An Intelligent Fabric Defect Inspection and Detection System Using Image Processing

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Abstract -- In this modern era, people are much conscious on what they wear. Hence delivering a quality product without any defect is the weaver's major concern. Local weavers daily wages are based on the quality product they produce but unfortunate defect due to transportation or some other may reflect their little penny. The existing fabric defect inspection system is made manually and are time consuming. The proposed methodology identifies the fabric defect using crossed area detection. The structure characteristics and texture features are obtained by using Gray Level Co-Occurrence Matrix (GLCM). Crossed area is detected by using a spatial domain integral projection approach. Proposed methodology also encompasses a fabric defect detection using crossed area detection.

Indexed Terms — 2-D Integral projection approach, Crossed-area detection, GLCM.

I. INTRODUCTION

In large scale industries, there is a machine for fabric inspection. These machines are costlier which is not affordable to the local weavers and local shops. There are many possible occurrences of human errors which causes major loss to the weavers. Even after thorough inspection in industries, still there is a chance of defect occurrence due to transportation, packing, etc. Costlier fabric inspection machine that are used in industry cannot be used for commercial purpose. In order to overcome this problem the proposed methodology implements a cost effective system for small or medium textile shops that detect fabric defect before marketing. So that they can supply a quality fabric to the customers and earn more profit. Woven fabrics are formed by the interlacing yarns. There are two basic yarns: "weft" and "warp". Warp refers to long vertical yarns that are wrapped around the looms. Weft refers to the horizontal yarns that are woven through the warp yarns. Any defect in the fabric can be identified by the discontinuity caused due to the defect. Crossed area detection is used to find any discontinuity in the fabric. Initially the acquired fabric image textures are analyzed by using GLCM. Texture is the replication of the patterns. It may be perceived as regular or irregular, coarse or fine, smooth or rough, directional or non- directional, etc.To detect the interlacing area where weft yarn and warp yarn are crossed over each other, a spatial-domain integral projection approach is applied. Thus any discontinuity in the weft or warp could be detected. This technique requires less time and accurate result is obtained.

II. LITERATURE REVIEW

R. Obula Konda Reddy et al., [7] have proposed a system for texture classification. This method is based on the features of GLCM, LBP, LLBP, SLBP and by applying K-NN, SVM and PNN as classification algorithms. First the image is acquired and the intensity of image is then normalized in order to accomplish a local contrast enhancement. This is done by histogram equalization. Binary patterned images are constructed such as LBP, SLBP and LLBP.Local Binary Pattern (LBP) are texture analysis operator is defined as the measure of gray-scale invariant derived from a common definition of texture in classification. Simplified Binary Pattern(SLBP) made the coding number reduced the pattern from 256 to 9.Local Line Binary Pattern(LLBP) is derived from LBP.The major process in all classification and recognition classification is feature extraction. Here GLCM is applied on the image and features are extracted. Thisfeature gives the spatial relationship of pixels and statistical measures. Thesteerable filter is used in this method .It helps to adjust any orientation in image.Atlast classifier is used for similarity and defect classification. Here K-NN, PNN, SVM are used for classifier. In pattern recognition K-NN are used for classifying objects based on closest training

sample in the feature space.[4] Dr. S. Anila et al., have proposed a system for texture analysis and weave pattern recognition. This method is based on the characteristic of woven fabric. i.e weave pattern and yarn count.Weave pattern is the weave that is periodically repeatedly through the entire fabric area. Number of yarns per centimeter is the yarn count. Weave pattern effects on twisting and trimming effect of the fabric gives different appearance to the fabric. Here fabric quality is measured using yarn count. In this system two categories of image are takeni.e. woven materials stimulated from the computer and second is real images taken from different fabric. The real fabric images are scanned using HP scanner. First image acquisition is done and then frequency domain Butterworth filter is applied in order to removenoise. Spatial-domainintegral projection approach is applied to detect interlacing area where weft and warp are closed over each other. The interstices between yarn appear darker grey levels than the pixel surrounding will have lower grey levels. The feature is extracted using GLCM.LDA is applied in order to reduce the redundancy in the feature vector sets and increases the signal.FCM is applied in order to classify a texture feature vectors with k dimensions into two clusters. The average of horizontal and vertical covariablities of each classified cluster are computed.2D FFT is applied in order to determine yarn count.[8]Xin Wang Nicolas et al., have proposed a system for fabric structure using principal component analysis and fuzzy clustering. In this method spatial domain integral projection approach is used in order to find weave pattern and yarn count. Here texture features are identified based on GLCM. It is then optimized by principal component analysis. Then the features are analyzed by FCM for classifying the different crossed area state.

