



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF ARDUINO BASE ORIENTEERING SPORT TRACKING SYSTEM

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

by

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I hereby, declared this report entitled “Development of Arduino Base Orienteering Sport Tracking System” is the result of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the Bachelor's Degree of Computer Engineering Technology (Computer System) with Honours. The members of the supervisory committee are as follow:

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(Encik Aiman Zakwan bin Jidin)

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(Encik Noor Mohd Ariff bin Brahin)

ABSTRAK

Orienteering adalah sukan individu yang mempunyai beberapa kelainan berbanding sukan lain. Selain menambahbaik prestasi fizikal anda, ia juga memerlukan kemahiran membaca peta dan navigasi. Pada permulaan acara Orienteering, setiap peserta akan diberikan sekeping kertas dan mereka dikehendaki untuk mendapatkan tandatangan di atasnya pada setiap stesen kawalan untuk menunjukkan kehadiran. Walau bagaimanapun, beberapa peserta memilih untuk menipu bagi memenangi pertandingan ini dan ia memerlukan banyak masa untuk mendapatkan keputusan rasmi kerana acara ini disertai oleh ramai atlet. Oleh itu, tujuan utama projek ini adalah untuk membangunkan sistem pengesanan yang berkesan untuk sukan orienteering ini. Tag pengenalan frekuensi radio (RFID) akan disediakan untuk setiap peserta, ia akan diimbas oleh Arduino (pembaca) pada setiap titik kawalan, dan secara automatik akan dikemaskini kepada perisian sistem pengesanan. Apabila tag RFID diimbas oleh Arduino, ia akan menghasilkan bunyi dan cahaya LED akan berkelip. Satu modul WiFi akan digunakan sebagai antena dan dengan membenarkan papan litar menyambung ke Internet, ia akan mengemas kini keputusan secara automatik kepada perisian komputer. Selain daripada itu, ia juga akan mengumpul data unik dari tag RFID serta masa yang tepat peserta untuk setiap titik kawalan dan keputusan akan ditunjukkan pada perisian. Dengan menggunakan sistem ini, pihak penganjur boleh mengesan kelajuan setiap peserta dan mendapatkan masa yang mereka ambil dari satu titik kawalan kepada yang lain. Selain itu, projek ini boleh dibahagikan kepada dua bahagian besar, bahagian pertama, RFID Tag dengan Arduino dan bahagian kedua, satu perisian yang boleh memaparkan semua keputusan pelari. Dengan melengkapkan projek ini, produk ini menyokong organisasi, kecekapan yang tinggi dalam penilaian acara Orienteering.

ABSTRACT

Orienteering is an individual sport which has some interesting twists compared to other sports. Besides improvising your physical performance, it also requires your map reading and navigational skills. At the start of an orienteering event, each contestant will be given a piece of paper at the start and they are required to get a sign on it on every control station to show the attendance. However, some participants choose to cheat in order to win the competition and it requires a lot of time to obtain the official results as this kind of event were participated by many athletes. Therefore, the main concern of this project is to develop an efficient tracking system for this sport. A Radio-frequency identification (RFID) tag will be provided for each participant, which will be scanned by the Arduino (reader) at each control point, and it will automatically update to the tracking system software. When the RFID tag is scanned by the Arduino, it will produce a sound and a LED light will blink. A Wi-Fi module will be used as an antenna and by allowing the board connect to the Internet, it will update the result automatically to the computer software. Other than that, it will also collect the unique data from the RFID tag as well as their exact time for every control point (check point) and that is how the result are shown in the software. By using this system, the organizer can track each participant's speed and obtain their time taken from one control point to another. Moreover, this project can be divided into two big parts, the first part, RFID Tag with Arduino and the second part, software that can display all the results of runners. By completing this project, this product is supporting the organization, the high efficiency of evaluation of Orienteering events.

