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A Supervised Player Prediction and Occlusion Handling in Sports Video

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Abstract: Video processing has made its mark in all the fields majorly in the sports. Having glance on literature work, we have not found any work on Kabaddi games as concerned with computer vision methodology. We have made initiation to build a kabaddi annotation system for player detection and tracking mainly concentrating on half of the court. In this paper we have proposed the Extended Gaussian Mixture Model (EGMM) along with Kalman Filter technique. These methods help to evaluate the player occlusions and predict those occluded player and label them with 'predicted' along with updated occluded values. The algorithms are implemented on image processing MATLAB tool and tested on three type of data sets includes broadcasted video and self developed videos in two areas. The annotation process has shown the good result in the player occlusion detection.

Key Words: Occlusion handling; Prediction method; Extended GMM; Kalman Filter.

1. INTRODUCTION

Video annotation has long been an active research area in computer vision. The goal is to automatically extract salient information from input videos either in real-time or off-line. One of the applications of this area is automatic sport video analysis and annotation. Many sports analysis tools have been developed on specialized with content analysis but still object occlusion identification and tracking became most challenging and difficult task. On adding new features to the Extended Gaussian Mixture Model (EGMM) the proposed method elaborates the content analysis and prediction detection in the Kabaddi video. In which occlusion is identified and can predict the occluded object by numbering the new arrived object in the frame. Then we use these predictions to generate a set of statistics for effective analysis of game play. Algorithm is tested on self developed video

2. RELATED WORK

1. Nathanael L. Baisa, proposed a new framework that extends the standard Probability Hypothesis Density (PHD) filter for multiple targets having N different types where N _ 2 based on Random Finite Set (RFS) theory, taking into account not only background false positives (clutter), but also confusions among detections of different target types, Under the assumptions of Gaussianity and linearity, with existing Gaussian mixture (GM) implementation of the standard PHD filter to create a N-type GM-PHD filter. The methodology is applied in two scenarios. First: Real video sequences containing three types of multiple targets in the same scene. two football teams and a referee. Second is tracking pedestrians and vehicles in the same scene handling their detectors' confusions [1].
2. Tsung-Yu Tsai et al, present an approach that integrates key player detection into tactic recognition. To save the annotation cost, this approach can work on training data with only video-level tactic annotation, instead of key players labeling. Specifically, this task is formulated as an MIL (multiple instance learning) problem where a video is treated as a bag with its instances corresponding to subsets of the five players. MIM helps to encode the spatio-temporal interaction among multiple players and the group behavior. It also precisely detects the key players which encodes both position and velocity information[2].
3. Anurag Ghosh et al, proposed end to end framing for automatic attribute tagging by analysis of badminton video. They have analyzed badminton broadcasted video by segmenting points played, tracking and recognizing the players in each point and annotating their respective strokes. The feature extraction is done with Gaussian Mixture model with 2 clusters and the extracted HOG features from every 10^{th} frame for labeling it as point frame and applied the Kalman Filter for smoothen the sequence. They achieved 95.5% of segmentation accuracy, 97.38 player detection accuracy, 97.97 player recognition accuracy and stroke segmentation edit score 80.5% of accuracy[4].

In addition with this many algorithms have introduced for detection and tracking of player irrespective of game[3].

3. THE PROPOSED METHODOLOGY

Video frame annotation and object tracking is a very essential task in the field of video processing. On addition to these objectives occlusion handling is the biggest issue running with video data accuracy detection and contest analysis in case of information sharing. The process of multiple object detection and tracking involves the following steps.

1. Frame by frame analysis for Player detection in a scene.
2. Predicting the player occlusion by motion analysis process
3. Updating the each prediction by object motion measures.
4. Numbering each occlusion by prediction updates with bounding box.

