UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF EMBEDDED CONTROLLER FOR FLEET MANAGEMENT SYSTEM

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

by

NURUL AIN BINTI SUHIMI

B071710788

980915086292

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING

TECHNOLOGY

2020

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: DEVELOPMENT OF EMBEDDED CONTROLLER FOR FLEET MANAGEMENT SYSTEM

Sesi Pengajian: 20/21

Saya **NURUL AIN BINTI SUHIMI** 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)

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

☐ 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,

.....

NURUL AIN BINTI SUHIMI

Alamat Tetap:

PT 1033 KG, BENDANG BARU,

MUKIM LESUNG, 06400 POKOK

SENA, KEDAH

Tarikh: 15.01.2021

Disahkan oleh penyelia:

shahrizal

.....

TS SHAHRIZAL BIN SAAT

Cop Rasmi Penyelia

Ts. SHAHRIZAL BIN SAAT
Pensyarah
Jabatan Teknologi Kejuruteraan Elektronik & Komputer
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik
Universiti Teknikal Malaysia Melaka

Tarikh: 16/01/2021

*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 EMBEDDED CONTROLLER FOR FLEET MANAGEMENT SYSTEM is the results of my own research except as cited in references. This project has not been accepted for any degree and is not currently submitted by any other degree candidates.

Signature: ……

Author : NURUL AIN BINTI SUHIMI

Date: 19.1.2021

UTeM
اونيۏرسيتي تيکنيکل مليسيا ملاک
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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 Electronics Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follow:

Signature: shahrizal .....

Supervisor: TS SHAHRIZAL BIN SAAT

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ABSTRACT

Fleet Management System (FMS) is heart to business operations these days. Business using fleet include e-hailing system, logistics, delivery services are constantly increasing within time. Sometimes, engine box or any other parts is over the limit and forget to be replaced due to human factor. This can indirectly affect the fleet operation leading to vehicles sudden breakdown and accident during operation. The objectives that need to be achieve in this project are to develop embedded controller which are able to log all important data such as mileage in order to notify maintenance department to check on part replacement. Next, to monitor vehicles speed movement on road simultaneously and in real time. Lastly, minimize vehicles downtime and operating costs by notifying maintenance team to check on battery, tire, engine oil and gear box oil replacement. Embedded controller needed medium to talk to car data Electronic Control Unit (ECU) and exchange of digital information between diagnostic scan tool and ECUs using standard Controller Area Network (CAN) protocol carried out by OBD-II scanner. This project is to develop microcontroller that function the same as OBD reader. This project use Arduino UNO as microcontroller, and DC motor encoder for feedback pulse before sending message and data logging process. In result, feedback pulse is counted as mileage, the data can be monitored and message alert will be send to both driver and maintenance team simultaneously and in real-time.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ABSTRAK

Fleet Management System (FMS) menjadi tumpuan operasi perniagaan hari ini. Perniagaan yang menggunakan armada termasuk sistem e-hailing, logistik, perkhidmatan penghantaran sentiasa meningkat dari suatu masa ke masa yang lain. Kadang kala, minyak kotak enjin atau bahagian lain melebihi had dan lupa untuk diganti kerana faktor manusia. Ini secara tidak langsung boleh mempengaruhi operasi armada yang menyebabkan kerosakan kenderaan secara tiba-tiba dan kemalangan semasa kenderaan beroperasi. Objektif yang perlu dicapai dalam projek ini adalah untuk mengembangkan pengendali terbenam yang dapat mencatat semua data penting seperti jarak yang dilalui untuk memberitahu bahagian penyelenggaraan. Seterusnya, untuk memantau pergerakan kelajuan kenderaan di jalan secara serentak dan dalam waktu sebenar. Akhir sekali, mengurangkan waktu kenderaan rosak dan kos operasi dengan memberitahu pasukan penyelenggaraan untuk memeriksa penggantian minyak bateri, tayar, minyak enjin dan kotak gear. Pengawal terbenam memerlukan media untuk komunikasi dengan data kereta Electronic Control Unit (ECU) dan pertukaran maklumat digital antara alat imbasan diagnostik dan ECU menggunakan protokol Controller Area Network (CAN) standard yang dilakukan oleh OBD-II. Projek ini adalah untuk membangunkan mikrokontroler yang berfungsi sama seperti pembaca OBD. Projek ini menggunakan Arduino UNO sebagai pengawal utama, dan pengekod motor DC untuk nadi maklum balas sebelum menghantar mesej dan proses log data. Hasilnya, denyut maklum balas dikira sebagai jarak yang dilalui, data dapat dipantau dan mesej peringatan akan dikirimkan kepada pemandu dan pasukan penyelenggaraan secara serentak dan dalam waktu sebenar.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEDICATION

