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TRAJECTORY BASED SOCCER BALL DETECTION AND TRACKING

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Abstract- Video segmentation is an application of computer vision aimed at automating the extraction of an object from a series of video frames. However, it is a difficult problem, especially to compute at real-time, interactive rates. Although general application to video is difficult because of the high range of image scenarios, user interaction can help to reduce the problem space and speed up the computation. This paper provides new method to detect the ball position by creating and analyzing the trajectory. It is very challenging to detect and track the ball from the broadcast soccer video. Candidate collection by use of the heuristic false candidate reduction, the Kalman filter based trajectory mining, and the trajectory evaluation is used to obtain the trajectory of ball.

I. INTRODUCTION

Soccer is a sport that not every scene attracts interest of spectators. This is possible due to advanced digital broadcasting and digital video recorders. Due to lack of structure in soccer game soccer video indexing is a very challenging task [2]. In a soccer game, analyzing the matches is increasing to know the tactics used in it. Also, viewer may want to see only the scenes of their interest. Hence it becomes necessary to know the position of ball. For this purpose, many methods are implemented such as template matching. But this method has some limitation as the operator has to give the position of player manually [4]. When the images are taken in natural light the ball appears as spherical cap hence Circular Hough Transform is used to detect the soccer ball. But this method works satisfactorily if applied in known environments. In order to reduce the computational complexity, many researchers are still working on the Circular Hough Transform [1]. In the game like soccer, ball becomes very important hence detection and tracking of ball is necessary. But till now, there are no satisfactory results of tracking and detection of ball in soccer game using the available algorithm [8]. This paper includes a system which will helpful in detection of ball using trajectory.

II. PROPOSED SYSTEM

Following figure 1 shows the block diagram of proposed system. It consists of 5 elements which are player detection and tracking, candidate detection, hitting detection, candidate trajectory generation and trajectory processing. Following points gives the detail description of proposed system.

1. Ball size Estimation:

The ball size can be calculated by using projection matrix. This projection matrix is made for each individual frame to compute ball size.

Ball Size sieve: It means filtering the objects out of ball size range.

Ball size Range = s (i, j) = [b (i, j).(1 - Δ1), b(i, j).(1 + Δ2)], where Δ1 and Δ2 are the extensions to tolerate the errors. S = s(i, j)w x h, forms the complete size sieve. W and h is width and height of frame.

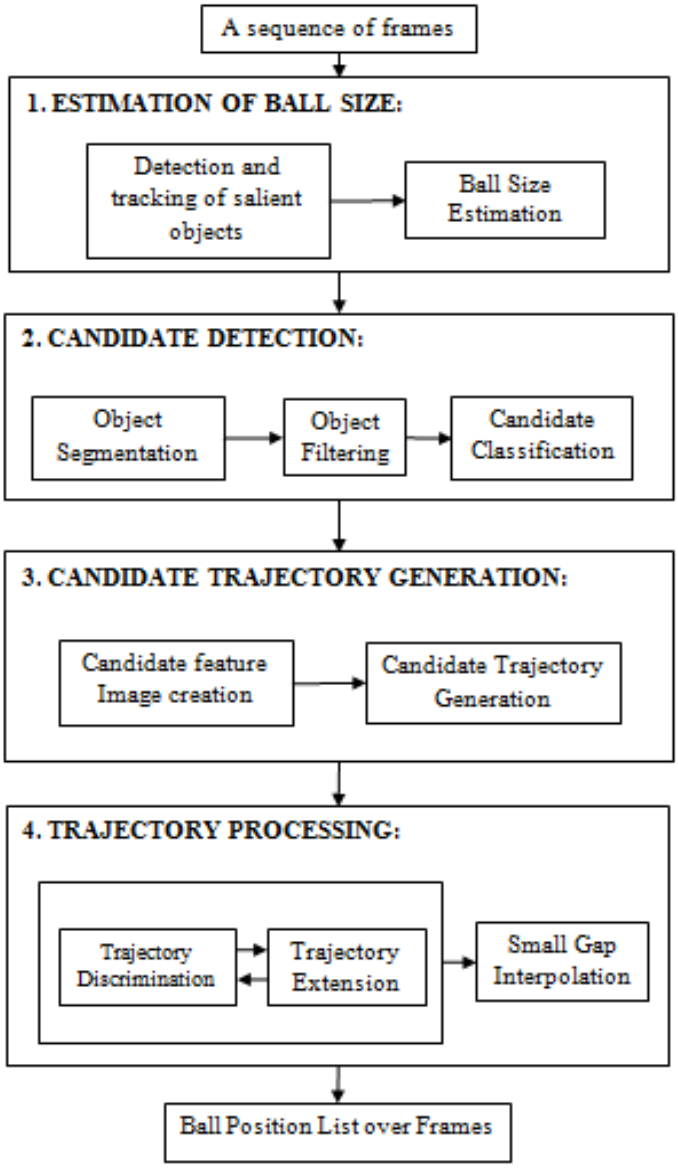


Figure 1 Block Diagram of Proposed System

2. Candidate Detection:

In a frame of video of soccer game, many objects are look like soccer ball. Hence to remove these non ball objects from frame, we need to use sieves. Candidate feature images are used to obtain the candidate trajectories which represent the ball candidates.