The detection of moving objects uses a background subtraction algorithm based on Gaussian mixture models. Morphological operations are applied to the resulting foreground mask to eliminate noise[6] and resulting pixel variation in the scene. This intern will help to remove the noisy pixels and fix the bounding box to detect the object. Thus blob will choose the fixed connected pixels with dynamic movement. Such objects will be taken into consideration of moving object and kept under the blob. The overall process takes the following steps.

1. Object allocation is based on motion and pixel variation. These motions of each track are estimated by a Kalman filter. Each new detection and its appearance on the frame is going to fetch by the filtering technique. It predicts the each new location by dynamic pixel variation each frame. Then assigns the predicted value with occlusion rate
2. Our main objective is to maintain the each track. By analysis the each of the frame some detected particles may get assigned or some may get unassigned. Unassigned consecutive frames will be in count in every track. These are called as occluded objects. When the count exceeds the threshold, it assumes that object apart from the view and deletes that prediction from the frame.
3. The initialize Tracks function creates an array of tracks, where each track is a structure representing a moving object in the video. This is used to maintain the detection assignments, track termination and display processes.
4. When total Visible Count exceeds a specified threshold. Here the tracks will turn off in the case of noisy detections. Because of avoiding the wrong detections and tracks.
5. KF use to predict the centroid of each move in the current frame, and update its bounding box accordingly[6][5].
6. The assign Detections to tracks function uses the Hungarian algorithm to compute an assignment which minimizes the total cost.
7. Then update each assigned track with the corresponding detection. It calls the vision.kalmanFilter method to correct the location estimate. New bounding box will get frame the predicted object along with updated track increments by 1. Then function will conclude the invisible count to 0.
8. Mark each unassigned track as unpredictable, and increase its count by 1. It deletes the invisible tracks, which arrives in consecutive frames in overall scene. Finally draw the bounding box and label ID for each track on the video frame and the foreground mask. It then displays the frame and the mask in their respective video players.

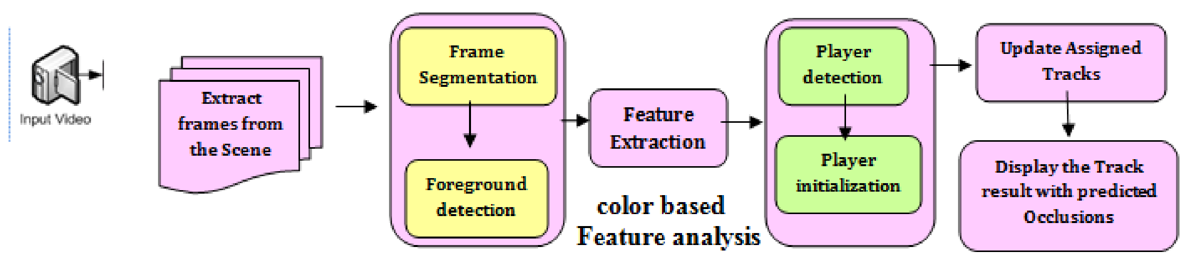


Fig. 1: Architecture of proposed System

4. HISTOGRAM EQUALIZATION

The two results with respect to the dataset are compared each other by the Histogram pixel distribution and the object behavior. In which the object enhancement Contrast is done with Histogram Equalization (HE) method.

The HE block enhances the contrast of images by transforming the values in an intensity image so that the histogram of the output image approximately matches a specified histogram.

As per the results shown in the Fig intensity level of broad casted video is very high as concerned to the self developed video frame the RGB pixel distribution is very low contrast.