This paper is devoted to my family for supporting me throughout degree life. My mother, Nor Aslinda binti Bakar for being the reason I am not giving up. My father, Suhimi bin Ariffin. My brothers, Taufik Suhimi, Amirul Ashraf Suhimi and Aliff Hakimi Suhimi for supporting me continuously. Special thanks to my project supervisor, Ts. Shahrizal bin Saat for always keeping me in track and giving full motivation and guidance in completing this project.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
UTeM
اونيۏرسيتي تيکنيکل مليسيا ملاک
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ACKNOWLEDGEMENTS

First and utmost important, I would praise Allah the Almighty for blessing me in my life journey, ease everything throughout my life that I personally could not ask for any better life. I will also take this opportunity to Universiti Teknikal Malaysia Melaka (UTeM) for giving me chance in fulfilling my degree requirement to complete my study in UTeM.

In the same way, I would like to deliberate my sense of obligation to my supervisor, Ts. Shahrizal bin Saat from Faculty of Electrical and Electronics Engineering Technology, Universiti Teknikal Malaysia Melaka for all his tips, support and guidance. Receiving advice continously from him build me and motivate me to keep going in completing this project.

Lastly, I would like to appreciate my friends for encouragement and suggestions throughout the project completion. Every each of them leave big influence for me. I hope all of us can finish the project we started and complete the study within time.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TABLE OF CONTENTS

		PAGE
ABSTRACT		**i**
ABSTRAK		**ii**
DEDICATION		**iii**
ACKNOWLEDGEMENTS		**iv**
TABLE OF CONTENTS		**v**
LIST OF TABLES		**ix**
LIST OF FIGURES		**x**
LIST OF SYMBOLS		**xiv**
LIST OF ABBREVIATIONS		**xv**
CHAPTER 1 INTRODUCTION		**1**
1.1	Background	1
1.2	Problem Statement	3
1.3	Research Objective	3
1.4	Scope of Research	3
1.5	Contribution of Research	4
1.6	Thesis Outline	5
CHAPTER 2 LITERATURE REVIEW		**7**
2.1	Introduction	7
2.2	Data Logging	8
2.3	Embedded Controller and Fleet Management System	10

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2.3.1 Embedded System 11

2.4 On Board Diagnostic (OBD) 12

2.4.1 Structure of OBD 13

2.4.2 Function of OBD 14

2.5 Controller Area Network Bus (CAN Bus) 14

2.5.1 CANBus Description 14

2.6 ELM327 Integrated Circuit 16

2.7 Summary of Related Work 25

CHAPTER 3 METHODOLOGY **26**

3.1 Introduction 26

3.2 Project Overview 26

3.3 Project Planning 29

3.4 Experimental Parameter 30

3.5 Experimental Setup 31

3.5.1 Hardware Setup 31

3.5.1.1 Arduino UNO 31

3.5.1.2 USB Cable 32

3.5.1.3 DC Motor Encoder 33

3.5.1.4 Motor Driver 34

3.5.1.5 Liquid Crystal Display (LCD) 34

3.5.1.6 Potentiometer 35

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

3.5.1.7 Breadboard 35

3.5.1.8 Buzzer 36

3.5.1.9 Jumper Wire 36

3.5.1.10 Power Adaptor 37

3.5.1.11 ESP-01s WiFi Serial Transceiver Module (ESP8266) 37

3.5.1.12 PVC CASING 38

3.5.2 Software Setup 38

3.5.2.1 Arduino IDE 38

3.5.2.2 Blynk Server 39

3.5.2.3 Microsoft Excel 39

3.6 Limitation of Proposed Methodology 40

3.7 Conclusion 40

CHAPTER 4 RESULTS AND DISCUSSION 41

4.1 Introduction 41

4.2 Project Implementation 41

4.2.1 Development Tools 41

4.2.2 Application Creation 42

4.3 System Working 45

4.4 Program Used In Project 46

4.5 Project Testing 48

4.6 Project Analysis 55

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

4.7 Discussion 56

CHAPTER 5 CONCLUSION **57**

5.1 Introduction 57

5.2 Project Achievement 57

5.3 Project Limitation 58

5.4 Recommendation of Future Work 58

5.5 Project Commercialization 59

REFERENCES **60**

APPENDIX **63**

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF TABLES

TABLE	TITLE	PAGE
Table 1:	Types of OBD Data Logger.	10
Table 2:	Summary of Related Work.	25
Table 3:	Arduino UNO Features.	32
Table 4:	DC Geared Motor Encoder Specification.	33
Table 5:	I2C LCD Specifications.	35

