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Fast recognition of foreign fibers in cotton lint using machine vision

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ABSTRACT

This paper presents an approach for fast segmentation of foreign fiber images and precise recognition of foreign fiber objects using machine vision. Live images were acquired in real time using a line scan CCD camera. After an image was acquired it was transferred to a host computer immediately for image processing and object classification. The captured image was firstly segmented according to the mean and standard deviation of R, G and B values of each pixel in the image. Then noises were removed using the area threshold method. Afterwards, color features, shape features and texture features of each foreign fiber object were extracted. Finally, a one-against-one directed acyclic graph multi-class support vector machine (OAO-DAG MSVM) was constructed and used to perform the classification. The results indicate that the image processing algorithm is fast and precise; the OAO-DAG MSVM gets a mean accuracy of 92.34% and a mean classification time of 12 ms, which can satisfy the accuracy and speed requirement of online classification of foreign fibers.

1. Introduction

The foreign fibers in cotton refer to those non-cotton fibers and dyed fibers, such as hair, binding rope, plastic film, candy wrapper, polypropylene twine, etc., which are accidentally mixed with cotton during picking, storing, drying, transporting, purchasing and processing [1]. Most of them were sorted out after cotton ginning, but some of them still remained in the cotton lint. The remaining foreign fibers affect the quality of the final textile products seriously. A machine vision system for online measurement of the content of foreign fibers in cotton lint is now being studied. High quality image acquisition, fast image processing, effective feature extraction, accurate object classification and precise content measurement are key factors in the implementation of the system. Fast image processing and accurate object classification will be discussed in detail in this paper.

Image segmentation is one of the key techniques in image processing and machine vision system, and is the precondition of image analysis and pattern recognition. The aim of image segmentation is to partition an image into meaningful connected components to extract the features of the objects [2]. Various image segmentation methods are available in the literature [3–7] and some of them are used in machine vision system in agriculture [8–10]. Fast and precise segmentation is an ongoing research work in image processing.

The aim of classification is to sort each element of a data set into one of the finite sets of classes utilizing a decision criterion [11]. Statistical, neural network and fuzzy logic are three traditional methods employed to perform classification. These traditional methods are based on a hypothesis that the training examples are very large even close to infinite. When only a small number of samples are available, overfitting becomes the main problem. Support vector machine (SVM) introduced by Vapnik [12] is a state-of-the-art classification method which can avoid overfitting effectively.

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