

**ANALYSIS ON THE EFFICIENCY OF IOT BASED TRAIL
RUNNING TRACKER**

MUHAMMAD ARIF BIN MOHAMAD ZABIDI

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**ANALYSIS ON THE EFFICIENCY OF IOT BASED TRAIL
RUNNING TRACKER**

MUHAMMAD ARIF BIN MOHAMAD ZABIDI

**This report is submitted in partial fulfilment of the requirements
for the degree of Bachelor of Electronic Engineering with Honours**

**Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka**

2018

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : Analysis on the Efficiency of IoT based Trail
Running Tracker
Sesi Pengajian : 2017/2018

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DEDICATION

For all of their sacrifice and unlimited support throughout these years, I am very thankful that my parents had been there by my side. If it is not because of them, I would not be able to reach to this point of life where my childhood dreams seem achievable. I have come a long way from the day I learnt alphabets to this day where I am able to guide myself to find success in everything I do. Their unbiased support drives me forward and no word can describe how grateful I am for having these two as my backbone. Finally, I would like to send my gratitude to each and every person who might be part of my final year project, directly and indirectly. Every comment and suggestion given are key factors upon completing this project.

ABSTRACT

Although it is newly introduced to the world, trail running has increased in popularity and has become quite competitive globally. A hybrid of running and hiking covers various distances in competitive races from 10 km to 100 km. Not just that, the courses also vary from normal flat roads to tough climbs that would push the participants to the limits. Inspired by the Industrial revolution 4.0, the main focus of this project is to develop an efficient IoT based tracking system for trail running races. An RFID tag with unique data of a particular participant would be given upon registration. Attached to their ankles, each participant is required to scan the tag at the Arduino reader located at their respective checkpoints. As the tag is scanned, the time elapsed and other details of the participant would be automatically updated into the database inside the computer at the control point. This process happens via Internet as the Arduino reader is also connected with a Wi-Fi module. This project would allow the organizer to keep track on the movements of participants and would definitely prevent cheating or lost in the jungle. The processing of data would also be faster and less manual labor would be used.

ABSTRAK

Walaupun baru diperkenalkan kepada dunia, larian denai semakin popular dan telah menjadi agak kompetitif di seluruh dunia. Gabungan antara larian dan pendakian ini meliputi pelbagai jarak dalam perlumbaan kompetitif dari 10 km hingga 100 km. Bukan hanya itu, laluan juga berbeza dari trek biasa ke pendakian yang sukar yang akan mendorong peserta ke had maksimum mereka. Terinspirasi daripada revolusi industri 4.0, tumpuan utama projek ini adalah untuk membangunkan sistem pengesanan IoT yang cekap untuk perlumbaan larian denai. Tag RFID dengan data unik setiap peserta akan diberikan semasa pendaftaran. Tag akan dilekatkan pada pergelangan kaki dan setiap peserta dikehendaki mengimbas tag pada pembaca Arduino yang terletak di setiap tempat pemeriksaan. Apabila tag telah diimbas, masa dan butir-butir lain peserta akan dikemaskini secara automatik ke dalam pangkalan data di dalam komputer di pusat kawalan. Proses ini berlaku melalui internet kerana pembaca Arduino juga dihubungkan dengan modul Wi-Fi. Projek ini akan membolehkan penganjur mengesan pergerakan peserta dan mampu mengelakkan penipuan atau kehilangan peserta di dalam hutan. Pemprosesan data juga akan lebih cepat dan kurang tenaga kerja manual diperlukan.

ACKNOWLEDGEMENTS

Praise be to Allah the Almighty for the excellent health and the wide range of knowledge that He had given upon completing this Final Year Project report within the time constraint. For my parents, my sincere gratitude for their love and support for which I might not be able to come to this point of life if it is not because of them. To my supervisor, Dr Siti Khadijah binti Othman @ Idris, I would like to address my deepest appreciation for her guidance, positive comments and encouragement throughout the report writing process. Thank you to the friends that might have put their effort on completing the report. Without all of their help, this report might have been impossible.

TABLE OF CONTENTS

Declaration	
Approval	
Dedication	
Abstract	i
Abstrak	ii
Acknowledgements	ii
Table of Contents	iv
List of Figures	ix
List of Tables	xi
List of Symbols and Abbreviations	xii
List of Appendices	xiv
CHAPTER 1 INTRODUCTION	15
1.1 Introduction	15
1.1.1 Trail Running	16
1.2 Problem Statement	18
1.3 Objectives	19

