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FABRIC DEFECT DETECTION AND IDENTIFICATION: A SURVEY

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ABSTRACT

Automatic fabric inspection is valuable for maintenance of fabric quality. Defect inspection of fabric is a process which accomplished with human visual look-over using semi-automated way but it is labor prone and costly. To reduce time and cost wastage due to defects, the automatic inspection system for defect detection is used for this purpose. Artificial neural network, threshold segmentation, structural, statistical and model based approaches, computer vision method with the consolidation of multi-layer neural networks, are the method to identify the detect defects of fabrics. Empirical outcome spectacles that visualized approach has benefit of greatly analyzing speed, easy utilization, pleasant noise immunity and highly meeting the requirements for automatic fabric defects inspection.

Keywords- ANN, Computer vision, gray level co-occurrence matrices, image segmentation. thresholding.

I.INTRODUCTION

Defect detection of cloth material is an important procedure to manage the quality of the textile brand. Different types and categories of fabric product are manufactured by fabric materials in Textile Corporation. Appearance of fabric is referenced by the fabric texture. Fabric can be smooth, uneven, unwrinkled, fluffy, cozy, burnish etc. Textile fabric is the coordination of natural and synthetic fabrics. Synthetic fabric is moderately new for textile industry. It is continuously growing up the development in textile industry. Some resistant fabrics can also be accessible if it is required and for constant modernization. There are some kind of resistant fabrics are used in textile industry like impervious to water, oil contrary, abrasive contrary.

Quality control is increasing day by day and it is an important factor in industrial production. Inthis regarding textile industry is not an exception**.** Quality control plays an important role in inspection of fabric. Different categories of weaves are used to manufacture the different fabric texture. All brands of fabric like cotton, wool and leather, silk have a texture. Fault analysis helps to figure out the defects properly, and give indication to appropriate characteristic. Aim of fabric defect detection (FDD) is to identify the quality and defects of fabric i.e. weather there is any fault or not. If any fault is founded then area of defect and category should be indicated. This is very highly needed in textile industry for manufacturing a good quality cloth.

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II.FABRIC DEFECTS

Defect is an area of fabric that does not conform the features of fabric or fulfill the requirements which increase the dissatisfaction of customer. There are three main categories of defects as follows-

- Captious defects- Injurious for health of the user.
- Major defects- Highly affect the acquisition of product.
- Insignificant defects- These do not effect on purchasing of product.

2.1. Weaving defects

These kind of defect occurs when thread has interlocking process.Broken ends, float, broken pattern, holes, gout, cut, oil stain, grease spot, water stain, heap and mille defect & missing end come under weaving defects.

The textile industry, as with any industry today is very concerned with quality. It is desirable to produce the highest quality goods in lower cost and shortest amount of time possible. Fabric defects detection is an important part of quality control in the textile industry. In this paper we analyze the faults using image processing techniques. Image processing techniques will help to increase the production of fabric industry as well as increase the quality of products.

2.2. Fabric Defect Detection System

Detection is a process of inspection of fabric whether cloth has fulfilled all the related specifications or not. There are two types of inspection system are used for defect examination.

2.2.1. Manual Defect Detection

Manual inspection is done by the humans. For this, textile industry is needed a very highly trained and experienced inspectors. A very extent ratio of fault has being identified upon cloth material in textile Manufacturing Corporation. It is costly and time consuming. Highly trained inspector can detect only 70% of defects.

2.2.2. Automatic or Semi-automated Defect Detection

Automatic defect detection is done by the machine; therefore inspection based on automatic system can increment the ratio of accuracy in a high order. It is a real time based detection method. Using this method, textile industry having a good and 100% inspected fabric. It is more reliable, fast inspection; reduce labor cost and improvement in fabric texture.

III. GENERIC FABRIC DEFECT DEFECTION SYSTEM OVERVIEW

The ultimate goal of Fabric defect detection system is to be able to identify the defects and it's typeno matter what the circumstances (shadowing, lighting effects etc.). As this is not trivial to achieve, a step by step approach, starting from segmentation to defect identification has to be developed. The method for the whole system can be characterized by the series of steps. The flow graph of generic fabric defect detection system consisting of basic steps is shown in Figure 1.

3.1. Image Acquisition

In any computer vision system image acquisition is basic and first stage.Fabric images are first captured with the help of digital camera. Firstly fabric images are captured then various methods ofpreprocessing are applied to that image.

