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Robust Color-Table based Object Localization And Event handling in Sports video

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Abstract: Video annotation process has become one of the crucial tasks in the field of computer vision from many decades because of the demand in automated analysis tools and requirement of digitized Medias. Here is an endeavor to accomplish the state-of-art for the Kabaddi event identification. Multi-dimensional Weiner Filtering (MWF) has applied for video frames to avoid the damages in the region of the FG object. Grid based line detection has achieved using Hough Grid Transformation (HGT) with line labeling. Combining these results with Color Table (CT) based segmentation has done for player detection and tracking in which similar object from the foreground has been extracted and accurate team localization has performed. Each video sequences are undergone for Team and labeling individual team member based on the color segmentation and dilation process. Feet regions for End line and middle line values for Mid-line event are examined by ROI methods. Experimental results achieve the high accuracy which congregates major issues in the proposed case study.
Key words: line segmentation, Player Localization, Event Handling, HGT, RCT.

1. INTRODUCTION:

Majority in the state-of-art object tracking era complexities like intense occlusion, scale variation, illumination deviation etc are the major issues made the video processing even more challenging. This paper aimed to acknowledge these challenges robustly based on three principal tasks, first: a supervised player detection and tracking has done using the Robust Color Table based team localization[3,4]. Team wise object classification has done by labeling and breeding the bounding box to the individual moving object[6,7,8,9,10]. Second: The play court lines are segmented by the Haugh Line Transformation (HGT) process with the highest threshold value assessment. Third: pedestal analysis of first and second modalities, game annotation has done by indentifying the middle line and end line events.

2. LITERATURE REVIEW:

[14] proposed Field detection and extraction in soccer robot based on color appearance. First calculate the sum of RGB intensity (s-RGB) in each pixel. Then group s-RGB in 16 bins to form a histogram of s-RGB. Second, obtain a modus of s-RGB. This modus is used to determine the interest bin. Third, from this interest bin, we create histogram of R, G and B intensity, then we calculate modus of R, G and B intensity. These intensities are supposed to be the background color. Applying a threshold can extract foreground. For image size of 640×480 pixels, the computation time is 97.29 ms, suitable for real time application.

Kevin M. Oldham [16] has proposed the video annotation CV based event classification and monocular devise based event detection in the table tennis sport. He has proposed i) the selection and optimization of a CV algorithm to detect the ball from the resulting single source video data. ii)validation of the accuracy of the 2-dimensional (2D) CV data for motion change detection, and iv) the data requirements and processing techniques necessary to automatically detect changes in ball motion and match those to match-play events.

Self-Taught Localization (in brief STL) proposed by Bazzani et.al. [8] To generate bounding boxes that is very likely to contain objects. Their proposed approach relied on the idea of covering out regions of an image provided as input to a deep network. The reduction in recognition score caused by the covering out is embedded into an agglomerative clustering method which merges regions for object localization.

A graph search algorithm was used by Sun et.al. [9] To split the graph of line fragments into smaller ones using certain node and edge weighting functions. They encoded how likely a line fragment or line fragment pair is to belong to an object. They used generic appearance and shape cues to score each cycle. These score are not constricted to linearly additive measures and can easily yield multiple hypotheses that share some edges.

Sigal [10] initialized object localization by performing object detection. In object detection, he performed object's part detection before detected the whole of object. He implemented graphical models and its inference method to detect the object's part and loose-limbed body model to localize the object. These method were able to detect and localize in multi-frame for single target and single frame for multi-target. However, it required a complex computation.

Murphy et.al. [11] Implemented object localization for feature dictionary with the bank of 13

filters and patch classifier of gentle Boost algorithm as local image feature. And gist of an image was as global image feature. With this method, they were able to detect and localize object well. However, they implemented the standard technique of object detection using sliding window classifiers applied to local features which required a large computation time.

P Mudjirahardjo[1], used novel method of object localization based on color feature. It is a combination of histogram of s-RGB and histogram of Hue. In the training phase these histograms to determine the color dominant in the initial Region of Interest (ROI). Then this information is used to label the interest object. Then by applying row and column density function of pixels to reduce noise and localize the interest which achieves a best result and takes a short computation time of 48.37 ms, in the video rate of 15 frames per second (fps).

