Detection and Location of Defects in Handloom Cottage Silk Fabrics using MRMRFM & MRCSF

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***Abstract*— The inspection of real fabric defects is particularly challenging due to the large number of fabric defect classes. Fabric defect detection is of great importance for the quality control in the textile industry. It is reported that the price of fabric is reduced by 45%-65% due to the presence of defects, which results in the emergence of intelligent inspection systems to ensure the high quality of products. This paper mainly focuses on detecting various kinds of defects that might be present in a given fabric sample based on the computer vision of the fabric, with more emphasis for silk fabrics.**

***Index Terms*—Silk Fabric, Gray Level Co-occurrence Matrix(GLCM), Multi Resolution Markov Random Field Matrix(MRMRFM), Multi Resolution Combined Statistical and Spatial Frequency(MRCSF), Texture, Fabric Automatic Visual Inspection (FAVI).**

I. INTRODUCTION

Fabric defect detection is an important part of quality control in the textile industry. Usual methods of fabric inspection on the production line is done essentially by the worker on the circular knitting machine by introducing a light source in the middle of the circular product which enables the worker to detect the produced defects, and then stop the machine immediately. Stress and fatigue happens to the worker due to inspection in case of higher and quicker productivity. However, the method has been both time consuming and has lower accuracy of detection. To increase accuracy, many experts and researchers have presented a lot of detection methods based on automated visual systems, in which defect detection based on wavelet transform has been a popular alternative for the extraction of textural features.

A. FAVI system

Fabric Automatic Visual Inspection (FAVI) system is an attractive alternative to human vision inspection. Based on advances in computer technology, image processing and pattern recognition, FAVI system can provide reliable, objective and stable performance on fabric defects inspection.

A good automated system means lower labor cost and shorter production time. There are numerous reported works in the past two decades during which computer vision based inspection has become one of the most important application areas [1].

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B. Texture Analysis

Texture analysis is used in many applications field like textile industrial, agricultural, remote sensing and biomedical surface inspection. For example, identification of defects in textile fabrics, disease identification in human organs, classification and segmentation of satellite imagery, segmentation of textured regions in document analysis, and many more. The major issues in the real world textures are not uniform due to changes in orientation, size or other visual appearance and also the measurement of texture features are very high computational complexity.

Texture is the repetition of image patterns, which may be perceived as being directional or non-directional, smooth or rough, coarse or fine, regular or irregular, etc.

The fabric texture usually is made of the repetition arrangement of warp and weft. Textile Fabric [2] materials are used to prepare different categories and types of Fabric products in the textile industry. Natural fabric and synthetic fabric are the two different classification of textile fabric. Synthetic fabrics are fairly new and have evolved with the continuous growth in textile industry.

II. PREVIOUS WORK

There have been four surveys of the FAVI: in 1982 by Chin and Harlow [3], in 1988 by Chin [4], in 1995 by Newman and Jain [5] and Thomas et al. [6].

Many attempts have been made in the past three decades to solve these problems. These attempts have been based on three different approaches: statistical, spectral, and model based. In statistical approach, gray-level texture features extracted from co-occurrence matrix [7], mean and standard deviations of sub-blocks [8], autocorrelation of sub-images [9], and Karhunen-Loeve (KL) transform [10] have been used for the detection of fabric defects. Bodnarova et al. [11] made use of normalized cross-correlation functions for detecting defects in fabrics. There exist many model-based techniques for fabric defect detection. For example, Cohen et al. [12] used a Markov random field (MRF) model for defect inspection of fabrics. Chen and Jain [13] used a structural approach to detect defects in textured images. Atalay [14] has implemented an MRF-based method on TMS320C40 parallel processing system for real-time defect inspection of fabrics. Attempts have also been made by Sabeenian and Paramasivam [15 – 16] to implement some of the above said features in a soft core processor. A much new technique of fabric defect detection has been implemented by Sabeenian and et.al in [17] using Multi Resolution Combined Statistical and spatial Frequency Method.

III. FABRIC DEFECTS

Fabric texture refers to the feel of the fabric. It is smooth, rough, soft, velvety, silky, lustrous, and so on. The different textures of the fabric depend upon the types of weaves used. Textures are given to all types of fabrics, cotton, silk, wool, leather, and also to linen. The objective of the proposed work is to identify whether the silk fabric is defective or not.

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In order to identify the most detrimental defects in textile fabrics, an industry survey was conducted to identify the most frequently occurring defects and the most costly defects as far as points were concerned. Data from leading fabric manufacturers was collected for their typical defects and the number of points lost by each. Broken picks, harness drops, and start marks top the list of the most frequently occurring defects. Broken ends, broken picks, waste and coarse picks were the most costly defects. A wide variety of defects are represented; many defects are a direct cause of machine malfunction while others are from faulty yarns [18].

The various types of defects detected during quality controls are broadly classified as follows.