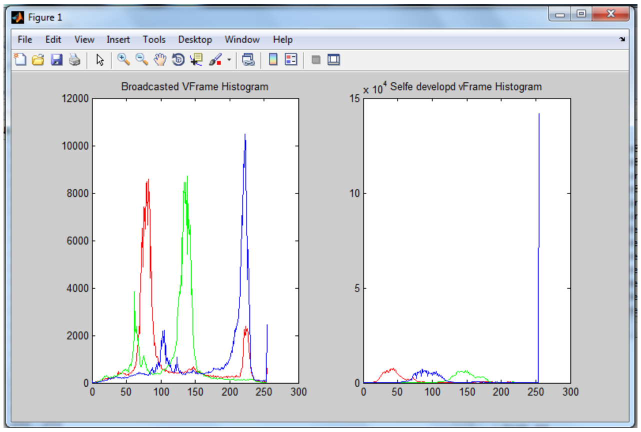


Fig 2: Comparison done by Pixel representation of the RGB intensity levels of the broadcasted video Frame and the self developed Video frame

5. THE PREDICTION PROCESS

Next we have elaborated I detail about the prediction process. The KF algorithm involves two steps, prediction and correction (also known as the update step). Prediction process keeps on measuring the state of object and its dynamic change in its position. Then in second 'correction process', it updates the object previous state and capture the current status of the object. Then it will be taken as predicted object and labeled based on the prediction location. The KF implements a discrete time, linear State-Space System. To make configuring a KF easier, you can use the configure Kalman Filter object to configure a KF. It helps to situate the filter for tracking a physical object in a Cartesian coordinate system by considering the constant velocity,

obj = vision.KalmanFilter….
(StateTransitionModel,MeasurementModel,ControlModel,Name,Value))   function -1

To Track Objects: Use the predict and correct methods based on detection results. With the Kalman filter object and the detection measurement. Call the methods in the following

order:[...] = predict(obj);   function -2

[...] = correct(obj,measurement);   function -3

When the tracked object is not detected, call the predict method, but not the correct method. When the tracked object is missing or occluded, no measurement is available. Set the methods up with the following logic:

[...] = predict(obj);   function -4
If measurement exists
[...] = correct(obj,measurement);   function -5
endIf

The distance method used after the prediction method to match the detection and prediction of object tracking status. Then we can finalize the accurate prediction measurement which suits the current scene. This strategy has used for matching object detections against object tracks in a multi object tracking problem[5]. State-Space System: This object implements a discrete time, linear state-space system, described by the following equations.

State equation:

$$x(k) = Ax(k-1) + Bu(k-1)+w(k-1) \qquad \text{eq-1}$$

Measurement equation:

$$z(k) = Hx(k) +v(k) \qquad \text{eq-2}$$

The value for the cost of not assigning detection to a track depends on the range of values returned by the distance method of the vision.KF method. This value must be tuned experimentally. By decreasing the cost of number of assignments we can get increasing in the new tracks. Consecutively fixing the high threshold value will result in the individual moving object. This has been tested in the kabaddi data set for the possible detections and track.

6. EXPERIMENTAL RESULTS

The result part contains the three types of data set such as 1. broadcasted videos, 2. Data set captured during the International Women's Kabaddi Tournament in Alva's Mangalore University and 2. Self developed data set which was played by the International players of Akkamahadevi Women's University Vijayapur, Karnataka. Date set 1 & 2 are implemented with the help of Physical Education Department (PED). These three kind of data sets are used for the proposed method for better testing and analyzing the result to achieve the efficient result with more accuracy.

(a)