In this paper we propose the object detection and event handling using color table generation and ROI which doesn't require any machine learning tool. Here we initiate the robust technique to evaluate the kabaddi events which was the first attempt made in the image processing using MATLAB tool.

3. OVERVIEW OF PROPOSED SYSTEM

The intrinsic chronological nature of video apparent by the evolution of video features typically shows wide variations in behavior. These variations create many complexities while raising the convention for object modeling and feature estimation. These have been conquering in the preprocessing stage. In this the input video clips are validated for frame rate, resolution and required video size. To do this MATLAB tool has its own functions to test the inputted video set. Then the input data has kept for the frame extraction and shot boundary detection process as shown in the architecture fig.1

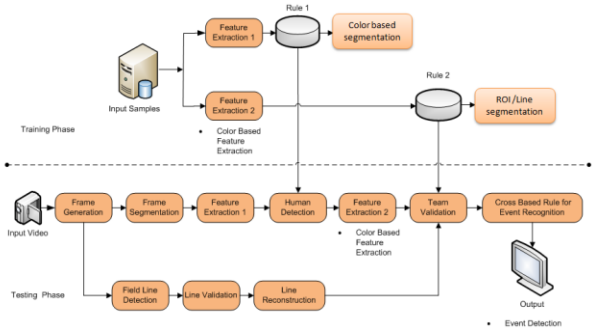


Fig.1. Architecture of step by step processing of proposed system.

4. TEAM LOCALIZATION BY ROBUST COLOR TABLE(RCT) GENERATION

It is a process of high-level object representation in image pixel like separation from background with required foreground object. With thresholding it is possible to segment the image based on color parameters. Example red pixels in the image can be separated from its surroundings colors. In this process which pixel in a range fall within the range of the threshold and remaining are rejected. The thresholding process involves the test against the function as shown

T = T[x,y,p(x,y),f(x,y)] **Eq-1**

Where f(x,y) is the gray level at the point (x,y) and, p(x,y) denotes some local property of the point such as average gray level of a neighborhood centered on (x,y)
Threshold image is represented with following measures as:

$$g(x,y) = \begin{cases} 1, \text{ if } f(x,y) > T \\ 0, \text{ if } f(x,y) >= T \end{cases} \quad \text{Eq-2}$$

Where above threshold function represents different sets of pixels, hereby those labeled 1 correspond to object, while pixels labeled 0 correspond to the background. RGB color format can represent any standard colour or brightness using a combination of RED, GREEN and BLUE components[1,2,3]. It typically stores as a 24bit number using 8-bit for each color components (0 to 255).

- Each Colum is

Maximum R	Minimu m R	Maximum G	Minimu m G	Maximum B	Minimu m B

- Based on the flag value respective team is generated Colour Table is designed for each team separately; the functioning of colour table generation algorithm is depicted as follows.

❖ **Algorithm description for color based Segmentation:**

Step 1: Inputs video clip with selected frame rate and resolution
Step 2: flagM - Variable to select the T1 table and T2 Table for color detection 1 for Team 1, 2 for Team 2
Step 3: colorTable - Color Table Geneartion function, which present the maximum and minimum color threshold for individual team i.e. T1 and T2 Each team colour Table with size is 5x6.

[meanColorTeam1] = colorTable(flagM)

Step 4: Color Table for Team 1

team = [Max R Value,Min R Value,Max G Value, Min G Value,Max B Value,Min B Value]

```
team =  [62, 15,37, 8, 104, 52;
         68, 11, 62, 06, 125, 56;
         67, 12, 53, 06, 115, 38;
        108, 29, 76, 12, 167, 57;
         47, 17, 30, 03, 95, 15];
      // same followed for team 2
```

Step 5: Maximum Mean Values for RGB has calculated using meanMax() function

Step 6:Minimum Mean Values for RGB calculated using meanMin() function

%After team table selection compute its mean values

step 7: + or - difference is considered for accurate results

```
meanColorTeam1.meanMaxR = meanMaxR + diffV;
        meanColorTeam1.meanMinR =
meanMinR - diffV;                                  Eq-3
    // similar for G and B color formats
```

