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Offside Detection inthe Game ofFootball Using Contour Mapping

Pratik N Patil[1], Rebecca J Salve[1], Karanjit R Pawar[1], Prof. Mrs. M.P. Atre[2]
[1]*Undergraduate students, Department of Electronics and Telecommunication, Pune Vidyarthi Griha's College of Engineering and Technology, Pune, Pune University, India.*
[2]*Professor, Department of Electronics and Telecommunication, Pune Vidyarthi Griha's College of Engineering and Technology, Pune, Pune University, India.*
Corresponding Author: Pratik N Patil

Abstract: -*This paper is about offside detection in the game of football using contour detection in computer vision. Here we use contour detection method to decide whether the player is in offside position or not. The purpose of contour detection method in this project is to find the position of furthermost defender and attacker, while the attacker is receiving the pass from his teammate. Their horizontal positions are compared with respect to each other to give the final results. Various filtering techniques are used to obtain the desired output. The main objective is to determine offside in football matches so that the officials can improve the accuracy of decision making.*

Keywords: -*Contours, Filters, Football, Frames, Images*.

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I INTRODUCTION

Offside is one of the most important rules in the game of football as it directly leads to the goal. The rule is given as, a player is in offside position if any of their body part except arm is in the opponent's half of the pitch and closer to opponent's goal line than both the ball and the second-last opponent (not necessarily the goalkeeper). In this, referees have to keep an eye on multiple players as well as ball at the same time. However, referee being a human, increases the chances of error as it is sometimes impossible to track the movement of multiple players at same instance. Nowadays the game is very fast and teams sometimes deliberately set ups offside traps which further makes the job of referees difficult.

Some of the previous approaches are GPS based approach and RF based approach in which GPS chips were mounted on the jerseys and studs of the players to obtain the co-ordinates of the players and then compute their distance from each other or RF signals were used to determine the distances of players from reference points. The current technology being used is Video Assistant Referee (VAR) in which assistant referee reviews decisions made by the head referee with the use of video footage. There is still ongoing research in detection of offside using image processing [1]. We propose a technique in which offside will be detected automatically using contour mapping.

II METHODOLOGY

The basic methodology can be categorized into three different sections.

2.1 Frame Acquisition

Firstly, the video containing offside is acquired. For this, 4 cameras can be mounted such that 2 cameras can capture each half of the field from both the sides and by this entire field can be covered. Once the video in which offside is occurring is acquired, it is broken down into individual frames. We can set frames per second according to our requirement. For our application, 5 frames per second is appropriate. After obtaining all the frames, the frame in which offside is occurring is selected. This frame can be read as an image for operations.

2.2 Image Filtering

The image is then converted into HSV image for color extraction. The colours of jerseys are known to us before the match, hence we can set the values for hue, saturation and intensity before the match. This image is then converted into grayscale image because contours can be located only on binary images in OpenCV. Hence a certain thresholding operation is required which in our case is colour extraction. The next step is to locate the contours in the image. Contours basically are simply a curve joining all the continuous points (along the boundary), having same color or intensity. Hence, we get many unnecessary contours such as contour for ball, contour for referee or line. These contours are not required and therefore should be eliminated. So, we

choose a particular region of interest such that only furthermost attacker and last defender is present in the image. After this, contours in selected region of interest are obtained. The image still contains small blobs or noise which are detected as contours and are required to be eliminated. We considered different filters having different masking values to remove these blobs. Median filtering with the mask of 5*5 reduces the total number of contours from 21 to 14. Bilateral median filter with mask of 5*5 reduced the total number of contours to 12. Gaussian Blurring with the mask of 3*3 reduced the total number of contours to 9 which is satisfactory based on our requirement. Increasing the value of mask further reduced the total number of contours in the image but blurred the image to such an extent that it was not possible to detect the attackers and defenders. So, we limited the value of mask to 3*3.

