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An Intelligent Cloth Quality Analysis and Reduction of Man Power in Image Processing

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Abstract*:*- Textile industries are one of the major revenue generating industry. So greater efforts are taken in manufacturing good quality of fabrics. Defects in fabric are the major threat to textile industry. Textile industries mostly prefer manual inspection strategy for detection of faults. Later automation is made through image processing technique. Traditional inspection process for fabric defects is by human visual inspection which is inefficient, costly and time consuming. To enhance the accuracy of fabric defects detection, and save human from this tedious and stressful work, so in this paper automated fabric inspection system has been proposed. To automate this process, the fault present on the fabrics can be identified using MATLAB with Image processing techniques.

Keywords*:-* *median filter; Histogram equalization; Discrete wavelet transform; Fuzzy-C Means (FCM); Support Vector Machine (SVM).*

I. INTRODUCTION

This automated inspection of industrial goods for quality control shows an ever-increasing role in production process as the market exhibits higher demand for quality. In most cases, quality inspection by visual inspection is still carried out by specially trained workers. However, the reliability of manual inspection is limited by ensuing fatigue and inattentiveness. In textile industry the most highly trained inspectors can only detect about 85% of the defects. Therefore, the automation of visual inspection process is required to maintain high quality of products at high-speed production.

Industrial knitting is a complex production process. Fabric quality is strongly influenced by machine parameters, mainly yarn tension, take-off tension, sinker height and rotation speed. Already small maladjustments of the machine's components may lead to fabric defects. A stripe is a knitting defect that occurs if at least one of the yarn feeding systems is misadjusted and applies a different tension to the yarn, caused by misadjusting either tension or sinker height. The fact that stripes can only be detected with a significant delay between production and inspection means that a large amount of fabric may have been produced before a defect is detected and corrected.

II. EASE OF USE

A. Existing system

The Traditional Fabric defect monitoring system used Electron Microscope. SEMs are expensive, large and must be housed in an area free of any possible electric, magnetic or vibration interference. Maintenance involves keeping a steady voltage, currents to electromagnetic coils and circulation of cool water. Special training is required to operate SEM as well as prepare samples. The preparation of samples can result in artifacts. The negative impact can be minimized with knowledgeable experience researchers being able to identify artifacts from actual data as well as preparation skill. There is no absolute way to eliminate or identify all potential artifacts. In addition, SEMs are limited to solid, inorganic samples small enough to fit inside the vacuum chamber that can handle moderate vacuum pressure. Finally, SEMs carry a small risk of radiation exposure associated with the electrons that scatter from beneath the sample surface. The sample chamber is designed to prevent any electrical and magnetic interference, which should eliminate the chance of radiation escaping the chamber. Even though the risk is minimal, SEM operators and researchers are advised to observe safety precautions. Hence an automated fabric inspection system based on image processing were introduced.

B. Proposed system

The automated fabric inspection system reduces false acceptance and false rejection rates and hence, the results are reliable and reproducible. The systems are robust and flexible and adapt automatically to achieve consistently high performance despite irregularities in illumination, or background conditions and accommodate uncertainties like angles and positions. They are fast and cost efficient. These systems are simple to operate, maintain and implement. It increases the efficiency of production and quality of product. By applying image processing techniques for fabric defects inspection, it is easy to identify faults on fabric image. It gives high accuracy compared to old methods. This process is less time consuming. It also reduces the manpower.

III. METHODOLOGY

With the advent of global sourcing, the need for effective quality measurements is more important than ever and there is an increased need for a consistent and comprehensive way to establish the quality of goods, for which automated fabric inspection is an excellent solution. Automatic inspection systems are designed to increase the accuracy, speed and consistency of defect detection in fabrics, which can consequently reduce labour costs, improve product quality and increase manufacturing efficiency. But, the main common alternative to human visual defect detection is the use of a computer vision system to detect differences between images acquired by a camera.

The operation of an automated visual inspection system can be broken down into a sequence of processing stages such as image acquisition, feature extraction, comparison and decision. It is important to note that the success of an automatic inspection system relies on the approach used in each of these steps. The central part of automatic inspection systems is the image processing operations and analysis techniques used. The standard defect detection system consists of five components.

