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Electric Vehicle Motor Speed Controller

Shreyash Salunkhe [1], Suyog Aundhe [2], Prerana Fuke [3], Tejashri Salunkhe [4],

Prof.Bhagyashree Sherkhane [5]

BE Electrical Student, Dept. of Electrical Engineering, ZCOER, Narhe, Pune, Maharashtra, India[1-4]

Assistant Professor, Dept. of Electrical Engineering, ZCOER, Narhe, Pune, Maharashtra, India[5]

ABSTRACT: The increasing popularity of electric vehicles (EVs) has spurred the need for advanced motor control techniques to enhance the driving experience and improve energy efficiency. One critical aspect is the reduction of jerk, the abrupt change in acceleration or deceleration, which can negatively impact passenger comfort and vehicle stability. This research paper investigates the implementation of a Pulse Width Modulation (PWM) technique in the motor speed controller of an electric vehicle to effectively reduce jerk during acceleration and deceleration phases. The study explores the theoretical background, design considerations, and experimental evaluation of the proposed PWM-based jerk reduction approach.

KEYWORDS: Active anti Jerk, PWM technique, .

I.INTRODUCTION

The increasing adoption of electric vehicles has led to advancements in motor control techniques to enhance their performance. Jerk, defined as the rapid change in acceleration, can negatively impact the driving experience and passenger comfort. Therefore, the development of motor speed controllers that minimize jerk becomes crucial. This research paper aims to investigate the implementation of a PWM technique to reduce jerk in electric vehicle motors.

II. LITERATURE SURVEY

1.Active Anti-Jerking control of Shifting for Electric Vehicle for Driveline

2.Development of Motor Controller Based on PIC18 study conducted by Hongbo Wang Fumio KasagamiYanshan University, China DAIHEN Corporation, Japan hongbo_w@ysu.edu.cn kasagani@daihen.co.jp

3.Bidirectional Speed Control of DC Motor Based on Pulse Width Modulation using Microcontroller study conducted by Ayman Y. Yousef, M. H. Mostafa Electrical Engineering Department, Faculty of Engineering at Shoubra, Benha University, Cairo, Egypt 2Distribution Sectors, South Cairo Electrical Distribution Co., Cairo, Egypt

4.A Microcontroller based Power Electronic Controller for PV assisted DC motor Control study conducted by S.Krithiga, and N.Ammasai Gounden

III. PWM-BASED SPEED CONTROL

1. Principles of PWM

Pulse Width Modulation (PWM) is a widely used technique for controlling the speed of electric motors. PWM involves rapidly switching the motor voltage on and off, effectively regulating the average voltage applied to the motor. By adjusting the width of the pulse, the effective voltage can be modulated, enabling precise speed control.

2. PWM for Jerk Reduction

The proposed motor speed controller utilizes PWM to minimize jerk during speed changes. By gradually changing the duty cycle of the PWM signal, the motor's acceleration and deceleration can be controlled more smoothly. This ensures a seamless transition between different speed levels, reducing the discomfort caused by sudden jerks.

IV. CONTROLLER DESIGN AND IMPLEMENTATION

1.System Architecture
The motor speed controller system consists of a microcontroller unit (MCU) that generates the PWM signal, a motor driver circuit, and the electric vehicle motor itself. The MCU receives speed commands from the vehicle's controls and adjusts the duty cycle of the PWM signal accordingly.

2. Jerk Reduction Algorithm
The controller incorporates a jerk reduction algorithm that calculates the rate of change of acceleration and adjusts the PWM duty cycle accordingly. By limiting the acceleration rate within predefined thresholds, the controller ensures smooth speed changes, minimizing jerk.

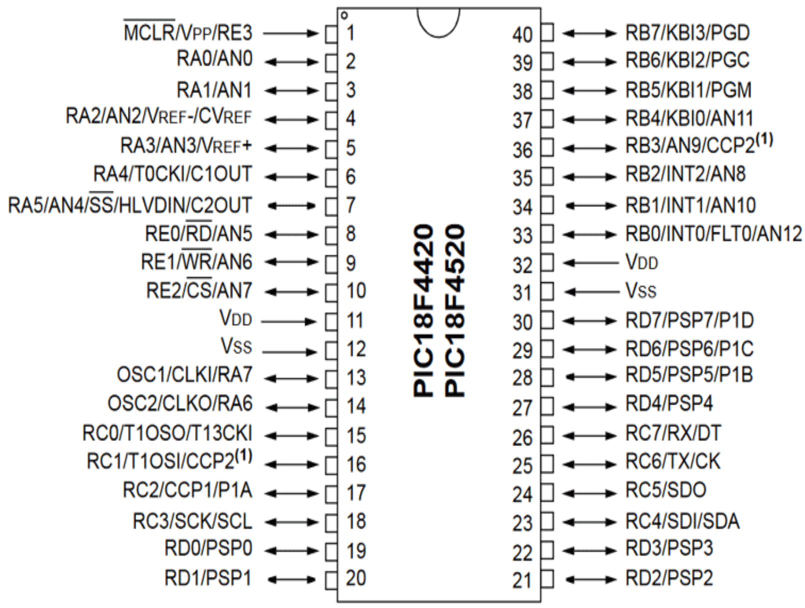
V. SIMULATION AND EXPERIMENTAL RESULTS

1. Simulation Setup: A simulation environment is created to evaluate the effectiveness of the proposed PWM-based motor speed controller. Various driving scenarios are simulated, including speed changes, acceleration, and deceleration.

2 Experimental Validation: To validate the simulation results, an experimental setup is constructed using an actual electric vehicle prototype. The motor speed controller is implemented and tested in real-world driving conditions. Measurements of jerk levels and user feedback are collected to assess the performance of the controller.

VI. HARDWARE

1.PIC18F4520 MICROCONTROLLER:
To gather data from the sensors and communicate with the other ECU and main controller , a microcontroller is needed. The microcontroller can be configured to carry out a number of functions, including data processing, sensor calibration, and wireless module communication.



2.Power supply: To run the microprocessor and LED display , the system needs a dependable power source
.

3.USB TO TTL Converter: This is used to validate the communication between the other ECU with the help of Hercules Software.

4.Transformer: This is used to step down the supply from 230v to 12v for the energizing the power supply kit rating is about 230/12v with secondary current of 1 amp.

5. LED Display: This will display the acceleration and error code / no. which is coming from other controllers.Having characteristics of 16*2 display.

6. Potentiometer (230): Potentiometer will provide manual variation in commanded power for the motor driver .this is used instead of the accelerator of vehicle.

7. Rectifier: Rectifier is used to convert AC supply to DC supply because for the operation of the microcontroller and display.

VII. SOFTWARE

1.MPLAB IDE : For the programming of the PIC18F4520 Microcontroller.

2.Protuse : For the simulation of the different project performed on the PIC microntroller.

3.Hercules: To provide the test error from the PC/Laptop to the microcontroller and validation of the completion the communication between other Microcontrollers.

VIII.RESULTS AND DISCUSSION

The simulation and experimental results demonstrate the effectiveness of the PWM-based motor speed controller in reducing jerk during speed changes. Significant improvements in driving comfort and passenger experience are observed compared to conventional speed control methods.

IX. CONCLUSION

This research paper presents a PWM-based motor speed controller designed to reduce jerk during speed changes in electric vehicles. The proposed controller utilizes a jerk reduction algorithm and demonstrates improved driving comfort and passenger experience. Further optimization and integration with advanced control techniques can be explored to enhance the performance of electric vehicle motor controllers.

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