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Image Analysis Technology in the Automatic Measurement of Garment Dimensions

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Abstract: The measurement of garment dimensions remains as a very important problem in garment making engineering. This study proposes a novel approach based on image analysis technology to cope with the automatic measurement of garment dimensions. First, a fuzzy entropy based image enhancement algorithm was proposed for enhancing the degraded original garment image. Then, a fast fuzzy edge-detection algorithm was used to detect the edges of garment. Finally, the key corner points were found based on Freeman chain codes. It can be seen from the experimental results that the proposed approach can detect the edges and corners of garment image exactly. In addition, this method can be realized easily and be processed very quickly.

Key words: Garment dimensions, automatic measurement, image analysis

INTRODUCTION

The measurement of garment dimensions is a very important problem in garment making industry. Traditional approaches for this problem are mainly based on manual measurement. However, the traditional approaches are greatly affected by human factors, so the precision of measurement cannot be satisfied. In addition, the low efficiency of these approaches makes the work of measuring a bottleneck of procedure in production. The use of image analysis to replace human vision is now widespread in industrial manufacture; there are many benefits in reducing fatigue and improving speed, consistency and cost effectiveness. The image analysis system is referred to realizing visual function of human, i.e. realizing the recognition of three-dimensional objective world, by means of computer. To be precise, the system can understand the observed object's shape, size, distance away form the observational point, texture, motion feature (such as direction, velocity) and so on. This paper focuses on the inspection of the measurement of garment dimensions using image analysis technology. The main related image analysis methods are proposed.

GARMENT IMAGE ENHANCEMENT BASED ON FUZZY ENTROPY

In analysis of garment images, It have to deal with many degraded images with ambiguous situations. Ambiguity caused by projecting a 3-D object into a 2-D image or digitizing analog images in digital ones and uncertainty related to boundaries and non-homogeneous regions are very common. Fuzzy entropy is a very useful mathematical tool for handling the ambiguity or uncertainty[1].

The membership of fuzzy entropy is defined as

$$\mu(x, F_e, F_d) = \left(1 + \frac{L-x}{F_d}\right)^{-F_e} \quad (1)$$

where x is the variable in the intensity domain F_e and F_d are two parameters which determine the shape of membership function. These two parameters can be selected by maximizing the fuzzy entropy through a genetic algorithm. The fuzzy entropy $H_{[f]}$ can be defined as[1]

$$H_f(A,M,\phi,\mu_A(x)) = \frac{-1}{\log M}\sum_{i=1}^{M} P_s(A_i)\log P_s(A_i) \quad (2)$$

Where A denotes the fuzzy event, *M* is the number of partitions in the fuzzy domain, ϕ is a parameter determining the equal partition or non-equal partition, $P_{[s]}(A_{[i]})$ is defined as

$$P_s(A_i) = \sum_{\mu_A(x)\in A_i} P(x) \quad (3)$$

whereP (x) is the probability of *x* in the intensity domain. In our problem, M can be set before the enhancement procedure and equal partition can be applied. Then the genetic algorithm is used to maximum the fuzzy entropy. As a result, the degraded garment can be enhanced.

EDGE-DETECTION USING A FAST FUZZY ALGORITHM

This study adopts a fast fuzzy edge-detection algorithm[2]. This algorithm introduces the simple

membership function. It transforms the image into membership matrix on the one hand and then transforms the matrix into image again. As a result the time of the operation is reduced. The algorithm steps is as following:

- Define a membership function and make G transform

$$\mu_{mn} = G(l_{mn})\ l_{mn}/(L-1) \quad L=\max(l_{mn}) \tag{4}$$

where l_{mn} is the original image matrix.

- Make $T_{[r]}$ transform according to the following formula

$$\mu_{mn}' = T_r(\mu_{mn}) = \begin{cases} 2(\mu_{mn})^2 & 0 \le \mu_{mn} \le \mu_c \\ 1-2(1-\mu_{mn})^2 & \mu_c \le \mu_{mn} \le 1 \end{cases} \tag{5}$$

usually, the iterative time r is assumed as 2 or 3, if r is 1, the enhancement is not enough.

- Make G^{-1} transform according to the following formula

$$l_{mn}' = \mu_{mn}'(L-1) \tag{6}$$

thereby the image is enhanced.

- Detect the edge using min or max operator, the edge-matrix is as

$$E_{edge} = \left[l_m n''\right]_{M\times N} \tag{7}$$

Where;

$$l_{mn}'' = \left| l_{mn}' - \min_{W}\left\{l_{ab}'\right\} \right|, \quad (a,b) \in W \tag{8}$$

The advantage of this fast fuzzy edge-detection approach is adopting simple function, avoiding plenty of floating point operation and cutting down the computation time.

When the edge-detection is finished, the most important problem is how to locate the corners of thegarment such as the neckline£¬the cuff of the garment. In the past years, many image processing methods have been proposed for finding the corners[3-5]. In this paper, we describe boundaries with Freeman chain codes, then found corners by comparing the distances between the ends of segments[6].

EXPERIMENTAL RESULTS

We apply our methods on a real garment image analysis. The original degraded garment image is show in Fig. 1. This image is obviously no stable for further processing, so we use our fuzzy entropy based method to enhance it. The enhanced image is shown in Fig. 2. Then the fast fuzzy algorithm is used to find the garment edges and the corners are correctly located based on Freeman chain codes. This result is shown in Fig.3.

Fig. 1: The original degraded garment image

Fig. 2: The enhanced garment image

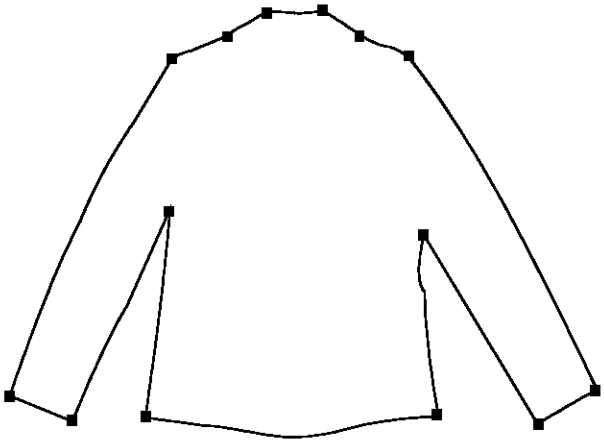

Fig. 3: The result after edge finding and corner locating

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CONCLUSION

This study proposes image analysis methods for automatic measurement of garment dimensions. The proposed fuzzy entropy based image enhancement algorithm is suitable for enhancing the degraded original garment image. The fast fuzzy edge-detection algorithm can detect the edges of garment correctly and quickly. Based on the found edges of garment image, the key corner points were found based on Freeman chain codes. This image analysis approach can be realized easily and be processed very quickly.

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