



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF PORTABLE AUTOMATIC SCOREBOARD
FOR SPORT TOURNAMENT USING ARDUINO**

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

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APPROVAL

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ABSTRAK

Bagi memulakan projek ini, setiap perlawanan sukan memerlukan papan skor yang merupakan peralatan paling penting untuk permainan tersebut. Setiap permainan perlu mempunyai satu papan skor sebagai maklumat terpenting untuk para penonton. Papan skor untuk sukan dan permainan mestilah sekurang-kurangnya memaparkan nama pasukan yang menyertai perlawanan tersebut, mata perlawanan untuk kedua-dua belah pihak dan tempoh masa perlawanan. Tujuan projek ini ialah untuk menghasilkan sistem pemarkahan secara automatik menggunakan sensor imej. Pembangunan Papan Skor Mudah Alih untuk Perlawanan Sukan menggunakan Arduino mengandungi satu program yang mengesan objek melalui warnanya dan mengenalpasti kedudukan objek tersebut melalui koordinat pada paksi melintang dan menegak padang. Pada permulaannya, warna objek mestilah ditetapkan supaya kamera boleh mengesan objek yang perlu diikuti sepanjang perlawanan berlangsung. Peranti elektronik yang digunakan untuk sistem ini ialah Kamera Pixy sebagai sensor imej, Arduino sebagai mikropengawal dan Liquid Crystal Display (LCD) sebagai papan skor. Setiap kali sensor mengesan bola melepasi julat gol, papan skor akan menunjukkan skor mata untuk pasukan yang berkenaan secara automatik. Ciptaan ini juga boleh dimudah alih, dimana ia boleh digunakan untuk beberapa sukan yang berlainan menggunakan papan skor yang sama. Untuk menjadikannya berfungsi dengan sukan yang berlainan, koordinat yang tertentu mestilah diukur dan dimasukkan ke dalam pengekodan sistem berkenaan.

ABSTRACT

To begin the project, every sport tournament need scoreboard which is the most important equipment for games. Every game should have one scoreboard as the foremost information of the game to the audiences. The scoreboard for the sports and game must at least display the name of teams that play the games, score points for both teams and the time duration. The purpose of this project is to create a system of automatic scoring using image sensor. Development of Portable Automatic Scoreboard for Sport Tournament using Arduino contains a program of detecting object through its colour and identify the position of the object by coordinate in horizontal and vertical axis in the field. The colour of the object must be firstly set so that camera can recognise the object that it should follow during the game played. The electronic devices used for the system is Pixy Camera as image sensor, Arduino as the microcontroller and Liquid Crystal Display (LCD) as the scoreboard. Whenever sensor detect a ball pass through the goal range, the scoreboard will automatically shows the score point for the respective team. This invention also can be portable, whereas it can be used for a few different sport using the same scoreboard. To make it function with different sport, a certain coordinate must be measured and inserted to the coding of the system.

DEDICATION

To my beloved parents, who always there for me
Huzaipah Binti Hassan and Mustapa Bin Che Ismail

To my siblings

Mohd Hafizi Bin Mustapa
Nur Hatikah Binti Mustapa
Nur Amanina Binti Mustapa
Muhammad Aiman Bin Mustapa

To my supervisor and lecturers, for their guidance and encouragement

IR Mohammad 'Afif Bin Kasno (Supervisor)
Farees Ezwan Bin Mohd Sani @ Ariffin (Co-Supervisor)

To my friends, for their unconditionally support

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Bismillahirrahmanirrahim,

In the name of Allah S.W.T, The Most Compassionate and The Most Merciful,

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CHAPTER 1

INTRODUCTION

1.0 Overview

This section will give a brief explanation about the project that been carried out. Moreover, this chapter also provided the user of some important contents such as the background of the project, problem statement, objectives, scope of work and report structure.

