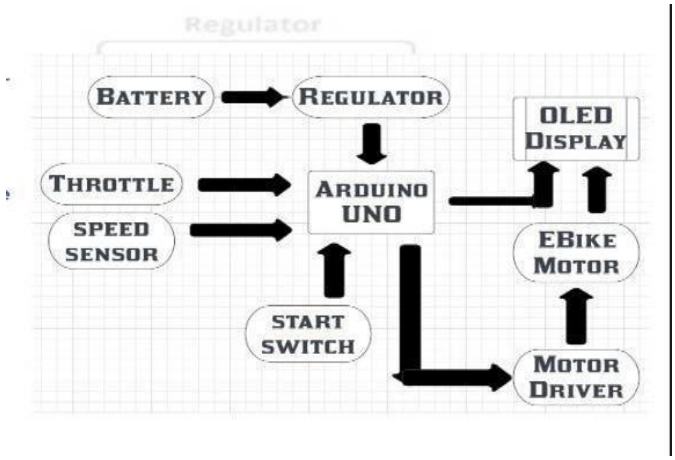
The systems that are currently on the market have numerous gears and a good capability for handling power and speed. The primary drawback of these devices is their exorbitant cost, which makes them unbearable for the majority of consumers. Odometers and regenerative brake salong are now built into the same circuitry as the present system, which also has a display.

IV. PROPOSED METHODOLOGY

In contrast to the conventional approach of using fossil fuels, which requires the implementation of combustion engines for the correct burning of fuel for vehicle propulsion, an electric bike uses electricity for its propulsion. The battery powers many input devices, including a controller that serves as the circuit's brain. The motor speed is adjusted by the controller, which controls the throttle input. Additionally, it may power helpful extra functions like GPS, Cycle, and Rider.

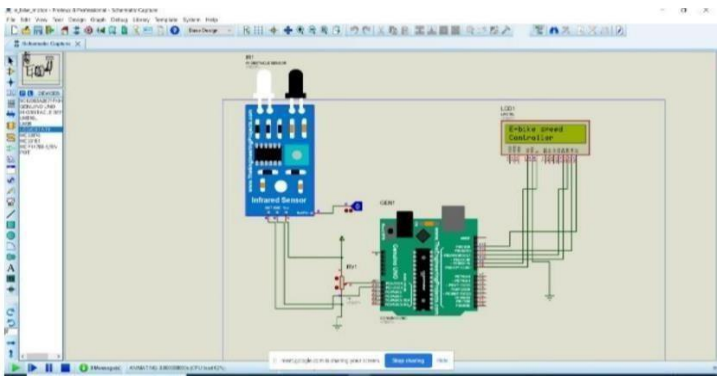
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ARCHITECTURE



In order to control the BLDC motor, the first step was to model the H-bridge driver circuitry using Proteus simulation software. The H-bridge driver circuitry was subjected to PWM pulses, and the BLDC motor's response was meticulously investigated using simulation. Studying the BLDC motor driver's speed control system in this simulated setting was the main goal. The circuitry for the H-bridge converter was then created in order to efficiently drive the BLDC motor. The BLDC engine and a tire that functioned as the rear wheel made up the assembly . The system was built around the Arduino microcontroller, while power was supplied by a Lithium-ion battery. A program was developed for the Arduino Uno microcontroller to generate PWM pulses, which were then fed into the H-bridge driver. The performance of the BLDC motor driver was thoroughly analyzed during this stage. Once the motor and tire assembly achieved precise control, the focus shifted towards developing and testing additional subsystems such as the speedometer, indicator, accelerator, horn, and braking system. Both the motor controller and the status monitoring controller worked in tandem, coordinating their actions to address any faults or abnormalities that may arise. Finally, The design of the chassis and mechanical assembly were started and finished satisfactorily. The resulting electric bike demonstrated how useful it is for daily use around the house. After about three hours of charging, it reached a top speed of 40 km/h and showed an amazing travel range of almost 70 km.

