



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF ELECTRONIC-BASED EDUCATIONAL
TRAINER KIT FOR HUFFMAN CODING DESIGN CONCEPT
USING ARDUINO AND MIT APPS**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Telecommunication) with Honours.

By

NUR SHAHIDAH BINTI SHAF AIE

B071610728

950310-10-6628

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING
TECHNOLOGY

2019

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: DEVELOPMENT OF ELECTRONIC-BASED EDUCATIONAL TRAINER
KIT FOR HUFFMAN CODING DESIGN CONCEPT USING ARDUINO AND MIT
APPS

Sesi Pengajian: 2019

Saya **NUR SHAHIDAH BINTI SHAFIAE** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)

SULIT* Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

TERHAD* Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

TIDAK TERHAD

Yang benar,

Disahkan oleh penyelia:

.....
NUR SHAHIDAH BINTI SHAFIAE

.....
AMAR FAIZ BIN ZAINAL ABIDIN

Alamat Tetap:

Cop Rasmi Penyelia

Lot 2222,

Kg Delek Kiri,

41250, Klang Selangor

Tarikh:

Tarikh:

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

DECLARATION

I hereby, declared this report entitled DEVELOPMENT OF ELECTRONIC-BASED EDUCATIONAL TRAINER KIT FOR HUFFMAN CODING DESIGN CONCEPT USING ARDUINO AND MIT APPS is the results of my own research except as cited in references.

Signature:

Author : NUR SHAHIDAH BINTI SHAFIAE

Date:

APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Telecommunication) with Honours. The member of the supervisory is as follow:

Signature:

Supervisor : **AMAR FAIZ BIN ZAINAL ABIDIN**

Signature:

Co-supervisor: **RAHAINI BINTI MOHD SAID**

ABSTRAK

Huffman Coding adalah salah satu mata pelajaran yang dikaji dalam bidang Kejuruteraan Elektronik. Kit ini dibangunkan dengan menggunakan Arduino untuk membantu pelajar meningkatkan pengetahuan mereka mengenai “Huffman Coding”. Di samping itu, tujuan kit ini adalah untuk membantu pelajar memahami lebih mendalam mengenai bentuk “Huffman Coding” bukan sahaja dari segi teori malahan dalam aspek praktikal juga. Terdapat 10 soalan yang perlu pelajar selesaikan dengan membuat penyambungan pada kit ini. Aplikasi MIT Apps dibina yang perlu pelajar menyambungkan kepada Bluetooth. Sekiranya jawapannya betul, MIT Apps Inventor akan mengeluarkan paparan ‘Tahniah anda betul’ pada telefon pintar dan LED akan menyala pada simbol tanda betul. Sementara itu, LED akan menyala pada simbol pangkah dan MIT Apps Inventor akan mengeluarkan paparan ‘Anda Salah’ pada telefon pintar jika pelajar gagal menjawab soalan tersebut. Kaji selidik dijalankan bagi 50 responden untuk mendapatkan maklum balas dan melihat daya maju sesebuah kit pendidikan yang diinovasikan untuk masa depan mereka dalam era revolusi ini.

ABSTRACT

Huffman Coding is one of the subjects studied in Electronics Engineering. This kit was developed by using Arduino to help students improve their knowledge of Huffman Coding. In addition the purpose of this kit is to help students more comprehension regarding of this Huffman Coding not only in theory but also in practical aspect as well. There are 10 questions students need to solve by connecting to the trainer kit. MIT Apps are built that require students to connect via Bluetooth. If the answer is correct, Apps will display 'Congratulations you are correct' on the smartphone and the LED will light up at the tick sign. Meanwhile, the LED will light up and the crossbar symbol and Apps will display 'You are wrong' on the smartphone when the student fail to answer the question. A survey was conducted for 50 respondents to obtain feedback and see the viability of an educational kit designed for their future in this era of revolution.

DEDICATION

To all those who have supported, encouraged, guided, love and inspired me to complete this project especially to my beloved parents, sibling, honourable supervisor, co-supervisor and friends and which has made it possible to make it up to this point.

ACKNOWLEDGEMENTS

In the name of Allah, the Most Gracious and the Most Merciful. Alhamdulillah, all praises to Allah for giving me the strength, blessing and chance to complete this thesis.

First and foremost, my deepest gratitude goes to my beloved parents Mr Shafaie Bin Othman and Mrs Rashidah Binti Ali and also my younger brother Muhammad Shafiq Bin Shafaie deserve special mention for their endless love, prayer and encouragement.