1.4	Scope of Work	19
1.5	Organization of Thesis	20
CHAPTER 2 BACKGROUND STUDY		21
2.1	Introduction	21
2.2	Literature Review	22
2.3	Trail Running	23
2.4	Internet of Things (IoT)	24
2.5	Radio Frequency Identification	25
2.5.1	Component of an RFID System	26
2.5.2	Tag Frequencies	28
2.5.3	Advantages and Disadvantages of RFID System	28
2.6	Tracking System	29
2.7	Theory of Components	31
2.7.1	Arduino	31
2.7.1.1	Arduino Uno R3	32
2.7.1.2	Arduino Mega	32
2.7.1.3	Arduino Leonardo	33
2.7.2	Wi-Fi Shield	35
2.7.3	ESP8266 Wi-Fi Module	35
2.8	Programming Language	36

2.8.1	Arduino Programming Language	36
2.8.2	MySQL37	
2.8.3	PHP	38
CHAPTER 3 METHODOLOGY		39
3.1	Introduction	39
3.2	Project Flowchart	40
3.3	Project Overview	41
3.3.1	Hardware Flowchart	43
3.3.2	Software Flowchart	44
3.4	Design and Preparation of the System	45
3.4.1	Material and Equipment	45
3.4.1.1	Arduino Programming Language and IDE (Integrated Development Environment)	45
3.4.1.2	XAMPP Software	46
3.4.1.3	ESP8266 Wi-Fi Module	46
3.4.1.4	Arduino Mega Board	47
3.4.1.5	Mifare MFR522C RFID	47
3.5	Budget and Costing	47
3.5.1	Direct Cost	48
3.5.2	Software Cost	49
CHAPTER 4 RESULTS AND DISCUSSION		50

4.1	Introduction	50
4.2	Hardware Layout	51
4.2.1	Hardware Schematic Layout	51
4.2.2	Configuration of MFR522C RFID Module	52
4.2.3	ESP8266 Wi-Fi Module Configuration	53
4.2.4	Setting up Hardware	54
4.3	Software Layout	55
4.3.1	Coding Development for the Arduino Mega	56
4.3.2	Coding Development for the Mifare MFR522C RFID	57
4.3.3	Coding Development for the ESP8266 Wi-Fi Module	58
4.3.4	Developing Website for Result Display	60
4.4	Experimental Result	64
4.5	Project Analysis	65
4.5.1	TX Connection of the Wi-Fi Module	65
4.5.2	Arduino Mega Power Limitations	67
4.5.3	Efficiency of the Mifare MFR522C RFID Tag	67
4.6	Discussion	68
4.7	Project Limitation	70
	CHAPTER 5 CONCLUSION AND FUTURE WORKS	71
5.1	Introduction	71

5.2	Conclusion	72
5.3	Recommendations	72
5.4	Commercialization Potential	73
	REFERENCES	74
	APPENDICES	77
Appendix A.	LIST OF COMMANDS FOR ESP8266 WIFI MODULE	77
Appendix B.	ARDUINO SKETCH CODE FOR HARDWARE	78
Appendix C.	PHP PROGRAMMING SCRIPT FOR DATABASE AND WEBSITE DEVELOPMENT	86

LIST OF FIGURES

Figure 1.1 Trail Running in the Forest	16
Figure 1.2 Trail Running Uphill	17
Figure 1.3 Trail Running Across Mountain	17
Figure 1.4 Checkpoint Station in a Trail Running Competition	18
Figure 2.1 RFID Attendance System	22
Figure 2.2 RFID Systems in Libraries	23
Figure 2.3 Running Across Rivers	24
Figure 2.4 Running in Tough Terrains	24
Figure 2.5 Basic Workflow of RFID System	26
Figure 2.6 Components of a RFID System	27
Figure 2.8 Arduino Uno	32
Figure 2.9 Arduino Mega	33
Figure 2.10 Arduino Leonardo	34
Figure 2.11 Arduino Wi-Fi Shield	35
Figure 2.12 ESP8266 Wi-Fi Module	36
Figure 3.1 Flow Chart of Project	41
Figure 3.2 Architecture of Project	42
Figure 3.3 Process Flow on Hardware Part	44

Figure 3.4 Software Operation Flowchart	45
Figure 3.5 Arduino Programming Language	46
Figure 3.6 XAMPP Software	46
Figure 3.7 ESP8266 Wi-Fi Module	46
Figure 3.8 Arduino Mega	47
Figure 3.9 Mifare MFR522C RFID	47
Figure 4.1 Electronic Design Automation of Trail Running Tracker	51
Figure 4.2 Breadboard View of Trail Running Tracker	52
Figure 4.3 Hardware Setup	55
Figure 4.4 Arduino IDE version 1.8.2	56
Figure 4.5 Mifare522C RFID Test Code	57
Figure 4.6 Different IDs of RFID tags scanned	58
Figure 4.7 ESP8266 Wi-Fi Module Test Code	59
Figure 4.8 WiFi Module Configuration	60
Figure 4.9 XAMPP Control Panel	61
Figure 4.10 PHP Files for Website Designing	62
Figure 4.11 Table Particulars in PHPMYAdmin	63
Figure 4.12 Display of Result	64
Figure 4.13 RFID Attached to Athlete's Ankle	65
Figure 4.14 Voltage Divider in Arduino TX Line	66
Figure 4.15 Location of Arduino Mega Voltage Regulator	67
Figure 4.16 Measuring the Distance from RFID to Antenna	68

