



**FOOTBALL SPEED ANALYSIS AND GAME ANALYSIS BY USING
IMAGE PROCESSING**

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Report submitted in partial fulfillment of the requirements

For the award of

B. Eng (Hons.) Mechatronics Engineering

Faculty of Manufacturing Engineering

UNIVERSITI MALAYSIA PAHANG

JUNE 2015

ABSTRACT

The Football Speed and Game Analysis by using Image Processing is a real-time system that is used to detect, track a football and analyses the speed of the moving ball. The system is used mainly to help in data analysis of a football player by allowing the calculations of the speed of a moving ball to know how the power of the kicking that a football player has. This project more focuses on short distance kicking and on a stationary mode. This project provides the detailed steps on designing a real-time detection, tracking and analyzing system and considerations involved when designing it. Considerations such as ball detection, tracking, computer software, camera specification and tracking capabilities were taken. To be useful in football analysis of the ball speed has be recorded. The system works by using OpenCV. OpenCV is an imaging processing system that can be used by programming with C++ language. A pair of cameras was used. The cameras is used to capture the images or videos of the player while running on OpenCV. As for the analysis, a simple formula for finding speed was used and programmed into the system.

ABSTRAK

Sistem Kelajuan Bola Sepak dan Analisis Permainan dengan menggunakan pemrosesan imej adalah satu system masa-nyata yang digunakan untuk mengesan, menjejaki, bola sepak dan analisis kelajuan bola yang bergerak. Sistem ini digunakan terutamanya untuk membantu dalam proses menganalisis sata pemain bola sepak sengan adanya pengiraan kelajuan bola sepak yang bergerak bagu mengetahui kuasa tendangan yang dilakukan oleh para pemain. Projek ini lebih fokus kepada jarak tendangan bola yang dekat serta berada di dalam keadaan yang tetap atau statik. Projek ini juga menyediakan langkah-langkah terperinci mengenai mereka yang ingin membentuk sistem mengesan, menjejak, perisn computer, jenis kamera yang terperinci dan keupayaan pengesan yang telah diambil. Kelajuan bola perlu direkod terlebih dahulu untuk mengetahui bagaimana sistem ini berfungsi. Sistem ini berfungsi dengan menggunakan OpenCV. OpenCV merupakan satu sistem yang memproses imej dengan menggunakan bahasa C++. Sepasang kamera telah digunakan. Kamera-kamera ini juga digunakan untuk menangkap atau merekod image pemain manakala ia akan berfungsi bersama OpenCV. Bagi melakukan analisis , formula yang mudah telah digunakan untuk mencari kelajuan yang telah dirakam dan digunakan serta diprogramkan ke dalam sistem.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Recently, the topic of football is the most talked topic of holding the FIFA World Cup 2014 in Brazil. When talking about football, it would be with the way the players in our favorite team showed their skills and expertise while on the field. Possession, attacker skill, defense skill and players who are in the middle, they are able to have an impact during the match. Furthermore, the cooperation of all members is also important and can be seen when the players do on passing skill during the match. Speed of the ball also should be analyzed to get perfect target during attack or defend.

Various studies and knowledge gained during this era of the ways to study the speed of the ball during the game because it is very useful and can be used by soccer coaches in world wide. Based on observations the importance of studying after the match of a football game is to improve their game pattern and this is one of the strategies to win. Study of the speed of the ball and the movement of the ball is the one of the hot topic during the analysis after the match between coach and player. The reason why need to study about the speed of the ball because, they can know how powerful their kick, any improvement or not. Furthermore, they can analyze how to control their ball in many situations.

By using this system, football player can easily analyze their pattern of the game and trying to improve their skill, especially how powerful they kick the ball by using this system they can determine the speed of the ball.

1.2 PROBLEM STATEMENT

A lot of effort gift by all researchers because they are still make the topic of analysis of football speed still alive. But only a few of them are successfully done because the analysis of football speed by using image processing is still complicated task and challenging job.

To collect the data, we need to identify the feature of the ball such as, size, color, and shape. This is because the image will not easy to interpret the data, especially there are many things that can be similar to the ball. As a result, the systems are not easily to detect and trace the movement of the ball because of there are many images that can be similar and confused during the process.