1.1 Background

Scoreboard is the most important equipment that should be provided during the sport tournament. From manual to electronic scoreboard, it has developed since the intent of the boards, which was simply display the list of scores and time of the game in progress. The first electric scoreboard is invented by George A. Baird at Chicago in 1908. With the new technology especially with the LED's and electronic timer, the new invention and development is produced and changed the scoreboard dramatically. It now can be controlled by remotes or computer. The idea for this project is instead using the camera to record the game, it can be used for goal detection by following the ball during the game. Furthermore, this project also eases the score keeper as they used it. This because, the Pixy Camera will do the job for him to keep an eye on the ball and give the score point the goal is made. In additional, this invention also portable whereas it can be used for other sport but it need to set the coordinate of the goal post.

1.2 Problem Statement

There are a few problem statements that is highlighted during the research that is related to this project. First of all, the referee is being unfair for the team that is played during the game.

According to The Express Time (2011) with headline “Suspect scorekeeping in softball is outright cheating”. The biggest problem that happened in this is the integrity of the official scorers for each team and there is possible abusive scorekeeping case happened during the game. It is unacceptable when the official scorers is asked why it was ruled a hit by the home team, she gave answer “because she is one of our girls.”

Another problem found is the scoreboard itself. It may have system failure during the game or meet with an error that caused it stopped working. This case has happened during NHL hockey game in Los Angeles.

Based on The Canadian Press (2012), the National Hockey League (NHL) is investigated a scoreboard error that happened during the game that is called as “enormous impact”. During the game, the clock displayed at the scoreboard is briefly stopped in the dying second which gave enough time for Drew Doughty (Los Angeles defenceman) to score the winning goal and gained victory over Columbus Blue Jacket. Commissioner Gary Bettman said that it is not acceptable that if the clock had run straight through, the game would have been at a tie at that point on NHL.com. The commissioner has confirmed that the goal should not have counted and he also said that the league would conducted an investigation on the case to determine what has caused the error.



Figure 1.1: A photo taken during Los Angeles King vs Columbus Blue Jacket game

These problem statements are taken from the news as the references for this project of automatic scoreboard for sport tournament using Arduino.

1.3 Objectives

- To study the related research of the project in order to gain information regarding the portable automatic scoreboard for sport tournament using Arduino.
- To develop a miniature prototype of the portable automatic scoreboard for sport tournament using Arduino.
- To analyse the performance of detection goal is made from the movement of the ball.

1.4 Scope of Work

This project is conducted for sport tournament which is has a larger scope for sport games. Limitation for this project is to be used for sport tournament during Sukan Antara Fakulti (SAF). This invention of the project is firstly be tested with a simple miniature prototype of soccer field for the purpose of testing the performance of the scoreboard.

The field is consisted of a few important equipment such as the ball, the goal poles for both home's and guest's teams. The goal poles is set with a specific coordinates and the camera will detect the coordinate as it placed at a certain place where it could see the whole court during the game is played. Each of the components in the court's prototype is assigned with different colours for camera detection. This invention is worked with the main component which is the camera functioned to follow the movement of the ball during the game played. In addition, this automatic scoreboard for sport tournament have two mode which is automatic and manual. This scoreboard is function automatically and can be controlled manually by the in charge person.

With specific distances and coordinates write in the coding in Arduino IDE the camera could detect whether the ball is strike to the goal or not. If the camera detected that the ball is strike, the automatic scoreboard connected to the Arduino and camera will display the score point for the succeed team.

This scoreboard is also provided with two push button for each team which is function as increment and decrement score point. This push buttons are the manual mode for the scoreboard. As an advance, those buttons are also provided as a precaution step if the camera has false detection of the goal hence send a wrong data to the scoreboard. The person in charge can easily pressed the button for the correction to the score point display at the automatic scoreboard.

1.5 Report Structure

In order to give a clear detail about this whole project, the study is already divide into five chapters which is introduction, literature review, methodology, result and discussion and conclusion and future work. Furthermore, all the five chapters shows that the logical step in order to understanding this whole project about. And to gain the appreciation and evidence of the methodology is used to produce the prototype of the project.

Chapter 1: Firstly, this chapter will introduce the brief idea of the project and it also covers the overview of the whole project. Moreover, this chapter also including the synopsis of the project or the background, objectives, work scope of the project, problem statement and the outcomes of this project.

Chapter 2: Secondly, this project is about how to gain the information about this project. All the information about this project will be classified into several articles such as journal, book and some related relevant sources.

