

# Investigating the Effect of Head Movement during Running and Its Results in Record Time Using Computer Vision

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## Abstract

The purpose of this paper is to study the effect of the movements and the turns of the athletes' heads while they run. The way of holding a head is different for athletes in various sports. Moreover, this paper analyzes the effects of head movements on the sport records. One of the factors influencing the runners' wins is the way they hold and move their heads whether he is a marathoner, a sprinter, or an athlete whose running is the main factor of his win. The environmental factors such as obstacles and visual signs can make a runner turn his head that can be challenging for his ideal position. As a result, it can also affect his final record. This article studies the effects of the athlete's head positions in two sport fields, and it compares the athletes' different records with each other through the image processing and software development in Android app.

**Keywords:** head, Image processing, android, competitive running, athlete's performance analysis, record

## INTRODUCTION

Running is one of the most important factors of athletes' fitness whether in terms of the physical health or in terms of the psychological analyses. Running is the most basic steps to warm up athletes' bodies in all sports, and it can be a good and reliable factor to differentiate the professional athletes from the amateur ones [1]. It can be find out the athletes' physical fitness level and their readiness by reviewing the quality and style of the athletes' running. Thus, it is believed that running is one of the most important factors in talent Identification. To get an ideal record, the concepts such as "Homeostasis" while walking, the movements of the body members while running could be important. Moreover, coaches always point out that the harmony between steps and the hand movements is important [2-3]. The purpose of this paper is to study both the head movements while they run at different distances and also the impact of it on the record time by using the image processing programming in Android. Nowadays, technology is pursuing a non-denominational role in the advancement of the sport goals such as the smart judgment technology for volleyball and soccer matches, other items related to smart stadiums, the practical and physical training programs with the virtual reality technology and remote or distance coaching [4]. One of the sciences used in today's sport technology is the Digital Image Processing. We use it not only for referee and talent Identification, but also for advertising and entertainment [5]. The last decade can be named as the "The Decades of the

Portable Technologies." Thus, Android programming is one of the major factors that is becoming increasingly popular not only for the computer experts, but also for the sport engineers and analyzers because of faster performances and easier accesses even in new and information sharing domains [6-7]. One of the main reasons of this paper is to study the significant effects of the head movements as one of the heaviest member of the body [8]. To achieve a good record, this issue could be really precise and ideal. Figure 1 shows the importance of the starting state of the different body members. As specified in "The Line of Attack," the irregularities of the placement of body parts will delay the record time [9-10]. According to the anthropometric tests of different athletes, the position mode of the heads in all sports is important. In these tests, runners' weights and heights while running have a unique effect on reducing or increasing the record time. It should be mentioned that prewise mobile applications that used IP and their connection Protocols [11]. Likewise IP webcams can also track the Idea of the paper, but due to the limitation of connection for long distance, the Idea for creating a mobile app for the first time to do performance analysis in sports has occurred. In this article, firstly the methods of doing research will be presented, then the programming details will be described, then in next section the detail of how to do the test is presented. In Section 3, first, the results and then the conclusions are presented at the end.