The five components are

(i) Sensing (Image Acquisition)

(ii) Preprocessing

(iii) Feature Extraction

(iv) Detection Scheme

(v) Post Processing.

- *Image Acquisition*

Sensing usually means image acquisition in a defect detection scheme. Different instruments such as line-scan camera, Charge Coupled Device (CCD) camera, webcam could be chosen as the sensor for an automated defect detection system. These devices are used to digitize the fabric into quantized images. The common requirement of acquired images is vibration-free and even illuminations for good quality images. Both on- loom or off-loom fabric needs to be moving steadily in motion during inspection.

- *Preprocessing*

During sensing, quantization errors are commonly introduced to an image during its digitization. Noise, such as background noise or Gaussian noise, is usually found in the input image due to uneven illumination of lighting. The purpose of this step is to eliminate illumination non-uniformity, remove background noise, increase the contrast between defects and backgrounds. In this paper, filtering techniques such as median filter, wavelet transform are sometimes applied to remove the noise in the acquired images. Histogram equalization is a widely used enhancement method to adjust the contrast of images.

- *Feature Extraction*

In this step, a set of known features are extracted from the image to characterize a specific application domain. The purpose is to obtain good classification results based on such features. It is the core process of the whole inspection software. Feature extraction is used to obtain for distinguished features that are invariant to unrelated transformation of the input.

- *Training*

For supervised learning, there exists an intermediate stage called a training stage (or learning stage), between feature extraction and detection. Certain amount of defect- free images will be collected and used as reference images for training. Depending on different feature extraction methods, the training will be fine adjusted to collect the optimum parameters and threshold values in detection. Some researchers like to use neural network classifiers to train defect and non-defect fabrics.

- Detection

Detection scheme, or called testing stage, is a stage to determine if an input sample is defective or not. This step aims at determining the presence of the defects out of the background.

- *Post-processing*

Post-processing may refer to: Image editing in photography. Audio editing software in audio. Differential GPS post-processing, an enhancement to GPS systems that improves accuracy. Video post-processing, methods used in video processing and 3D graphics. Post-processing is an essential stage of additive manufacturing. It's the last step in the manufacturing process, where parts receive finishing touches such as smoothing and painting.

A. *Software Simulation Tool*

Matlab is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include:

- Math and computation
- Algorithm development
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including Graphical User Interface building

B. *Image Processing in Matlab*

Matlab image processing toolbox provides a comprehensive set of reference-standard algorithms and

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workflow for image processing, analysis, visualization and algorithm development. It performs image segmentation, image enchancement, noise reduction, geometric transformations, image registration, and 3D image processing.

Image Processing Toolbox apps performs automated common image processing workflows. It interactively segment image data, compare image registration techniques, and batch process large data sets. Visualization functions and apps let you explore images,3Dvolumes, and videos; adjust contrast; create histograms manipulate region of interest.

Matlab accelerates the algorithms by running them on multicore processors and GPUs. Many toolbox functions support C/C++ code generation for desktop prototyping GPUs and embedded vision system deployment.

C. Fuzzy-C Means (FCM)

Image segmentation plays an important role in medical image processing. Fuzzy c-means (FCM) is one of the popular clustering algorithms for medical image segmentation. But FCM is highly vulnerable to noise due to not considering the spatial information in image segmentation. An improved FCM image segmentation algorithm which takes some spatial features into account. FCM Image segmentation is the procedure in which the original image is partitioned into homogeneous regions. Fuzzy C-Means (FCM) is one such soft segmentation technique applicable for medical images. The performance of this method to obtain an optimal solution depends on the initial positions of the centers of the clusters, the measure of membership degree for each data point, and so on. FCM image segmentation approach which only takes the gray feature into account and ignores the other features is very sensitive to noise.

$$J_m = \sum_{i=1}^{N} \sum_{j=1}^{C} u_{ij}^{m} \left\| x_i - c_j \right\|^2 \quad (1)$$

where m is any real number greater than 1, u_{ij} is the degree of membership of x_i in the cluster j, x_i is the ith of d-dimensional measured data, c_j is the d-dimension center of the cluster, and ||*|| is any norm expressing the similarity between any measured data and the center. Fuzzy partitioning is carried out through an iterative optimization of the objective function.