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3.2. Preprocessing

Image preprocessing simply means that the resize the image, histogram equalization and noise removing etc. In the images the noise is randomalteration in the energyof an image that can be simplyremoved by using different filtering approaches.

3.3. Filtering

Filtration is a technique for modifying or enhancing an image.Theimage filtering is helps to various kind of applications, such as smoothing, sharpness, noise removal , and edge detection. A filter is simply defined as a small array that can be applied to each pixel of images and its neighbor's pixel of an image.

3.4. Thresholding And Segementation

Segmentation in image processing is simply means dividing the image into multiple segments. Each pixel of an image has same characteristics. Then faulty pixels can easy to be finding by image segmentation. Thresholding portioning the pixels in foreground and background parts of image in which fault can be easily detected.

3.5. Feature Extraction

Providing the input data into the group of features is called Feature Extraction of image .Image characteristic gives the useful information about an image and rejects the rest.

3.6.Classification

Image classification is most important part of image analysis.Classification is nothing but group the similar types of object and dissimilar type of object into a different partition, with the aim to providing a easy way for image analysis.

3.7 Recognition

In the image processing the recognition means identifying and finding an object or a feature in a image. Typical the concept of image recognition are using in various processes such as security surveillance, toll booth monitor and system for factory automation. Recognition is simply a method in which finding a pattern and object on the basis of prior knowledge or the information that can be extracted from the fabric image.

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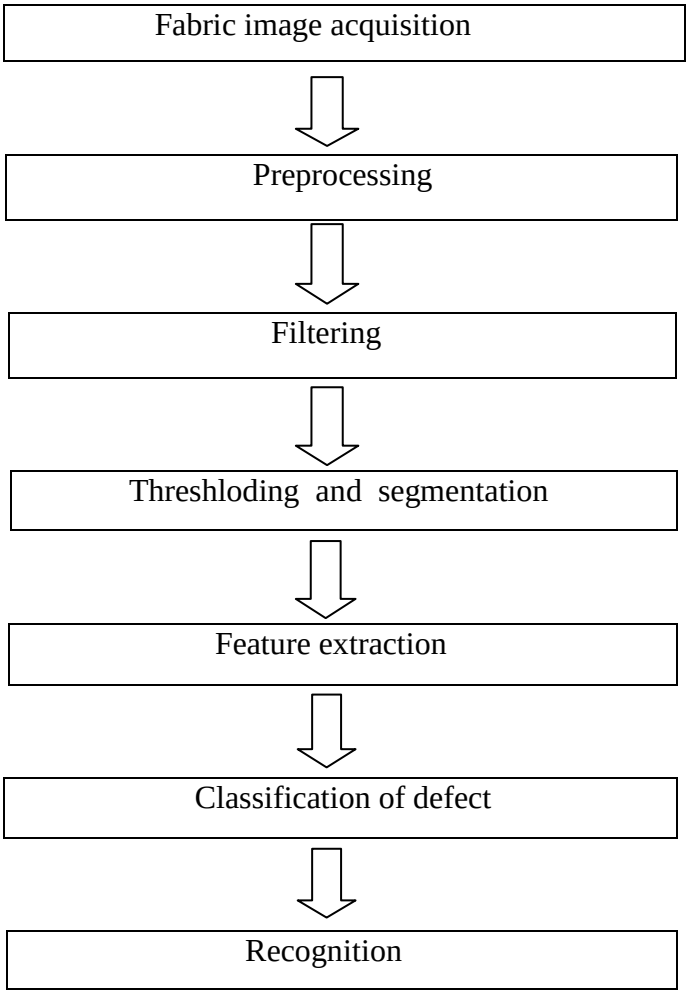

Fig.1 General Defect detection flow chart

Firstly the fabric image is capture with digital camera. After that preprocessing approach are applied to that image (like noise removal, histogram equalization etc). Further, filtering operation is performed. With the next proceeding Threshold using segmentation are applied. So that image feature is extracted for neural network and fuzzy logic (for humanistic approach). To complete the detection apply neural network and fuzzy logic in order to detect and classification of defects.

IV.EXISTING SYSTEM

P. Banumathi and Dr. G. M. Nasira [1] they have proposed an Artificial Neural Network (ANN) based approach. An ANNusing back propagation method for calculating the weighted factors and provides the desired output of classification of fault in the fabrics**.** Jagrti Patel [2] proposed a feature extraction and Segmentation based method. This method providing 85 % accuracy for classification of defects in the fabric. They have used local threshold based on graph segmentation and the defects are classify using the multi-class SVM.

