**UNIVERSITI TEKNOLOGI MARA**
**CAWANGAN PULAU PINANG**

# AN AUTONOMOUS WHEELCHAIR SPEED CONTROL USING FUZZY LOGIC CONTROLLER

**MUHAMMAD ASHRAF BIN MOHAMAD GHAZALI**

**BACHELOR OF ENGINEERING (HONS) ELECTRICAL AND ELECTRONIC ENGINEERING**

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# AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations, Universiti Teknologi MARA, regulating the conduct of my study and research.

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|---|---|---|
| Name of Student | : | Muhammad Ashraf Bin Mohamad Ghazali |
| Student I.D. No. | : | 202110 |
| Programme | : | Bachelor Of Engineering (Hons.) Electrical And Electronic Engineering |
| Faculty | : | College Of Engineering |
| Thesis | : | An Autonomous Wheelchair Speed Control Using Fuzzy Logic Controller |
| Signature of Student | : | ..... ..... |
| Date | : | February 2025 |

# ABSTRACT

Assistive technologies aim to enhance the mobility and independence of disabled people especially for individuals with severe paralysis, like Spinal Cord Injury (SCI) that can result in tetraplegia. However, current control system for autonomous wheelchair may not adapt to changes in the road condition that posing safety risks. To address this issue, the system must interpret vibration input from the autonomous wheelchair's sensors to adjust speed to ensure safe navigation across various road condition. Main focus of this study is developing a DC motor speed control using fuzzy logic control in response to a vibration sensing mechanism with the aim of integrating the system into a wheelchair to enhance safety while navigating unpredictable road conditions. The proposed system design requires 2 input and 1 controller that implement the FLC to adjust the PWM input to the DC motor driver to control the speed. The controller is designed to receive two inputs: one from a vibration sensing mechanism that uses a piezoelectric sensor, and another from a DC motor with an encoder to provide speed feedback. Both inputs are processed by an Arduino Uno microcontroller using pre-defined Fuzzy Logic rules to adjust the motor speed based on the vibration and speed feedback. MATLAB Simulink simulation was utilized to model and validate the FLC before hardware implementation. The simulation was performed to model and validate the FLC with comparing the standards function that is triangular and trapezoidal MFs to determine optimal performance. The hardware integration combines vibration sensor, DC motor with encoders and Arduino Uno microcontroller that supported by Python for real-time data processing, user interface visualization and data storage. Results from the simulation showed that the triangular membership function provided better performance in terms of response time, accuracy, and adaptability to speed variations. The hardware implementation successfully replicated the simulated results, demonstrating the effectiveness of the proposed FLC-based speed control system. The triangular membership function was confirmed as the optimal choice due to its faster response time and computational efficiency. Despite minor hardware limitations, including an encoder malfunction that produced inconsistent speed readings, the system effectively adjusted motor speed based on real-time terrain conditions. Overall, the study validates the feasibility of implementing an FLC-based speed control system in autonomous wheelchairs, ensuring improved mobility, stability, and safety for users navigating various terrains. Future enhancements could involve integrating additional sensors and refining the control algorithm for enhanced performance in real-world applications.

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