Fabric Defect Detection Using Fuzzy With Pso And Cascaded Random Forest

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Abstract— *Defect detection on a fabric surface is one of the most important tasks of an automated visual inspection system. The most modern defect detection systems are required to operate in real-time and handle high-resolution images. One of main difficulties in system applications is that it cannot be used for general inspection of various types of surface without tuning the internal parameters. In this paper, we demonstrate how to solve the problem mentioned above by using efficient Clustering method and applying it to the Cascaded Random-Forest-based machine learning algorithm. Improvised Fuzzy with Particle Swarm optimisation is used to segment the defect Region in the Fabric. The Different types of Feature Extraction method can be applied generally to various types of surface and defect. For effective learning and reduction of false detection cascaded random forest and improvised Fuzzy with PSO methods are introduced. The experimental results demonstrate reliable fabric defect detection for various surface types without changing parameters.*

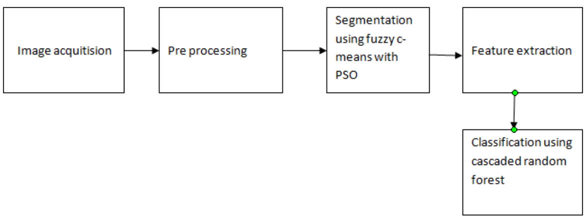
Keywords—Fabric Defect, Preprocessing, Fuzzy with PSO, Cascaded Random Forest

1. INTRODUCTION

Digital image recognition technology to solve the fabric defect in textile enterprises in recent years. Fabric defect detection system has been in research and application stage in the United States, Germany and other developed countries, while only a small number of research and development reports and some immature products in our country. In this paper, aim at the development status of fabric defect detection [3] use efficient image processing and analysis algorithms, combine with the ideas of distributed network processing, put forward a fabric defect detection systemthat adapts to current domestic enterprises. The system uses image- recognition technology, through the fabric digital image preprocessing and recognition measures the fabric defects which have been identified, and stores related information in order to achieve the automatic of fabric defect detection, improve the efficiency of defect detection.

2. PROPOSED WORK:

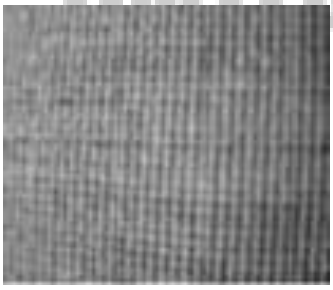
In the proposed work ,effective segmentation method is done using fuzzy cmeans along with paertical swarm optimisation. This provides the segmention with better segmentation result.the feature extraction is done using GLCM and Statistical feature extration. From the feature extractionn result the classification is done using cascaded random forest



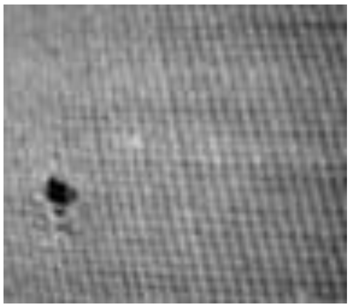
3. MODULES:

Image Acquisition:

A fabric database image of different size is collected. It can be a colour image or black and white image . The collected image is given as input and it is used for futher processing.



(A)



(b)

Figure.1 a).Normal fabric b).Abnormal fabric

Figure.1 shows the normal and abnormal input images for the process of detection of defect in fabric using fuzzy pso and cascade random forest machune learning algorithm

4 Image preprocessing:

In preprocessing section, the input image may be in different size, cointains noise and it may be in different colour combination. These parameters need to be modified according to the requirement of the process. Image noise is most apparent in image regions with low signal level such as shadow regions or under exposed images. There are so many types of noise like salt – and – pepper noise, film grains etc., All these noise are removed by using filtering algorithms[9]. Among the several filters, weiner filter is used. In preprocessing module image acquired will be processed for correct output. Pre-processing was done by using some algorithm. For all images the pre- processing should be done so that the result can be obtained in the better way. To find out the transformation between two images precisely they should be pre processed to improve their quality and accuracy of result. If these images are too noisy or blurred, they should be filtered and sharpened.figure2 shows the noisy image of fabric.

Noise removal using filtering techniques for improve the efficiency of the process. Pre processing is a common name for operations with the images at the lowest level of abstraction both input and output is the input images. The aim of pre processing is an improvement of image data that suppress unwanted image data distortions or enhance the some image features important for the further processing.