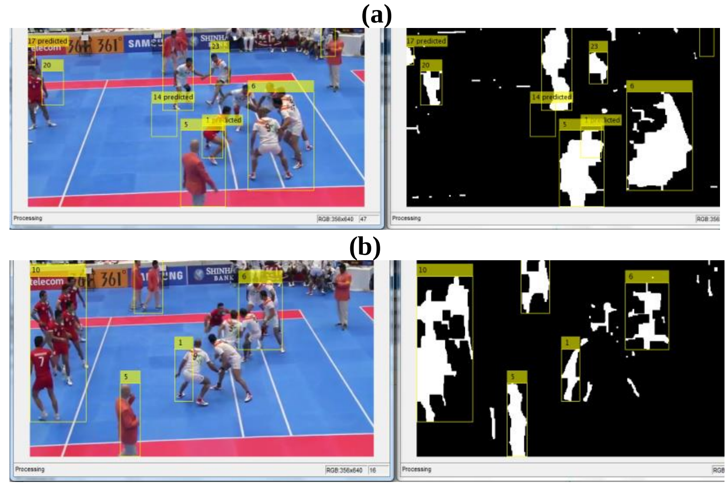
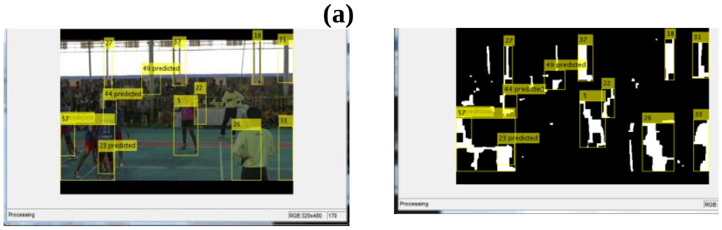
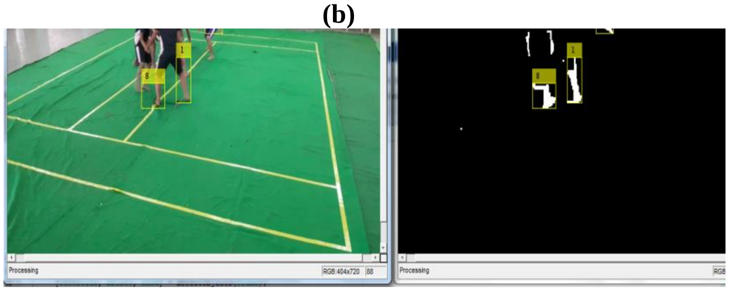


Fig 3: (a),(b) Broadcasted Videos containing one teaser in red dress code and five chasers in white dress code detected with bounding box for each player, labeled with occluded number and predicted number

(a)



(b)



(c)

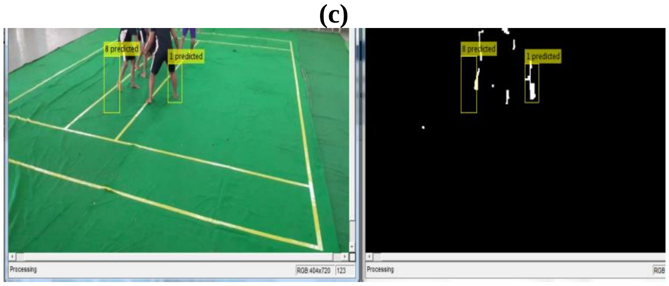


Fig 4: (a) result on Manglore data set, (b)& (c) Self Developed Videos by international kabaddi players of AWUB, both resulting predicted object along with updated number bounding box labeling and right side window shows the generated Mask of each foreground object.

Experimental results explore two windows. Left side displays the detected object prediction value with bounded box where as right side window indicates the foreground detected object mask with labeling. All the data sets are tested and compared with occlusion detection grade which is clearly stated in the bellow table. The results are tested based on the formula

$$\textbf{Occlusion Rate} = \frac{\text{no.of Predicted Players}}{\text{Total no.of players}} \times 100 \qquad \textbf{eq-3}$$

$$\textbf{Error Detection} = \frac{\text{no.of falls detection(excluding players)}}{\text{Total no.of players inside the court}} \qquad \textbf{eq-4}$$

Table 1: Result Analysis of all three Data set taken for testing the algorithm

Sl. No	Data Set	No.of Samples	Occlusion Rate	Error Rate
1	**Self Developed DB**	4	85.7	0.14
2	**Manglore DB**	4	98.8	0.85
3	**Broadcasted DB**	4	71.42	0.42

