JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Motor Controlling of Electric Two Wheeler

[1]**Syed Ayesha,** [2]**Patnam Chandana Priya,** [3]**Jangala Vignana Lekhana,** [4]**Badvel Preethi**
[5]**Dr.G Venkateshwarlu,,M.Tech Ph.d**
[1,2,3,4,5] UG Scholars, Narayana Engineering College, Nellore, Andhra Pradesh, India

Abstract *:* Electric Two-Wheeler (E-bikes) represent a promising and rapidly growing segment of the urban mobility land space. New energy vehicles are driven by pure electricity and integrate advanced technologies such as vehicle drive control and vehicle networking. They are simple in structure and friendly to the environment. As concerns about climate change, air pollution, and urban congestion escalate, e-bikes offer a sustainable, convenience and efficient alternative to traditional modes of transportation. Despite their considerable advantages, challenges such as infrastructure integration, public perception and regulatory harmonization remain. Controlling the motor in an electric two wheeler involves managing its speed, torque, and direction effectively. The growing transition to electric two-wheelers offers substantial environmental advantages. Unlike traditional internal combustion engine (ICE) motorcycles and scooters, which contribute to air and noise pollution, electric two-wheelers produce zero tailpipe emissions, significantly reducing pollution levels. The push on electric mobility given by the government of India gained a lot of importance in the recent years with a subsequent growth in the electric vehicles especially two-wheeler focused. This brings an urgent need for the improvement of performance criteria in electric vehicles. Although electric vehicles are more efficient than conventional vehicles, the parameters like the efficiency of the electric motor, torque measurement, back emf, and speed of the electric vehicle and motor are to be continuously evaluated to hold the electric vehicles place at the top.

IndexTerms - E-bike, Eco-Friendly,Motor

I. Introduction

There is a rapid development in transportation industry to move toward EVs, which are considered to be highly efficient and reliable, and are now becoming commercially competitive. EVs include HEVs (Hybrid Electric Vehicles), PHEVs (Plug-in Hybrid Electric Vehicles), more MEVs and all AEVs, depending on the electrification level of the vehicle. In order to meet the increasing demand for EVs, substantial investment from governmental sectors, research institutions, industry and public have been directing into research and development, production and commercialization activities of EVs. EVs have a very broad range of specifications. Each application places different demands on the motor and hence many different technologies are appropriate. In urban areas, passenger vehicles have been the major source of air pollution and therefore the focus of this paper.

Modern world demands the high technology which can solve the current and future problems. Fossil fuel shortage is the main problem now-a-days. Considering current rate of usage of fossil fuels will let its life up to next five decades only. Undesirable climate change is the red indication for not to use more fossil fuel any more. Best alternative for the automobile fuels to provide the mobility & transportation to peoples is sustainable electrical bike. Future e-bike is the best technical application as a visionary solution for the better world and upcoming generation. E-bike comprises the features like high mobility efficiency, compact, electrically powered, comfortable riding experience, light weight vehicle. E-bike is the most versatile future vehicle considering its advantages.

II. Literature Review

BLDC motors are widely used in electric two-wheelers due to their high efficiency, power density, and robustness. Researchers have focused on various aspects of BLDC motor design, modeling, and control for electric two-wheeler applications.BLDC motors are another popular choice due to their simplicity, reliability, and efficiency. According to [Miller, 1989], BLDC motors have a longer lifespan and require less maintenance compared to brushed motors, making them ideal for electric scooters and motorcycles.

Loss minimization techniques focus on reducing the energy losses in electric motors. [Hwang et al., 2014] discuss methods such as optimizing the switching frequency of inverters and using advanced materials for motor construction to reduce losses and improve overall efficiency.The literature on motor control for electric two-wheelers highlights significant advancements in motor technology, control strategies, and efficiency optimization. PMSM and BLDC motors are the most commonly used due to their high performance and reliabilityStudies have examined the influence of rotor design on the performance of BLDC motors, finding that optimized rotor configurations can improve efficiency and power density. Virtual design optimization techniques have also been used to further enhance BLDC motor performance for two-wheeler use.In terms of control, conventional control methods as well as advanced techniques like state feedback control and IC-based control algorithms have been explored to improve efficiency, reduce torque ripple, and enable fault detection in BLDC drives.