Figure.2 shows a) the salt and pepper noisy images

Four categories of image pre- processing methods according to the size of pixel neighborhood that is used for the calculation of new pixel brightness:
1). Pixel brightness transformations 2). Geometric transformations
3). Pre-processing methods that use a local neighborhood of the processesd pixel,
4). Image restoration that requires knowledge about the entire image
If pre processing aims to correct some degradation in the image, the nature of a priori information is important:
1.Knowledge about the nature of the degradation; only very general properties of the degradation are assumed,

2.Knowledge about the properties of the image acquisition device, the nature of noise (usually its spectral characteristics) is sometimes known,

3.Knowledge about objects that are searched for in the image, which may simplify the pre- processing very considerably .If knowledge about objects is not available in advance it can be estimated during the processing.

5 SEGMENTATION PROCESS:

Fuzzy c means with particle swarm optimisation (PSOFCM)

A new Fuzzy c-Means Clustering Algorithm based on Particle Swarm Optimization (PSOFCM) is presented to identify the defected image. after analyzing the advantages and disadvantages of the classical fuzzy c-means clustering algorithm. It avoids the local optima, and also is robust to initialization [1].

Particle component analysis:

PSO has been originally introduced in terms of social and cognitive behavior by Kennedy and Eberhart. The individuals, called particles, are flown through the multidimensional search space. Each particle tests a possible solution to the multidimensional problem as it moves through the problem space. The movement of the particles is influenced by two factors, the particle's best solution (pbest) and the global best solution found by all the particles, which influence the particle's velocity through the search space by creating an attractive force. As a result, the particle interacts with all the neighbours and stores in its memory optimal location information. After each iteration the pbest and gbest are updated respectively if a more optimal solution is found by the particle or population. This process is continued iteratively until either the desired result is achieved or the computational power is exhausted.

Fuzzy c means:

Fuzzy clustering (also referred to as soft clustering or soft k-means) is a form of clustering in which each data pointcan belong to more than one cluster. Clustering or cluster analysis involves assigning data points to clusters such that items in the same cluster are as similar as possible, while items belonging to different clusters are as dissimilar as possible. Clusters are identified via similarity measures. These similarity measures include distance, connectivity, and intensity. Different similarity measures may be chosen based on the data or the application.

Fuzzyc-means with PSO

Firstly, we provide PSOFCM algorithm. In the context of clustering, a single particle represents the c clustering centers vectors. A swarm represents a number of candidate clustering centers for the current data vectors. The PSOFCM algorithm is iterative and consists of the following steps:

1. Initialize an array of particles with random positions and velocities on s dimensions. Each

particle contains c clustering centers which have been selected randomly. Fix the constants 1 2 c , c

2. for t=1 to tmax do a) for each particle i do

b) for each data vector i.Calculate the Euclidean distance using (5) to all clustering centers. 6056 ii.Calculate the fitness using (9).

c) Update the gbest and pbest positions. d) Update the clustering centers using (1) and (2)

3. Output the resulting fuzzy partition matrices and fuzzy clustering centers. where tmax is the maximum number of iterations. The experiment shows PSOFCM algorithm presents the fluctuation which attributes to the essence of PSO algorithm, which is a population-based stochastic search process, the change of the particle's position and velocity has very great randomness. After analysis, we find the step 2 can further be improved by selecting the evolutional swarm with the result of the FCM algorithm and adding the norm termination criterion of the original FCM algorithm. So the step 2 is mended as follows:

2. while (t < tmax & || ffg (t)ʳË ffg (t+1) || >İ) do

a) for each particle i do

b) for each data vector

i. Calculate the fitness using (9), mark as originalfitness(i).

ii. Calculate the fuzzy partition matrix using (7). Update the c fuzzy clustering centers using (6). Get the new fitness through the update clustering centers, mark as update-fitness(i).

c) Choose the better half from the fitness, including original-fitness and update-fitness, and label their corresponding particles separately in order to compute one's own pbest, which are the evolution particle of next time.

d) Update the gbest and pbest positions. e) Update the clustering centers using (1) and (2). where ffg is the maximum of the fitness. We define this approach as improved PSOFCM. We can get the optimum of the FCM through the improved PSOFCM. Our approach combines FCM with PSO, and let them run at the same time, in addition, combine the evolutional result criterion and original termination criterion. Do it in this way, not only improved the clustering analysis performance but also improved the speed of Convergence of the algorithm. Below is the figure .3 shows the defected part of fabric

Figure. 3 defected part of fabric Feature extraction:

In machine learning, pattern ecognition and in image processing, feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction.