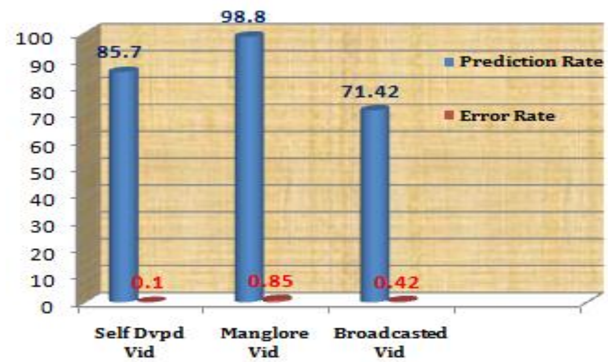


Fig 5: The graph shows the prediction rate and error rate in the Detection and tracking process on All three kinds of data set

The above results clearly shown that, self developed data set works well for the proposed methodology. Because the result table clearly shows that, even though the accuracy of object prediction level in the Manglore Data set is high by comparing with broadcasted and self developed data set, but it got rejected because of its high error rate. By taking average result rate the algorithm fits on self developed video in case of prediction status and even in the error rate. Because of background object space and noise generated by the sun light which created more noise in the frame. It finds difficulty to judge the object trajectories and tends to detect the outside particles like white light and so on. This gets increase in the error rate. Where as in broad casted data set videos are downloaded from the you-tube since videos are not developed for the research purpose and while uploading such videos data gets compressed and during this uploading and downloading process frames gets noisy and loss of information. Because these genuine technical reason we have preferred to use self developed videos having high quality video resolution and mainly developed for research purpose with the guidance of the Physical education department of AWUK.

7. FUTURE WORK

As stated above the player occlusion detection is a major challenge in the video annotation system. Moving forward player classification and labeling is one of the crucial tasks in kabaddi video content analysis. This will guide to judge the player performance evaluation and decision making in the game rules.

8. CONCLUSION

The proposed method does the best prediction process for occlusion handling in frame by frame appraise, which is the most challenging issue in the video processing field. The overall process is implemented using EGMM and most efficient technique KF. It helps to keep on updating the count of occluded objects in the scene. Algorithm is tested on three different data set and the comparison results shown the best output on the self developed video. For testing complex video models can be used such as constant acceleration, or by using multiple KF for every object. Also, in future we can incorporate other cues for associating detections over time, such as size, shape, and color.

9. ACKNOWLEDGMENT

There is no legal data set available for the research on the kabaddi game, since have created our own data set. This was done with the guidance of Dr.Rajakumar Malipatil, Director of Sports Department, AWUBK, for the right ground truth examination and played by AWU-PED International Kabaddi players. Another data set was created in Mangalore University by taking official permission from the parent university and Alva's PED Director. We are grateful to both PED team for their supervision, which made possible to develop our own data base on Kabaddi game.

REFERENCES

[1] Nathanael L.(2017): "Development of a N-type GM-PHD Filter for Multiple Target, Multiple Type Visual Tracking", Student Member, IEEE, and Andrew Wallace, Fellow, IETarX4:1706.00672v2 [cs.CV] 27 Nov issue.

[2]. Tsung-Yu Tsai.(2018): "Recognizing Offensive Tactics In Broadcast Basketball Videos Via Key Player Detection", Image Processing (ICIP), 2017 IEEE International Conference on, 22 February .

[3] Huang-Chia Shih.(2017): "A Survey on Content-aware Video Analysis for Sports", IEEE Transactions On Circuits And Systems For Video Technology, VOL. 99, NO. 9, January 2017.

[4] Anurag Ghosh.(2017): "Towards Structured Analysis of Broadcast Badminton Videos", IETarX4:1706.00672v2 [cs.CV.

[5] Aziz. Makandar et al, "Frame by frame analysis on different cases of sports video", International conference ICCUBEA, Pune, IEEE Xplore, 978-1-5386-4008-1/17/$31.00, 2017 IEEE.

[6] Aziz Makandar.(2017):"Key frame Extraction and Object detection in the sports video", International Conference on soft computing Techniques in Engineering and Technology, IEEE Xplore.

[7] A. Palraj.(2012): "Development Of Match Analysis System For Kabaddi Matches", IJIAR.