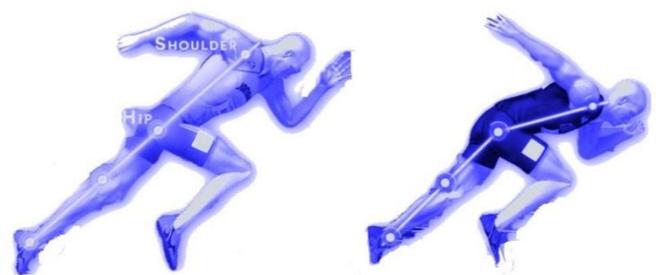


Figure-1. The line of attack for start position in running

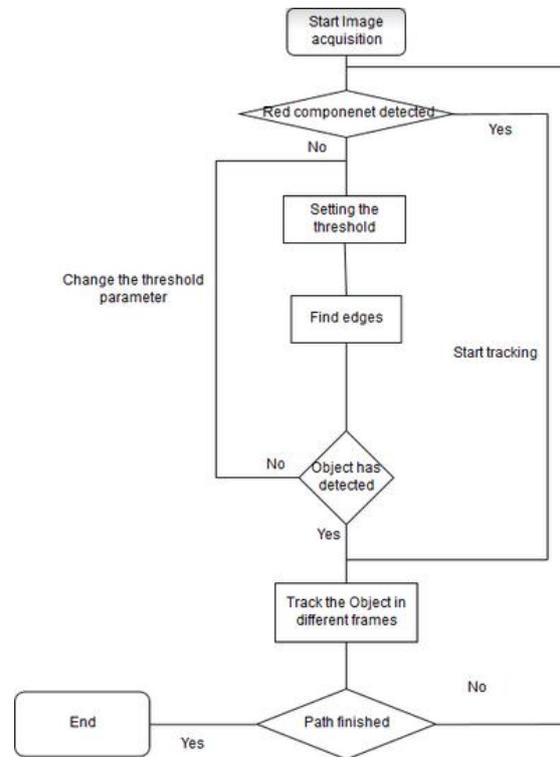
## METHODOLOGY

According to table 1 in this research, 10 male elite athletes were chosen as the cases. It consists of athletes from Taekwondo and Futsal (courses). Both exercises require a lot of running to increase either aerobic capacities or the concentrations. Each athlete ran a 75-meter distance as a test only once. In the second stage of the test, the athletes would take part again in the test without notifying them of the changes in the field. Due to the requirements for each sport field, this low mileage in running

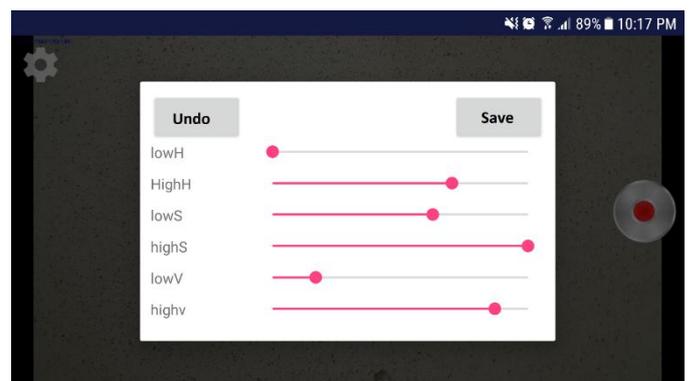
had some reasons. Firstly, the length does not decrease because of the test conditions of the peak performance of the athletes in terms of the multiplicity of the tests, and the long distances. Secondly, running is essential for these two sports not their core expertise; however, the imposed differences on the second test are the same for all 10 athletes [12]. That is how they put red signs in the field along the track at clear intervals randomly. Moreover, they are in accordance with the height of each athlete, they check the runner's re-records again. These signs do not interfere with each person's rally, and they are put just only to measure the amount of wasting time for each athlete while looking at the signs. It is done in order to be compared with the first test. In fact, they follow the athlete's manners, movements, and their head positions while the athletes look at the off-target situations. In the third stage of the test, all 10 players were asked to go through this once again, but this time, the goal of the camera is a red object at the end of the 75-meter route. The reason for this test is to assess the runners' attentions to the end of the track. In fact, test number three tries to record, assuming that the head is steady along the path. It should be noticed that the rest time between each test is 15 minutes for each player. Besides, the player is in a good recovery condition for the next test [13]. Finally, we can find the differences between the normal states and the movements of the heads by obtaining results. The purpose of this study is also to compare two factors. The first one is the time of running due to movements of the head and neck. The second one is to focus on the visual signs. In this study, "Opencv, version 3" was written based on Java programming language by the library's supports. By using Android 6<sup>th</sup> version, it was written to detect and track the red objects. One of the most important reasons to use this language and software is the low volume of this program (8 MB), and furthermore these mobile phones have high quality along with a good quality camera. However, some conventional cameras that are not programmable such as "Gopro" [14]. As you can see in the algorithm in figure two, setting the threshold of the object's color is important, and it should be corrected based on the situation and the light conditions. As can be seen in figure 3, it can be changed and improve the parameters of the HSV color standard based on the quality of light and environmental conditions. In the next step, the editing is done by using "Canny Filter." It is done after the detecting stage of the object and storing the films of each test that the red objects are also traced. At the final stage, the time for red marks is measured as well. The conclusion of each player's performance is shown. These results are based on the differences of the camera-free mode. Nevertheless, the important point of these two tests is how to keep the camera on the head to reduce or remove the noises, and how not to change the camera calibration. As a result, they not only do not disturb the player's running, but also provide a view for the analyzer so that the accuracy of the measurements does not fall down. [15]. Therefore, to fulfill the high quality of filming, the "Head Mount," have been used, which is the brand of "Action Mount." Hence, the angles must be limited in such a way that the direct path can be traced, and runners have to turn their heads to see the objects on the margins of the path. This is the main goal of the research; the goal of this study is the impact of these areas by generating artificial attentions, calculating, and comparing the record times.

