# A Note on Face Detection of Comic Image with Different Background

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## 1. Introduction

In recent years, Japanese comics have been very popular in the world. Readers who are interested in the digital version of the comics have also increased rapidly. User's convenience would be improved if human-like characters of comic images are extracted since they could be used for content search and retrieval. However, so far, the character detection algorithm for comic images is still in the development stage. Comic images have different characteristics compared with general images. In addition, different authors have different styles. In this paper, we investigate the effect of background image to the detection performance of character's face in comic images.

## 2. Characteristics of comic image and analysis algorithm

(1) Characteristics of comic image

Comic is drawn as a binary image which consists of black and white pixels. Main elements are dots, lines and texts [1]. For natural images, we usually use the Haar-like features for face detection proposed by Viola and Jones [2]. To detect human face, various kinds of feature vectors can be used based on luminance levels. However, the face of the comic character is drawn by line. Thus, Haar-like feature may not work effectively.

(2) Analysis algorithm of comic image

Histograms of Oriented Gradients (HOG) are feature descriptors used in computer vision and image processing for object detection [3]. First, the gradients of luminance values at a point are calculated. Second, a cell with N×N pixels is composed, and divided into some degree. Then, luminance gradient histogram for each cell is created, M×M cell as one block. Next, all areas are normalized while shifting by one cell. According to the above method we can get the characteristics. Because of this, we select the HOG feature in this research. The learning algorithm we use is the AdaBoosting which is proposed by Freund and Schapire [4].

## 3. Face detection experiment

In the experiment, we evaluate the detection performance of character face that has different background in comic images. First, we infer that the elements of dialogue balloon, onomatopoeia and object would give some influence to the detecting result. As shown in Table 1, we cut out dialogue balloon from comic image, and named Learning Negative-1. Similarly, we obtained other elements and named Learning Negative-2 and Learning Negative-3 accordingly. Before learning, we have converted all the Learning Image resolution to 50x50 pixels cut out by hand. Next, we select the comic images that include all three elements. Then, we try to separate the elements into three groups. Each group contains only one interference element and the character.

Finally, we delete all background but the character and named it Testing Positive Image. All the 4 groups were detected respectively. The results of learning and testing are showing in Table 2. For the testing image, onomatopoeia has the least influence to the result.

Table1. Number of Learning and Testing Image

| Data Set | Positive Image | Negative Image-1 | Negative Image-2 | Negative Image-3 |
|---|---|---|---|---|
| Learning Image | 40 | 38 | 38 | 38 |
| Testing Image | 55 | 27 | 27 | 27 |

Table2. Detection Rate

| Data Set | Testing Image |
|---|---|
| Positive Image (P.I.) | 0.89 |
| P.I. + Negative Image-1 | 0.52 |
| P.I. + Negative Image-2 | 0.63 |
| P.I. + Negative Image-3 | 0.48 |

## 4. Conclusion

In this paper, we applied the method combined with HOG feature and AdaBoosting to detect the character's face in different background from comic images. It was turned out that background will give a significant effect to the detection results.

## 5. Acknowledgement

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