Group A0: Pixel-wise anomaly detection for AOS

Computer Vision Project 2021/2022

Pablo Díez Arrizabalaga

Laura Legat

Christian Willdoner

Daniel Schatzl

René H. Reich

ABSTRACT

In this document the project for computer vision laboratory in year 2021/22 of group A0 is described. Avoiding deep learning models, we developed an unsupervised model based on classical computer vision techniques capable of detecting moving anomalies in multiperspective images.

KEYWORDS

pixel-wise, anomaly detection, mask, occlusion, merging, unsupervised, forest, wood, human, rescue

1 DESCRIPTION

Initially, the procedure presented in [1] was considered. Nevertheless, the unsatisfactory results obtained made us neglect both the Autoencoder and the Discriminator from our model, and only contemplate the RX detector. Along the same lines, using the OpenCV library we were able to apply classical image masking methods. Thus, our final pipeline is shown in Fig. 1 and Fig. 2.

The database was composed of several samples each containing 7x10 images, 7 timesteps for 10 different views of the same scene. By merging the images on the camera axis, we obtained 7 images each representing one timestep, of which we only used the 1st, 4th and 7th (last) timesteps. Since we considered that these frames offered enough information to discern the movement of the people to detect from the background.

For the classification of the merged images, a modified Mahalanobis Detector (RX) has been developed, which makes use of the Mahalanobis distance to identify clusters. Once the different clusters are identified, their contours are observed, and a binary image is generated. Afterwards, the binary images corresponding to 1st and 7th timesteps are multiplied, to later check which contours overlap with the 4th timestep. The anomalies in the 3rd timestep which overlap with static contours are considered static and therefore removed. To filter the resulting image, a probabilistic method is applied. Around every anomaly in the static-anomaly-free image, an area of interest is defined. If the distribution of RGB-values inside this area of interest is outside the distribution of RGB-values of all images in the dataset, the anomaly is considered an actual anomaly and, thus, is kept. Otherwise, it is not considered an anomaly and removed from the image. Finally, the bounding boxes are drawn around the obtained anomalies.

Based on this procedure, the average precision on the validation set is 43.33%.

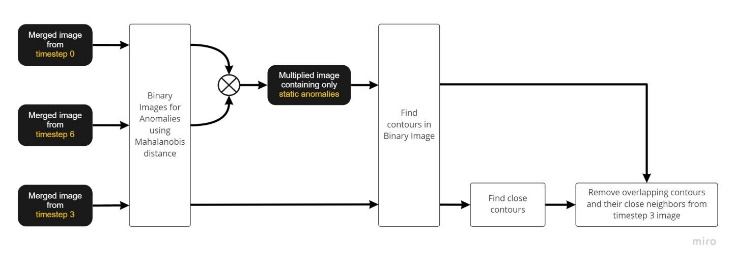


Fig. 1: Remove static objects

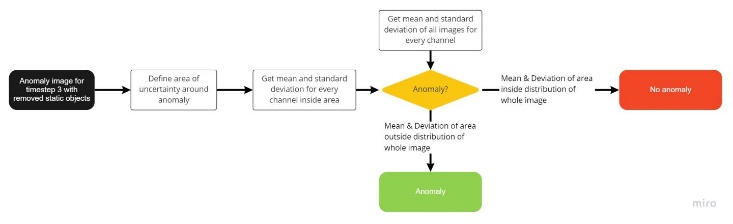


Fig. 2: Anomaly detection

**2** **MODEL FAILURES**

A moving person might appear static when only considering the last and first timesteps of the data, since there is a possibility where he/she returns to the initial position. Thus, we tried improving the results by assuming all timesteps. Taking the product of all binary images associated with all timesteps, we removed the static anomalies from these images by using the same approach as in the first version. Due to occlusion, people might not be visible in the centre timestep (timestep where the predictions are made), so we added up these binary images in order to include the information of all timesteps. This new approach resulted in a better identification for people, however, it also misclassified the background as anomalies. Unfortunately, these latter anomalies can not be ruled out using just probabilistic methods.

On the other hand, our method depends highly on hyperparameters. In this line, we were unable to find a set of values that seemed "globally optimal". A poor tuning of these hyperparameters results in an unbalanced performance of the model, as it may present good results for certain images while for the rest the classification is unacceptable.

REFERENCES

[1] Sertac Arisoy, Nasser M. Nasrabadi, 2021. Unsupervised Pixel-wise Hyperspectral Anomaly Detection via Autoencoding Adversarial Networks*. arXiv*, 1 (Jan, 2021)

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