LIST OF TABLES

Table 2.1 Types of RFID Frequencies	28
Table 2.2 Advantages and Disadvantages of RFID System	29
Table 2.3 Tracking Systems Comparison	30
Table 2.4 Comparison of Arduino	34
Table 2.5 Examples of Arduino Programming Commands	37
Table 3.1 Costs Involved in Project Development	48
Table 3.2 Software Costs	49
Table 4.1 Connections between Arduino Mega and MFR522C RFID Module	53
Table 4.2 Connections between Arduino Mega and ESP8266 Wi-Fi Module	54
Table 4.3 Distance for RFID Tag to be Readable	68

LIST OF SYMBOLS AND ABBREVIATIONS

RFID	:	Radio Frequency Identification
LED	:	Light Emitting Diode
IoT	:	Internet of Things
km	:	Kilometers
mm	:	Millimeters
IT	:	Information Technology
PC	:	Personal Computer
MHz	:	Mega Hertz
UHF	:	Ultra-High Frequency
GPS	:	Global Positioning System
GSM	:	Global System for Mobile Communications
Wi-Fi	:	Wireless Fidelity
SMS	:	Short Message Service
FTDI	:	Future Technology Devices International
PWM	:	Pulse Width Modulation
USB	:	Universal Serial Bus
kB	:	Kilobyte
IC	:	Integrated Circuit
GPIO	:	General Purpose Input Output

SPI	:	Serial Peripheral Interface
PHP	:	Pre-processor Hypertext
HTML	:	Hypertext Mark-up Language
IDE	:	Integrated Drive Electronics
MOSI	:	Master Out Slave In
MISO	:	Master In Slave Out
SCK	:	Serial Clock
RST	:	Reset
NSS	:	Slave Select

LIST OF APPENDICES

Appendix A:	LIST OF COMMANDS FOR ESP8266 WIFI MODULE	82
Appendix B:	ARDUINO SKETCH CODE FOR HARDWARE	83
Appendix C:	PHP PROGRAMMING SCRIPT FOR DATABASE AND WEBSITE DEVELOPMENT	91

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter will discuss important topics regarding the project's background, problem statement, objectives, scope of the project and the organization of the thesis. The background of study would explain on important subtopics such as trail running and the RFID technology.

1.1.1 Trail Running

It was declared by the International Trail Running Association (I-TRA) that trail running is a sport that involves natural environment only. There is a condition that the course should not have more than 20% of paved roads from the exact distance of the race.

Trail running is actually a combination of two different sports of the same concept, which are running and hiking. The concept of these sports is that an athlete is to complete a course from start to finish. The course itself covers a long distance from a maximum of 100km where the type of course also varies. Rather different than track running or marathon running, trail running covers mostly mountainous trails which makes it tougher and more challenging. What makes it unique is that competitors are able to experience changing scenery from dense forest to cold and calming mountain tops. Figure 1.1, Figure 1.2 and Figure 1.3 shows the different terrains that most trail runners go through.



Figure 1.1 Trail Running in the Forest



Figure 1.2 Trail Running Uphill



Figure 1.3 Trail Running Across Mountain

One of the major rule of trail running is that each contestant are required to pass several checkpoints and they need to show proof that they had run pass those checkpoints. Each contestant had been given bibs upon registration and they need to wear that at their waist. As they pass one checkpoint, a checkpoint staff would put on a sticker on their bibs as a mark that they have run pass that particular checkpoint. Figure 1.4 shows the conventional checkpoint of a trail running event where several people are in charge of giving checkpoint stickers.



Figure 1.4 Checkpoint Station in a Trail Running Competition

This method however is inefficient as the stickers might fall off as the race progresses. Due to the tough course and unexpected weather changes, it might damage the stickers. In addition, this would also make the result processing slower as checking each bib would require a lot of men's work and time as well. Therefore, RFID technology is applied to this race. An RFID tag will be attached inside the bibs of each contestant and they just need to run past the antenna reader at each checkpoint without the need to put on stickers. As the race finished, each antenna reader would send all the data of contestants to the control point for result processing.

1.2 Problem Statement

Normally in each event, there were hundreds or thousands of participants to handle. Conventionally, the race is managed manually with only the start line and finish line as checkpoints. Participants were given stickers as a sign that they have passed through a certain checkpoint. This would make the result processing delayed as the organizer would need to check on each participant whether they have enough checkpoint stickers or not. It would also require more manpower as the race are often participated by hundreds to thousands.