Cat and Dog Face Detection Using Deformable Part Model

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Abstract: "Deformable Part Model" (DPM) based on "Histograms of Oriented Gradients" (HOG) is known as a robust shape detection algorithm, especially for human body detection. For cat face detection, HOG has been applied since they are quite uniform regardless of the bleed. However, in general, dog faces show larger variation than cat faces. Therefore, we assumed that DPM may work well to the dog face variation. In this paper, DPM is tested to detect dog faces, and its performance is compared with the conventional HOG. Experimental results show that detection accuracy of DPM is about 21-25% better than HOG.

1 Introduction

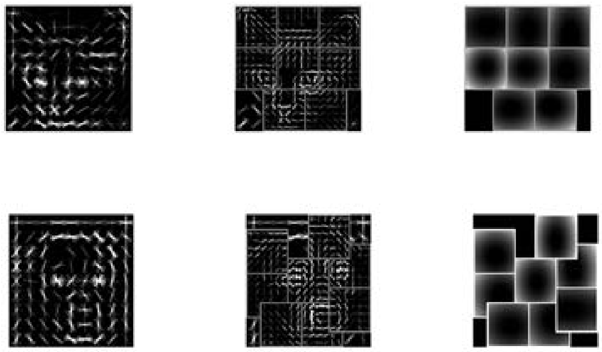
Cat and dog recognition is one of the interested targets in object recognition. A cat feeding machine with automatic cat face recognition capability has been appeared on the market [1]. However, the similar version to dogs is not yet released. We assumed that cat faces are quite uniform regardless of the bleed, but dog faces may vary widely depends on the bleed.

Kusano has studied on cat face detection based on Haar-like and HOG features [2]. From their results, HOG is better than Haar-like, but precision and recall are 35% and 75%. As for the dog face detection, Wang has reported the performance of classification whether dog or cat using Deformable Part Model [3].

In this paper, DPM, which is known to provide robust shape detection [4-5], is proposed to apply dog faces detection, and its performance is compared with the conventional HOG.

2 Deformable Part Model

In the experiment, DPM based on HOG and the conventional HOG are applied to cat and dog face images. As a dataset, the Oxford-IIIT-Pet dataset is used. The numbers of positive and negative images are 1188 and 3578. Features of Root filter, part filter and allocation of part filter for a cat and a dog are shown in Fig.1. It is recognized that the allocation of a part filter for a dog is actively changed from the regular alignment.



(a) Root filter (b) Part filter (c) Allocation

Figure 1: Filter characteristics of detection model at DPM (upper for cat, lower for dog)

3 Experimental Results

First, DPM detection performance is measured to the known images, i.e. 1188 cat and dog images. As a result, average precisions to cat and dog images are 75% and 71.5%. Precision-Recall curves are shown in Fig. 2 and Fig. 3.

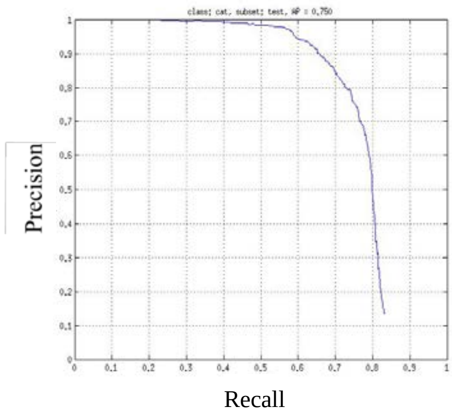


Figure 2: Precision-Recall Curve (cat)

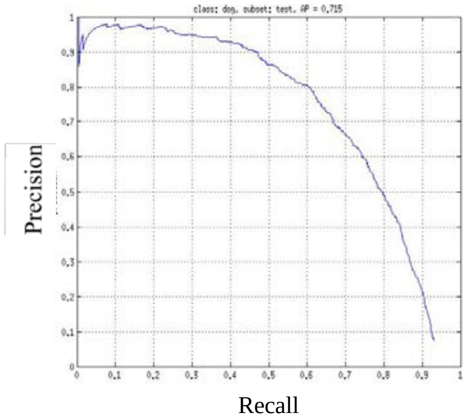


Figure 3: Precision-Recall Curve (dog)

To 30 unknown images, DPM is applied. In 30 images, multiple numbers of cats and dogs are included. These are 59 cats and 61 dogs. Within them, DPM detects 44 cats and 56 dogs. Thus, detection accuracy for cats and dogs are 74.5% and 91.8%.

4 HOG feature and AdaBoost

HOG and AdaBoost are applied to the same training images for the comparison purpose. Learning iteration is 1000 times. To the unknown 59 cats and 61 dogs, detected images are 29 cats and 43 dogs. This result contradicts to the original assumption and detection accuracies for cats and dogs result in 49.1% and 70.4%.

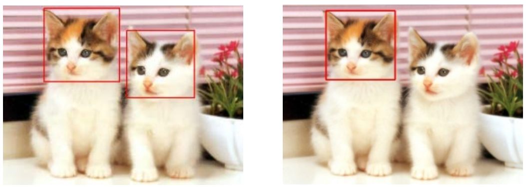
The comparison of detection accuracy for DPM and HOG is shown in the Table 1. From this table, it is confirmed that DPM outperforms HOG, and detection accuracy of DPM is about 20-25% better than HOG.

Table 1: Comparison of detection accuracy

	Cat detection	Dog detection
DPM	74.5%	91.8%
HOG	49.1%	70.4%
DPM-HOG	+25.4%	+21.4%

5 Examples

Example of detected results for cats and dogs by DPM and HOG are shown in Fig.4 and Fig 5. Some cases when DPM provides better results are picked up for comparison. Since data augmentation is not employed this time, detection errors can be found for rotated faces.



(a) DPM (b) HOG

Figure 4: Cat face detection results

(a) DPM (b) HOG

Figure 5: Dog face detection results

6 Conclusion

We have shown that Deformable Part Model provides better cat and dog face detection than the conventional HOG feature method. The improvement is more than 20% for both animals.

References

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[4] P. E. Felzenszwalb, R. B. Girshick, D. McAllester and D. Ramanan: "Object Detection with Discriminatively Trained Part Based Models," IEEE Trans. PAMI, vol.32, No.9, pp.1627-1645, 2009

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