The literature highlights the importance of accurate modeling and analysis of BLDC motors to enable effective control strategies that can meet the performance requirements of electric two-wheelers. Ongoing research aims to address challenges such as high initial cost, limited range, and long charging times through continued advancements in motor, battery, and charging technologies.The need for clean energy and removal of toxic emission from internal engines have led researchers and engineers into exploring and developing new drive systems.The development of electric two wheeler has greatlyreduced the emission level of vehicles.However,this is not enough.the purely electrical vehicles are 100% clean in service and such their deployment is of great importance.

Therefore, these vehicles replace the internal engines in normal two wheeler bikes and automobiles with electric motors.hence, the need for the motor drive in an electric vehicle that is highly efficient with low weight, high power density and cheaply available in the market. In this paper,a review of different electric motors with respect to their design simplicity, cost, ruggedness and efficiency is presented. Finally, the brushless DC motor is proven to be an efficient and most suitable candidate for propulsion drive in electric vehicles.A conceptual methode to improve its control is also presented.

III. Methodology

- Conventional vehicles which uses fossil fuels to generate power.
- Electric vehicles which uses pure electrical energy to generate power.
- Dynamo electric vehicles which converts mechanical work to electric energy which is then used to generate power to run the vehicle.
- The methodology involved in this project is to first design a basic structure of the two wheeler vehicle which can accommodate batteries, motor, seat, brakes etc.
- In this project BLDC motor(60V and 1.5KW/H) is mainly used which is connected to the rear wheel by a chain drive.
- Lithium ion batteries(12V) have been used which are connected in series and can run the motor. The batteries are charged by using electricity

IV. Working Principle of an Electric Motor

Motor: A Brushless DC (BLDC) motor with a 1.5 kW rating is commonly used in electric two- wheeler designs due to its efficiency, reliability, and compact size. Here's a detailed explanation of its key features and why it's suitable for electric two-wheelers:

i. Working Principle:

- Unlike traditional DC motors, BLDC motors do not use brushes for commutation. Instead, they use electronic controllers to switch the current in the stator windings.
- The interaction between the magnetic field from the stator windings and the permanent magnets in the rotor creates rotational motion.