D. Support Vector Machine (SVM)

Support Vector Machine (SVM) is the most commonly used classification algorithm for disease prediction. It is a supervised learning technique that is used for discovering patterns for classification of data. SVMs were first introduced by Vapnik in 1960s for classification of data. The two elements used for the implementation are the mathematical programming and the kernel functions. The kernel function allows it to search for a variety of the hypothesis spaces. In SVM, classification is performed by drawing hyperplanes. In two class classification, this hyperplane is equidistant from both the classes. The data instances which are used to define this hyperplane are known as support vector. A margin is defined in SVM which is the distance between hyperplane and the nearest support vector. For good separation by this hyperplane, the distance of margin should be as large as possible because large distance gives less error. If the margin is close, then it is more sensitive to noise. For better results of SVM, the features that are given as an input to SVM need to be reduced. To reduce features set, only the useful features are selected from the entire set of features

IV. IMPLEMENTATION AND RESULTS

Experiments were conducted by collecting samples from two different large circular knitting machines at different parameter presets to simulate different production scenarios. Table I gives detailed information on machine settings and image acquisition for each of the three sample sets. All samples were produced using 250 dtex, 68 filament highly intermingled and texturized polyester yarn. Two defective fabric samples and one defect-free sample were produced in each session. For the defect-free samples, all yarn tensions were set to 6 cN, while stripe defects for the two defective sets were induced by increasing the tension of one of the yarns to 8 and 10 cN respectively. All samples were photographed using a 5 megapixel industrial color camera at a resolution of 20 pixels per mm using a white backlight panel for illumination. Subsequently, each resulting image was divided into 20 patches of 50% image height and 10% image width to increase the number of training and test samples, resulting in the numbers given in

Parameters	Set 1	Set 2	Set3
Machine (both Beck GmbH2)	BSM 3.0	BSJEM1.3	BSJEM1.3
Cylinder diameter [inch]			
Needles per inch	30	19	19
Equipped yarn	24	16	16
feeders	18	4	10
Image patches with defect	960	480	480
Image patches with defect	480	240	240

Table - 1 Machine Parameter Setting

A. Algorithms used

There are 3 stages in this algorithm

- *Preprocessing stage*
- Filter selection in noise reduction.
- Threshold in edge detection.

- *Feature extraction stage*

- Probability of selecting neighboring pixels.
- Width of the profile.
- The distance between tracking point and cross point.
- The number of repeated times.
- Threshold in binarization.
- Threshold in spatial reduction

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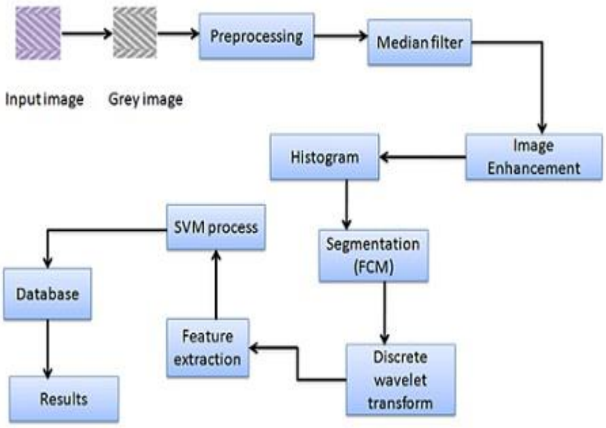
- *Matching stage*
  - Displacement between two templates.