Step 8: After computing maximum and minimum mean values compute their difference values

i.e ± maximum and minimum R. G and B

$$RGB(x,y) = I_R(x,y) + I_G(x,y) + I_B(x,y) \qquad \text{Eq-4}$$

Step 9: Based on min max value the blob is generated

Here we generate the Mean(max,min) of RGB(mm-RGB) where RGB(x,y) is sum of RGB intensity at pixel coordinate (x,y), IR(x,y), IG(x,y), and IB(x,y) are red, green and blue intensity at pixel coordinate (x,y), respectively. When we use 8 bit to code a color intensity, then we can get the mm-RGB value of 0-765. Second, we divide the mm-RGB value into 16 bins, then create the histogram of mm-RGB).

5. EVENT HANDLING BY REGION OF INTEREST (ROI):

The flow chart for the ROI based event handling is drawn bellow. It elaborates the step by step process taken to identify the events occurrences in the input scene. BG evaluation has done by using frame subtraction method. Each lines of the BG model has extracted. Team localization has done by RCT method. With this bounding box generation has done with respect to the rider and defender. These player detection will applied to the ROI process. In these players only the feet regions are extracted for the line touch by the player analysis process. through this we can examine the End Line Event (ELE). Through Middle line pixel state extraction we can highlight the MLE in the video samples. This has done with one algorithm for both event analysis and alert message generation will be bone.Selection of specified/required Region of an object is the one of the crucial task in the image processing to perform the event handling. This can be done with filtering or other morphological function.

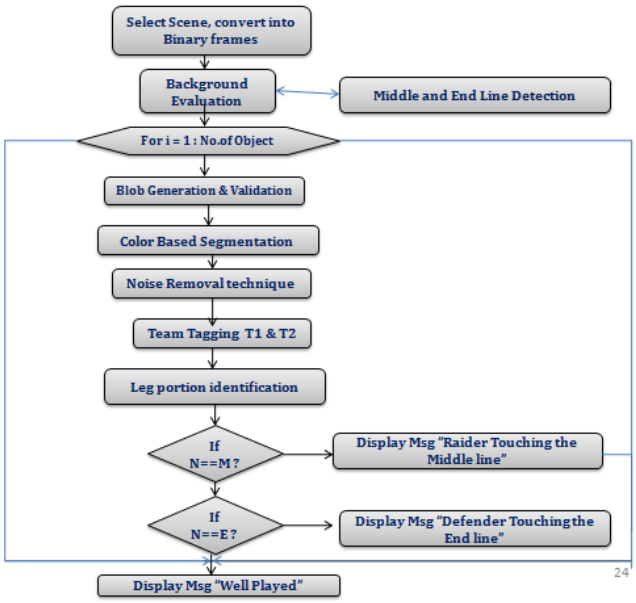


Fig. 3. Flow chart of event handling and event message alert generation

ROI are group of contiguous pixels. Regions are extracted by many shapes with high level functions. It also have collection of ROI creation classes, such as, images.roi.Circle or image.roi. Polygon or intensity values, in this case regions are not necessarily contiguous. The ROI classes support properties, methods and events that you can use to customize the behavior of the ROI. It is mainly use to create the binary mask[11,12,16].

The event handling process entail two main events of Kabaddi those are End line Event (ELE) and Middle line Event(MLE). ELE requires extracting the feet region of the defender. Whereas the MLE required extracting the static sate pixel values of the middle line inside the court shown in fig 2. Here we used intensity values in which regions are not contiguous so as in this process the pixel are nearer to the required ROI are set to 1, pixels outside the region are set to 0.