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1:	Example of Full assembled OBDII/GPS Logging Device.	8
Figure 2:	Example of Full assembled OBDII/GPS Logging Device.	8
Figure 3:	Example of data logging with RTC.	9
Figure 4:	Fleet Management System.	11
Figure 5:	Example of OBD Reader.	13
Figure 6:	Physical Connection of CAN Bus According to ISO1198.	14
Figure 7:	CAN Bus Node.	15
Figure 8:	ELM327 Integrated Circuit Connection Diagram.	16
Figure 9:	ELM327 Integrated Circuit Block Diagram.	17
Figure 10:	Block Diagram for Overall System.	27
Figure 11:	Flowchart for Overall System.	28
Figure 12:	Implementation Planning Flowchart.	29
Figure 13:	Gantt Chart PSM1.	30
Figure 14:	Gantt Chart PSM2.	30
Figure 15:	Arduino UNO Front View.	31
Figure 16:	Arduino UNO Back View.	31
Figure 17:	Arduino UNO Hardware Description.	32

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Figure 18: USB B Type Cable. 32

Figure 19: DC Geared Motor with Encoder. 33

Figure 20: DC Motor Driver Shield for Arduino (2 channel). 34

Figure 21: I2C 1602 LCD. 34

Figure 22: 10K Potentiometer. 35

Figure 23: Breadboard. 35

Figure 24: Passive/Piezo Buzzer. 36

Figure 25: Female to Male Jumper Wire. 36

Figure 26: Male to Male Jumper Wire. 36

Figure 27: 12V DC Power Adapter. 37

Figure 28: ESP8266 WiFi Module. 37

Figure 29: PVC Box. 38

Figure 30: Arduino IDE software. 38

Figure 31: Blynk Application's Architecture. 39

Figure 32: Example of Blynk Application's Interface. 39

Figure 33: Microsoft Excel Software. 39

Figure 34: Creating New Project Using Blynk. 43

Figure 35: Choosing New Device Using Blynk. 43

Figure 36: Auth Token Sent To User e-Mail. 44

Figure 37: PLX-DAQ Interface and Setting. 44

Figure 38: PLX-DAQ User Interface. 45

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Figure 39: Estimated Approximate Tire Design Life According Safercar.gov in 2006. 46

Figure 40: ESP8266 Firmware Setup. 47

Figure 41: ESP8266 Connection Setup. 47

Figure 42: Library and Blynk WiFi Credential. 47

Figure 43: Excel Data Logging Code. 48

Figure 44:Microcontroller Hardware Setup. 49

Figure 45: Project Hardware Setup. 49

Figure 46: Project Hardware Setup. 50

Figure 47: Overall Project Hardware Setup. 50

Figure 48: Running DC Motor For PWM, Pulse and RPM Value. 51

Figure 49: Example of Motor Stopping But Remaining Distance Travelled Count. 51

Figure 50: FMS Blynk Interface. 52

Figure 51: FMS Blynk Interface While Vehicle Moving. 52

Figure 52: Driver's Notification When Driving Maximum Speed. 53

Figure 53: Driver's Notification When Tire Need To Be Change. 53

Figure 54: Blynk Server Notification If Controller Offline. 53

Figure 55: Driver's Notification When Gearbox Oil Need To Be Change. 54

Figure 56: Driver's Notification When Battery Need To Be Change. 54

Figure 57: Driver's Notification When Battery Need To Be Change. 55

Figure 58: PLX-DAQ Displaying Mileage and Part Status. 55

Figure 59: Serial Plotter Viewing Speeding Pattern. 56

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Figure 60: MarketsandMarkets FMS Market Forecast. 59

UTeM
اونيۏرسيتي تيکنيکل مليسيا ملاک
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF SYMBOLS

D, d	-	Diameter
Ω		Ohm, Resistor Unit

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
اونيۏرسيتي تيکنيکل مليسيا ملاک
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF ABBREVIATIONS

IC	-	Integrated Circuit
FMS	-	Fleet Management System
OBD	-	On Board Diagnostic
ECU	-	Electronic Control Unit
RTC	-	Real Time Clock
DTC	-	Diagnostic Trouble Code
CAN	-	Controller Area Network
MIL	-	Malfunction Indicator Lamp
UART	-	Universal Asynchronous Receiver/Transmitter
TX	-	Transmit
RX	-	Receiver

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

CHAPTER 1

INTRODUCTION

1.1 Background

Transportation is an primary resource for businesses, particularly for businesses concerned in areas like supplying, delivery services, e-hailing services, public transport, and logistic services. In addition, with socio-economic changes, vehicle ownership has increased significantly. Both ordinary users and organisations need to have adequate management and maintenance awareness of their vehicles. (O. Stapleton et al, 2011).