III. METHODOLOGY

The proposed method identifies the defect in fabric using crossed area detection. The major concern associated with successful delivery of the fabric to the customer is fabric defect. This proposed methodology uses crossed area detection to identify any discontinuity in the fabric. Defect identification is carried out by undertaking various steps. These steps involve preprocessing of the obtained image using histogram equalization, texture analysis using GLCM and crossed area detection.

i. Image acquisition and pre-processing

Many computer simulated sample images and real time images of the fabric with and without defect are taken. The RGB colour image is converted into gray scale image. Then the noise present in the image is removed and enhanced using Histogram Equalization
.

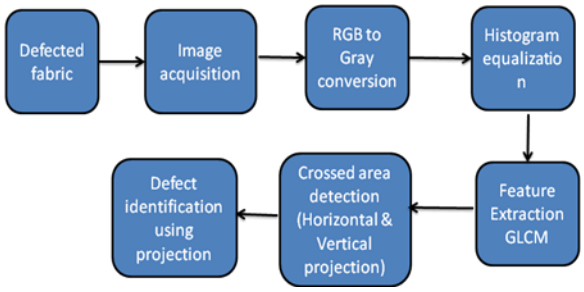


Figure 1. Block diagram for fabric defect identification

ii. Feature extraction using GLCM

Feature extraction is done by using texture analyzing method GLCM (Gray Level Co occurrence Matrix).It is the method for examining texture of the image by using the pixel which has spatial relationship with each other and it is also known as Gray-Level spatial dependence matrix. Texture can be analyzed by using the matrix called gray co matrix. This matrix is formed by calculating how often pairs of pixel with same values and in a specified spatial relationship occur in an image. Then the several statistics value can be obtained by using this matrix. The GLCM texture features that are calculated are

1) Contrast
2) Homogeneity
3) Energy
4) Entropy
5) Correlation
6) GLCM Mean
7) Variance

These features are obtained for various sample images and their statistical characteristics are studied.

iii. Crossed Area Detection

To identify the interlacing area that is the crossed area where weft yarn and wrap yarn are crossed over each

other, a spatial domain 2D integral projection approach is exploited. Intersection of the weft and wrap in the fabric are dark whereas the pixels surrounding them have the lower gray level than the intersection points. The 2D integral projection approach involves obtaining horizontal projection and vertical projection for the identification weft and wrap in the fabric. The horizontal and vertical projection for the given image is given by

$$H(y) = \sum_{x=1}^{N} I(x, y)$$

$$V(x) = \sum_{y=1}^{M} I(x, y)$$

By the detection of local minima for the horizontal and vertical projection, the warp separation lines and weft separation lines are obtained respectively. The interlacing of wrap separation line with the weft separation line gives the crossed area of the fabric. Once the crossed area of the weft and wrap are detected the textile image is segmented into the sub image and projections for the each are found. Thus if there is any discontinuity in the fabric it will affect the crossed area i.e. the intersection of weft and wrap yarns. Since the weave pattern, interlacing of weft and wrap in the fabric is considered to be same in the entire sample fabric taken, the horizontal and vertical projection for the sub image are appeared to be same. If there is any discontinuity the projections differ from the other which do not have any defect. Thus the defect in the fabric is identified which has changes in the projection found.

