Group A0: Pixel-wise anomaly detection for AOS

Computer Vision Project 2021/2022

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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. 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) was developed, which made use of the Mahalanobis distance to identify clusters. Once the different clusters were identified, their contours were observed, and a binary image was obtained. Afterwards, the binary images corresponding to 1st and 7th timesteps were multiplied, to later check which contours overlapped 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 was applied. Around every anomaly in the static-anomaly-free image an area of interest was 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 is kept. Otherwise, it is not considered an anomaly and removed from the image. Finally, the bounding boxes were drawn around the obtained anomalies.

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

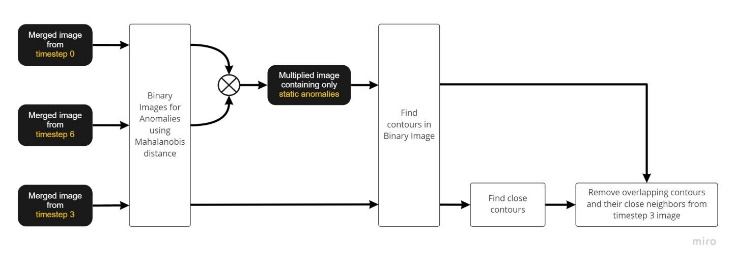


Fig. 1: Remove static objects

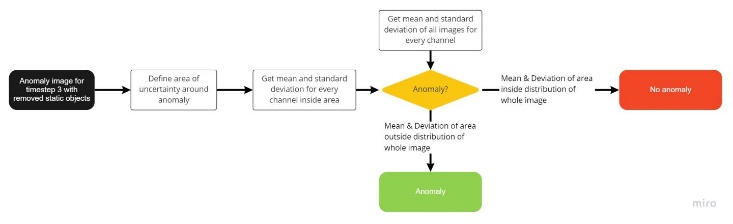


Fig. 2: Anomaly detection

**2** **WHAT WE TRIED BUT LED TO NO IMPROVEMENTS**

We tried to improve results by considering all timesteps. To obtain the static anomalies, we took the product of all binary images of all timesteps. The reason for doing so is that a person could move between the first and last timestep but by at the same position again in the last timestep. We then removed all the static anomalies from the binary images of all timesteps using the same approach as in the first version and added those images up. The idea behind this is that sometimes persons are not visible in the center timestep where the predictions are made and therefore the person could not be detected. By adding the images up, we could also include the information from all the other timesteps. This approach could detect people well but also detected other anomalies as persons. If with intensive experiments those wrongly classified anomalies could not be ruled out using just probabilistic methods.

The approach highly depends on hyperparameters. We could not find a set of hyperparameters that was “globally optimal” which led to good solutions for every image. By tuning hyperparameters, the performance improved for some images but got worse at the same time for others.

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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