Intelligent Support of Video Surveillance At Airports

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Background

This poster outlines relevant aspects of a security research project that is being tested and implemented at two reference airports. This project aims to develop an intelligent system that supports the human operator in analyzing video data in order to track and search for suspicious people in the case of an alert. A security operator can select a suspicious person in a video data set so that the system knows whom to look for. Major requirements of the system are the efficient processing and thinning of different video data sets as well as the very high speed in analyzing image material. Furthermore the system combines different video analytical subsystems for the identification and re-identification of persons to achieve robust results under different conditions. Here, we present two aspects of the developed security system:

Data Fusion

A series of image processing modules is used to analyze the video data, e.g. motion detection, background subtraction or people / head detection methods, which all struggle to perfrom well under certain conditions. In order to obtain better results and to minimize false detections we fuse the results of the different single modules. Since most of the methods write their results in the form of ROIs into a central database, it is easy to combine the different outcomes. Here, we decided to apply a decision-based fusion which is shown is Fig. 2. The fusion process works as follows:

- Check whether there is a person detection ROI
- Look for intersections with ROIs of other modules
- Compute a score based on the intersections
- If this score is above a specified threshold, the ROI of the person detection method is considered to be true

Results:

A complete elimination of false detections is not achieved in all scenarios. However, compared to the result of the single modules the overall result is considerably better. An example is shown in Fig. 3. We tested the performance of the fusion process on different sequences which were recorded on two reference airports and could achieve a reduction of false-positives of about 97 % on average.

GPU-based detection methods

Especially in security scenarios speed is a very important factor. However, reliable people detection methods like the histogram of oriented gradients algorithm (HOG) are very slow and not suitable for realtime applications. Hence, we decided to use a GPU-based implementation of the HOG algorithm which is based on [Prisacariu, 2009]. Our system is equipped with two NVIDIA GeForce GTX 590 video cards, so that 4 GPUs are available for parallelization.

Results:

- Core i7 3,4 GHz CPU: 3270 ms per frame
- NVIDIA GeForce GTX 590: 350 ms per frame

Since we need to process images at 10 fps, we revised this approach in such a way, that it is possible to process each incoming image on a different GPU. Therefore, we developed a multi-threading approach which handles the incoming data. The processing loop is shown in Fig. 4.

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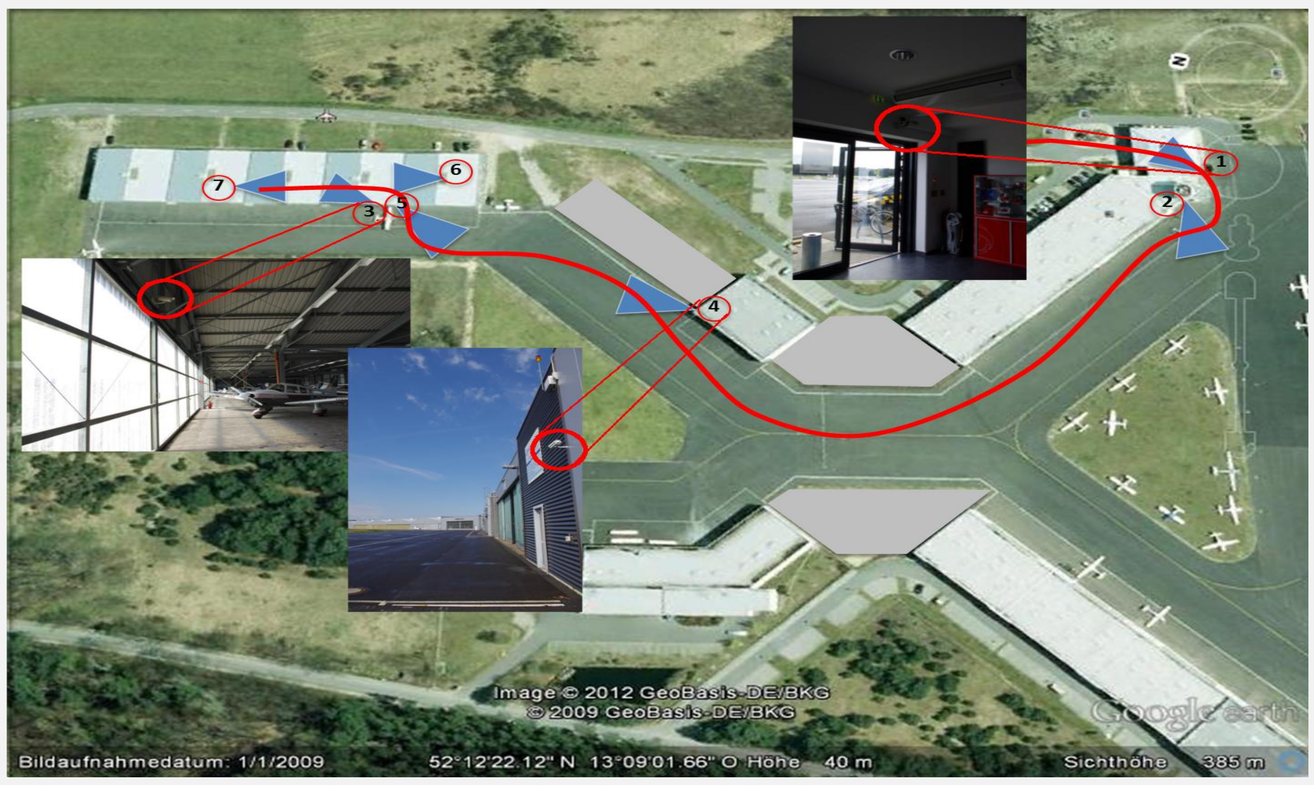