1.3 OBJECTIVES

The main objectives of this preliminary study are:

1. To detect a football by using 3D video image.
2. To tract the movement of the ball
3. To analyze the speed of the ball

1.4 SCOPE OF STUDY

In order to achieve the objectives, there are important task needs to be carried out:

1. Develop software that could detect a football in 3D real-time video.
2. Develop software that could tract a football in 3D real-time video.
3. Build algorithm for the movement of ball and speed analysis.

1.5 BENEFIT OF THIS PROJECT

1. Easily to investigate and analyze the movement of the football at the field.
2. To study the powerful of the ball especially for short distance kick.
3. Football player and coach can study their own team and try to make improvement.

1.6 EXPECTED OUTCOME

1. Creating a 3D image video application or creating software that can detect the movement of ball during the game.
2. Capable to determine the speed of the football and the movement of the ball by consider the distance of the ball.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter, need to evaluate and summarize all the information get from selected area of study by doing some research. Literature review also important because, we need the theoretical solution related to the project title. It also can help to solve the problem that we face throughout the project. Furthermore we need to do in-depth study about the project to understand all the purpose of the project to achieve the goal which is successfully get the perfect result.

By going through the research, we also can make the comparison from all the journal or articles that we read with the purpose and goal of our project. By doing the research we can examine the information either to accept the result to review. Furthermore, as an engineer we need to try hardly how to solve the problem and acknowledge that many sources can help us to solve the problem.

2.2 FOOTBALL GAME ANALYSIS

Football is one of the famous sports to participate among us in the world. There are 6 confederation and 209 national associations recognized by FIFA, (Fédération Internationale de Football Association) around the world. There are worldwide ranking of viewers releases by television network. More than 3.2 Billion viewers was aim in the World Cup 2014 for TV victory and they achieve it. They broke a whole host of viewing records during the first round of group matches in Brazil, highlighting the growing popularity of the competition and football around the world.

With the popularity of the game of football, come the ideas from the researchers from different kind of scientific disciplines to study and analyze the football game and attempt to analyze different views through the game. We all know that, the formation of the football or soccer player are very importance. Soccer skill also should take seriously because once the match is begun all the players need to stay focus. Because of that, I think the most important is game preparation which is the strategy of the coach for their player. The coach will evaluate each of the player performance once the game is begun. Game analysis will give the perfect professional teams and useful planning and strategy to get win with the match, Gilbert Kotzbek, Wolfgang Kainz. *Football Game Analysis : A New Application Area For Cartographers And GI-Scientists.* (2014,p.299-306).

Football is a sport that requires skill and training in order to become great players. Nevertheless, the stage of discipline also should be applied in order to improve the self-confidence of those around them and become a professional player. *What Are The Fundamental Skill In Soccer? | LIVESTRONG.COM.* (2014).Furthermore, soccer game skill required such many tactical either in

“closed-kick” or “far-kicked” style. They need to sharpen the skill and arrange the strategies wisely.

Despite the famous football in the eyes of the world, football is also known as a sport that has a variety of easy movement punctuated with solid skills to beautify the game on the field. Among the basic skills needed to learn and improve to all the players are passing skill, receiving a pass skill, heading skill, shooting skill, dribbling skill and goal keeping skill. Football also can be call as “open skill” game Knapp B. *Skill in Sport : the attainment of proficiency*. (1977, p. 1-6). Every player and every football team techniques and skills of different movements. As an example of the Brazilian national football team is known by different samba with teams from England and Germany. Nevertheless, right timing performance from the great player is much more important because if they cannot give great performance it will ruin the game and the possession of the game will drop.

2.3 MOTION AND SPEED ANALYSIS

In the sports field, fitness is the one of the most important to success. Same goes to football or soccer sport the most important to be highlight is aerobic fitness. Moreover, anaerobic fitness which is very important to highlight because anaerobic fitness can give different feel especially related to speed and agility. The fitness and flexibility to make powering the speed during the match important to all the teams including the goalkeeper which is need the specific fitness demands, *Topend Sports : The Sports Fitness, Nutrition and Science Resource*. (2014).