[8] Dr. Kavita Sharma.(2016): "A Comparative Study of competitive state anxiety among team sport and individual sport players at Delhi University", International Journal of Advanced and Innovative Research (2278-7844) / # 344 / Volume 3 Issue.

[9] National Club Games Rule Book Kabaddi

[10] Dr. Aziz Makandar, Daneshwari Mulimani.(2017): "Analysis Of multiple object detection using Kalman Filter in Sports Video", National Conference on Computer Science and Information Technology (NCCSIT).

[11] Slawomir Mackowiak.(2010):"Football player detection in video broadcast", Springer-Verlag Berlin, Heidelberg, September 20 – 22..

[12] Archana. (2017):"Video Analysis using Kalman Filter", , Department of Computer Science and Engineering, Annamalai University, Chidambaram, India, E-mail: archana.aucse@gmail.com, I J C T A, 9(2) 2, pp. 411-418.

[13] M. Archana, M.Kalaiselvi Geetha.(2016):"Robust Player Tracking in Broadcast Tennis Video using Kalman Filter", I J C T A, pp. 411-418.

[14] Wei-Lwun Lu,'Learning to Track and Identify Players from Broadcast Sports Videos', IEEE Transactions On Pattern Analysis And Machine Intelligence.

[15] Jacob Foytika, Praveen Sankaranb.(2011): "Tracking and Recognizing Multiple Faces Using Kalman Filter and ModularPCA", ELSEVIER, Procedia Computer Science, 256–261.

[16] M. Archana, M. Kalaisevi Geetha.(2015):" Object Detection and Tracking based on Trajectory in Broadcast Tennis Video", Second International Symposium on Computer Vision and the Internet (VisionNet'15), ELSEVIER,Procedia Computer Science 58 225 – 232.

[17] Nikita Rawat, Rohit Raja.(2016): "Moving Vehicle Detection and Tracking Using Modified Mean Shift Method and Kalman Filter and Research", International Journal of New Technology and Research (IJNTR) ISSN:2454-4116, Volume-2, Issue-5, Pages 96-100.

[18]http://www.divilabs.com/2013/11/motion-trackingdetection-in-tlab.html#ixzz4lsDES7nX

[19] Xinguo Yu, Dirk Farin.(2005):" Current and Emerging Topics in Sports Video Processing", 0-7803- 9332-5/05/$20.00 © IEEE

[20] Qiang Huang et al, "Detection of Ball Hits in a Tennis Game Using Audio and Visual Information".

[21] C. V. Sakthi Priya.(2013): "Integrated Hidden Markov Model and Kalman Filter for Online Object Tracking", IJSRD - International Journal for Scientific Research & Development| Vol. 1, Issue 6, ISSN (online): 2321-0613.

[22] Mukesh A .(2004):," Small and fast moving object detection and tracking in Sports Video Sequences", 0-7803-8603-5/04/$20.00 © IEEE.

[23] Iman Iraei, Karim Faez, " Object Tracking with Occlusion Handling Using Mean Shift, Kalman Filter and Edge Histogram", Dept. Electrical Engineering Amirkabir University of Technology (Tehran Polytechnic) Tehran – Iran E-mail: iman.iraei@aut.ac.ir, kfaez@aut.ac.ir.

[24] Hitesh A Patel, Darshak G Thakore," Moving Object Tracking Using Kalman Filter", International Journal of Computer Science and Mobile Computing, ISSN 2320–088X.

[25] Thota Vinod Raja, M. Tirupathamma.(2016): "Object Detection and Tracking in video using Kalman Filter", IJRAET, Volume 5.

[26] B. Chakraborty, S. Meher. (2012): "Real-Time Position Estimation and Tracking of a Basketball," In Proc. of IEEE Int. Conf. on Signal Processing, Computing and Control, JUIT, India.