DEDICATIONS

To my beloved parents, I acknowledge my sincere indebtedness and gratitude to them for their love, dream and sacrifice throughout my life. I am really thankful for their sacrifice, patience, and understanding that were inevitable to make this work possible. Their sacrifice had inspired me from the day I learned how to read and write until what I have become now. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to achieve my dreams. Lastly, I would like to send my gratitude to any person that contributes to my final year project whether it is directly or indirectly. I would like to acknowledge their comments and suggestions, which are crucial for the successful completion of this study

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LIST OF SYMBOLS AND ABBREVIATIONS

RFID	-	Radio-Frequency Identification
LED	-	Light-emitting diode
IOF	-	International Orienteering Federation
Km	-	Kilometres
PC	-	Personel Computer
IT	-	Information Technology
GHz	-	Giga Hertz
MHz	-	Mega Hertz
m	-	Meter
UHF	-	Ultra High Frequency
GPS	-	Global Positioning System
GSM	-	Global System for Mobile communication
Wi-Fi	-	Wireless Fidelity
SMS	-	Short message service
FTDI	-	Future Technology Devices International
AVR	-	Modified Harvard architecture
PWM	-	Pulse Width Modulation
USB	-	Universal Serial Bus
kB	-	kilobyte
I/O	-	Input/output
IC	-	Integrated board
GPIO	-	General-purpose input/output
TCP	-	Transmission Control Protocol
UDP	-	User Datagram Protocol
SPI	-	Serial Peripheral Interface
SD	-	Secure Digital
PHP	-	Hypertext Pre-processor
HTML	-	Hypertext Mark-up Language
IDE	-	Arduino Software
MOSI	-	Master Out Slave In
MISO	-	Master In Slave Out
SCK	-	Serial Clock
RST	-	Reset
NSS	-	Slave Select

CHAPTER 1

INTRODUCTION

1.0 Introduction

In this chapter, the introduction of the most important topics that involve background, problems statement, objectives, a scope of the project are provided and the thesis organization of the overall chapters is provided within the same chapter. The background of the study describes the most important subtopics such as about orienteering.

1.1 Orienteering

The International Orienteering Federation defines orienteering as follows:

Orienteering is a sport that combines both a physical and a mental element. The basic idea in orienteering is to proceed from course start to finish by visiting a number of control points in a predetermined order with the help of map and compass. In order to choose the best possible route, orienteers look at the characteristics of the terrain, and the winner is determined by the fastest time to complete the course. What is unique to orienteering is that an orienteer must navigate and make quick decisions while running at high speed.

Orienteering has four major disciplines as stated by The International Orienteering which is foot, mountain bike, ski and trail orienteering. Here are some of the examples:



Figure 1.1: Foot Orienteering



Figure 1.2: Ski Orienteering



Figure 1.3: Trail Orienteering



Figure 1.4: Mountain bike Orienteering

Foot orienteering is the major type among all four and all of them have one common problem: Each contestant must show proof that they pass through each control points in their respective order. This is proven by some kind of mark to their paper card by means of a stamp or needle punch from each control points. Because of that, it shows that this system is not efficient as contestants might punch the card, not by their respective position, i.e. the punches might not be in order.

In addition, checking the control cards needs a lot of men's work. We can observe now that electronic punching has been used in most orienteering tournaments. There is a device at each control point which requires the contestants to insert a chip and a timestamp will appear on the chip. By the time a contestant finishes his run, the running time and split times will be read out by the organizers from the runner's chip. To sum it all up, software capable of processing timing data and creating a list of results is used.

1.2 Problem Statement

In the Orienteering competition, each participant will be given a piece of paper at the start line. They are required to obtain a sign from each control station as the attendance as shown in Figure 1.5. The sign is in the form of different punch dots on the table of the control cards. Participants might skip checkpoints by going to the nearest checkpoint first instead of following the actual sequence of the checkpoints.

Other than that, the control cards checking need a lot of people's work. Not just that, some of the people-in-charge may take for granted when checking the control cards. They will also cheat when they are checking the cards as some of the participants might be their friends. Besides, it requires a lot of time to obtain the official results as this kind of event where it participated by many athletes.

This system is also not eco-friendly as it uses a lot of paper just for a single orienteering event. A particular event often participates by thousands of athletes across the country and for sure, the need for paper is massive. Besides, using paper as control cards is also inefficient. This is because the weather condition during the event itself might changes. If it rains, it will definitely ruin the control card.