Inadequate information of a transport, fleet maintenance could be risky. Taking an example, vehicles breakdown throughout operation on highways at essential moments. (Desa et al,2001) diagnosed that between 70 to 80 percent breakdowns will be prevented by deploying preventive upkeep. Therefore, frequently reporting of maintenance of management repercussion are indeed crucial.

Fleet Management System (FMS) is a hot and skyrocketing topic. FMS will facilitate firms to try manage vehicle funding, vehicle sustentation, vehicle chase and problem, driver behaviour operation, acceleration monitoring, fuel and protection upkeep (Fleischer, P.B et al,2012).

Worldwide fleet management market is foretold to cultivate starting in 2015 from worthy USD 8.03 Billion to the range of USD 22.35 Billion by 2020 as market research report forecasts that. FMS has the big-timer challenge and that actually needs good technical skills. Surprisingly, a lot of people do not have any idea on

what beneath the hood of a car or any other vehicles nor a way to do regular check up to evade breakdowns.

Different type of transportations are accessible in each countries. Thenewest model are fitted with constitutional sensors accessed through an On board diagnostic (OBD) system which squeal the motive force of any essential condition in which this device are absent in older vehicles. Whereas the OBD is helpful, it is incorporated into the vehicle's dashboard and is accessible solely in-vehicle. Moreover, scanning error codes by OBD acquire an adapter, solely record the present state of the vehicle and no analytics are accomplished. It is fascinating that a maintenance system ought to analyze the chronicles of the state of a vehicle and forecast maintenance before real failure take place.

Google Maps is incorporated with OBD system (Google,2020) to channel the motive force to the closest workshop if a components or parts are perceived to report the failure. Example of fueling wherever analysis show if vehicles is ought to be refuel due the present and remaining miles for journey left. In beating these issues, it is vital to possess a system for observation and keep up a fleet in confluence with real time of health analytics for intact and dependable transportation. Not solely a system that monitors the present health state of a vehicle however conjointly forecast the failure of various essential elements by performing arts analytics on the history of information is anticipated.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

This method not solely reduces the upkeep price however may also give a stronger prediction for fleet maintenance management. This can conjointly provide businesses a foothold as a result of it cut down repair prices, unclog the fleet job and dodge abrupt tailspin.

1.2 Problem Statement

Fleet management need to monitor several aspects such as battery condition, engine oil, tire, insurance, road tax and other features. For fleet company such as lorry or bus business, all the item in checklist will be updated manually by driver. Sometimes, the limit for gearbox or engine oil is over and forget to be replaced due to human factor. This can indirectly effect the fleet operation leading to vehicles breakdown and accident during operation**.**

1.3 Research Objective

The objectives that need to be accomplish in this project are:

i. To develop embedded controller which are able to log all important data such as mileage in order to notify maintenance department.

ii. To monitor vehicles speed movement on road simultaneously and in real-time.

iii. To minimize vehicles downtime and operating costs by notifying maintenance team to check on battery, tire, engine oil and gear box oil replacement.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1.4 Scope of Research

The research range are as follows:

i. Data logging from embedded controller in notifying maintenance department and driver on important information

needed to take action.

ii. Monitor the vehicles speed simultaneously and inreal-time.

iii. Keep the maintenance date and data obtained from vehicles in management database to be continuously monitor by management authorities.

1.5 Contribution of Research

The thesis is made in contribution to the following related areas:

i. Continuous monitoring the vehicles in real time: Authorities such as company management having access to the system can track and battery condition, engine oil level, tire, insurance, road tax expire date mileage and send alert message to driver to send vehicles to maintenance team when essential parameter goes beyond normal range. This will prevent vehicles breakdown during operation and lessen the accident factor dueto vehicles problem.

ii. Reduce fleet management operating costs: The main focus in fleet management system is to control and reduce vehicles repairing cost. By reducing the risk of vehicles breakdown, management can cut the cost for repairing vehicles even replacingunnecessary parts.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA