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Fabric Defects Detection and its Implementation in TI-OMAP

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Abstract

In today's scenario, one of the most frequent problem faces in textile technology is breakages of both warp and weft yarns. This problem not only reduces the production rate, also decreases the quality of produced fabric. In modern weaving technology, many types of fabric defects occur during production and they are still detected by human inspection. The objective of this paper is to describe an effective and accurate method for automatic defect detection in fabrics. The statistical parameters such as mean, standard deviation, kurtosis, skewness and histogram representation of fabric images are considered to compare the fabrics with and without defects using Aphelion Dev software. Morphological techniques are used for attaining accurate result of defects in fabrics. The result image has been implemented in open multimedia application platform which enhances the processing speed of 60ns. This technique is proficient in detecting the defects in fabrics with more precision, efficacy and with less time.

Keywords: *Textile technology, kurtosis, skewness, histogram, aphelion dev, open multimedia application platform*

INTRODUCTION

The new trend in manufacturing industry move towards the quality inspection. Particularly in textile industry manual inspection is carried out for the past several years. Textile product quality is acutely degraded by the presence of defects in fabric. So, early and accurate fabric defect detection is an important phase of quality control. It has been attracting extensive attention of the researchers of many countries for recent years.

The fabric defects cannot be done completely by normal vision even for the skilled person, so there is demand and need for an alternate solution with 100% accuracy. So, automated fabric detection is needed to overcome some of the current problems faced in the textile industries. This automation can be focused with the computer aided design software. By using image processing technique a part of the fabric can be analyzed and identified its quality in rapports with defects. Texture analysis plays a major role in the automated visual inspection of fabric images to detect their defects. It helps instant correction of small defects. Therefore, automated inspection of fabric defect becomes a natural way to improve fabric quality and reduce labor costs. The development of fully automated inspection system requires robust and efficient fabric defect detection algorithms.

In textile industry, scrutiny is needed to declare the fabric quality before any deliveries are sent to customers, because defects in fabrics can reduce the price of a product by 45% to 65%. Nowadays, the quality assertion of fabrics by online processing is mostly supported by manual checkup. However, the reliability of manual checkup is limited by resulting lassitude and inattention. Indeed, about $3/4^{th}$ of faults can be detected by the most highly skilled examiners.

Priyanka Vyas *et al.* developed a process used in textiles in which the defects in the fabrics can be identified using Image

processing [1]. This technique is applied using MATLAB in the input image of a defective fabric, and the output is obtained.

Halil Ibrahim Çelik *et al.* proposed a machine vision system that can be adapted to different types of fabric inspection [2]. Image frames of denim fabric were acquired using a CCD line-scan camera. An algorithm has developed using Gabor filter and double thresholding methods. The recital of the procedure has tested real-time by analyzing a denim fabric sample which contained six types of defects such as hole, warp absent, weft deficient, stained yarn, water soil and yarn flow (knot). The defective regions of the denim fabric sample were detected and labeled.

Jagrti Patel *et al.* developed an automated method in which the fabric images have obtained by image procurement device [3]. Input image has been converted into binary image using restoration and threshold techniques. This image processing technique is done using MATLAB 7.10.

Jagruti Mahure *et al.* developed an approach to identify fabric defects in textile industry for decreasing production cost and time [4]. The wastage in textile industry can be reduced through precise and early detection of defects in fabrics. It also helps to improve the quality of fabrics.

P. Y. Kumbhar *et al.* explained various approaches for fabric defect detection [5]. Here, the Support Vector Machine (SVM) classifier is trained by the acquired defect samples. Genetic algorithm is used for searching penalty factor and kernel parameters.

METHODOLOGY

Image Procurement

Image procurement is the first stage; here the image of material has been obtained with the help of high resolution camera. The background image has been caught when the fabric is placed on the conveyor strap and used for further processing.

Color to Gray Image Conversion

The procured image has been converted into gray scale to eliminate the shade and permeation information while retaining the luminance. In this stage the color image is given as the input which is converted to the gray. A grayscale image is an image in which the value of each pixel contains only intensity information. The resulting image from this stage also known as black-and-white, are poised completely with shades of gray. The pixel value has varying from black at the lowest intensity and white at the highest intensity.

Pre-Processing of an Image

Digital images consist of different types of unwanted noise. Noise is an error which results in the image acquisition process. Pre-processing deals with the removal of external noise and instabilities presents in an input image. In this process, the Gaussian filtering has been used to eliminate the presence of noise with the Gaussian shape of 3.

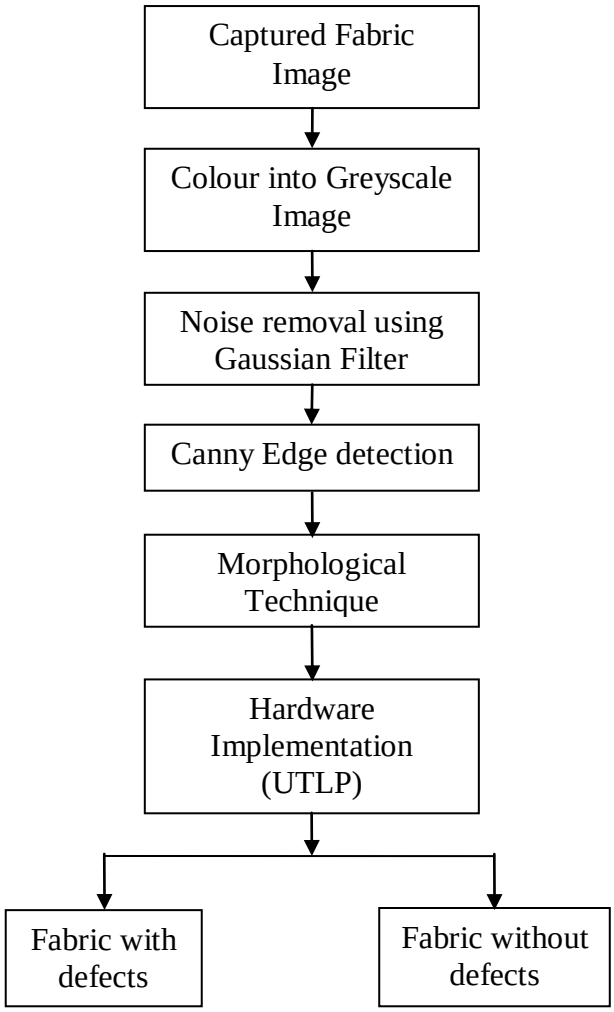


Fig. 1: *Developed Algorithm for Fabrics Detection.*

Histogram Representation

An image histogram is a graphical representation of the tonal distribution in an image. It plots the number of pixels for each tonal value. A histogram output acquired from the complete processing is considered for the decisions and the classification of the faults. The horizontal axis of graph represents the tonal variations, while the vertical axis represents the number of pixels in that particular tone.

Segmentation using Thresholding Technique

The thresholding algorithm is applied to detect the borders between the two main image classes. It results in a binary image where the classes are formed based on pixel values 0 and 255. The value 0 represents the yarn class and value 255 represents the defects in fabrics. Image thresholding is most effective in images with high levels of contrast.

Implemented in OMAP kit

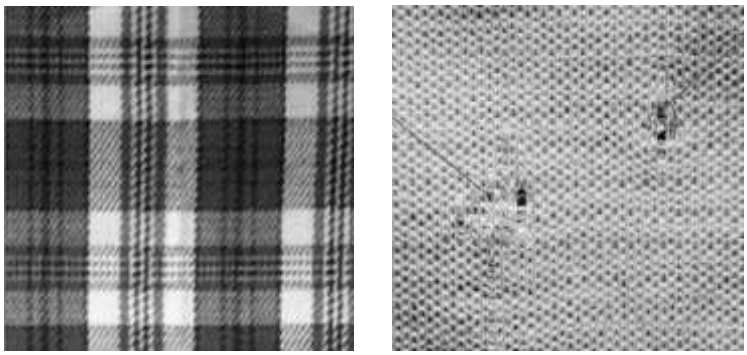
An integrated learning environment consisting of hardware and software tools as shown in Figure 2.

Fig. 2: *Spartan 6 FPGA with OMAP.*

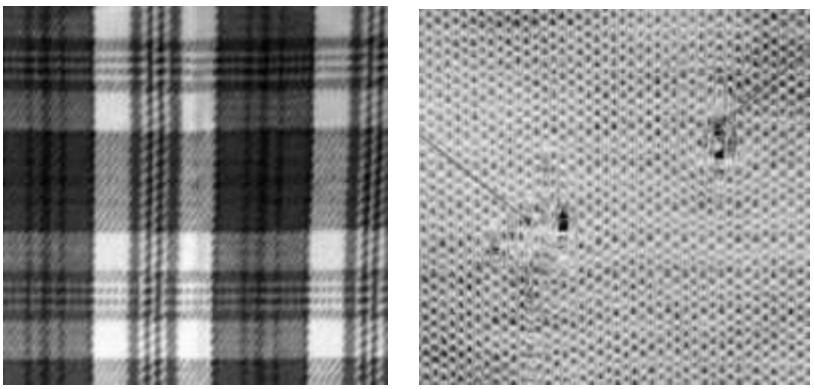
The segmented fabric image has been implemented in OMAP kit which has 320 x 240 Graphical Liquid Crystal Display (GLCD). An image can be displayed on GLCD with the help of Application Programming Interface (API) which is coded with the help of Eclipse software.