V. CIRCUIT DESIGN

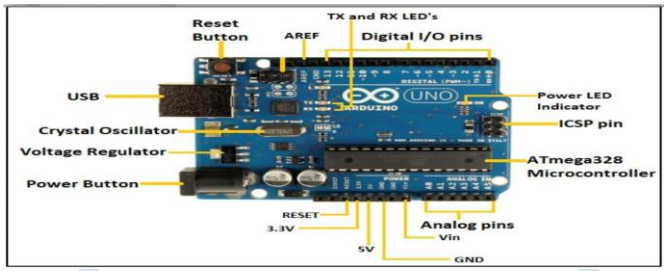


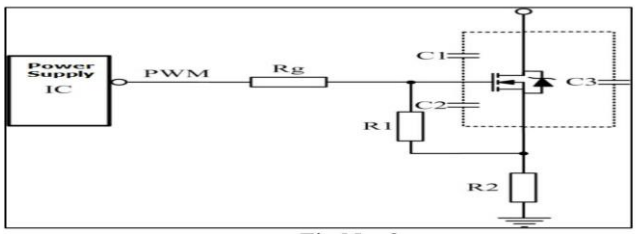
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Due to the project's motor's operational power requirement of 24 V, the primary power source is 24 V. A driver circuit is used to efficiently drive the BLDC motor by connecting the power source via the pulse width modulation technology and a potentiometer, which functions essentially as a throttle to regulate speed.

COMPONENTS DESCRIPTION:

1. ARDUINO UNO:- The Arduino UNO is an ATmega328P-based microcontroller board with various essential components. It boasts 14 digital input/output (I/O) pins, out of which 6 can function as pulse width modulation (PWM) outputs. Additionally, it offers 6 analog inputs for voltage measurement. The board features a 16 MHz ceramic resonator that ensures accurate timing. It includes a USB connection for easy communication and programming by connecting it to a computer. Power can be supplied via a power jack using an AC-to-DC adapter or a battery. The ICSP header facilitates in-circuit serial programming and debugging. Lastly, a reset button is provided for restarting or rebooting the Arduino. Overall, the Arduino UNO is a comprehensive microcontrollerboard that simplifies the process of supporting and utilizing the ATmega328P microcontroller. It can be swiftlyset up byconnecting it to a computer or powering it with an appropriate adapter or battery.





MOSFET DRIVER:

An essential part of an e-bike motor speed controller that permits effective motor control is a MOSFET driver. It serves as a conduit between the high-power MOSFETs that power the motor and the low-power control signals coming from the controller's microcontroller.. The MOSFET driver amplifies and shapes the control signals to provide the necessary gate drive voltage and current for fast switching of the MOSFETs. It also includes features such as dead time control to prevent shoot- through current and protection mechanisms like overcurrent and overtemperature protection. These drivers ensure optimal power transfer, minimize switching losses, and enhance the overall efficiency and reliability of the eBike motor speed controller system.

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BLDC MOTOR:- Because of its great efficiency and dependability, brushless DC (BLDC) motors are frequently found in eBike motor speed controllers. It works with a permanent magnet rotor and stator windings that are electronically commutated. BLDC motors are advantageous for e-bike applications in a number of ways.

They have a higher power-to-weight ratio compared to brushed motors, enabling better performance and longer range. BLDC motors are also more durable due to the absence of brushes, which reduces friction and wear. They make riding more pleasurable by operating more smoothly and quietly. The power electronics circuitry in an eBike motor speed controller, which usually consists of MOSFETs or IGBTs, drives the BLDC motor.

. The controller uses feedback from sensors, such as Hall effect sensors or encoders, to determine the rotor position and control the commutation of the stator windings. This precise control allows for accurate speed regulation and torque delivery. Based on human input, such as the location of the throttle or the level of the pedal assist, the eBike motor speed controller modifies the power supplied to the BLDC motor. It ensures smooth acceleration and effective power use by controlling the motor's speed, direction, and torque output. Regenerative braking, which transforms extra energy while braking into electrical energy to replenish the battery and increase the eBike's range, may also be included by advanced controllers.