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Utkarsha Singh [3] proposed a Gabor filter scheme. This research successfully conducted on various defective images shows that locating the defects in a fabric image can be achieved with the parameters of Gabor filter. For finding the location of defects, the Gabor filter followed by thresholding. This algorithm gives 83.5% overall accuracy. Papiya Dutta [4] they have been using graph based segmentation method. The Fabric fault identify in the simple fabrics are defines the by this graph based segmentation method**.** Result of 89% accuracy in fabrics can be detected whose preprocessing is done usin g local threshold followed by graph based segmentation.

Dr. G. M. Nasira [5] proposed a new fabric fault identification system based on the method of Back Propagation and Feature Extraction.Theimage extracted features providing as a input to the Back Propagation classifier for further detecting process. This method works on woven fabrics. GaidhaniKavitaGajanan and BadadheVibhawari [6] presenting a new method for detection fault in the fabrics using the thresholding method and morphological operations based segmentation method.

SheetalThorave and Prof.M.S.Biradar [7] they have presenting a new K-Means algorithm in fabric for defect detection that can be based on clustering approch. The segmentation is used in the clustering algorithm to flaw the defect in the fabric. K-Mean clustering amethod gives high certainty and very less computation time as compared other already existing algorithms. Dr.R.S.Sabeenian and M.E.Paramasivam [8] has proposed a Multi Resolution Combined Statistical and Spatial Frequency (MRCSF) based method. MRCSF is a combination of first order, second order statistical features along with spatial frequency for multi resolution analysis. The Location of defects and type of the defects also identified.

Mrs.P.Banumathi1 and Ms.T.S.Ushanandhini [9] have proposed an Artificial Neural Network based defect identifier for identifying defects in woven fabrics and total of 200 woven fabric images are taken as samples, out of which 150 are used for training and 50 used for testing the network. HaiqinZuo, Yujie Wang, Xuezhi Yang and Xin Wang [10] they have presented a defects detection method based on the concept of gray level co-occurrence matrices (GLCM) with *NL-Means* algorithm. Jing Sun and Zhiyu Zhou [11] are used fabric defects detection method with the help of segmentation and filtering based approach in the defect image, feature extracting of the fabric defect, detecting based on local feature and training.

During the last two years, we have seen various approaches that work in direction of Fabric defect detection using digital image processing A. Serdaroglu, A. Ertuzunand A. Ercil [12] they have proposed a new approach combined approach of wavelet transformation and ICA (Independent Component Analysis) that can be used for defect detection in the fabric. ICA is used to find a linear transformation of the actual image such that minimizes the statistical dependency of the image components. ICA also find out the hidden image components, which are capture the primary structure of the image.

Srinadhunnava, Kirankumarjetti and MVSS Nagendranath [13] uses the concepts of Regular Bands and ICA for patterned fabric defect detection are used for efficient defect detection in fabrics because ICA isNoise free and Regulars bands are fast. GaidhaniKavitaGajanan [14] has been using the combination feature of three approaches such as spectral approach ,statistical approach and model-based approach because of this approaches produceda different output and therefore the combine concept of these approaches produced a useful and better results.

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B.Karunamoorthy, Dr. D. Somasundareswari and S.P.Sethu [15] in this paper they are proposed a novel Image Decomposition method for patterned fabric. This method is quite useful for the identify the locations of defected objects in pattern fabric images with sharp edges and the Artificial Neural Network classifier are applies to separate the defected fabric from the detects free ones. Prof. P. Y. Kumbhar, TejaswiniMathpati, RohiniKamaraddi and NamrataKshirsagar [16] presenting a SVM (support vector machine) approach for defects detection in fabrics. The SVM classifier is trained by the acquired defect samples and by the genetic algorithm for acquired the optimal SVM classifier in the condition of limited samples information.

Priyanka Vyas and Manish Kakhani[17]have been using neural network for fabric defect detection. They worked on image acquisition, grey scale image, filtering and noise removal techniques, image thresholding and feature extraction. Theirfabric identification is 87.5%. K.V.Naveen Kumar and U.S.Ragupathy [18] proposed a fabric fault inspection method using Fuzzy logic implemented with Lab VIEW. The proposed system produces an overall accuracy of 85 %.

