Key frame extraction and Object Detection in the Sports Video

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Abstract:

Once we take the analysis of sports videos, the main issue arises on detection of players inside the boundary of the 'play track'. This paper elaborates the process of Object detection in the Kabaddi game (One of our National Games). This is done by key frame extraction, Background Elimination (BGE) elimination with the foreground (FG) frames, then we apply thresholding technique and Morphological Operations to get the accurate object positioning in the extracted key frames. The results are compared with Gaussian Mixture Model(GMM).

Introduction :

The Image processing techniques are becoming challenging in the field of video processing, because videos are referred to resolve the issues raises in place like traffic area, surveillance places and in sports videos as well. To handle the any issue in video processing accurate moving object detection is an initial step. This is again depends on the quality of the video frames and speed rate of the moving object. Then detected object has to be tracked frame by frame which is an crucial and difficult task. First step is Moving object detection(MOD) in video analysis. There are some advantages of MOD in sports video application:

A. Content based video retrieval: It apply on human behavioral analysis system useful to identify the player moments and event happening in the specific games. Any event specific or action occurrence will results in the form of output

B. Accurate analysis of athletic performance: use to track the each athlete throughout the game to better analyze the individual role and their involvement in the specific game.

Along with these advantages MOD can be more applicable in the visual surveillance like crowded areas, banks, country border and parking lots. In all these applications videos has to capture with fixed camera in static background. Then we can apply the BG elimination technique.

This is done by frame by frame analysis in whole video. Individual frame will be examined to find the pixel difference between one frame to another frame throughout the video. Then we must extract the key frame which contains the highest information. In the literature many techniques have applied to find the exact key frame from the huge video. This paper organized as follows: section-I. key-frame extraction, Section-II.BG subtraction for player detection in FG, Section-III. Applying Threshold and morphological operations to detect object in the play track. Section-IV. Experimental results, Section-V. Conclusion and Future work.

1 Key frame extraction

Videos are collections of frames. Frame rate depends on the quality of the individual video. We have taken the videos of frame rates 15 fps. Every bit of frame contains the unique information for every scene change. Extracting the each moment from the video without losing the single information is a difficult task in the video pre-processing. This is done by efficient key frame extraction process. There are many techniques were used to generate key frames[1]. As per analysis[1] we applied X^2chi square model to extract the key frames. It achieves 98% of accuracy in KFE.

The following algorithm explains the KFE method.

Algorithm:

Step 1: Open the video file which should be in the current directory and get the total number of frames in the video

Step 2: Process the frames in the video, compute the sum of the absolute value of the grayscale image and their Histogram difference of the each adjacent frames in the video and store it in diff array.

diff(i) = sum(abs(imhist(rgb2gray(read(obj, i))) - imhist(rgb2gray(read(obj, i + 1))))) (1)

Step 3: Set threshold to 3 / 4 of the maximum value in the array diff which will find the maximum threshold value for the frame difference.

Step 4: Set the first shot boundary at 1, now to check if the difference in adjacent frame is greater than the threshold value then store the Frame number in the shot boundary array.

$$\text{Threshold} = \max(\text{diff}) * 3 / 4 \quad (2)$$

Step 5: If the frames block difference is greater than threshold then it is a keyframe.

$$\text{diff}(i) > \text{threshold} \quad (3)$$

Step 6: Now we display and save the "key frame" to the current directory which is the middle frame of the 2 shot boundaries. If even frame generated in case, select the any one of the middle frame. Then store it as the Key frame.

Step 7: This process will be applied on all the frames of the video, which should not miss the any scene in the video.

2 Background subtraction:

The subtraction of the image is pixel based subtraction. Apply subtraction operation and compare it with certain threshold values. If the pixel difference is greater than the set threshold value T, then it determines that the pixels as the moving object, otherwise, as the background pixels. It generates the background difference mask by comparing the current input image and the background image stored in the background buffer. This background difference mask is our primary information for object shape generation.

In the foreground detection step, pixels in the video frame, which are not explained enough by the background model, are defined as a binary candidate foreground mask[4]. The most important limitation of background subtraction is the requirement of fixed (i.e. stationary) cameras. Camera motion usually distorts the background models and causes false or partial object detection.

