

HIGH EFFICIENCY HYDROGEN/ELECTRIC VEHICLE  
USING FUEL CELL

MICRO NUR AZIZI BIN ZULKIPLY

FACULTY OF ELECTRICAL ENGINEERING  
UNIVERSITI TEKNOLOGI MARA  
MALAYSIA

## **ACKNOWLEDGEMENTS**

In the name of Allah S.W.T Most Gracious Most Merciful

First and foremost, I would like to praise God the Almighty for His guidance. Though difficulties occurred, His guidance gave me the chance to still complete this challenging project successfully.

My deepest appreciation goes to my supervisor, Madam Wan Noraishah Binti Abdul Munim for her concern, valuable time of consultation and advice, guidance, patience in supervising my project from the beginning until the completion of this project and guided me with moral supports throughout my project. I really acknowledge all the precious words from her and hope the moment working with her remains as valuable experience for my future undertakings. Not to forget, my highest gratitude to all the lecturers of UiTM, my beloved family members, and also my friends especially to Hadi, Syed harunsani, Azim, Irfan, Idham and all eco member team that gave feedbacks and helped a lot through their useful ideas, advises and support.

Summing everything up, I really appreciate and pleased to all the helping hands given to me. I enjoyed this project even though it was quite tough. The experience gained throughout this project was so meaningful and I hope that my project could also be used as reference for the other students.

## **ABSTRACT**

Abstract- Spermotive-2 is an ultra-lightweight vehicle designed for the Shell Eco-marathon Asia 2013 competition in the prototype category. The specialty of this lightweight vehicle is that it using hydrogen gas instead of petrol or diesel (green technology). The gas is converted into electrical energy by a chain of chemical reactions done by a special device called the fuel cells. The generated electrical energy is used to run the system of the vehicle as well as the drivetrain of the vehicle. The electrical system of the vehicle uses an automatic throttle control in which the motor of the vehicle is controlled by a controller that will start and stop the motor based on the velocity of the vehicle. If the vehicle is moving slower than the desired speed, the power will be supplied to the engine. When the desired speed is achieved, the power will be stopped, thus reducing the usage of the power as the power will only be used when necessary. Spermotive-2 objective is to run with the most efficient fuel usage to ensure optimum usage of power.

# TABLE OF CONTENTS

<b>CHAPTER</b>	<b>PAGE</b>
<b>DECLARATION</b>	<b>ii</b>
<b>ACKNOWLEDGEMENT</b>	<b>iii</b>
<b>ABSTRACT</b>	<b>iv</b>
<b>TABLE OF CONTENTS</b>	<b>v</b>
<b>CHAPTER 1 : INTRODUCTION</b>	<b>1</b>
1.1 Introduction	1
1.2 Problem Statement	2
1.3 Objectives	2
1.4 Scope and Limitations of the Research	3
1.5 Significance of the Study	3
1.6 Thesis Organization	3
<b>CHAPTER 2 : LITERATURE REVIEW</b>	<b>4</b>
2.1 Introduction	4
2.1.1 Introduction Shell Eco-marathon	4
2.1.2 History	5
2.1.3 Shell Eco-marathon Rules and Regulations 2012	5
2.1.4 Team UiTM Eco-Sprint Goals	8
2.2 Full Cell and Hidrogen Vehicle	8
2.3 Ultra Capacitors for Hidrogen Vehicle	10
2.4 DC Motor	11
<b>CHAPTER 3 : METHODOLOGY</b>	<b>13</b>
3.1 Introduction	13
3.2 Methodology Process	13
3.3 Hardware Development	17
3.3.1 Chassis Design	17
3.3.2 Assemble Body Vehicle	20
3.3.3 Hardware Modification	18
3.3.4 Hardware Functional Test	19

3.3.5	Electrical And Electronic Circuit Design	22
3.4	Electric and Electronic Design	23
3.4.1	Part list	23
3.4.2	General Information Demensions	26
3.4.2	General Specification	27
3.5	Electric Circuit Diagram	31
3.6	System Setup	31
3.6.1	Setup Gas Line to the stack	32
3.6.2	Setup Controller	34
3.6.3	Ready to Start up	42
3.6.4	System Manual Shut Off	44
3.6.5	Troubleshooting	45
3.7	Software Development Process (Telemetry System)	46
3.7.1	eLogger System-Installing	46
3.7.2	Installation of the eLogger	47
3.7.3	Installing and Using the Windows Software	48
3.7.4	Setting the “Set Capture Rate” Feature	50
3.7.5	Setting the”Choose Instrumentss to Display”	51
3.7.6	Configuring and Calibrating Throttle	52
3.8	Last Product	53
<b>CHAPTER 4 : RESULT AND DISCUSSION</b>		<b>56</b>
4.1	Desiging the Electricical Powertrain	56
4.2	Experiment to Determine the Perfotmance Vehicle	58
<b>CHAPTER 5 : CONCLUSION AND FUTURE DEVELOPMENT</b>		<b>67</b>
5.1	Introduction	67
5.2	Conclusion	67
5.3	Future Development	69
<b>REFERENCES</b>		<b>70</b>
<b>APPENDIXES</b>		<b>72</b>