For movement and speed analysis, especially for sports that use balls, the analysis of the movement of the ball during the game is one of the important things for athletes to observe and learn then can improve their own skills, Hubert Shum, Taku Komura. *Tracking The Translational And Rotational Movement Of The Ball Using High-Speed Camera Movies*. (2005, p.1084-1087).

This analysis also arises various technologies developed by the researchers of the world who always think to ease the work. Duties as football coach to become more fluent with the technology to analyze the movement of the players on the field when it does not matter whether you're practicing or during the match. Magnus Burenius, Josephine Sullivan, Stefan Carlsson. *Motion Capture from Dynamic Orthographic Cameras*. (2011, p. 1634 – 1641) suggested to use dynamic cameras in 3D which is can freely to translate and make rotation in full 3D image. 3D model of image can capture human in complex situations, suitable for soccer player which is move at different place every seconds, Ajinkya Chavan, Sreela Sasi. *Vision-Based Real-Time Speed Tracking*. (2005. P. 16 -21).

To study the movement and speed of the players on the field is not an easy as we think. Various experiments and attempts are made to obtain satisfactory results. This is because the movement image difficult to capture plus the background of the movement object can make it more confused because of the shape, colour, and other features. Mark Barnard, Jean-Marc Odobez, Samy Bengio. *Multi-Modal Audio-Visual Event Recognition For Football Analysis*. (2003, p. 469 - 478) suggestes to use audio and video features.

This technique can be demonstrate easily compared to other higher level set of features to capture. Motion analysis also can prove the team work, Tsuyoshi Taki, Jun-ichi Hasegawa, Teruo Fukumura. *Development of Motion Analysis System for Quantitative Evaluation of Teamwork in Soccer Game.* (1996, p. 815 – 818), the evaluation of teamwork also can help to improve their weakness in team work part. This is because, to do the passing skill and to defend the other team to score the goal, teamwork is very need to highlight. So, many ways to improve the weakness in a team, that is why need to analyze and improve it.

2.4 BALL DETECTION AND TRACKING ANALYSIS

In football game other than attack, defend, control the ball, passing, shooting and dribbling the ball there are certain technical abilities that can be prove by world stage player. As we can be seen within the player and national team, such as Real Madrid's football team, which has world-class players like Cristiano Ronaldo, who is famous for speed and exceptional skills. Similarly, Manchester United football team has the best defensive players in the world, Rio Ferdinand. This shows that every football team has its strengths and weaknesses. However, various methods and strategies can be taken to correct the deficiency and improve the already good performance.

Every team wants conquests in the game on the field with the lead goal. With the hard work of the team is very important when the game is running. With this, the players and coaches need time to analyze the game and make some improvement, Pedro Abreu*, Jose Moura, Daniel Castro Silva*, Luis Paulo Reis, Julio Garganta. *Football Scientia – An Automated Tool For Professional Soccer Coaches.* (2010; p. 126 – 131). Suggested that to concern about the sport video analysis by detect the movement of player and detect the speed of ball. With various study on ball detection and tracking, all the players

and coaches can analyze every practice and game just finished fighting or the first half of the match. Joydip Dhar, Anurag Singh. *Game Analysis and Prediction of Ball Position in a Football Match from Video Footages*. (2014, p. 978 – 983). There are so much research nowadays to detect and track the location of ball at the field. Sophie Xiaofan Liu, Lijun Jiang*, Jacob Garner, Sharayah Vermette. *Video Based Soccer Ball Trecking*. (2010, p. 53 – 56). The ball detection frame must be separate from the image of the player to get the best result.