Special appreciation goes to my supervisor, Mr Amar Faiz Bin Zainal Abidin and not forgotten my co supervisor Mr Muhammad Izzat Zakwan Bin Mohd Zabidi as a great advisor, who has given a sincere guidance and supported me throughout this thesis with their patience. One simply could not wish for a better or friendlier supervisors.

Sincere thanks to all my friends especially Nurin Lydia Binti Marah Azman, Arfah Hafieza Binti Mohd Harun and Asyraf Bin Zainal Ludin and others for their love, kindness and moral support during my study.

Last but not least, I would like to thanks everybody who was indirectly contributed in this thesis and project, your kindness means a lot to me, as well as expressing my apology that I could not mention personally one by one. Thank you very much.

TABLE OF CONTENTS

	PAGE
ABSTRAK	vi
ABSTRACT	vii
ACKNOWLEDGEMENTS	ix
TABLE OF CONTENTS	x
LIST OF TABLE	xvi
LIST OF FIGURE	xvii
LIST OF APPENDIX	xxii
LIST OF SYMBOL	xxiii
LIST OF ABBREVIATION	xxiv
CHAPTER 1 INTRODUCTION	1
1.0 Introduction	1
1.1 Background Study	1
1.2 Problem Statement	3
1.3 Objectives	4
1.4 Scope of Work	4
1.5 Project Contribution	5

CHAPTER 2	LITERATURE REVIEW	7
2.0	Introduction	7
2.1	Past Related Research	7
2.1.1	Development of Educational Contents for Electronic Circuit Learning	8
2.1.2	Pneumatic Trainer Kit	9
2.1.3	Module-Based Edukit for Teaching and Learning 8051 Microcontroller Programming	10
2.1.4	Reseducational Kit	11
2.1.5	The Development of an Electronic Educational Quiz Board that Test Student Knowledge on Control Principle's Second Order Transient Response by Using DC Motor Speed Control as Application	12
2.1.6	An Educational Kit to Teach and Learn Operational Amplifiers	13
2.1.7	Design and Fabrication of Programmable Logic Control Kit with Multiple Output Module for Teaching and Learning Purposes	14
2.1.8	LabVIEW Based Sign Language Trainer Cum Portable Display Unit for the Speed Impaired	15
2.1.9	Design and Development of a Modular Robotic Kit “CubeBot” for Educational Purposes	16
2.1.10	Development of Educational Environment for Online Control of a Biped Robot using Matlab and Arduino	17

2.1.11	Arduino as an Educational Tool to Introduce Robotics	18
2.1.12	E-Tester: The Development of an Electronic Board that Check Commonly Used Arduino-Based Electronic Components and Modules	19
2.1.13	A Feasibility Study of Arducation Bot	20
2.1.14	Theories and Methods of Using the Educational Technology in Teaching Chinese as a Second Language	21
2.1.15	Development of a Multitasking Mobile Robot for the Construction of Educational Robotics Kits	22
2.1.16	DidacTronic : A Low-cost and Portable Didactic Lab for Electronics	23
2.1.17	Low Cost Motor Control Systems Laboratory Kit for Distance Learning Courses	24
2.1.18	Enriching Computer Science and Programming Class with Arduino Game Development	25
2.1.19	Bluetooth Low Energy (BLE) based Portable Medical Sensor Kit Platform with Cloud Connectivity	26
2.1.20	A Reconfigurable and Expandable Kit to Teach Electronic Circuits Based on Operational Amplifiers	27
2.1.21	Design and Implementation of Children's Art Educational Software "Happy Baby Drawing Board"	28

2.1.22	A Learning Kit on IPV6 Deployment and Its Security Challenges for Neophytes	29
2.1.23	Inspiring Undergraduate Students in Engineering Learning, Comprehending and Practicing by the Use of Analog Discovery Kits	30
2.1.24	Solar Power Observatory for Educational Activities	31
2.1.25	IC Design Course Based on the Synopsys DesignWare ARC 600 Processor Core and 32/28nm Educational Design Kit	32
2.1.26	Proposal of Global PBL Education for Engineers using Sequece Learning Kit	33
2.1.27	FGPA/Embedded System Training Kit Targeted to Graduate Students towards Indusry Level Short Training	34
2.1.28	An Experience Report on Teaching Programming and Computational Thinking to Elementary Level Children using Lego Robotics Educational Kit	35
2.1.29	Huffman Encoding and Decoding algorithm using IJulia	36
2.1.30	Learning Programming Using Educational Robotics	37
CHAPTER 3	METHODOLOGY	38
3.0	Introduction	38
3.1	Project Overview	38

