**A Servo Controller for Brushed DC Motor**

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***Abstract***

This project focuses on the design and implementation of a servo controller for a brushed DC motor aimed at achieving precise position control. The motor driver circuit was developed using an H-bridge configuration, controlled by PWM signals generated from an STM32 microcontroller. A PID controller was integrated to ensure accurate positioning, utilizing feedback from an optical encoder and following a user-defined trapezoidal motion profile including parameters such as position, speed, acceleration, and deceleration.

The motor driver circuit was evaluated for its ability to maintain consistent PWM signals and reliable gate drive voltages, demonstrating smooth and efficient operation at different duty cycles. The use of IRF3205 N-channel MOSFETs in the H-bridge circuit provided high current handling capabilities and low on-resistance, ensuring efficient power management. The IR2110 MOSFET gate driver was instrumental in providing the necessary drive signals to the MOSFETs, enhancing the overall reliability of the circuit.

The PID controller was tested under various load conditions, showing effectiveness in closely following the theoretical motion profile with minimal errors. The controller's performance was evaluated by configuring the servo controller to move through various angular positions under no load, constant load, and varying load conditions. The system demonstrated precise control, maintaining accurate positioning with minimal deviation from the desired motion profile. However, some limitations were identified, such as the inability to dynamically adjust the motion profile during operation and challenges in maintaining smooth motion at very low speeds.

The integration of the PID control system with the motor driver circuit allowed for real-time feedback and fine-tuning of the motor's output. The optical encoder provided accurate position and velocity data, enabling the PID controller to make immediate corrective responses. This closed-loop control system ensured that the motor adhered to the predefined motion profile, effectively handling external influences such as load variations.

The findings highlight the system's robustness and suitability for high-precision applications, making it a viable solution for various industrial and commercial uses. The designed servo controller meets the precision requirements for brushed DC motor control, offering reliable and accurate performance. This project contributes to the advancement of motor control technology, providing a foundation for future innovations in the field.