The detection of the ball same goes to the detection movement of player during the match. But, the purpose to detect and tract the ball is to facilitating the players and coaches to know the position of the ball when the players wear a different kind of speed. M. Leo, N. Mosca, P.Spagnolo, P.L. Mazzeo, A. Distanto. *Real-Time Multi-View Event Detection In Soccer Games*. (2008. P. 1 – 10). In addition to the speed of the ball is kicked by a player, there are other factors that can influence the process to detect the ball, which is the features of the football (shape and color). Charles Perin, Romain Vuillemot, Jean-Daniel Fekete. *SoccerStories : A Kick-Off for Visual Soccer Analysis*. (2013. P 2506 - 2515). This is because football is sphere shape, but there are many things surround the soccer field looks similar shape to the football. The detection must be accurate to get the best result. The capture of the image also must be accurate especially when the detection of the ball related to the speed. Cris Poppe, Sarah De Bruyne, Steven Verstockt, Rik Van De Walle. *Multi-Camera Analysis of Soccer Sequence*. (2010. P. 26 – 31).

The captured of image for this analysis must be accurate with the axis (movement of the ball). So that, the ball can be track and observed by the player and coach for their better performances.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

In the analysis process, the undergone primary goal is to achieve the objectives of the project and require multiple steps to get the complete and successful results. It covers all parts and procedure that related to the research design of the existing project which is about video analysis of football game. There are about four main parts that need to use in this project which are study the existing research, design the concept of the project, calculation and analysis, then the most important is the final result.

3.2 DESIGN PROSESS FLOW

The Figure 3.1 shows the design flow of the project.