When the input data to an algorithm is too large to be processed and it is suspected to be redundant (e.g. the same measurement in both feet and meters, or the repetitiveness of images presented as pixels), then it can be transformed into a reduced set of features (also named a feature vector). Determining a subset of the initial features is called feature selection. This method involves Statistical and GLCM for fabric defect detection and Classification[8-9].

Statistical features:

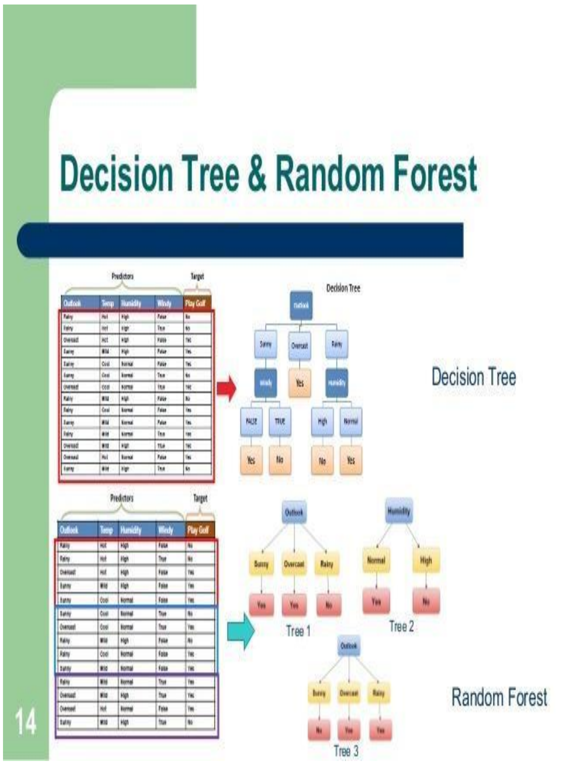
Statistics is the study of the collection, organization, analysis, and interpretation of data. It deals with all aspects of this, including the planning of data collection in terms of the design of surveys and experiments. This is the meaning of statistics. Statistical feature of image contains

- Mean
- Variance
- Skewness
- Standard deviation

GLCM

Texture Analysis Using the Gray-Level Co-Occurrence Matrix (GLCM). A statistical method of examining texture that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix.

For statistical confidence in the estimation of the joint probability distribution, the matrix must contain a reasonably large average occupancy level. Achieved either by



a) Restricting the number of amplitude quantization levels (causes loss of accuracy for low-amplitude texture),
(b) Using large measurement window. (causes errors if texture changes over the large window). Typical compromise: 16 gray levels and window size of 30 or 50 pixels on each side. Now we can analyze

- maximum probability entry
- element difference moment of order k: P i P j (i − j) k cij This descriptor has relatively low values when the high values of C are near the main diagonal. For this position operator, high values near the main diagonal would indicate that bands of constant intensity running "1 pixel to the right and 1 down" are likely. When k = 2, it is called the contrast:

- Contrast = P i P j (i − j) 2 cij
- Entropy = − P i P j cij log cij This is a measure of randomness, having its highest value when the elements of C are all equal.

Figure.4 represents the cascaded random forest

- Uniformity (also called Energy) = P i P j c 2 ij (smallest value when all entries are equal)

- Homogeneity = P i P j cij 1+|i−j| (large if big values are on the main diagonal)

The gray-level co-occurrence matrix can reveal certain properties about the spatial distribution of the gray levels in the texture image. For example, if most of the entries in the GLCM are concentrated along the diagonal, the texture is coarse with respect to the specified offset.

Classification using cascaded random forest

Cascaded random forest:

A Random Forest consists of several independent decision trees are- ranged in a forest [2]. A majority vote over all trees leads to the final decision. In this paper we propose a Random Forest framework which incorporates a cascade structure consisting of several stages together with a bootstrap approach.

