Second assigment
Ear detection

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In this paper ear detection with haar cascade is described and implemented. Ear detectors average accuracy level is around 10 percent. It detects most of the ears when the cheek is facing the camera but it has difficulties to detect ears when the front of the face is facing the camera.

1 Introduction

Haar cascade classifier method proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001 is an efficient method for object detection. In this paper, it will be used for ear detection. It is a machine learning-based approach therefore it has to be trained on negative and positive images before it can detect objects in the images .[1] Negative pictures should not contain elements you want your detector to detect.

2 Methods

To successfully train your haar cascade classifier some steps must be followed [2] .

Firstly, the data preparation. The negative images contains images from haar-cascade-negatives database [3] which contains grayscale images of random object that are not containing any ears. To improve it some additional pictures of faces, earrings and clothes were added. Positive images from the AMI Ear Database [4] in majority contains pictures of ears from the angle when the face is facing the camera sideways. Also, positive images were additionally added to improve the performance - so some additional pictures of ears from different perspectives were added. Even though some pictures already contain manly only ears every picture was annotated by hand. So that the box contains as little noise as possible.

After data preparation, a list of all the negative pictures (their path and name) must be created and also a list of all the positive pictures. Before starting using cascade for detection the most important step has to be done - training. After the cascade is trained the XML file is generated which is used for detection.

The code can be found on the following URL: https://github.com/sziva/SB_homework/tree/main

3 Results

Ear detector was tested on 80 images. Results show that the average accuracy is around 10 percent. In figure 1 example of a bad detection is shown. In figure 2 one of the best ear detection examples is show. It was expected that side face images would produce better results since the majority of positive pictures were side face pictures. In figure 3 the average accuracy is shown along with accuracy for every image.

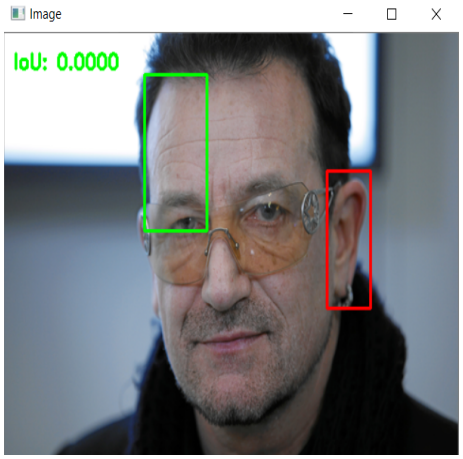

Figure 1: One of the worst examples of ear detection.

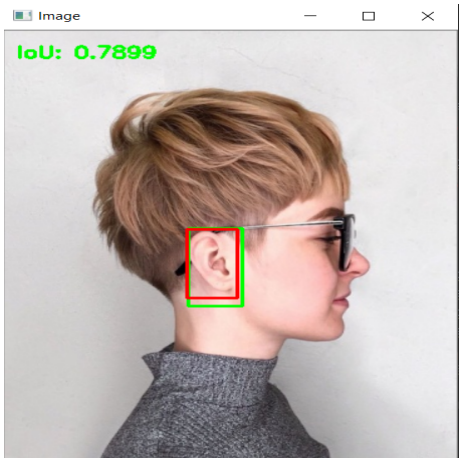

Figure 2: One of the best examples of ear detection.

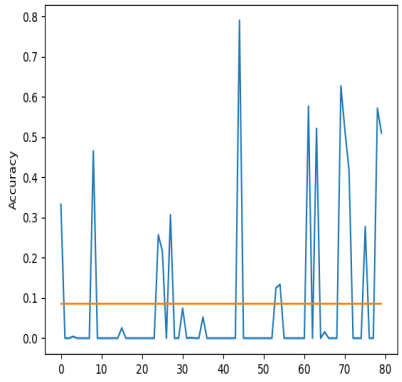

Figure 3: Accuracy for every image. Orange line represents the average accuracy

4 Conclusion

For evaluation, the intersection over union was used (IOU). As already mentioned the average accuracy was around 10 percent while the best was around 80 percent. But it also has to be taken into account that pictures were annotated by hand. Therefore some accuracy of detected pictures that are above 60 or even 50 percent could be 100 percent because the ear is correctly detected but the bounding box is a bit smaller or bigger than the annotated area 2. The results are not the best what can be improved with a bigger dataset of positive pictures that contain more different perspective of the ears since now only a few were from different angles. It can also be improved by adding more accurate negative pictures - since it was ear detection it would be better to have more face pictures of people in general rather than buildings and random patterns.

References

[1] "Cascade classifier." [Online]. Available: https://docs.opencv.org/3.4/db/d28/tutorial_cascade_classifier.html

[2] "Cascade classifier training." [Online]. Available: https://docs.opencv.org/3.4/dc/d88/tutorial_traincascade.html

[3] JoakimSoderberg, "haarcascade-negatives." [Online]. Available: https://github.com/JoakimSoderberg/haarcascade-negatives

[4] L. A. Esther Gonzalez and L. Mazorra, "Ami ear database." [Online]. Available: https://ctim.ulpgc.es/research_works/ami_ear_database/