Fig. 1: Camera positions at the Schönhagen airfield.

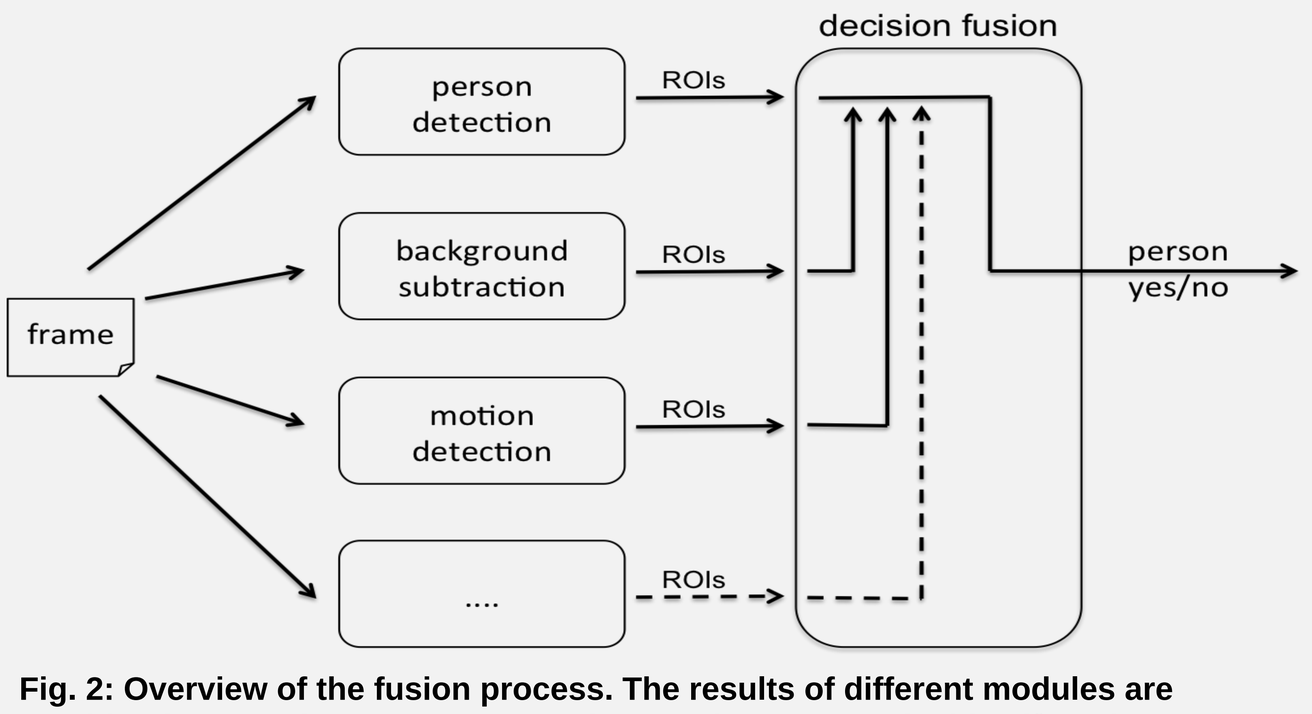

Fig. 2: Overview of the fusion process. The results of different modules are combined. Dependent on a computed score the process decides if a ROI can be discarded.

Fig. 3: Data Fusion. *Left:* Result of a person detection method with a high rate of false-positives. *Right:* Result of the