In the sports video fixed cameras are used in the required static background to detect the moving foreground objects. This paper takes complexities in Kabaddi game which is one of our national games. Our goal is to track a player who touches the middle line and the end line. Here the observations are made only in half of the kabaddi track. The algorithm works with extracting the players and avoiding the noise, shadow and audience in the play ground. This is done by the frame variance with existence frame and frame without players as background image. Initially we tried the KFE code on video taken by google, which face more complexities by presence of audience, logos, nose and continues interruption by coach and umpires. For the better accuracy this BS code will be applied on self developed videos. Here we can avoid noise and occlusions.

3 Thresholding and morphological operations:

The object detection in the sports video is one of the major challenging processes in video processing. The proposed technique helps to extract the multiple player detection on the kabaddi play-track. This is followed by pixel-by-pixel verification. Any pixel that has intensity lower than the threshold will be discarded and processed into black.

$$\text{Imextendedmax(player, playerValue)} \quad (a)$$

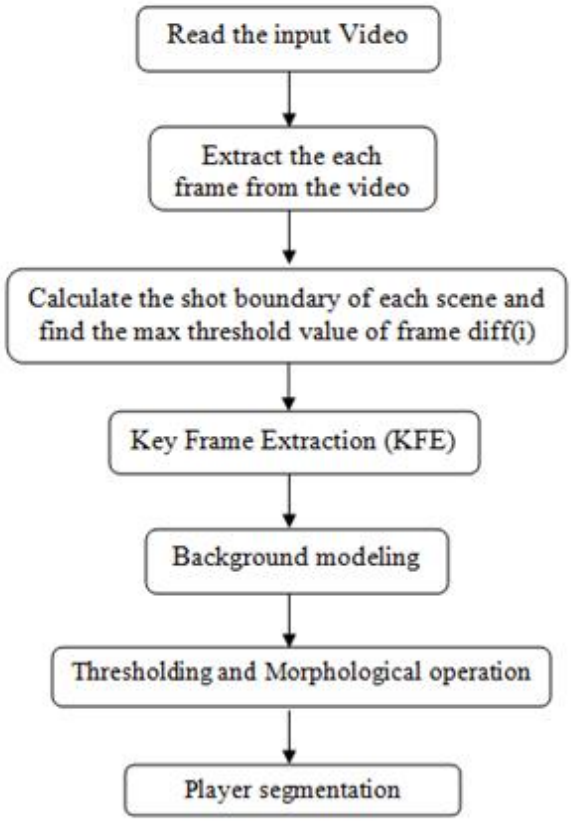

Fig 1: Background subtraction and object detection

We fixed the threshold value at 150 and it is a little bit above the average intensity of the audience outside the play-track

3.1 Morphological processing using imopen() :

Morphological method is considered as geometric or even "size" operation. Any object smaller than the certain size (width OR length) will be discarded. So, not only any small objects outside the play-track will be removed but also the bright white colored

outline marks will be gone due to the width of the line is smaller than the "disk". We removed small objects by comparing the size of our "disk" which is created by the function strel(). The strel() create morphological structuring element such as 'ball', 'square', 'line', etc.

$$IM2 = imopen(IM,SE) \quad (b)$$

This function performs morphological opening on the grayscale or binary image IM with the structuring element SE. The argument SE must be a single structuring element object, as opposed to an array of objects. The morphological open operation is erosion followed by dilation, using the same structuring element for both operations. This method extracts the position of the players inside the play-track. The accuracy level is compared with GMM based BGS method[1] and the optical flow method. As per the experimental results GMM(BS) reflects the players and audience cordially, where as proposed method achieves the required output with more accuracy.

