Cricket Activity Detection

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INTRODUCTION

- The use of Optical flow analysis along with the shot boundary detection can greatly help in the analysis of broadcasted sports' videos. In this project we classify different types of cricket strokes played by a batsman during the match into four different directions.
- This requires solving problem of shot boundary detection in a video. We split the video into shots by supervised learning approach using colour histograms.
- We then classify the video frames into four classes namely, ground, fielder, pitch and other using multi-class SVM.
- We do optical flow analysis [2] on video segment in which batsman play the stroke, to determine the direction of the stroke played.

MOTIVATION AND PREVIOUS WORK

- This can be a major step in further developing an automatic commentary system which would be a huge contribution to the field of sports.
- Our approach although presently tested on complete videos, can be easily used with streaming videos also.
- Some work like ball-start detection and cricket highlights retrieval have already been done in this field.

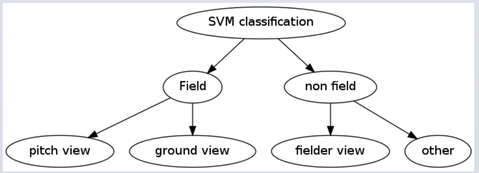


Fig 3: Multiclass SVM

Fig 1:cut between two frames

Fig 2: Gradual/fade transition between two frames

IMPLEMENTATION

SHOT BOUNDARY DETECTION

- A shot is an uninterrupted sequence of frames captured by a single camera. Two consecutive shots can be separated by various transitions like cut(fig 1) or fades(fig 2)(also called shot boundaries).
- we have followed a histogram based approach using color histogram [4].
- For each frame we compute YUV image histogram which stores the total number of pixels in each bin (distribution of colors in an image).
- We compute both global and local histograms corresponding to a frame and represent each frame as a feature vector.

$$Global_{diff}(f,g) = \frac{Hist_f(c) - Hist_g(c)}{max(Hist_f(c), Hist_g(c)}$$

$$Local_{diff}(f,g) = \sum_{i=1}^{m}\sum_{i=1}^{m} \frac{Hist_{f_{i,j}}(c) - Hist_{g_{i,j}}(c)}{max(Hist_{f_{i,j}}(c), Hist_{g_{i,j}}(c)}$$

- Training and testing were done using K-fold cross validation method with K=3.
- For cut and fade classification in testing data we used K-NN algorithm with K=5.

FRAME CLASSIFICATION

- A frame in a cricket match video can be classified into 7 major classes - {Ground view, Batsman view, Crowd view, Long shot, Pitch view, Fielder view and others}.
- For the classification we first tried the grass pixel ratio - colour based approach [5] to classify the frames into field view (Ground view, Long shot and Pitch view) and non-field view (Crowd view, Batsman view, Fielder view and others)(fig 4).

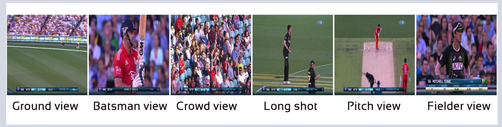


Fig 4: Different classes of frames

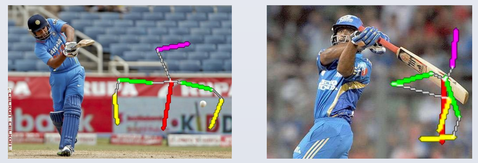
- Supervised learning methods gave better results than this approach as it depends on the colour of grass and time of the game-play.
- In our work we did not require explicit classification into Batsman view , crowd view etc. and thus classified into 4 major classes only - {Ground view, Pitch view, Fielder view and others}.

IMPLEMENTATION (cont.)

- Finally we used multi-class SVM to classify the frames into these classes.(Fig 3)
- We split the single camera shots obtained in Step 1 into parts where the batsman plays a stroke. We find it by checking for continuous pitch view for a duration of 2*fps.
- So we know that the batsman will play the ball in a next few frames. Now if the batsman plays the shot, say a cover drive, then there is a sequence of ground view after a cut in the video.

OPTICAL FLOW ANALYSIS

- For stroke classification we first followed tree-structure approach [3] for batsman pose estimation, but this approach didn't work.



- Then we used optical flow approach to classify direction of the stroke played into one of the 4 directions.
- The direction of motion of significant pixels (which have velocity vectors > average velocity vectors) is opposite to the direction of stroke played.
- Using the video segments we can also classify whether the batsman missed the ball or played a defensive shot too.

RESULTS AND DATASETS

- We chose an 8 over cricket match video played between Australia and England (25 fps) as the dataset.
- Training and testing were done using K-fold cross validation method with K=3.

Fig 5: Results (Precision and Recall)

- We achieved good recall values for finding the video segment when the batsman plays the shot.
- Recall: 90%
- Precision: 50%

RESULTS (cont.)

Transition	Total Present	Total Obtained	Correct Obtained	Precision	Recall
Cuts	82	81	73	90.12 %	89.02 %
Gradual	46	47	39	82.97%	84.78%

Table 1: *Shot Boundary Detection*

Frame Class	Total Present	Total Obtained	Correct Obtained	Precision	Recall
Pitch View	571	573	499	87.00%	87.39%
Ground View	773	781	732	93.70%	94.60%
Fielder View	453	400	373	93.25%	82.30%

Table 2: *Frame Classification*

- The overall accuracy of stroke direction classification with optical flow analysis of the video segments is 80%.
- Good results also available for detecting defencive shots.

Fig 6: Example of common errors.

- In shot boundary detection most of the false positives are observed in frames having fade/gradual change[fig 6].
- Misses are observed in frames having similar background. For example - when the camera shows crowd view in two shots separated by a cut then, the background is almost same and the classifier misses the cut.

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