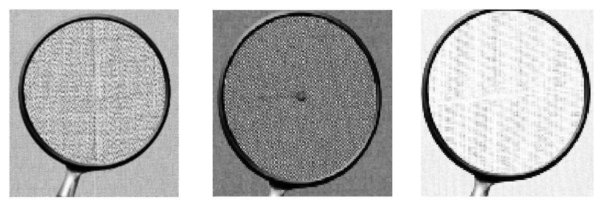
- Critical Defects – Defects which are likely to cause hazard to the health of individuals using it.
- Major Defects – More serious defects which are likely to affect the purchase of the product.
- Minor Defects – Include small faults which have no effects on the purchase of the product.

Some of the commonly occurring fabric defects are discussed here.

A.Yarn Defects

The defects originating from the spinning stage or winding stage. Different types of yarn defects are shown in Figure 1

- **Broken Filaments-**Occurs when the individual filaments constituting the main yarn are broken.
- **Knots-**Occurs when broken threads are pieced together by improper knotting.
- **Slub-**A Slub is a bunch of fibers having less twist or no twist and has a wider diameter compared to normal spun yarn.



Broken Filament Knots Slub

Figure 1. Yarn Defects

B. Weaving Defects

The defects which originate during the process of weaving. Some of the various types of weaving defects are shown in Figure 2.

- **Broken Ends-**This defect is caused by a bunch of broken ends woven in the fabric.
- **Float-**A float is the improper interlacement of warp and weft threads in the fabric over a certain area.
- **Gout-**A gout is a foreign matter usually lint or waste accidentally woven into the fabric.
- **Hole, Cut or Tear-**The occurrence of hole, cut or tear which is self explanatory.
- **Oil or Other Stain-**These are spot defects of oil, rust, grease or other stains found in the fabric.

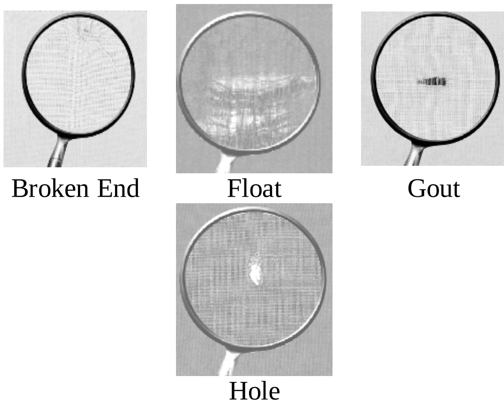


Figure 2 Weaving defects

There are many other defects that might appear in a fabric during manufacturing. A detailed analysis and discussion about the same is available in [18]. Some of the major defects that occur in silk fabric are due to improper handling of the salesman or the customer.

III. PROPOSED METHOD

The main motive for the proposed method is to develop an economical automated fabric defect detection considering the reduction in labor cost and associated benefits. The development of fully automated web inspection system requires robust and efficient fabric defect detection algorithms. Numerous techniques have been developed to detect fabric defects and the purpose of this paper is to propose a better method when compared to other techniques.

A brief overview of the process of MATLAB simulation for the method proposed is shown in figure 3.

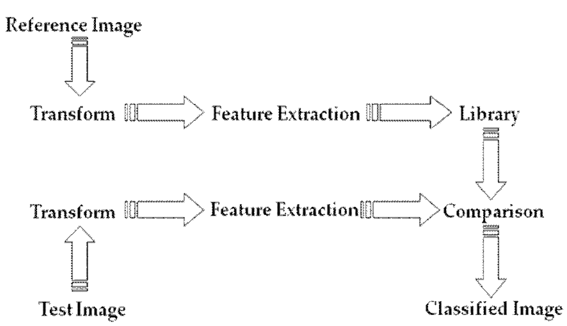


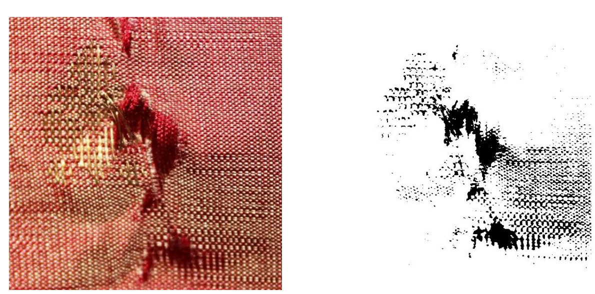
Figure 3 MATLAB Simulation Flow

1. Feature Extraction of original image: This is the initial task in which the original non-defective reference samples are collected and their features are extracted using appropriate algorithm and stored in a database. Before feature extraction the sample images are wavelet transformed so that the samples are localized in both time and frequency. MRCSF Features like mean, standard deviation, energy, entropy, spatial frequency, Multi Resolution Markov Random Field Matrix and Gray Level Co occurrence Matrix (GLCM) for both the reference fabric and the fabric to be tested were extracted using MATLAB and hence compared for classification. All the above mentioned steps are done using MATLAB Image Processing toolbox and Database Toolbox.
2. Capturing and Feature extraction of test sample: This part comes under the classification stage where the test samples are captured using a digital camera which is attached to a shaft which moves over the entire sample. The movement of the shaft is controlled by embedded system which employs a microcontroller. After capturing the sample images the feature are extracted in the same way as in the case of original image.
3. Comparison with Library: In this stage the stored features of the original image and the test sample are compared using the nearest neighborhood algorithm. The test samples are classified as defective or non-defective based on the comparison results.
4. Indication of the Defects: The obtained defect is analyzed for its type using the available database of defects and hence the defect type is displayed on the screen. The location of the defect is also displayed on the screen for the ease of the user.