Chapter 3: Next, for this chapter, it will cover all the methodology that is taken and project implementation in order to achieve the goal of this project. Other than that, the software and hardware technical details also explained in this chapter.

Chapter 4: After that, this chapter is very important for this project because it contains the development and implement of this project. Moreover, this chapter also gives many analysis in order to determine whether the objectives for this project is achieved or not. Furthermore, this chapter also covers the result of this project, theoretically and actual findings and the simulation of the software on the prototype.

Chapter 5: Lastly, this chapter is about then whole contents of this thesis. This is because it consists the references, discussion and all attachments also will be included for the future references and the most important part is included.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter is a guide for the user on the project as this section contains a few articles of related research of Automatic Scoreboard for Sport Tournament using Arduino project in both aspects, software and hardware. It also has a brief explanation about the history of scoreboard as it will be the outcome of this project. The sources of information is referred as references to the user in order to finish this chapter as well as the project. These information has been compiled from the relevant sources such as articles, journals, books and other related sources.

The information of the related research has been studied to improve the knowledge as it help to guide the user in the project.

For this chapter, many sources as the references that has been referred to finish this chapter successfully such as the articles, journal and more relevant sources. In addition, all the information that is related to the project is included in this chapter. All the useful information is collected and will be used as a guide to finish this chapter. Some information from the references that has been studied are about some major components and topic which related to this project as it will be useful for the project in both aspects of software and hardware.

2.1 History of Scoreboard



Figure 2.1: An electronic scoreboard

Generally, scoreboard is a large board that displaying the score in the game for the public. It is used at least one scoreboard for the most levels of sport from the high schools to the higher level. This equipment is used for keeping score, measuring time and displaying statistics. It once worked when a point was made by the player, a person would put the appropriate digits on the hook. For the most modern scoreboards nowadays, they used electromechanical or electronic which means of displaying the score of the games. In these, the digits displayed are composed of large dot-matrix or seven-segment displays made up of incandescent bulbs, light-emitting diodes or electromechanical flip segments. The control panel is use by an official person or as known as neutral person to operate the scoreboard.

2.1.1 Technology of Scoreboard

Most scoreboard were electromechanical which prior to the 1980s. Major improvements in scoreboard technology of advances in solid state electronic in the beginning of 1980s. Thyristors and transistors are power semiconductors that replaced mechanical relays. Then the light bulbs is first replaced with light-emitting diodes for indoor scoreboards and for the outdoor scoreboards, their brightness would increase. This light-emitting diodes are much more efficient at converting electrical energy to light and last many times as long as light bulbs, are not subject to breakage. This LED advanced more which it can last up to 100 000 hours before it could be replaced. The introduction of computer control is permitted as it advanced in large-scale integrated circuits. The signals that control the operation of the scoreboard could be send either through the existing AC wires that provided the power to the scoreboard or just through the air made it as cost effective. Frequency shift keying (FSK) is the common method that send digital data over power lines at the rate less than 2400 bits per second and there would be two frequencies which represent binary 0 and 1. The data is digitally sent through FSK as the radio transmission. But then, the radio transmission was subject to short range and interface by the other radio sources. Spread spectrum is the recent technology that permits much more robust radio control of scoreboards. It distributes the signal over a wide portion of the radio spectrum. This technology helps the signal resists interference which is usually confined to a narrow frequency band.

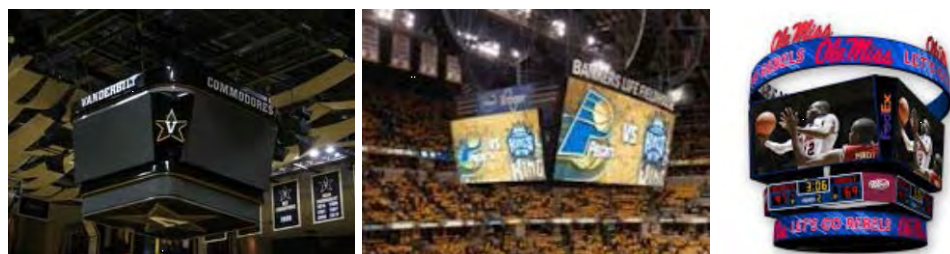


Figure 2.2: Examples of other electronic scoreboard

2.1.2 Soccer Scoreboard

An association football (soccer) scoreboard is usually display the score for the home and away team on the board. A current stoppage time also usually display on a board by one of the match officials towards the end of the first and second half of the game played. During the substitution, the same board that displayed the score will also use to denote the jersey numbers of players that coming in and leaving the game with a system of the substitute's number will appeared in green and the leaving's number in red.