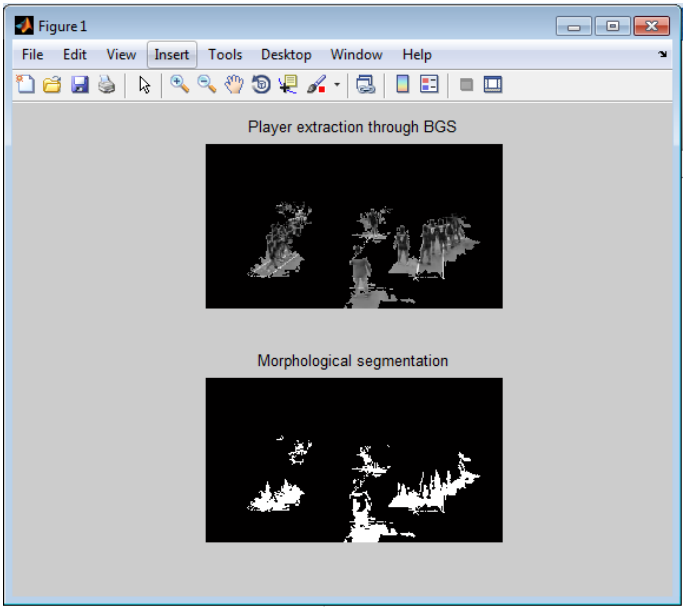

Fig 3: Player segmentation using morphological operation

4 Experimental results :

The proposed work has been developed using MATLAB 7.10(R2013a) on Intel dual core processor, 2GB RAM and Windows XP SP2. The real time video sequences are acquired at the rate of 30 frames/second with the frame size of 640×360 pixels resolution. The result shows the extracted players inside the play-track. This will be referred for the outline detection and the events handling on the line.

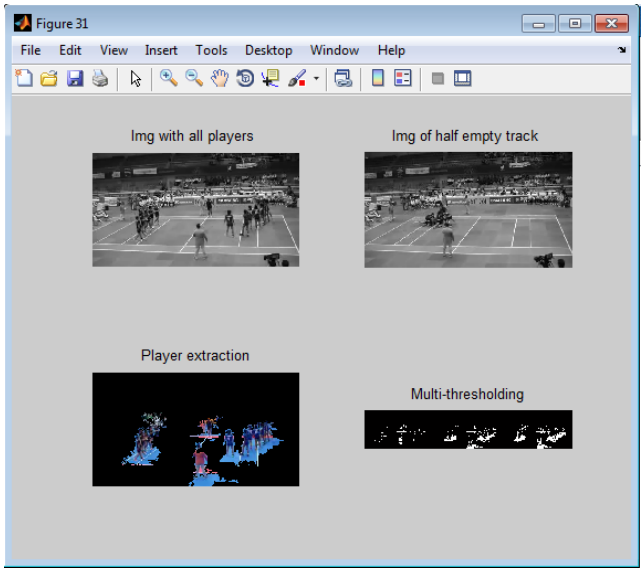

Fig 2: BGS with FG Frame and Multi-Thresholding

Moving object detection Techniques	Advantage	Disadvantage
Gaussian Mixture Model	Pixel to pixel verification calculation is done with more accuracy.	Fails in multiple moving object detection
Morphological based Background Subtraction Method	[1] Simple and Fasted process for frame analysis [2] Efficient and more accuracy in the object detection	Only fixed cameras have to apply for required position Need static background with more clearance
Optical flow method	(1) This method gives satisfactory result. (2) It can produce complete movement information.	(1) The computational complexity is very high. (2) Require large amount of calculations.

Table 1: Comparison of Object detection techniques in sports video

The following Table explains the GMM method, Optical flow method and the proposed techniques. GMM model fails to extract the players inside the play track. Which makes illusion with other components comes in the image. These kinds of occlusions are eliminated by morphological method with better accuracy as compared with GMM method.

5 Conclusion and future work :

In the computer vision system sports video processing faces many visual obstacles. Because at every moment of a player follows many rules and constrains. So it will be kept for observation for judgment. These will more noticeable in the Kabaddi game. The Proposed method achieves the more accuracy level in key frame extraction and Object detection using BGS method. The segmentation is done with the Morphological operation and Thresholding technique. It achieves multiple players detection in Kabaddi play track. Then the results are compared with GMM and optical flow techniques.

These outcomes are referred for the implementation of play-track detection. Then tracking the players inside the track and Event handling has to be done. For the more accuracy in the detection process self developed videos will be referred.

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