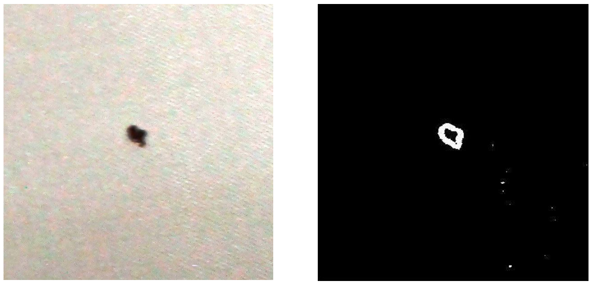
IV. RESULTS

The high definition camera was used for capturing the images from the silk fabric. The grabbed image of size (1024 x 1024) was directly given to MATLAB for processing. Some of the processed outputs are shown in the figure 4 below.

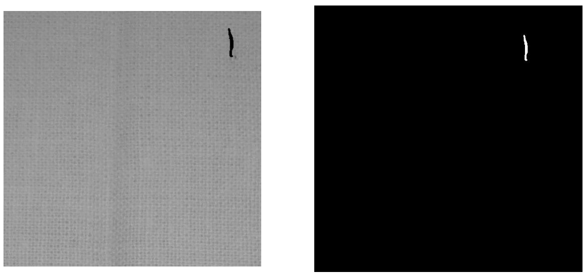
The graphical user interface used for the algorithm is shown in the figure 5. The GUI consists of options to xdisplay the standard library image along with the defective image. The GUI also has the option to display the co-ordinate systems that are defective and non-defective. A MATLAB database has been created for the easy access of the library elements.



Hole Defect Identification in Silk Saree

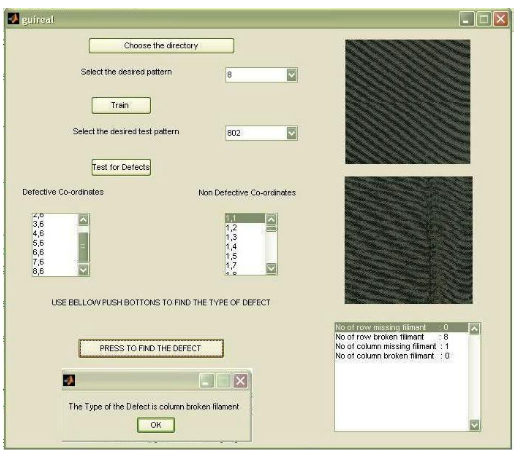


Oil Stain Identification in a Silk Dhoti

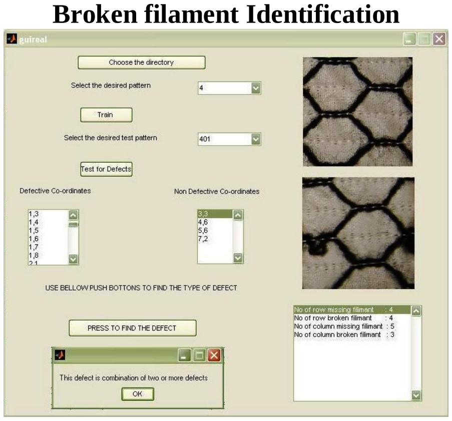


Gout Identification in a Silk Dhoti

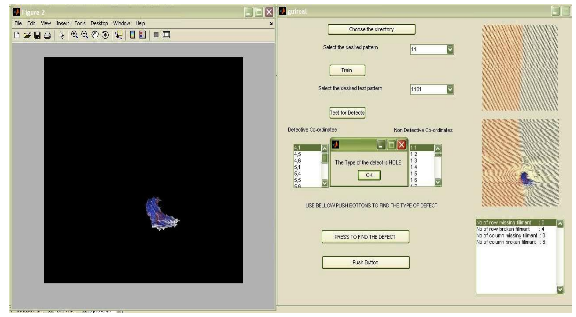
Figure 4 Identification of various defects in silk fabrics by the proposed algorithm



Broken filament Identification



Identification of two or more defects in fabric



Identification of Hole in the Fabric

Figure 5 Graphical User Interface used in the proposed algorithm.

V. CONCLUSION

The Defect detection and location identification in the normal fabrics and silk fabrics are done using the proposed method. The proposed method classifies 85% of defect in fabric and locates the defect in the normal fabric at an acceptable rate. And in case of Silk fabric the proposed method provides 80% classification accuracy. The problem in silk is due to reflection in the silk jaari during the process of image capturing. Now, the authors are trying to overcome such problems by adding some other feature extraction techniques.

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