B. Block diagram



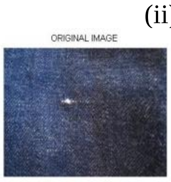
The fabric is continuously monitored to detect the part of the fabric with defect. It is captured using a industrial color camera with a high resolution of 0.264(no unit). The captured digital image is converted into gray scale image to reduce complexity in processing a colored image with a wide pixel range. Hence the gray scale converted image is preprocessed to remove noises in the image and involves filtering using median filter. The image enchancement is carried out using thresholding and histogram equalization. The image is then segmented using FCM segmentation which involves

1. Convert image into feature space of clustering method (usually is used RGB color space, but IHS, HLS, L*u*v* or L*a*b* color spaces are used too).
2. Run fuzzy c-means method on converted image.
3. Use some defuzzification rule or rules to classify each pixel to segment. Simple defuzzification rule is based on maximal membership grade of pixel to cluster.

The segmented image is fed to the SVM classifier which classifies the material as defect or defectless after being compared with the database.

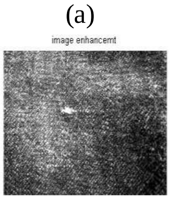
It classifies the image as

(i) Defect _TOO LARGE
(ii) Defect _TOO SMALL

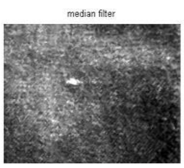


(a)

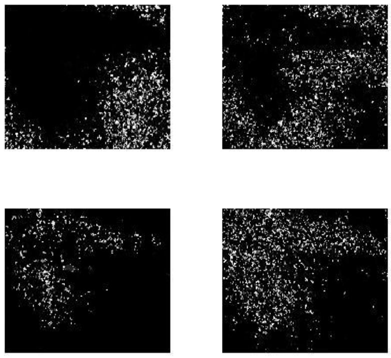
(b)



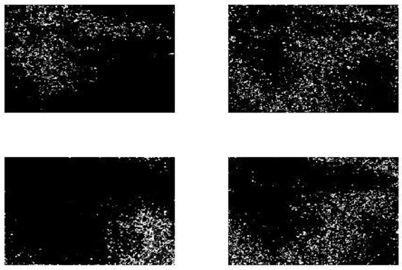
(c)



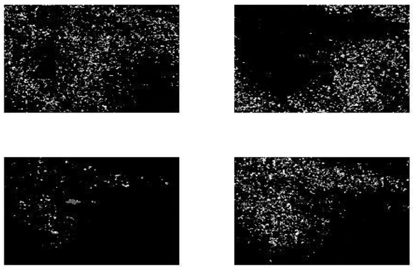
(d)



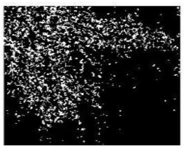
(e)



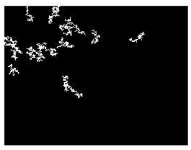
(f)



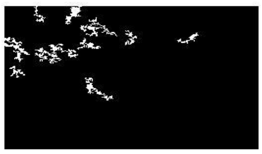
(g)



(h)



(i)



(j)

Figure -1 (a) Original image

(b) Gray scale image

(c) Enchanced image

(d) Median filtered image

(e) FCM Segmented image - 1

(f) FCM Segmented image - 2

(g) FCM Segmented image – 3

(h) FCM Segmented image – 4

(i) FCM Segmented image - 5

(j) Input fed to SVM classifier

V. CONCLUSION

This paper presented a method for automated enhancement and detection of subtle periodic defects such as stripes in knitted fabric. It was shown that the suggested pipeline allows both a visual enhancement of defect appearance for manual inspection as well as training of a machine learning-based classifier for detecting defects automatically. The method shows excellent classification rates on the current samples. Combined with a mathematical morphology filter, a satisfactory detection rate is obtained on the knitting machine. The proposed method has a detection rate up to 98.9%. Future work includes adapting and validating the approach on larger and more complex datasets, introducing new defect classes as well as integrating the pipeline into an online inspection system that makes it possible to detect defects without delay and possibly leads to automatic online readjustment of machine settings based on image data.

- In textile industry we can detect the fault in real image & can be remove the fault by using advanced control system.
- In textile industry fault can be detected through wireless in consent people.

In this paper we use MATLAB software but in future can be used new software like SCILAB, Virtual LAB & Computer Vision.

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