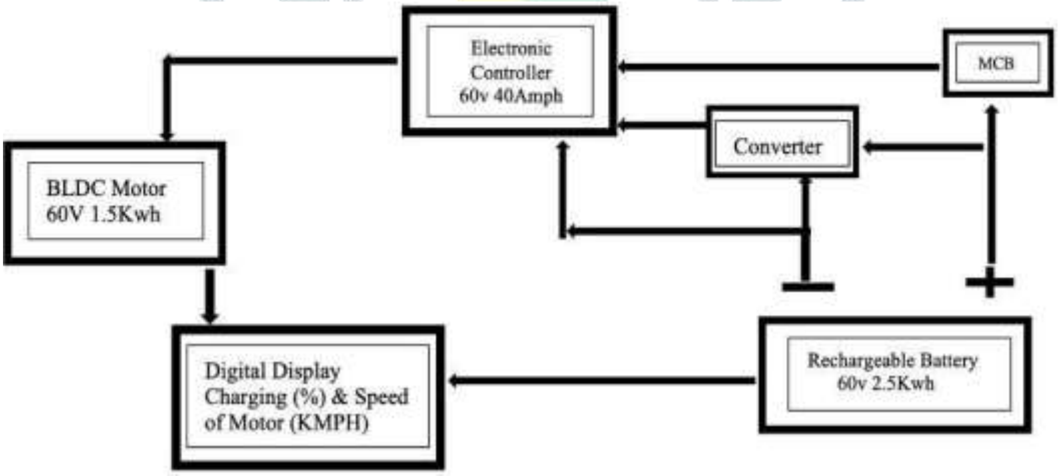


Fig 1: Block Diagram of Motor Control

ii. Controller – STM32 In EV

STM32 microcontrollers, developed by STMicroelectronics, are crucial components in the architecture of modern electric vehicles (EVs). Their versatility, performance, and robust feature set make them ideal for managing various subsystems within an EV, including battery management, motor control, infotainment systems, and advanced driver-assistance systems (ADAS).

- **Motor Control**

Efficient motor control is essential for the performance and smooth operation of EVs. STM32 microcontrollers excel in this domain by executing advanced control algorithms such as Field- Oriented Control (FOC) to optimize motor performance. They manage the speed and torque of the motor, ensuring efficient energy use and a smooth driving experience. Features like Digital Signal Processing (DSP) capabilities and Floating-Point Units (FPU) in STM32 microcontrollers enable precise control, while high-resolution Pulse Width Modulation (PWM) timers are used for controlling motor drivers. The real-time performance of STM32 microcontrollers ensures low latency and high efficiency in motor control applications.

- **Infotainment Systems**

In EVs, infotainment systems enhance the driving experience by providing multimedia management, navigation, and connectivity features. STM32 microcontrollers handle audio and video playback, radio functions, and integration with smartphones. They manage user interfaces through touchscreens and display units. Advanced graphics libraries and hardware acceleration in STM32 microcontrollers ensure a smooth and responsive user interface. Additionally, connectivity features like USB, Bluetooth, Wi-Fi, and Ethernet support seamless integration with external devices and internet services.

- **Advanced Driver-Assistance Systems (ADAS)**

ADAS features are becoming increasingly common in modern EVs, improving safety and driver convenience. STM32 microcontrollers process data from various sensors such as cameras, radar, and lidar to create a comprehensive understanding of the vehicle's surroundings. They enable features like adaptive cruise control, lane-keeping assistance, automatic emergency braking, and parking assistance. The high processing power of STM32 microcontrollers is essential for real-time sensor data processing and execution of complex algorithms. They also support basic AI and machine learning models for tasks like object detection and decision-making. Compliance with automotive safety standards (ISO 26262) ensures the reliability and safety of these system.

- **General Vehicle Control**

STM32 microcontrollers are also used in various Electronic Control Units (ECUs) within an EV, managing subsystems such as climate control, lighting, power windows, and door locks. They act as communication gateways between different vehicle subsystems, ensuring seamless data flow. Features like CAN and LIN interfaces are essential for in-vehicle communication networks, and their low power consumption helps reduce the overall energy footprint of the vehicle. The robustness of STM32 microcontrollers ensures high reliability and tolerance to the harsh environmental conditions often encountered in automotive applications.

Fig 9 STM32 Microcontroller

In summary, STM32 microcontrollers are integral to the functionality of modern electric vehicles. Their diverse features and high performance enable efficient battery management, precise motor control, advanced infotainment systems, sophisticated driver assistance capabilities, and overall vehicle control. With extensive support for communication interfaces, real-time processing capabilities, and compliance with automotive safety standards, STM32 microcontrollers provide a reliable and versatile solution for EV manufacturers. Their pivotal role enhances the performance, safety, and user experience of electric vehicles, contributing significantly to the advancement of this technology.