**Table1.** The Anthropometric feature of 10 applicants

Taekwondo/Futsal	T	T	T	T	T	FS	FS	FS	FS	FS
Weight	74	78	65	70	80	65	78	74	75	79
Height	180	179	175	179	180	180	181	175	177	180



**Figure-2.** The diagram of application detection procedure



**Figure-3.** The Setting part of android application

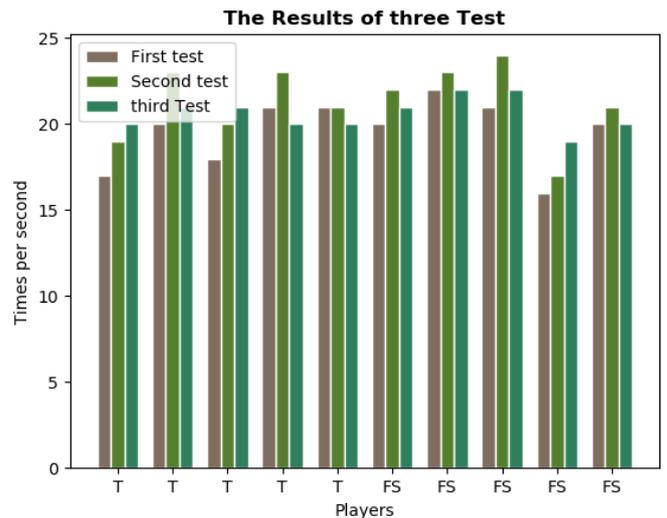
## RESULTS AND DISCUSSIONS

It should be noted that the position of the head is in accordance to figure 4, as one of the following three modes: First, keep straight, and move forward all along the 75-meter path. Second, heads, and shoulders are down. Third, the head is almost

perpendicular and above normal [16]. According to the weight of the head, if the head has a shift of 0.5 cm can affect the cervical, which it means more weight of head during running and extra weight to carry [17]. As shown in Figure 5, the maximum difference between the three modes is 3 seconds, and this is very important for professional competition running. However, it should be paid attention to it that running might not be the main expertise of the participants in this test. When the heads and eyes are down, the runner face with aerobic energy shortage, and he loses the game on the long tracks due to the weight of the head and neck on the chest which is the main duct of the respiratory system [18]. The third mode also rarely occurs and consumes a lot of energy. It should be noticed that looking at the signs along the path could reduce the focus, and may lose the record time. However, the inertia of the head and neck also increases his fatigue. Therefore, it is necessary to strike a balance between moving the head and not losing the target. As can be seen in graph 1, in the first test, the athlete tries to sustain and maintain the starter mode, and the records are ideal for the person. However, the record time increases in the second test due to the visual signs and attentions. In the third test, the experienced player in the previous stage did the test well because of his experience of the second test, and similar results could be obtained. The approximate position of the head in different parts of the path can be checked as below. In the third part of the second test, the player tried to keep his start state. Nevertheless, in the middle of the one third of the finish line, the athlete tried to improve the condition because of the tiredness of the muscles. Moreover, turning his head, he tried to reduce the tiredness due to the same reason. At the end of the track, the player returned to his start state, and he tried to compensate for wasting time resulting from the second stage. Therefore, he ran toward the finish line in this situation. However, the third test condition, in which there is only one colored object at the end of the path, results in an improvement of the record for around 0.5 seconds, in comparison with the second test, that is because of the experience of the second test. The existence of the midway visual signs makes the player not use the necessary level of energy from the initial level, and consequently he did not get enough time to record. New record can be achieved by increasing the level of focus and creating a recovery in the middle of the running track.



**Figure 4.** Three different head posture categories. In second and third positions the weight of neck and head can feel more than normal in long running distances.



**Figure 5.** The results of different test time recording. T is stand for taekwondo and FS is stand for futsal

### Conclusion

The paper tried to get a new way by using the image processing in Android app. The purpose of this study is to clarify the following items. The amount of wasting time due to the athletes' head rotations and movements. The athletes whose running around the field is not their main sport course, but they always need to run. Understanding the importance of the position, and how to hold their heads at different times in rally. Paying attention to the urgent needs of oxygen for runners subsequently and keep their heads relaxed to maintain their record Time, it can not only increase the athletes' performances but also can be used in talent identification.

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