fusion process. Here, the results of person detection, background segmentation and motion detection are fused which, in that case, eliminates all false-positives.

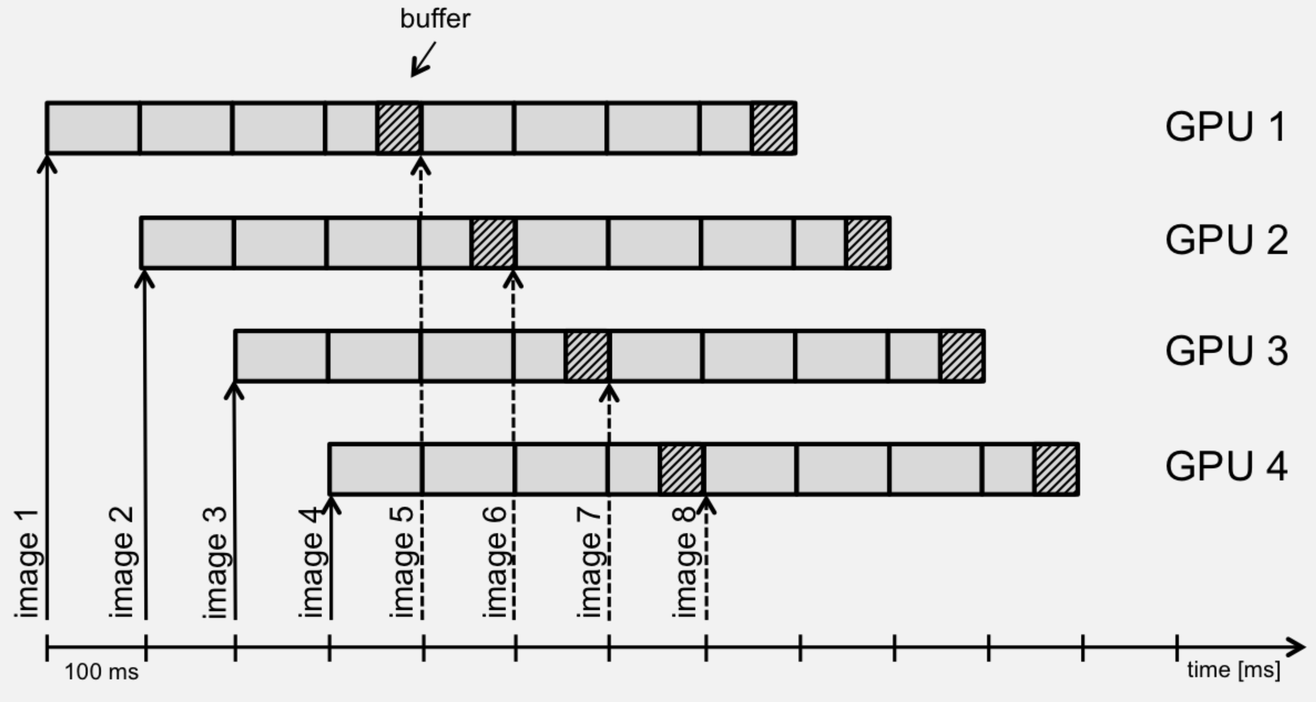

Fig. 4: Multi-Threading-Approach of a GPU-based person detection method. Each time an image is available, it is send to a free GPU which is then blocked until the processing has finished.