3.2	Flowchart of the Project	43
3.3	Block Diagram of the Project	45
3.4	Project Layout	47
3.5	PCB Circuit Layout	48
3.6	Hardware Component	50
3.7	Software Component	51
3.8	Build of Materials	53
3.9	Project Costing	54
CHAPTER 4 RESULT AND DISCUSSION		56
4.0	Introduction	56
4.1	Reliability Testing	56
4.1.1	Drop Test	57
4.1.2	Aging Test	58
4.2	Functionality Testing	59
4.2.1	Unit Testing and Integration Testing	59
4.2.2	Boundary Testing	61
4.3	Comparison Testing	61
4.3.1	Hardware Design	62
4.3.2	Application Design	64

4.3.3	Design theFlowchart of the Project	66
4.3.4	Prototype of Simulation Result	70
4.4	Result Analysis and Survey Question	78
CHAPTER 5 CONCLUSION		89
5.0	Conclusion	89
5.1	Recommendation for Future Improvement	90
REFERENCES		91

LIST OF TABLES

TABLE	TITLE	PAGE
Table 3.0:	Gantt Chart PSM 1	41
Table 3.1:	Gantt Chart PSM 2	42
Table 3.2:	The Actual and Expected Price	55
Table 4.0:	Drop Test for Project	57
Table 4.1:	Aging Test for Project	58
Table 4.2:	Unit Testing for Project	59
Table 4.3:	Integration Testing for Project	60
Table 4.4:	BoundaryTesting for Project	61
Table 4.5:	Comparison between Actual and Hardware Design	62
Table 4.6:	Comparison between Actual and Expected Application Design	64
Table 4.7:	Design the Flowchart of the Project	66
Table 4.8:	Simulation Result for the Correct Connection	70
Table 4.9:	Simulation Result for the Wrong Connection	74

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.0:	Development of Protoype Kit (a) Electronic Circuit Learning Kit (b) Prototype with Acrylic Material (c) Cube Unit (d) Spherical Unit	8
Figure 2.1:	Pneumatic Trainer	8
Figure 2.2:	Edukit was Placed in Ice-cream Box	10
Figure 2.3:	The Resducational Kit Prototype	11
Figure 2.4:	The Demonstration of Project Design	12
Figure 2.5:	(a) Overall Architecture of The Electronic Kit (b) Picture Exemplifying the Electronic Kit using Two External Instruments (Oscilloscope and Function Generator)	13
Figure 2.6:	Existing PLC Trainer Kit with Toggle Switch	14
Figure 2.7:	Portable Display Unit	15
Figure 2.8:	Design of The “Cubebot” (a) General Piece for All Cubes (b) Piece for the Infrared Cube	16
Figure 2.9:	Bioloid Robot with FSR circuit on Feet and Arduino Mega Board to Control Servos via PC	17
Figure 2.10:	Robot with Arduino	18

Figure 2.11:	The Prototype of E-Tester	19
Figure 2.12:	“Arducation Bot”	20
Figure 2.13:	(a) Left: A Clicker Made by NERCEL (b) Right: The List of the Answers Sent by using Clickers	21
Figure 2.14:	Arrangement of the wheel and Other Parts	22
Figure 2.15:	Three Types Viable Kits	23
Figure 2.16:	Concept of Control Systems Laboratory Kit	24
Figure 2.17:	Educational Board for Arduino	25
Figure 2.18:	Block Diagram of the Medical Sensor System	26
Figure 2.19:	The implemented Kit of Overall Architecture	27
Figure 2.20:	Happy Baby Drawing Board	28
Figure 2.21:	Learning Kit of IPv6 Deployment	28
Figure 2.22:	Wearable Device ‘Communicare’	30
Figure 2.23:	The Solar Kit Connection	31
Figure 2.24:	Internal Interfaces of ARC 600	32
Figure 2.25:	For the Left Side is for Positioning Control Device and the Right Side the Pinball Board	33
Figure 2.26:	Students are Testing their Project on Embedded System	34
Figure 2.27:	The Methodology and Research Framework	35
Figure 2.28:	Huffman Tree Outcome on Jupyter Notebook	36

