

ASL Classification System Using Hierarchical Features Based on appearance, moment invariants, and direction

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Abstract. An American sign language(ASL) classification system using hierarchical features based on appearance, moment invariants, and direction is proposed. First, to reduce the error rate and illumination change, infrared image is used in this article. The appearance feature calculates circularity and eccentricity. And then ASL is classified by K-means using them. Next, the Hu-moment invariants features are used to recognize ASL by back-propagation (BP). Finally, the direction feature can accurately classify similar gestures like G and Z, I and J, U and H. The goal of this article is to achieve an efficient and effective classification system that meets the accurate classification of gestures. As a result, the performance evaluations of the recognition rate shows 97.15% and it takes 0.046 s to process one frame.

Keywords: ASL, BP, Classification, Direction, Hierarchical features.

1 Introduction

The hand gesture recognition methods can be divided into two groups according to the contact condition: contact-based method and contactless-based method [1]. Typical contact-based methods are a finger sensor method and an electromyogram (EMG) sensor method. It should exactly recognize hand gesture. However, they are expensive. Also, they are inconvenient and fatigue increase on wearing sensors for a long time [2]. The contactless-based method is used for image of hand gesture such as cameras. It is convenient and has low prices.

The ASL classification system proposed in this article employs contactless method based on camera. To offset weakness in contactless method, it presents hierarchical features based on the kinect for the high recognition rate [3].

The rest of this article is organized as follows. In Section 2, the proposed method is introduced. The experimental results and conclusions are described in Section 3.

2 The Proposed Method

The proposed recognition system is shown in figure 1. This has three steps. The first step is an execution of the preprocessing for hand region. The second step involves

hierarchical features construction. The last step is the classification of the hand gestures using BP [4][5]. Finally, the proposed recognition system finds the most accurate hand gestures.

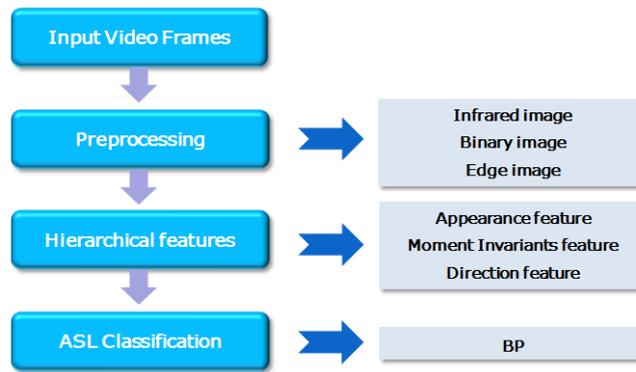


Fig. 1. The process of proposed method in this article.

In first step, the obtained images are used in hierarchical features of next steps. In detail, the second step can be describe as follow:

Hierarchical features are computed from obtained images (infrared image, binary image, and edge image)[6]. Hierarchical features consist of appearance, Hu-moment invariants, and direction features. First, the appearance feature calculates circularity and eccentricity. And then, ASL is classified by K-means using them (circularity sets x-axis and the eccentricity sets y-axis). Next, the moment invariants features are used to recognize hand gestures by back-propagation(BP). Finally, the direction feature can accurately classify similar gestures like G and Z, I and J, U and H.

5 Experimental Results and Conclusions



Fig. 2 ASL recognition results (G and Z).

Figure 2 shows The resulting images of ASL recognition about G and Z. In each figure, a top right image is RGB image, a bottom right image is hand detection image

in infrared image. And five top left images are binary image deleted inner noise, edge detection image, a depth invariants image, an infrared image, and a binary image by turns. Consol window indicates width, height, the number of pixels in hand region, edge length, area, circularity, eccentricity, moment values and angle value. Finally, a bottom center image is recognition resulting image.

Table 1. The comparison of the recognition rate and average processing time for each method.

	Methods		
	The method based on contour	The method without direction	The proposed method
Recognition rate(%)	93.81	95.21	97.15
Sec/frame	0.046	0.039	0.041

Table 1 indicates the comparison of the recognition rate and average processing time for each method. The recognition rate of the proposed method is higher than other methods. Through experiments, the proposed method can increase the recognition rate at about 3.34%. In case of the proposed method, it takes 0.041 s to process one frame. Owing to extracting direction information, it is slower than the method without direction. However, the proposed method is faster than the method based on contour and it is sufficient time to recognize ASL in real time.

In this article, we improve the recognition rate through the experiment of various gestures. By using the hand gesture recognition system, application of the complex shape recognition is expected in future.

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