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

# ENHANCED EFFICIENCY AND STABILITY PHOTOVOLTAIC SYSTEMS: INTEGRATING IMPROVED MPPT PHOTOVOLTAIC SYSTEMS

**MOHD HAZNI BIN ABDUL HALIM SHAH**

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

February 2025

# 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.

| | | |
|---|---|---|
| Name of Student | : | Mohd Hazni Bin Abdul Halim Shah |
| Student I.D. No. | : | 202152 |
| Programme | : | Bachelor of Engineering (Hons.) Electrical and Electronic Engineering - CEEE200 |
| Faculty | : | Electrical Engineering Studies |
| Thesis | : | Enhanced Efficiency and Stability Photovoltaic Systems: Integrating Improved Mppt Photovoltaic Systems |
| Signature of Student | : | .... ..... |
| Date | : | February 2025 |

# ABSTRACT

This project conducts a comprehensive investigation into enhancing the performance of photovoltaic (PV) systems by integrating a Cuk converter with a Perturb and Observe (P&O) algorithm for Maximum Power Point Tracking (MPPT) under dynamic environmental conditions. The primary objective was to design and evaluate an MPPT system that combines a Cuk converter with the P&O algorithm to optimize energy extraction at varying irradiance levels. A methodical approach was employed, including an extensive literature review, system design, actual and simulated data simulations, and performance analysis. The system's response was evaluated under irradiance levels of 400 W/m², 600 W/m², and 1000 W/m² to assess its accuracy, efficiency, and adaptability. The MPPT system consistently demonstrated accurate Maximum Power Point (MPP) tracking, achieving accuracy levels ranging from 98.32% to 98.35% across varying irradiance conditions. The system effectively transformed input power into usable output power with efficiency levels between 95.58% and 97.11%. The duty cycle profiles reflected the converter's adaptable operational behavior, maintaining a stable and predictable response to changes in irradiance. The results also revealed a strong correlation between increasing irradiance levels and proportional increases in input and output power, with the system achieving its highest performance at peak irradiance. These findings underscore the system's reliability, flexibility, and potential for practical applications in optimizing solar energy generation, making it a robust solution for renewable energy systems in diverse environmental settings.

# ACKNOWLEDGEMENT

First and foremost, I am grateful to have been given the opportunity by the divine to commence my degree and to successfully complete this arduous and lengthy journey. I would like to extend my heartfelt appreciation to my supervisor, Prof. Madya Ir. Dr. Zakaria Hussain, and co-supervisor, Dr. Ahmad Asri Bin Abd Samat, for their invaluable assistance, support, and guidance throughout the project. Their constructive feedback has significantly enhanced the quality of this thesis. Additionally, I would like to acknowledge my family, particularly my beloved parents, for their unwavering support, kindness, and encouragement during this endeavour. I am also thankful to my colleagues and friends for their assistance and support. Finally, I express my sincere gratitude to all those who contributed to this thesis.

# TABLE OF CONTENTS