Line sieve: Line sieve is filtering out the long lines along with curves as the ball cannot be deformed into straight line.

Ball Colour Sieve: Ball colour sieve is filtering out the objects without ball colour pixels.

Shape Sieve: The shape of ball is quite different from the circle which can be understood from width-height and height-width ratio which are less than 2.5.

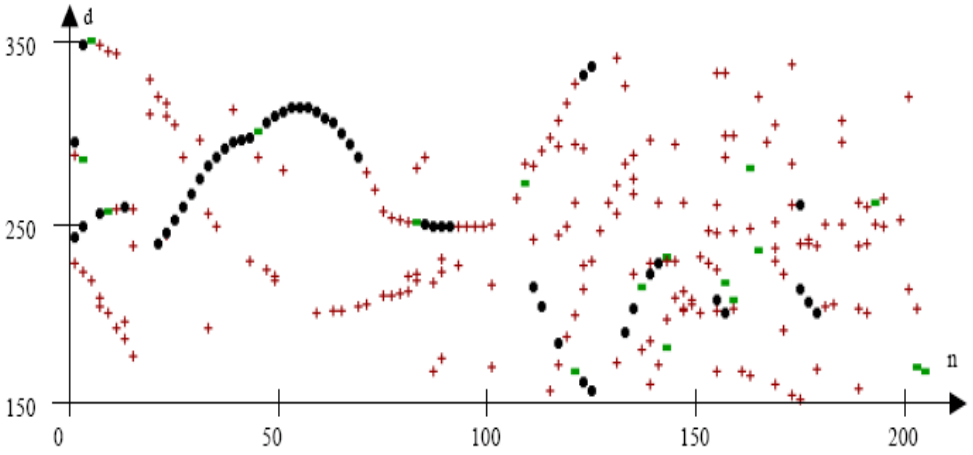
Ball Location Sieve: Ball location sieve is removing the objects that are far from hitting player.

Candidate Classification:

The candidates are classified into two types according to the probability that the candidate is ball. Features of ball such as colour, circularity are decided and then the probability that a candidate is ball is obtained according to the decided features.

3. Candidate Trajectory Generation:

Candidate Feature Image Creation: The combination of various features of candidate in a frame is obtained from candidate feature image creation. In a candidate Y image, width of image is a frame number and height of image is height of frame. Following figure 2 shows the candidate trajectory generation for the candidates in category 1 to 3.



(a) The obtained candidates. Black dots, green rectangles and red crosses stand for candidates in category 1 to 3.

Trajectory Generation:

The trajectory generation is obtained using the Kalman filter based procedure. Good and clear candidate around the hitting positions can be obtained from the near player by finding the candidate trajectories from the location of near player who is hitting the ball.

4. Trajectory Processing:

Trajectory Discrimination: There is at most one ball in soccer game video. Once the trajectory of ball is obtained all the other candidates are detected as the non ball candidates so that we can discard them. Following figure 3 shows the ball trajectories after discrimination.

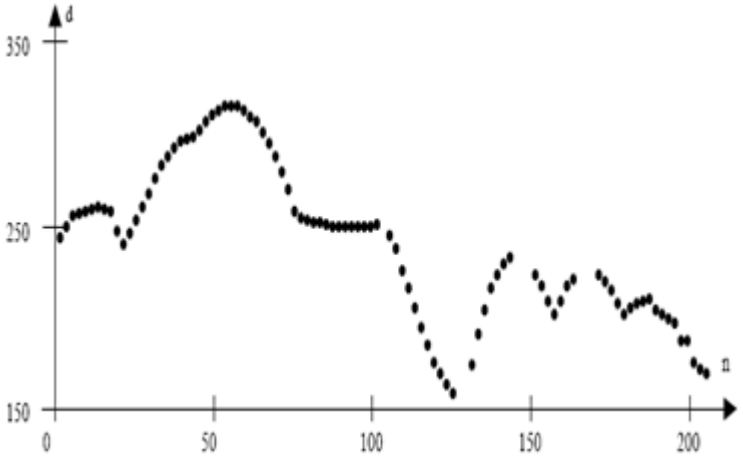


Fig 3 ball trajectories after discrimination

Trajectory Extension: Kalman filter approach is used to obtain the ball trajectories but this method cannot be helpful because it is not capable to track more number of balls. Extensions procedure is continued until number of iteration reaches a threshold. Following figure 4shows the ball trajectories after trajectory processing.