The clock counting down is also provided on the board for some amateur and youth levels.



Figure 2.3: A soccer scoreboard

A multi-purpose gridiron/soccer venue type scoreboard is used by some American where various statistics are shown on the board. Either shots on goal, corner kicks, total fouls or other important statistics are also included for the scoreboard for spectators to know their team's overall performance.

2.2 Related Research of Tracking System for Sport

2.2.1 Automated Camera-Based Tracking System for Sport Contests

This project is about provided a system that allows the accumulation of detailed moment-by-moment information concerning the movements of the players and the ball using, strategically placed imaging devices such as visual bandwidth or infrared cameras provide the source of images of the playing area. Some of the camera may be placed overhead to provide views of the game action relatively few instances of player images overlapping one another for the case of an indoor sport such as basketball.

While for the outdoor sport like soccer, the use of cameras positioned on the perimeter of the playing area will in general required resulting in a relatively high incidence of player image overlap, at least as viewed from one camera. A real-time image processing system (the “tracking processor” or “tracker”) either directly live, or through some indirect image storage medium such as video tape or magnetic medium are provided as the video information from the cameras.

For some cases, a long distance connection such as a satellite link may be convenient. The players are localized by the tracking processor in each frame on the basis of computing the centroid of each player’s image silhouette. Using the conventional image processing techniques, the silhouette is isolated by distinguishing those pixels which likely correspond to the player from those that likely belong to the background. The tracking performed automatically, as the invention is made efficient and practically. An object of the invention is an edited game record for an example, the comprehensive data about the position of each player and the ball during the course of the game (Larson Noble G and Steven Kent A, 1994).

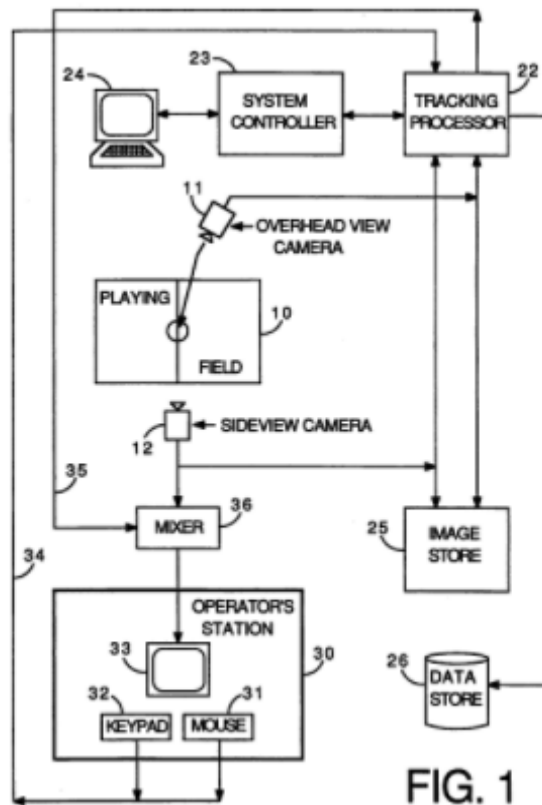


Figure 2.4: A sport playing area amenable to overhead camera angle and equipped with the tracking apparatus.

2.2.2 Tracking System for Sport

The invention of this system is related to the tracking system for sports and particularly to a tracking system for a plurality of sports players positioned on a pitch or similar area. This system also could track others objects such as racing cars or horses on a track. This is a tracking system that measures the location of players and other objects on the field with high accuracy and video update rates and to be marketed under the name of SporTrack.

This system has the ability to track up to 100 players or more simultaneously in real-time for long periods of times. With state of the art