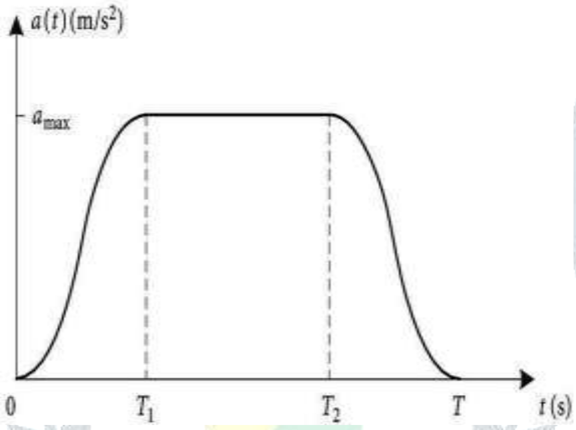
iii. Controlling Techniques

Although there are different types of electric motors, we will focus on those normally installed on EVs, like BLDC/PMSM DC motors. The motor control techniques used in EVs will therefore depend on the type of motor and control (open or closed loop). The latter necessarily requires the presence of sensors capable of accurately determining the motor's position at any moment.

iv. Trapezoidal Control

Trapezoidal control is one of the simplest types of BLDC motor control. Even if it is very popular and cost-effective, it suffers from a torque ripple problem during commutation.

Trapezoidal commutation method defines the shape of back EMF and drive current waveform. To get the optimum performance from the motor, the drive current should match the back Electro Motive Force waveform. As back EMF of BLDC motor is in trapezoidal shape it should be driven with trapezoidal current to get best performance. Trapezoidal commutation is also known as "Six Step Commutation" because there is total six steps of drive current used to complete one revolution of rotor. In trapezoidal control at a time only two phases are active. This method has simple control algorithm but the torque ripple exists in the motor at every commutation (60 Degree).



Advantages
- Control Algorithm is simple
- Only two phase is needed to active at time
- Less switching loss

Disadvantages
- Torque ripple at every commutation
- Torque produced is less
- Acoustic and electric noise

V. Result and Discussions

The result of our project is a motor controlling using trapezoidal control . The specifications of our electric vehicle is shown in the below figures.

s.no	Feature	Description
1	Battery Voltage(V)	60
2	Battery Capacity(Kw/h)	2.5
3	Distance Travelled(KM)	65
4	Top speed	60
5	Motor Type	BLDC
6	Weight Carrying Capacity(Kg)	120
7	Charge Duration	4hr

VI. Conclusion

The customization of motor controllers in electric two-wheelers offers enhanced performance, energy efficiency, safety, and cost-effectiveness. By tailoring controllers to match vehicle specifics like weight and battery capacity, manufacturers can optimize acceleration, speed, and range. Additionally, custom controllers can improve stability and responsiveness, making the vehicle safer to ride. This customization not only enhances user experience but also reduces costs by optimizing performance and efficiency. In conclusion, customizing motor controllers is crucial for improving the overall value and competitiveness of electric two-wheelers.

Electric two-wheelers are rapidly gaining popularity due to their eco-friendly nature and ease of use. However, to ensure the best possible performance, it's essential to customize the motor controller to match the specific needs of the vehicle and its end-user.

VII. References

1. "The Electric Bicycle: Worldwide Research Trends". Department of Engineering, University of Almeria, ceiA3, 04120 Almeria, Spain.Received: 26 May 2018; Accepted: 18 July 2018; Published: 20 July 2018.
2. "Design and Fabrication of Electric Bicycle". International Journal of Engineering Research & Technology (IJERT),ISSN: 2278-0181.ETEDM - 2018 Conference Proceedings.
3. International Journal of Scientific Research in Mechanical and Materials Engineering © 2020 IJSRMME | Volume 4 | Issue 3 | ISSN : 2457-043509. "Fabrication of Electric Bike".
4. International Journal of Mechanical and Production Engineering Research and Development (IJMPERD).ISSN (P): 2249–6890; ISSN (E): 2249–8001.Vol. 10, Issue 3, Jun 2020."The design and performance investigation of solar e-bike using flexible solar panel by different battery charging controller."
5. https://www.electricaltechnology.org/2016/05/bldc-brushless-dc-motor-construction-working-principle.html