Figure 1.5: Inefficient method of Orienteering

1.3 Objectives

The objectives of this project are:

1. To study on the method of capturing and creating a new database that can be linked with Arduino system.
2. To develop an efficient tracking system for participants in the orienteering sport based on Arduino.
3. To analyze how the developed system works and how efficient it is to perform the required tasks.

1.4 Scope of Work

The scopes of work under consideration for this current project are consisting of two work scopes. The first work scope is about a hardware called Radio-Frequency Identification (RFID). Each RFID tag contains the information of a particular athlete by means of their name, registration number and the category they are participating in. Using a cable tie, the RFID tag must be attached to the athlete's wrist so that it is easier for them to scan at the Arduino for each control point. To ensure the RFID tag has already been scanned, the Arduino will produce a sound and a LED light will blink. In addition, it will also collect the unique data of the RFID tag as well as their exact time for every control point (check point). In addition, using a Wi-Fi module as the antenna will allow an Arduino board to connect to the Internet to read the RFID tag and send the result in a form of website on a computer.

The second work scope is to develop a database to be linked with the Arduino. This database must have the ability to read each RFID tag in order to obtain the athlete's information and the exact time taken for each control point where organizer just needs to access the website which has been created. To develop this database, it requires the PHP, MySQL and XAMPP software.

After I finished developing the project, tests will be conducted on a simple test event. From the result obtained, the analysis will be made so that it will meet the specifications and the main objectives of the project. If there are errors, the source of

error will be identified and corrected. The project will also undergo a few adjustment and improvement so that it will give the best result. Once all the objectives are met, the project is a success.

1.5 Organization of Thesis

Chapter 1 explains the introduction of the project, which includes the background, problem statements, objectives and the work scope of the study. In Chapter 2, the chapter briefly explains the review of theories, experimental works and some findings that had been done during the past research that is related to the current project. In Chapter 3, methodology and strategy to achieve the objectives are explained in detail. The working procedure, materials, and apparatus are well explained. Chapter 4 presents the result and the findings of the study, the result from the experiments that are presented in tables, figures, drawings and graphs and are discussed elaborately in the chapter. Several observations are also projected from the findings. Chapter 5 summarizes the outcomes of this experiment. The chapter also outlines several recommendations for further development and improvement of the design. Suggestions for future inventor are also provided within the chapter.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In order to make this project successful, some studies and information had been done. The information is skimmed from many sources such as books, articles, journals, and the internet. All of this information is very useful as a guide to doing this project. The theories and findings from the previous studies are reviewed and described to find the highlight knowledge associated with the current study.

2.1 Orienteering

The Kungliga Tekniska Högskolan (KTH) Royal Institute of Technology (2011) has conducted a study that proclaims orienteering as a sport that is played on both on and off-road terrain with a certain amount of checkpoints. The winner of this sport is the athlete with the shortest time of completing the whole course. By using a map and a magnetic compass provided by the organizer, participants must go to each control points by their particular order.

Although it has a few categories to compete in, the International Orienteering Federation (IOF) states that there are four major disciplines; on foot, mountain bike, ski and trail orienteering. Internationally or regionally, this sport is organized at different levels by different organizations with IOF as the highest one. Different types of orienteering are practiced commonly, they are explained below:

Table 2.1: Types of Orienteering

Types	Description
1. Foot Orienteering	Red and white markers indicating the control points for orienteers to find will be scattered around the course. The total distance differs according to categories and the start and finish line will be at the same place most of the time. From a particular checkpoint to another, the degree of difficulty and length varies and there will be six to twenty checkpoints throughout the course.
2. Bike Orienteering	By riding mountain bikes, competitors will ride by each point in sequence based on a topographical map and the shortest time of completion will be the winner.
3. Ski Orienteering	Played only during the winter, this endurance sport requires navigating and cross-country skiing skills along with a rough course. Multiple skills like powerful endurance and strength, excellent technical skills and the ability to choose the best line of routes is a must in this sport.
4. Trail Orienteering	Designed for the people with disabilities, this sport would give meaningful orienteering competitions. The speed of movements is not part of the competitions, so any sorts of assistance are permitted.

The course length ratios from the Table 2.2, points out to the length of the climb from the ground which is added by 0.1km per 10m climb. Not like the course length, the difficulty level of 1, 2 and 3 is more important. The various courses lengths were mentioned in the table above as a guide.