RESULTS WITH DISCUSSION

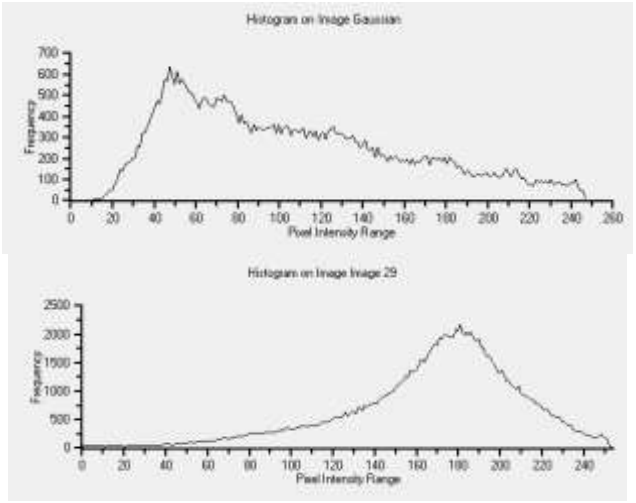
The related image of fabrics have obtained as shown in Figure 3(a) and saved for further processing. The developed technique results for defects detection in fabric as shown below. The presence of noise which affects the in fabric images has removed using Gaussian filtering with the guassian shape of 3 as shown in Figure 3(b). Histogram equalization has been obtained to classify the defects in fabrics which are shown in Figure 3(c) for both normal and defective fabrics. Then the edges are extracted from noise free images to characterize them as shown in Figure 3(d). After that threshold segmentation has been applied on edge image to segment the defects present in the materials.



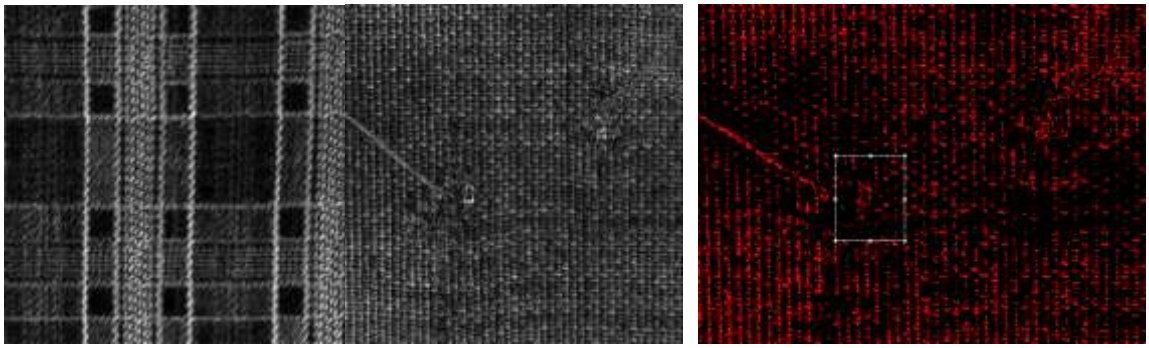
(a)



(b)



(c)



(d) (e)

Fig. 3: *a. Input Image (Without and with Defect), b. Noise Removal Images, c. Histoqram Equalization, d. Edges of Noiseless Image, e. Defect Identification.*

Fig. 4: *Result from CLCD of UTLP Kit.*

The result has been obtained from CLCD of dedicated UTLP hardware as shown in Figure 4 which shows that Gaussian filtering provides better noise elimination than other filtering methods.

CONCLUSION

The breakage in warp and weft yarns not only reduces the production rate, also decreases the quality of produced fabric. The human inspection for fabric defect detection has many problems in accuracy. The conclusion is that an effective and accurate method for automatic defect detection in fabrics has been described. The statistical parameters such as mean, standard deviation, kurtosis, skewness and histogram representation of fabric images have been considered to compare the fabrics with and without defects using Aphelion Dev software. Morphological techniques have been used to attain

accurate result of defects in fabrics. Finally the image with or without defect has been implemented in open multimedia application platform with the processing speed of 60ns. This technique is proficient in detecting the defects in fabrics with more precision, efficacy and with less time compared with existing methods.

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