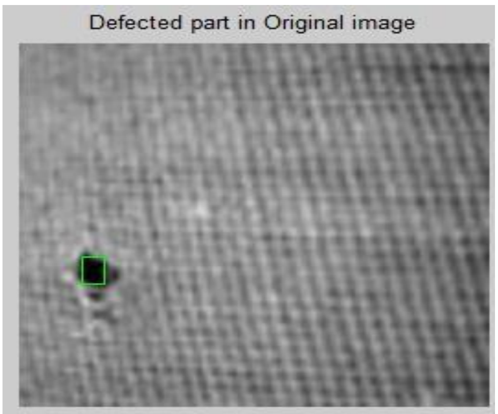
The proposed algorithm, named cascaded random forest, aims to take advantage of both the discriminative information and local structural information provided by the limited labeled and massive unlabeled samples, thus providing better class separability for subsequent classifications of normal and abnormal fabric.

RF is a combination of tree predictors in which each tree depends on the values of a random vector sampled independently and with the same distribution for all trees in the forest shown in figure 4. In the training stage, RF creates multiple decision trees and each trained sample is selected by the bootstrapped method from the original training samples. The final output is determined by a majority vote of the results derived from the individual trees. This enables RF to deal with the image, and the computation time is generally less than conventional ensemble approaches.
Figure.5 defected part in original image

Figure 5 shows the result of fabric defect detection using cascaded random forest algorithm, and it is more accurate and efficient than existing algorithms.

Conclusion:

Quality is a very important factor in textile industry. In our work, we tried to implement a system based on image processing and neural networks to detect and identify three fabric defects (missing threads, oil stains and holes). Our system works according to four steps. We begin by capturing the image, then we eliminate parasite information and increase the sharpness of the image by image analysis. After that, we determine three parameters witch characterize the



mentioned defects (the rate of straight lines, the rate of dark areas and the rate of voids). Finally we apply a neural network to recognize the category of defect present on the fabric.

REFERENCES

[1] Particle Swarm Optimization for Fuzzy c- Means.Clustering.Li Wang, Yushu Liu and Xinxin Zhao Yuanqing XuSchool of Computer Science and Technology, School of Chemical Engineering and Environment,Beijing Institute of Technology Beijing Institute of Technology Beijing, China Beijing, China

[2] Cascaded Random Forest for Fast Object Detection ∗ Florian Baumann, Arne Ehlers, Karsten Vogt, Bodo Rosenhahn Institut fur Informationsverarbeitung, ¨ Leibniz Universitat

[3] A Kumar and G.K.H. Pang, "Defect detection in textured materials using Gabor filters", IEEE Trans. Ind. Appl., vol. 38, no.2, pp. 425-440, 2002.

[4] Hannover, ¨ Appelstraße 9a, 30167 Hannover, Germany K. Srinivasan, P. H. Dastoor, P. 3)A Serdaroglu, A Ertuzun, and A Ercil, "Defect detection in textile fabric images using wavelet transforms and independent component analysis ", Journal Pattern Recog- nition and Image Analysis 16 (2006), no. 1, 61- 64.

[5] J. S. Lane and S. C. Moure, "Textile fabric inspection system," U.S. Patent 5 774 177, 1998. [9] E. J. Wood, "Applying Fourier and associated transforms to pattern charecterization in textiles," Textile Res. J., vol. 60, pp. 212-220, 1990.

[6] C. Chan and G. K. H. Pang, "Fabric defect detection by Fourier analysis", IEEE Trans. on Ind. Appl, vol 36, no.5,ppI267-1276 Oct 2000

[7] WANG Sanwu, Zhao Ying, Liu Tao, "Fabric Defect Automatic Detection Research Method Based on Computer Vision ", Modern Machinery, 2008.5, pp62-64.

[8] Xue Tongze, Cui Bo "Fabric Defect Detection Research Based on Computer Image Recognition Technology ", Instrument Technology and Sensors, 2008.6, pp109-112.

[9] X. Xie. “A Review of Recent Advances in Surface Defect Detection using texture analysis Techniques”, Electronic Letters on Computer Vision and Image Analysis, 7(3), pp. 1- 22, 2008.

[10] A. Kumar. “Computer Vision-based Fabric Defect Detection: A Survey”, IEEE Transactions on Industrial Electronics, 55, pp. 348-363, 2008.

[11] J. Garson. “Connectionism”, Stanford Encyclopaedia of Philosophy, Stanford University, 2012.