IV. SIMULATION RESULT

The proposed method is evaluated for different types of images. The sample image is preprocessed initially. By using GLCM various texture features of the given fabric image is found. Clustering is done by using FCM. The crossed area is detected by using 2D projection method. In order to find the defect horizontal and vertical projection are found. Defected area in the image have zero pixel value, thus projection graph of respective defected row and column drops to zero. In order to reduce the complexity the image is sub dived into four parts- upper left, upper-right, lower-left, lower-right and then the projection are applied to find the defect. In Matlab, the array with indices value zero cannot be plotted as graph thus projection of row(horizontal) and column(vertical) is stopped where the defect is found.

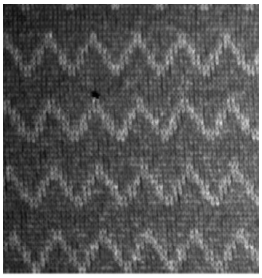


Figure3.1 Gray image

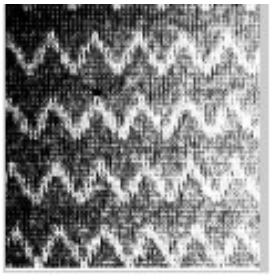
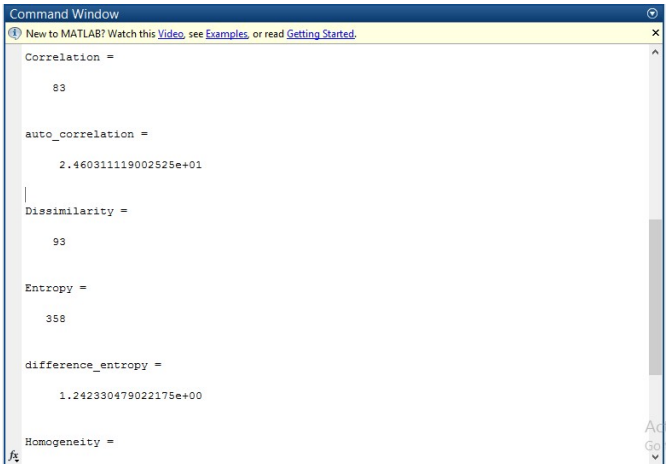