The MLE and ELE detection has done in the each input data set. Then the moving object with horizontal evaluation is isolated with the line detection. This together makes the pixels deviation costing in the dynamic state-of-art for the ongoing event. MATLAB supports the createMask method to support the classes and methods. Here we applied the roiColor method to extract the required region of the player. The horizontal pixel evaluation is done to capture the event happening. In this vertical pixel towards the y axis are ejected and only the horizontal regions of the pixels nearer to the x axis have to be extracted using the following methods. The selection region of interest is shown in below Figure 3.

a. Each frame has been filtered with efficient filtering process by Multidimensional Wiener filter [MWF]. Wiener filter has capacity to achieve high gain in noise removal. But it can cause serious damage to the edge of

the image during the process of the noise removing, especially in noise-free areas. Because of this reason we preferred the MWF in which only the homogeneous directions are chosen for the filtering by preserving essential structures of the image. The principal of the Wiener filter stats that, ability to yield the restoration of the *R(i,j)* as possible as to the original image x(i,j) from the degraded image *y(i, j).* in which the σ^2 is the Gaussian noise with zero mean and variance σ^2_n (i,j). here the *y(i,j)* is the sum of original image and x(i,j) and sum of noise n(i,j), that is,

$$y(i,j) = x(i,j) + n(i,j). \qquad Eq\text{-}4$$

the formula for the wiener filter is as stated bellow,

$$W(i,j) = \frac{\sigma_n^2(i,j)}{\sigma_n^2(i,j) + \sigma_y^2(i,j)} \cdot y(i,j), \qquad Eq\text{-}5$$

Where $\sigma_n^2(i,j)$ is the variance of the noise over the input image (noisy image) $y(i,j)$

b. Each feet region of the defender is detected for the ELE. These ROI values are kept in observation with looping for the rigorous observation of the event occurrences. T1 for the MLE and T2 for the ELE will be monitored with unique color bounding boxes. By fetching the feet regions the by the defender ELE will be occurred. Line touch raises with 1 pixel value on the EL will display the event message "Defender violating the rules".

c. Whereas pixel state value are red on the Middle line which was detected in the BG analysis along eith labeling. These results are adopted for MLE handling process. Dynamic nature FG object state which varies the values in ML will raises line sate change to 1 when the hand region tap the ML will occur the MLE. Here the rider team gains the points by displaying the message "Rider achieves the points". If no such region pixels varied in any of the line, the state displays the "well playing".

(a)

(b)

Fig.3. a. middle line has traced for the midline event, b. ROI for the feet region and the player with bounding box represented in the different color

- **Mathematical Equation Considered**
  - **a. White bounding box information (Original detected Image)**
    - Left = BoundBox(1);
    - top = BoundBox(2);
    - Width = BoundBox(3);
    - Height = BoundBox(4);
    - Bottom = top + Height;
  - **b. Yellow bounding box information (Feet Region detection)**
    - New_Left = Left;
    - New_Top = Bottom - (Height *0.15);
    - New_Width = Width;
    - New_Height = (Height *0.15);
    - New_BoundBox = [New_Left, New_Top, New_Width, New_Height];

These two events are tested on 20 video clips which have captured from different angles for different event state. Proposed algorithm have achieved greater accuracy by handling both the events and displaying the proper alert messages with respective event and state of art of the game.

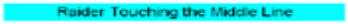
6. EXPERIMENTAL RESULTS:

Proposed methodology works very efficiently for event detection and significant message generation. Two events are handled appropriate state-of-art evaluation process and the potentiality shown in the figure below.

(a)

(b)

(c)



(d)

Fig 4. Events detected with generating alert message,

a) first row results of end line event, when no event it displays "Well Played" Message,
b) when Defender touches the End line "Defender violating the rules" message will display
c) Third row indicate for Mid line event. When rider touches the line "rider touched the Middle line" alert message will generate.
d) Team localization with no event, "well played Message"

7. CONCLUSION:

The object identification and state representation is an overall goal of the proposed work. To achieve this effectively, robust color table generation method and efficient ROI based techniques are applied on Asian sport Kabaddi game. In which we have successfully accomplished the player identification and event handling process with FG and BG detection, bounding box generation for each player, tracking and their respective event message generation has done. This work has been the innovative over the sports video annotation. It will be effectively useful as third referee in the Kabaddi game analysis sage.

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