

VISUAL FIRE AND SMOKE DETECTION

using computer vision methods

INTRODUCTION

The goal of the project was to develop real-time methods for visual fire detection using a static RGB camera. Already published methods for fire detection based on color features are extended (or replaced) with methods derived from the motion description of the fire, in combination with a background detection.

Motion features alone can be used not only for detection of typical red colored flames, but also in case of variable colored flames (important for detection in industry areas).



RELATED WORK

Existing approaches (1), (2) are depending on the color of the fire, which is generally considered as its strongest feature. Simple motion description was used only in additional filtration steps.

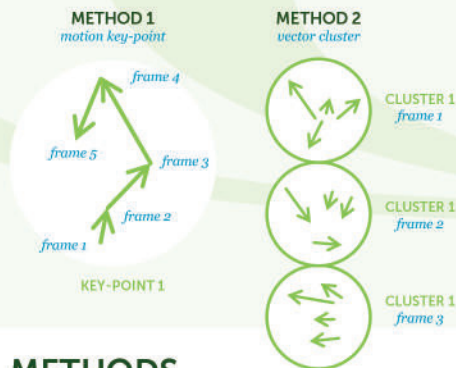
Visual smoke detection (1), (3) as a research topic seemed to be closed, therefore most of the effort was focused primarily on the fire detection.

IMPLEMENTATION

- C++, MFC, OpenCV, Microsoft Visual Studio
- Detection speed in 720p video is 2-7 FPS.

See video previews at bit.ly/linner-firedetection
Dataset available to download at bit.ly/linner-dataset

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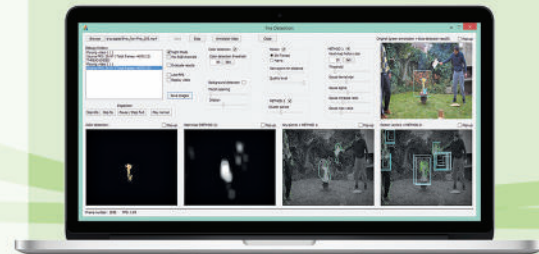
METHODS

METHOD 1:

- Motion description features are derived from a motion key-point position in the time series (this represents one observation)
- Features: key-point time of life (number of frames), variance of motion vector magnitude, variance of motion vector angle difference
- SVM classification of a key-point
- Heat-map model built from positively classified key-points

METHOD 2:

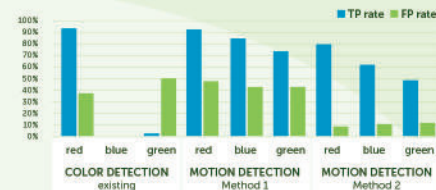
- Clusters of motion vectors observed in a given number of following frames
- Output of METHOD 1 determines the cluster (region of interest)
- Features: vector direction mean, direction variance, magnitude variance
- SVM classification of a vector cluster



CONCLUSION

Proposed methods of fire motion detection have been evaluated using our own annotated dataset (2 hours of video which presents fire and also includes other moving objects).

The results of the fire detection based on the proposed statistical motion feature description and SVM classification are comparable with the fire detection based on color; moreover, this detection is robust also to non-red colored fire.



For the simulation of different flame colors, the combination of RGB channels has been swapped.

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References:

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- (3) TOREYIN, U., DEDEGLU, Y., CETIN, E., Contour based smoke detection in video using wavelets, In: Proceedings of European Signal Processing Conference (EUSIPCO), September 2006, p. 123-128.