Figure 3.2 Enhanced image



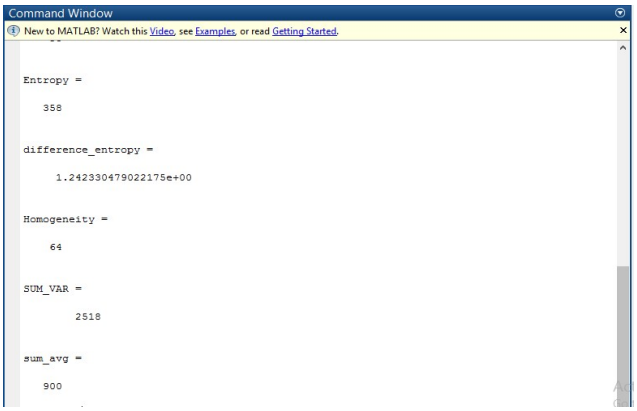


Figure 3.3 GLCM Features

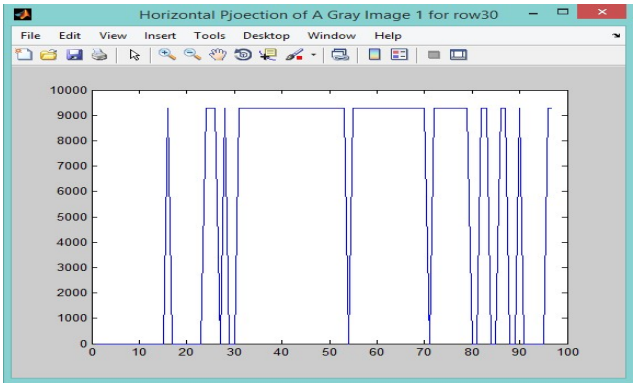


Figure 3.5 Horizontal projection

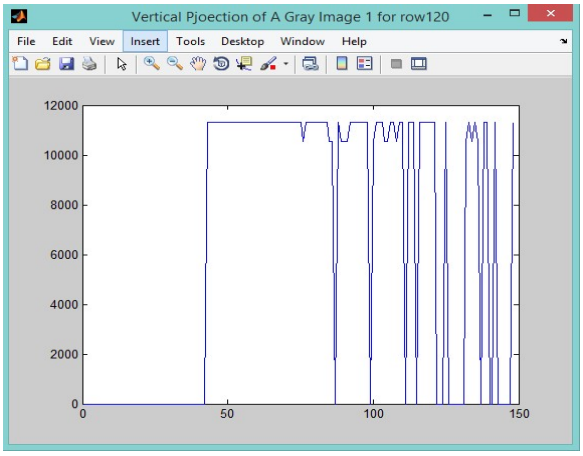


Figure 3.6 Vertical projection

V. CONCLUSION

This methodology is tested by using variety of fabric sample with different texture and yarn counts are taken. The various texture features of the fabric image are acquired by using GLCM. Crossed areas are detected using projection method and any defect in the fabric is identified using projection. Hence it is concluded that the proposed methodology can be used to identify defect in the fabric.

VI. REFERENCE

[1] Mrs. S. Sahaya Tamil Selvi , Dr. G. M. Nasira, "Plain Woven Fabric Defect Detection using GLCM based Feature Extraction," International Journal for Research in Applied Science & Engineering Technolo, vol 06, pp 874 – 879 , May 2018.

[2] Kaibing Zhang , Yadi Yan, Pengefi Li, Junfeng Jing, Xiuping LIU, Zhen Wang, "Fabric Defect Detection Using Salience Metric for Color Dissimilarity and Positional Aggregation," IEEE, vol 6, pp 49170 – 49181, Aug 2018.

[3] ChuleliLi,Guangshuai Ga, Zhoufeng Liu , Miao Yu, Di Huang, "Fabric Defect Detection Based on Biological Vision Modelling," IEEE, vol 6 , pp 27659 – 27670, May 2018.

[4] S.Anila, K.Sheela Sobana Rani, B. Saranya, "Fabric Texture Analysis and weave pattern recognition by intelligent processing,"ISSN, Vol 10, 2017.

[5] Swapnil R. Kurkute, Pallavi S. Sonar, Shweta A. Shevgekar, Dipali B. Gosavi , "DIP based automatic fabric fault detection," International Research Journal of Engineering and Technology (IRJET) , vol 04, pp 3356-3360, April 2017.

[6] Agilandeswari. V, Anuja. J, Elizabeth Dona George, "Fabric Quality testing using Image Processing," ICICES, 2014.

[7] R. Obula Konda Reddy, Dr. B. Eswara Reddy, Dr. E. Keshava Reddy, "Classifying Similarity and Defect Fabric Textures based on GLCM and Binary Pattern Schemes ," I.J. Information Engineering and Electronic Business,vol 5, pp 25 – 33, Nov 2013.

[8] Xin Wang, Nicolas D. Georganas, and Emil M. Petriu, "Automatic Woven Fabric Structure Identification by Using Principal Component Analysis and Fuzzy Clustering ," 2010.

[9] D. X. Zhao, H. Wang, J. L. Zhu, J. L. Li, "Research on a New Fabric Defect Identification Method," International Conference on Computer

Science and Software Engineering, pp 814 – 817, 2008.

[10] Tamnun E Mursalin, FajranaZebinEishita , Ahmed Ridwanul Islam , "Fabric defect inspection system using Neural network and Microcontroller," Journal of Theoretical and Applied Information Technology, pp 560-570, 2005-2008.