VI. RESULTS AND DISCUSSION

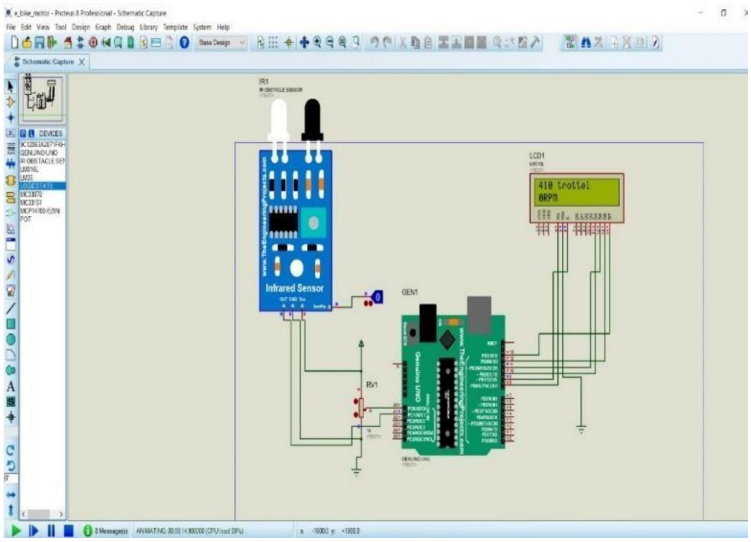
The electric bike controller will be performing the following operations:

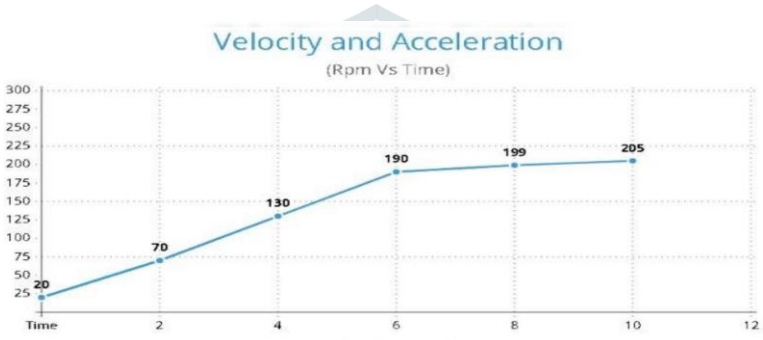
- Getting throttle inputs
- Controlling motor pace as per throttle
- Getting Speed Value’s and exhibiting on display
- Starting and shutting down bike as per begin switch

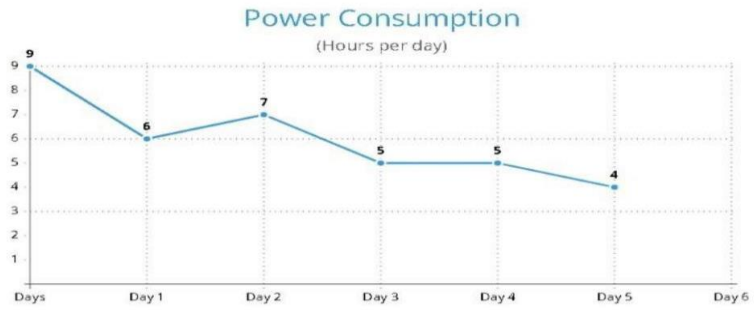
SIMULATION

- When input is applied the system
- By varying Potentiometer here, we can see the change in speed of the motor

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XII. CONCLUSION

A key component in regulating an electric bike's efficiency and performance is the motor speed controller. To efficiently control the power delivery to the motor and enhance the riding experience overall, it makes use of a number of parts and technology. Power MOSFETs can be efficiently controlled thanks to the incorporation of MOSFET drivers. which in turn regulate the current flow to the motor windings. This facilitates rapid switching, minimizing losses and maximizing power transfer. The MOSFET driver also ensures proper gate drive voltage and current, allowing for precise control over the motor's speed and torque. Furthermore, the use of BLDC motors in electric-bike motor speed controllers provides several advantages such as higher efficiency, lower maintenance requirements, and smoother operation. These motors, combined with the controller's advanced control algorithms and feedback sensors, allow for accurate speed regulation, torque delivery, and responsive performance. In order to protect the system, the electric bike motor speed controller also has a number of safety features, including overcurrent and overtemperature protection. To maximize energy efficiency and increase battery range, it might also have regenerative braking. All things considered, the electric bike's motor speed controller serves as its brain, coordinating power delivery, managing motor performance, and guaranteeing a comfortable and effective ride. It enhances the entire functionality, dependability, and fun of electric bikes by combining cutting-edge technologies with effective control systems.

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