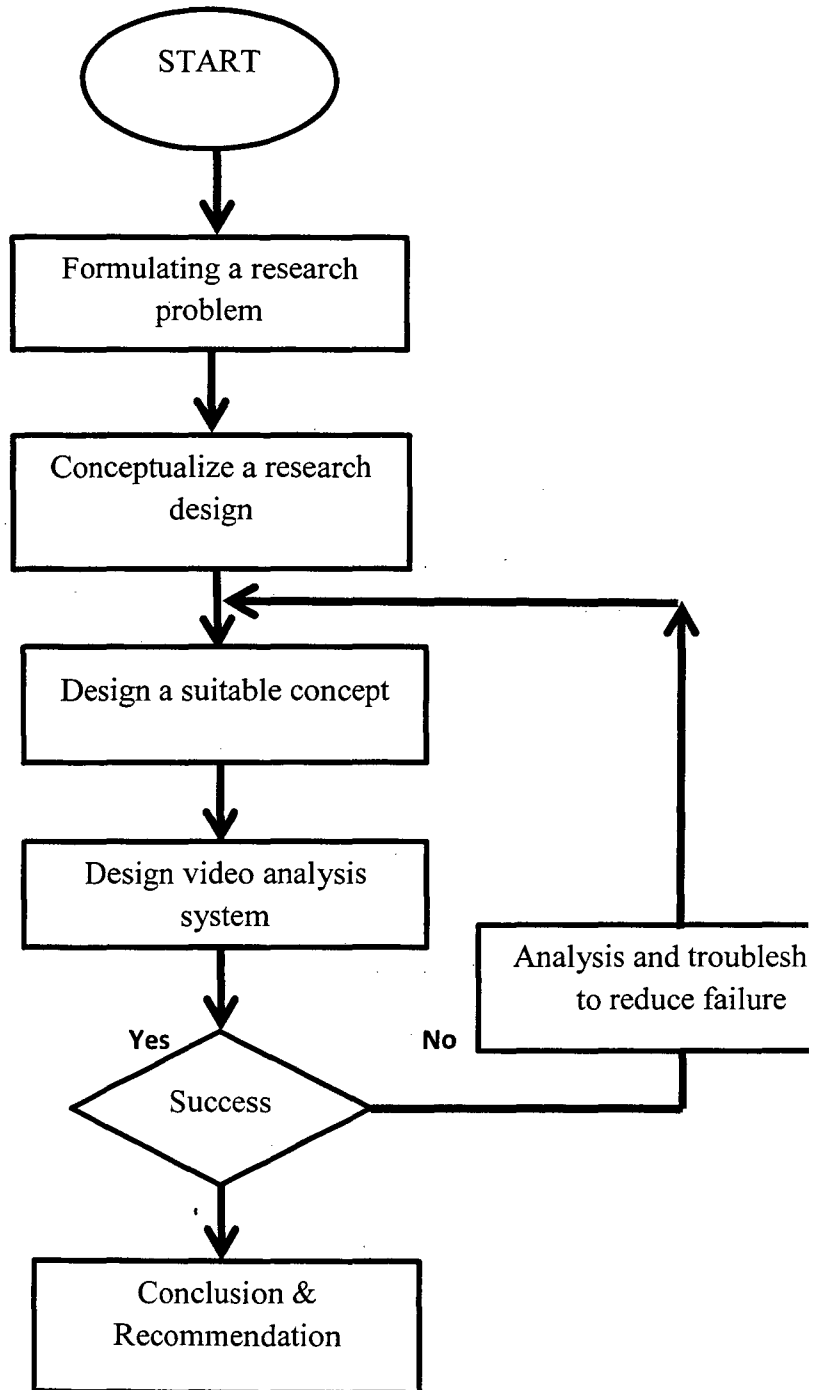


Figure 3.1: Design process flow

3.3 DESIGN STUDY OF THE PROJECT

Design study is one part of the process to carry out a project which is begin with the basic step based on the system and related to the existing previous sources. In a lot of resources that already exist for many years, some of them are very relevant to what is being sought, which are detection of football, tracking and analysis parts of various even though they had different capabilities. Furthermore, in the recent years, various of research in game analysis has been increased in variety of aspects. By using the system term, most of the systems are works on pre-recorded video of football games in broadcast videos. Through the system used, there are many positions of the cameras that used, but some of the system used fixed cameras that have been positioned in stadium. Camera position will be considered whether it is above or below. Various of information can be collected through a journal that has been read, such as design concept of the experiment. From overall design study, there are four existing design concept can be customized in order to develop new football detection, tracking and analysis system.

3.3.1 Concept 1: Ball tracking and virtual replays

In this project, Gopal Pingali, Agata Opalach, Yves Jean et al. Ball Tracking and Virtual Replays for Innovative Tennis Broadcast. (2000, p. 152-156) presented the real-time vision system by the computer that can tract the motion of tennis ball. We also can apply this system on soccer game analysis because they have similarity with the speed and tennis ball is smaller than soccer ball.

The potential of computer vision has affirmed the greatness and efficiency for enabling during broadcasting.

Moreover, nowadays video analysis is very important and the existence of multi-camera based on real-time tracking and visualization becoming a new phenomenon to sports broadcasting. The cameras are placed at the certain part that can track the ball in 3D image. They also use auto-iris lenses for the changes the intensity of light especially during the day and use different tracking parameter that can make the particular view from any point of view at any speed more efficient.

3.3.2 Game analysis and prediction of ball positions in football match

From this system, Joydip Dhar, Anurag Singh et al. Game Analysis and Prediction of Ball Positions in a Football Match from Video Footages clearly stated to propose two algorithms for automatic analysis and prediction to give more optimum passes during football match by using the detection and tracking of players and ball as well from the video footages. First algorithm use the grass ratio which is to mark the playing field as a frame and they use connectivity table automatically to perform the tracking and detection by find out the possession of a ball for both team during the match. Another algorithm is created to predict the optimum pass by an individual and also can detect the player who possessed the ball during the match according to the team player.

The advantages of this system are can detect and recognized the color of each team and the background. It also have detector that can narrow down the image and can be more clear because usually the camera will located far from the player and ball. This will be make the image can process more clear and can detect the speed of the ball accurately.

3.3.3 Adidas Snapshot application

From this system, Adidas snapshot (itunes, 2013), is an application that was developed by Adidas. This system is to analyze the detection and the speed of the ball kicked by the player. The system also will detect and consider the player or kicker use left or right footed. The screen also will display with a circle to locate the position of the ball. Then, the kick is recorded. Moreover, after trying many times with selected within 20 frames, the application will ask the user of this system to relocate the ball in the selected frame. Finally, the application will directly calculate the speed of the ball motion and can estimate the distance.