Dr.R.S.Sabeenian, M.E.Paramasivam and P.M.Dinesh[19]have been using the concept of Gray Level Co-occurrence Matrix and Multi Resolution Markov Random Field Matrix, Multi Resolution Combined Statistical and Spatial Frequency with feature extraction methodforfabric Defects detection and identification the location of defects in the normal fabrics as well as silk fabrics. This approaches identify the accuracy rate 85% and 80% defect in normal fabric and Silk fabric respectively.Tamnun E Mursalin, FajranaZebinEishita and Ahmed Ridwanul Islam [20] in this paper the detection of fabrics fault is normally identify by using thresholding through the Neural Network. The accuracyrate in types of fabric defects like hole, fade and scratch are 86%, 66%, and 77% respectively. The overall accuracy rate to detect fault in the fabrics is 76%.

4.1. Comparative Study On The Basis Of Exiisting System

Sr No.	Objective	Methodology	Achievement	Limitations	References
1.	Fabric defects detection and image analysis	Image Acquisition,Gray Scale, ImageFiltering,HistogramProcessing,Segmentation, Noise Removal,Feature Extraction, Neural Network	Physical and applicable in which system have obtained and tested for static images which are selected by manual standard of common types and limited in No.	This approach is limited for a set of common type of images.	P. Banumathi&Dr. G. M. Nasira, 2012.
2.	Fabric defect detection and location	Feature extraction, image acquisition and segmentation, contrast	Classification accuracy is 80%	Limited fabric image are used and don't have public dataset.	JagrtiPatel,Meghna Jain ,Papiya Dutta2013

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		enhancement,			
3.	Automated fabric defect detection	Gabor filter, wiener and mean filter, thresholding,	Overall accuracy of defect detection is 83%.	They are using limited class of fabric for defect detection.	Utkarsha Singh, Teesta Moitra, Neha Dubey, &MrsM.V.Patil, 2015.
4.	Fault Detection in fabric	Graph based segmentation using image pre-processing, threshold.	Hole, tear, scratch, knot, stain accuracy are- 90%,83%,85%, 86% and 96% respectively	They use normal fabric for defect detection.	Papiadutta, Jagrti Patel, Meghna Jain, . 2013
5.	Detect the defects in woven fabric.	ImagePre-processed, NormalizationStructural feature extraction , ANN.	The overall average accuracy to detect fault is 93%. But accuracy for hole, Dropped stitch and scratch is 75%, 60% and 70% respectively	The accuracy for types of defects is not efficient.	Dr. G. M. Nasira& P. Banumathi, 2014.
6.	Defect detection in fabric.	Morphological & Thresholding based Segmentation Methods and Neural Network using classification	Better performance as compare to existing method	Automated system required.	GaidhaniKavitaGajanan, BadadheVibhawari A. 2014
7.	Fabric defect detection.	K-means algorithm, Thresholding, cluster analysis	Accuracy using K-mean is 96%.	It didn't work well with global cluster.	SheetalThorave, Prof.M.S.Biradar, 2014.
8.	Defect detection and identification	Statically and spatial frequency using Feature extraction(MRCFS), compare with library, indicate the defects	Classification rate using MRCFS- Grayscale-100% Color-100% Real time-95%	In real time size of fabric window reduced that also reduce the identification rate of defects	Dr.R.S.Sabeenian& M.E.Paramasivam, (2010)
9.	Image preprocessing and ANN	Six statistical values standard deviation, mean, entropy,	By using these 6 statistical value defects percentage is	Using 9 statistical feature defect detection is 96%	Mrs.P.Banumathi& Ms.T.S. Ushanandhini ,

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		energy, skewness and kurtosis	98%.		(2015)
10.	Defect detection on texture enhancement & analysis	Grey level co-occurrence matrices.	Accuracy for all defects are GLCM-67.30%.,NL+GLCM - 88.79%.	NL-mean algorithm require large enhancement of discriminant power.	Haiqinzuo, Yujie Wang, Xuezhi Yang, Xin Wang. 2012
11.	Structure based pattern recognition	Images acquired Pre-processed Structural feature extracted Multi-layer neural networks	Average accuracy to fault detection is 76.3%. But accuracy for hole, fade and scratch is 86%, 66%, and 77% respectively.	The average accuracy is not efficient	Jing Sun &Zhiyu Zhou , (2011)
12.	Wavelet transform and independent component analysis	Independent component analysis to find a linear transformation of original data.	Combination of wavelet analysis and Independent component analysis increase the defect detection rate.		A .Serdaroglu, A.Ertuzun&A.Ercil , (2006)
13.	Knitted fabrics defect detection and identification.	Image acquisition, Defect segmentation algorithm, Feature extraction, Statistical features, and Texture features.	AchievementOf this method in knitted fabric with92% coverage.	The scope has been limited for machine printed fabric.	Srinadhunnava ,Kirankumarjetti& MVSS Nagendranath, 2013.
14.	This approach Identify the fabric Defect.	Image acquisition, Pre-processing.	The accuracy rate of detect defects is 90%.	This approach works only plainFabrics.	GaidhaniKavitaGajanan, 2014.
15.	Automated patterned fabric fault detection	Image pre-processing, thresholding, histogram, ANN	Accuracy percentage of defect detection is 95%.	Inspection of Patterned fabric can't pinpoint the location of faulty object.	B.Karunamoorthy, Dr.D.Somasundareswari, S.P.Sethu 2015.