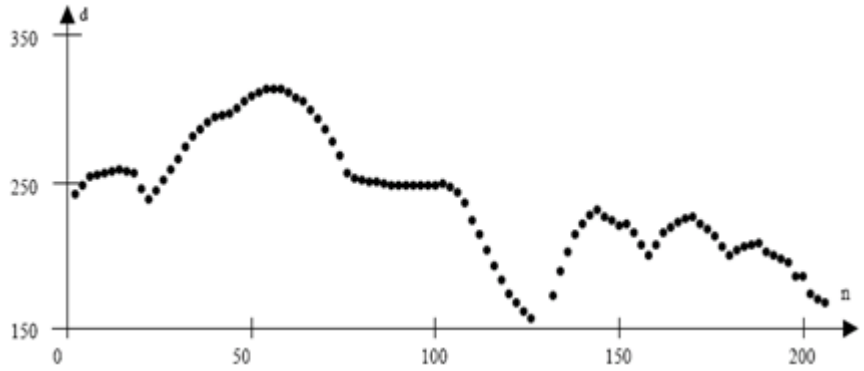


Figure 4 Ball trajectories after trajectory processing

III. EXPERIMENTAL RESULTS

This section describes how the proposed system works actually. The required result (ball detection) is shown in the video which is played in GUI (Graphical User Interface). Following figure 5 shows the GUI made for the output.

The proposed work is implemented in Matlab Version 2010b, image and video processing tools are employed here. The algorithm is executed on Pentium® Dual-Core processor with 3GB RAM memory. The proposed model accepts the input video in the form of —.avi.

Figure 5 Graphical User Interface (GUI)

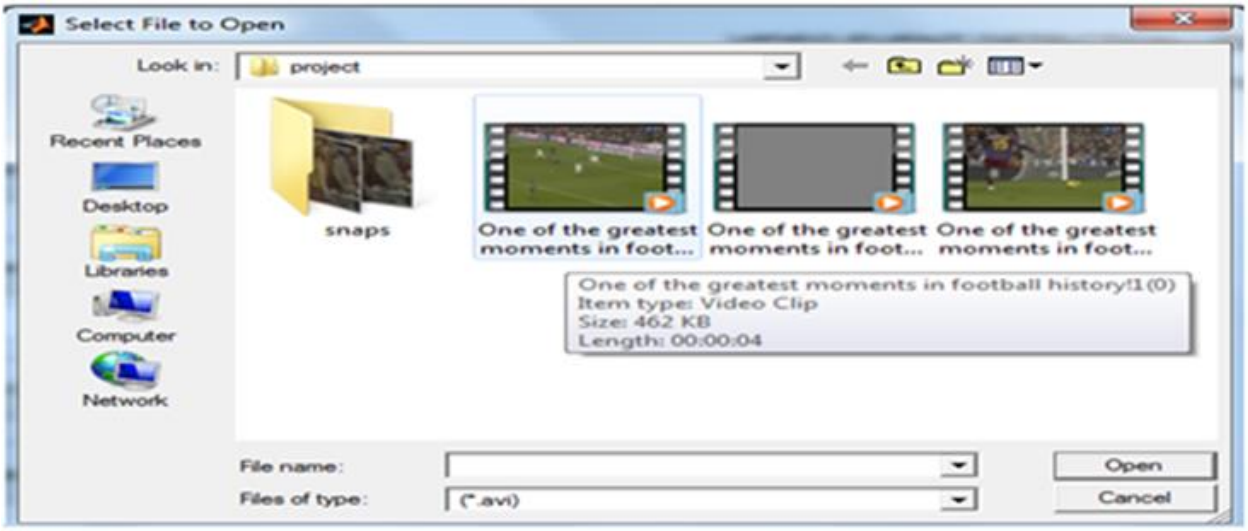


Figure 6 Selection of file to load the video

For the system to detect and track the ball, initially the video is loaded by selecting the file stored in the computer hard disk as shown in the figure 6. After that the number of frames and number of goals detected are calculated. After all the extraction and other procedures, the ball position is detected as shown in the figure 7. In figure 7 the detection of ball is shown by the red square around the ball.

Figure 7 Ball Detection after playing the video in GUI

IV. CONCLUSION

The proposed approach makes use of the statistical method to track the ball, thus it is very successful for the full-view segments of the video. However, it still cannot find the ball positions for some close-up segments of videos. In the future, we will deal with the close-up segments in a slightly different algorithm to detect and track the ball based on reliable frame classification approach that will lead to the

correct ball size range estimation. The current Kalman filter also does not work perfectly for those segments that the ball speed changes fast, so we will extend Kalman filter to cover this case in the future. We will evolve our detection and tracking methods into a complete system eventually.

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