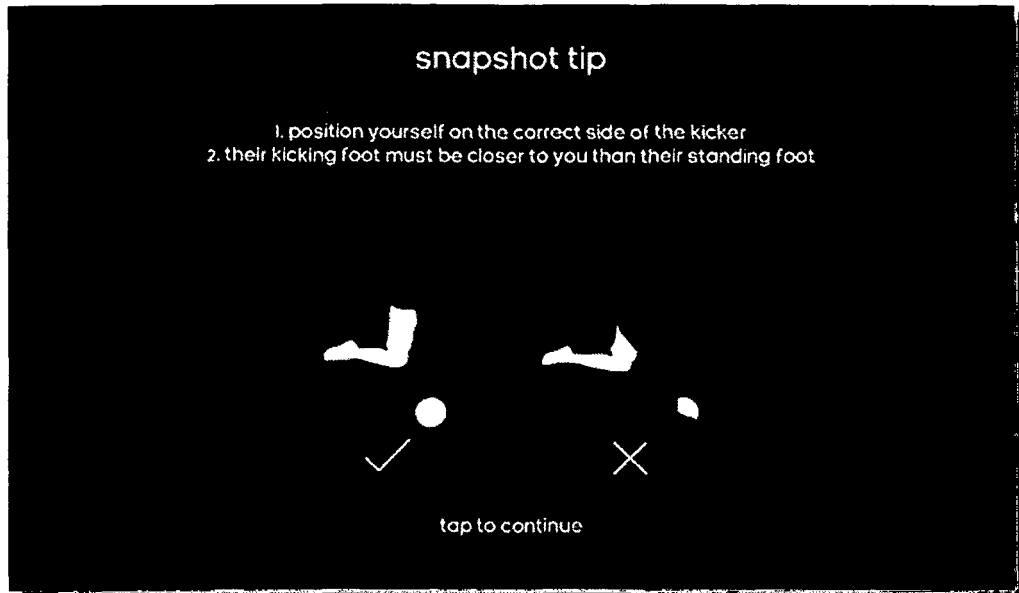


Figure 3.2: The selected ball position with right leg.

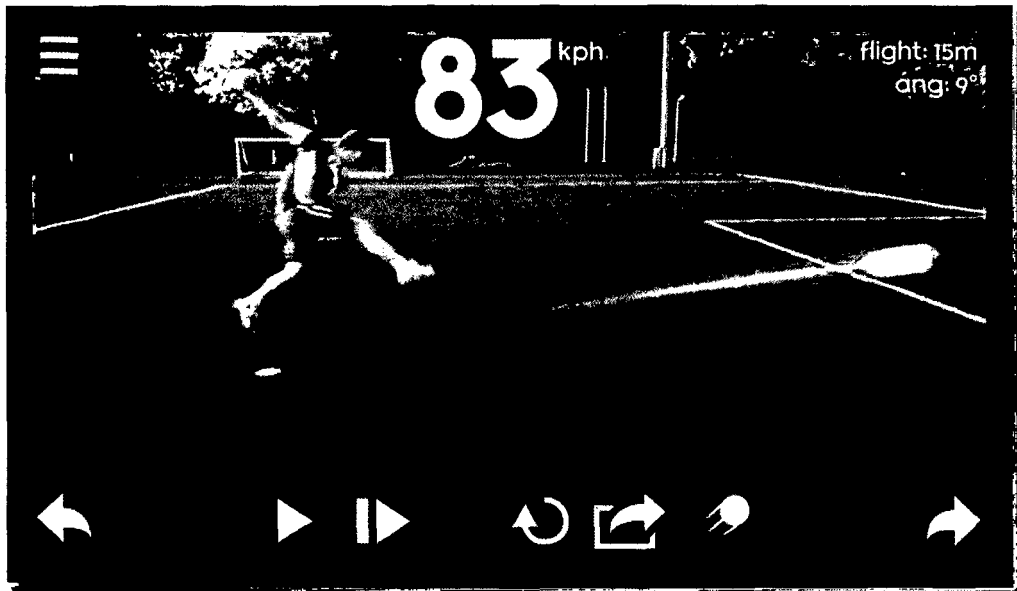


Figure 3.3: The angle and speed of the ball