Background Segmentation Methods in Analysis of Live Sport Video Recordings

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A sports video analysis application was developed by Spiideo for mobile devices. It presents recordings from practices and competitive games for game-play analysis. Available analysis tools, such as on-screen drawings, require a robust background foreground segmentation. The currently used segmentation method have difficulties to master the shifting conditions in weather, shadows and shirt colors. An alternative method with better classification scores, visual perception and reduced complexity was found and is presented here.

I. Introduction

The application was developed to enable game-play analysis for coaches, analysts and players. Besides the pan, tilt and zoom functions, the user can apply on-screen drawings to highlight certain things in the recording, see Figure 1.

Figure 1: The Spiideo application enables on-screen drawings for game-play analysis. The drawings should only be projected on top of the background, and players should not be overdrawn.

To optimize the visual presentation, it is important that the drawings are projected only onto the background of each frame. The foreground, the players and the ball, should not be overdrawn and "disappear" behind the drawings. To achieve this should the segmentation method for each frame in the recording, be able to determine which pixels that belong to the background and which that belong to the foreground.

The currently used method struggles to correctly segment the outdoor recordings due to shifting weather conditions and the possible presence of snow, sun and shadows. This often results in drawings being projected on top of the foreground and/or behind the background as in Figure 2.

Figure 2: Some conditions causes the current background foreground segmentation to fail. This leads to drawings that are incorrectly presented on top of the foreground or behind the background.

To improve the background foreground segmentation in the application, alternative methods were evaluated and compared with the current method. The methods were applied to a data-set with recordings from Spiideo clients.

II. Results

The resulting performance of the evaluated methods are presented in Table 1. F_1-score is a measure on how good the methods resemble the true foreground and background in the recordings, where a value of one means perfect resemblance. The visual evaluation ranges from one to four where a value closer to one means that the method was perceived as the best one. The time evaluation results are related to the currently used method in Spiideo's application.

Table 1: Results of the pixel classification scores, the computational time ratio and the results of the visual evaluation.

Method	F_1-score Full Resolution	F_1-score Zoomed Area	Visual Evaluation	Time Ratio
ColorCube	0.08	0.38	3.67	1.00
Median	0.61	0.63	1.54	0.81
MOG	0.67	0.62	1.83	2.84
KNN	0.70	0.72	*	8.62

** Was not included in the visual evaluation due to its high complexity score.*

III. Conclusion

A method that significantly improved the segmentation results was found. The *Median* method showed a robust performance on all recordings in the data-set with a reduced computational time compared to the current method. It was also chosen as

the best method in the visual evaluation.

A drawback of the median method is the need for initialization by using information from past frames. As users often jump between interesting events in recordings, optimal segmentation may not be carried out during the first few seconds.

Future work could include to implement the evaluated methods in Spiideo's application to enable a more realistic evaluation. To further improve the median model more work could be put in how to faster initialize a good background model directly.

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