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16.	Fabric defects detection and sorting	Image pre-processing, SVM, ANN, feature extraction.	Defect detection accuracy with SVM is 90%.	All feature not combined with texture statistical feature for detection of defects.	Prof. P. Y. Kumbhar, TejaswiniMathpati, RohiniKamaraddi and Namrata Kshirsagar 2016.
17.	Fabric defect inspection	Image Processing, Neural Network, feature extraction, image acquisition.	Fabric identification rate is 87.5%		Priyanka Vyas, Manish Kakhani. 2015
18.	Fault detection in textile web material	Feature extraction, frame conversion, image pre-processing, fuzzy system.	Using 4 textual features accuracy is 85.71%. using 9 feature it is better than others.	Textual features characterized the classification accuracy.	K.V.Naveen Kumar & U.S.Ragupathy 2012.
19.	Detection and Location of Defects in Handloom Cottage Silk Fabrics	MRMRFM MRCSF, GLCM,	This method classifies 85%of defect in normal fabric And in Silk fabric provides 80% classification accuracy.	During the process of image capturing silk jaari reflects, so classification can't found.	Dr.R.S.Sabeenian, M.E.Paramasivam and P.M.Dinesh. 2011
20.	Fabric defect inspection	Neural network and micro-controller using percetron network.	Hole, fade, scratches are 86%, 66%, 77% respectively.	Color fadedness is vey less.	Tamnun E Mursali, FajranaZebinEishita , Ahmed Ridwanul Islam 2008.

VI. DISCUSSION

A generalized fabric defect detection system needs near perfect and efficient pattern recognition to be incorporated to detect and identify defects in various kinds of fabrics. It also needs an environment for efficiently and coherently managing the fabrics manufacturing unit and inspection unit with acceptable recognition results. As fabrics may be characterized by different color, pattern and texture, it is impossible to detect defects automatically into whole fabrics in real time production environment. Existing system have been produced to work on manual or catalogue of textile industry which include limited set of fabric and defects samples. Also, the types of defects has identified by human operator. Automatic acquisition of fabric images and detection of defects in real time environment poses an immense challenge to warn the manufacturing unit as well as recovery units about the defects occurred in the fabric. Thus, development of an automated system

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emulating the learning and understanding fabric pattern by human being has been visualised as solution to the detection of defects in fabric and sending warning to the respective manufacturing unit. Defect detection accuracy rate of existing system are not efficient and all types of defects are not covered in these systems. Artificial Neural network, SVM, computer vision is used for defect detection purpose but their overall accuracy is 90% approximately. MRMRFM, MRCSF, GLCM methods are used for find out the type of defects. These method detected hole, scratches, fade, stain and their classification accuracy is 85%. Textile industry is highly concerned with the good quality fabric product. So defect detection accuracy percentage should be high for fabric inspection.

VII. CONCLUSION

At present, visual inspection being carried out mostly through manually this is tedious, slow and expensive too. So, there is a great need of a system capable of automated detection of defects of fabrics and provides warning to manufacturing unit to stop or recover the production. Extraction of such information from fabric is a challenging task. Algorithms have to deal with varying texture and colour representations as well as shadowing and lighting effects. Pattern recognition algorithms have to be applied for acquisition of defect information from highly varied fabric. Few systems are unable to distinguish between types of defects. Their performance is limited by as they are based on some statistic approach methods. They can detect faulty & non faulty region, but failed to recognize variance between different faults. Also these are fewer faults tolerant as they are to not handle lighting & shadow effects. Main difficulties of this task are due to fabric variability. In contrast, human being extracts features of fabrics and interprets the highly complex pattern quite easily.

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