2.3 Final Contour Determination and Position Comparison

After the filtering, contour of the furthermost attacker and defender is chosen such that the contour represents the goal scoring part, that is contours for hand is neglected because only goal scoring parts are considered for offside. After determining the contours of furthermost attacker and the last defender, coordinates of their contours are obtained. From these coordinates, leftmost or rightmost coordinates are chosen depending on the side of the field. The x coordinates of these extreme points are compared. If the x coordinate of attacker is greater than the x coordinate of defender and the goal is on the right side of the field, then attacker is in offside position. Otherwise if goal is on the left side of the field and if x coordinate of attacker is smaller than x coordinate of defender, then attacker is in offside position.

The whole method can be overviewed by the given block diagram.

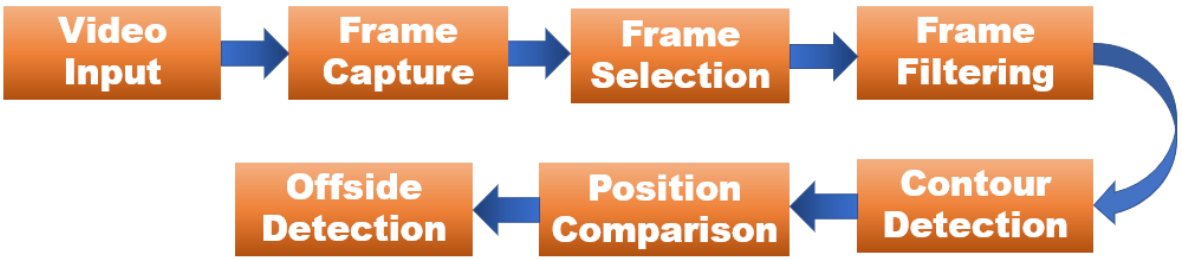

Fig1: System block Diagram

III EXPERIMENTED RESULTS:

Fig 2: Selected Frame

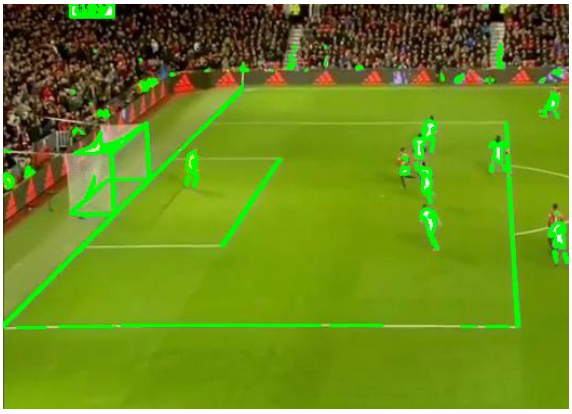

Fig 3: Contours (highlighted by green colour) for white colour in selected frame. Total number of contours is 102.

Fig 4: Selected Region of interest.

Fig 5: Contours in selected region of interest. Total number of contours is 15.

Fig 6: Noise removal using Gaussian filter reducing the number of contours to 9.

Fig 7: Leftmost point of attacker and defender shown by blue point.

IV CONCLUSION

We experimented our technique on multiple videos and the results were satisfactory. Hence, contour detection method can be successfully used to detect offside. In this method problem of occlusion can be solved by placing cameras on either side of the field. Thevalues of Hue, saturation and intensity should be matched exactly with the colour of jersey which is the only limitation in this methodology. So, in our method, we directly converted the frame into grayscale image and then set the appropriate threshold. However, by achieving the proper HSV conversion, this method can be made more dependable. The resolution of our proposed method is 1 pixel, that is offside can be detected even if the attacker is just 1 pixel ahead of the defender in the frame. Hence, our technique is highly accurate. The total time required for execution is 7 seconds on an average which is acceptable for our application. The system is also cost effective because of the use of open source libraries. This method can be easily employed as compared to different tracking algorithms which require vigorous data set and training.

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