[27] S.Saravanan1, Dr.K.A.Parthasarathy.(2014): "Video Object Detection and Tracking using kalman filter and color histogram-based Matching algorithm", International Journal of Engineering Research and Development e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com Volume 9, Issue 7 , PP. 31-3931.

[28] Dr. Aziz Makandar, Daneshwari Mulimani.(2016) "VIP methods for Sports Video - an Analysis", Asian Journal of Convergence in Technology Volume 3,Issue 2/Issue 3.

[29] Dr. Aziz Makandar1, Daneshwari Mulimani.(2016): "Key frame extraction and Object Detection in the Sports Video", International Conference on Soft Computing Techniques in Engineering and Technology (ASCTET), published in IEEE Xplore.

[30] Bahadır Karasulu.(2010): "Review And Evaluation Of Well-Known Methods For Moving Object Detection And Tracking In Videos", Journal Of Aeronautics And Space Technologies Volume 4 Number 4 (11-22).

[31] M. Parisa Beham, A.B. Gurulakshmi.(2012): "Morphological image processing approach on the detection of tumor and cancer cells" **IEEE Xplore:** Devices, Circuits and Systems (ICDCS), International Conference.

[32] Deng Caixia, Chen Yu, Bi Huiand Han Yao.(2014)" The Improved Algorithm of Edge Detection Based on Mathematics Morphology", International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.7, No.5, pp.309-322.

[33] Ritu Sharma1, Rajesh Sharma.(2013):" Image Segmentation using Morphological Operations for Automatic Region Growing", (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 4 (6) , 844-847.

[34] Resmi H.B, Deepambika V.Ab, M.Abdul Rahman.(2015):" Symmetric Mask Wavelet Based Detection and Tracking of Moving Objects Using Variance Method", Second International Symposium on Computer Vision and the Internet (VisionNet'15). ELSEVIER Procedia, Computer Science 58-65.

[35] Khurram Soomro and Amir R. Zamir.(2014):" Action Recognition in Realistic Sports Videos", Computer Vision in Sports, Advances in Computer Vision and Pattern Recognition, DOI 10.1007/978-3-319-09396-3_9, Springer International Publishing Switzerland.

[36] Nicola Greggio et al,(2010): "Self-Adaptive Gaussian Mixture Models for Real-Time Video Segmentation and Background Subtraction", IEEE 978-1-4244-8136-1/10/$26.00_c .

[37] M.Manafifard,H.Ebadi,H.Abrishami Moghaddam.(2017) :"A survey on player tracking in soccer videos", Computer Vision and Image Understanding ELSEVIER ,Volume 159, June issue, Pages 19-46.

[38] Lie Yun.(December 2010): "Basketball Court Detection Based on Adaptive Gaussian Mixture Model and the Application in Basketball Video Annotation", Information Processing (ISIP), Third International Symposium on, IEEE Xplor.

[39] Pei-Chih Wen, Wei-Chih Cheng et all, "Court Reconstruction for Camera Calibration in Broadcast Basketball Videos".

[40] JeonghwanGwak.(2017): "Multi-object tracking through learning relational appearance features and motion patterns", Computer Vision and Image Understanding ELSEVIER, Volume 162, September issue, Pages 103-115

[41] Xinguo Yu, Dirk Farin.(2005): "Current and Emerging Topics in Sports Video Processing", 0-7803-9332-5/05/$20.00 © IEEE.

[42] Kazimierz Choroś.(2012): "Detection of Tennis Court Lines for Sport Video Categorization", N.-T. Nguyen et al. (Eds.): ICCCI 2012, Part II, LNAI 7654, pp. 304–314. © Springer-Verlag Berlin Heidelberg.

[43] Rafal Kapela.(2014):"Real-Time Event Detection in Field Sport Videos",© Springer International Publishing Switzerland issue.

[44] Lee Yong Ong et al.(2017): "Performance of invariant feature descriptors with adaptive prediction in occlusion handling", 2017 3rd International Conference on Control, Automation and Robotics (ICCAR), IEEE Xplore.