Figure 2.29:	The Development Cycle	37
Figure 3.0:	This Flowchart for PSM 1 and PSM 2	40
Figure 3.1:	Flowchart of the Project	44
Figure 3.2:	Block diagram of the Project	45
Figure 3.3:	The Architecture of the Project	46
Figure 3.4:	Upper Layout for the Huffman Coding Trainer Kit	47
Figure 3.5:	The Design Circuit of the PCB Layout	48
Figure 3.6:	Male Header	50
Figure 3.7:	Female-Female Jumper Wire	50
Figure 3.8:	LED	50
Figure 4.0:	Drop Test with a height of 0.5m	57
Figure 4.1:	Drop Test with a height of 1.0m	57
Figure 4.2:	Temperature test from 5am	58
Figure 4.3:	Temperature test until 3pm	58
Figure 4.4:	Temperature test in refrigerator from 6am	58
Figure 4.5:	Temperature test in refrigerator until 4pm	58
Figure 4.6:	Expected design upper layout for trainer kit	62
Figure 4.7:	Actual design upper layout for trainer kit	62
Figure 4.8:	Expected Prototype of the Huffman Coding trainer kit	63
Figure 4.9:	Actual Prototype of the Huffman Coding trainer kit	63

Figure 4.10:	Expected design for welcome message	64
Figure 4.11:	Actual design for welcome message	64
Figure 4.12:	Expected design for the display question of Huffman Coding	65
Figure 4.13:	Actual design for the display question of Huffman Coding	65
Figure 4.14:	Expected design layout to check the answer	65
Figure 4.15:	Actual design layout to check the answer	65
Figure 4.16:	The expected design for welcome message and the click button for connect with the Bluetooth	66
Figure 4.17:	The actual design for welcome message and the click button for connect with the Bluetooth	66
Figure 4.18:	The expected design interface for the selection of Bluetooth	67
Figure 4.19:	The actual design interface for the selection Bluetooth	67
Figure 4.20:	The expected design for the question appears on the phone screen	68
Figure 4.21:	The actual design for the question appears on the phone screen	68
Figure 4.22:	The expected design for the display correct answer	68
Figure 4.23:	The actual design for the display correct answer	68
Figure 4.24:	The expected design for the display wrong answer	69
Figure 4.25:	The actual design for the display correct answer	69
Figure 4.26:	The expected layout for the overall score will display on the phone screen	69

Figure 4.27:	The actual layout for the overall score will display on the screen	69
Figure 4.28:	Pie Chart for Question 1	78
Figure 4.29:	Pie Chart for Question 2	79
Figure 4.30:	Pie Chart for Question 3	79
Figure 4.31:	Pie Chart for Question 4	80
Figure 4.32:	Pie Chart for Question 5	81
Figure 4.33:	Pie Chart for Question 6	81
Figure 4.34:	Pie Chart for Question 7	82
Figure 4.35:	Pie Chart for Question 8	83
Figure 4.36:	Pie Chart for Question 9	83
Figure 4.37:	Pie Chart for Question 10	84
Figure 4.38:	Pie Chart for Question 11	85
Figure 4.39:	Pie Chart for Question 12	85
Figure 4.40:	Pie Chart for Question 13	86
Figure 4.41:	Pie Chart for Question 14	87
Figure 4.42:	Pie Chart for Question 15	87

LIST OF APPENDIX

APPENDIX	TITLE	PAGE
Appendix 1:	Arduino Mega 2560 Datasheet	96
Appendix 2:	Survey Question	97

LIST OF SYMBOLS

%	-	Percentage
R	-	Resistor
k Ω	-	Kiloohm
μ	-	Micro
cm	-	Centimetre
nm	-	Nanometre
m	-	Metre

LIST OF ABBREVIATIONS

PC	Personal Computer
LED	Light Emitting Diode
MIT	Massachusetts institute of Technology
IEEE	Institute of Electrical and Electronics
MCU	Microcontroller Unit
PCB	Printed Circuit Board
LCD	Liquid Crystal Display
VDR	Voltage Divider Rule
EQB	Educational Quiz Board
DC	Direct Current
TFT	Thin-Film-Transistor
OpAmp	Operational Amplifier
PLC	Programmable Logic Controller
WFD	World Federation of the Deaf
LabVIEW	Laboratory Virtual Instrument Engineering Workbench
GUI	Graphical User Interface
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange