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Automatic Fabric Fault Detection Using Image Processing

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Abstract— **This paper provides an overview of automatic fabric fault detection approaches that have been developed in recent years. Fabric fault detection is very popular topic of automation moreover quality control is one of the important features in textile industry. The performance of the projected idea is evaluated by using different techniques of patterned fabric images with different types of common fabric defects. Moreover detection methods were also evaluated in real time using a model automation specification system. This research paper will be useful for both researchers and practitioners in the field of image processing and computer vision to understand the uniqueness of the different defect detection methods. The recognition receives a digital fabric image from the image acquisition device and transforms it to a binary image using the restoration and threshold methods. This research presents a technique that decreases physical exertion. This image processing method was performed using "MATLAB 7.10". Therefore, this study uses a textile fault detector with a systematic vision approach for image processing.**

Keywords—Rgb; threshold; image processing; filtering

I. Introduction

Automatic inspection of stained cloth has been an admirable research topic in manufacturing and quality control for over twenty years. It aims to identify and paint defects on the surface of stained fabric at the stage of production. In the past it was mainly achieved through the supervision of skilled workers, but there were some disadvantages such as high error rates due to human fatigue, high labor costs and slow verification speed. Automatic vision monitoring improves the effectiveness of such controls and provides satisfactory detection accuracy for quality control in the textile industry. To overcome these hindrances, a system of image processing is employed using MATLAB 7.10. A smooth fabric is taken as a sample and the defects will be observed on the basis on roughness and tear. To get a proper result we use 512 X 512 camera in the acquisition of data. In the textile industry, some common defects occur are discussed below:

• Yarn defects - The defects arising from the rotating or winding stage.

• Weaving defects - The defects that occur during weaving.

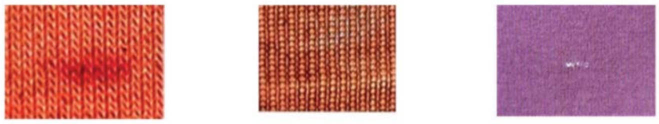

Fig. 1. Yarn and weaving defects

II. Literature Review

Over the last two years, fabric defect detection by means of image processing has received considerable attention, and several methods have been suggested in the literature. Cho et al. [1] proposed an inspection method that works at the line level to detect defects in uniform textures.

Tajeripour et al. [2] used local binary compression (LBP) to detect defects in fabric. In this work, a training phase was first performed by applying the B-slide to the non-disabled tissue image. The disadvantages are found in the new image using the correct level. However, the convenience of these methods is restricted to uniform (non-patterned) textures. Chan and Pang used Fourier analysis to detect defects in the gray images [9].

Kumar and Pang [3] used a variety of filters that controlled and trained to detect defects in textured materials. However, the Gore technique usually requires a lot of computation, while the integration of different channels is still an open question.

Recently, Nan et al. used wavelet transforms to detect gaps in patterned textures. This method can detect defects for different types of textures. However, it does use a sensitivity level that is manually locked [8].

More recently, Cézar et al. [7] used independent finite element analysis (IRA) to detect block-level errors in texture images. This method works best with uniform gray level texture. However, this does not summarize the model with good texture and many disadvantages are not found in this method.

In Tilocca and Antonio [4] the researchers introduced a new method for the automatic fabric testing based on optical system of acquisition using an artificial neural network (ANN)

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to study the collected data. They also proved that a direct automatic method with textile controls can achieve good results using optical technology and powerful data processing research capabilities. The large amount of data that can be collected with the investigation in a relatively short period of time seems sufficient to obtain a rapid and accurate classification of pre-qualified ANNs without any other data exchange [6].

New methods for categorization of fabric defects have been designed and implemented to meet the needs of manufacturers. An analysis was conducted in the industrial environment to highlight the most costly and destructive defects occur in fabric. The most repeated defects are missing weft or wrap threads, oil stains and holes [3].

Jackson [5] came up with a concept for automatic fabric detection through image processing and artificial neural networks.

III. METHODOLOGY

Digital analysis of 2D fabric images is created on the basis of receiving images from a system. The system must be able to accept a defective fabric image and then convert it to a grayscale image. The appropriate noise exclusion of the image must be applied and transformed to the equivalent binary image. The result must be in the form of a histogram. Furthermore to the histogram properties, a well-defined threshold function is also measured for the results. The whole system can be monitored as shown in Fig.2. A detailed explanation and task of each block is summarized as follows.

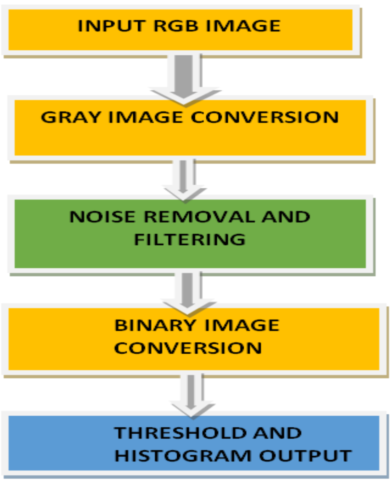

Fig. 2. The flow system of image processing

A. Capture Image

This is basically an image recognition unit. In this unit the faulty image is captured by a digital camera having 320 X 420 pixels. Digital images can be generated by a variety of input devices and methods such as digital cameras, scanners and coordinate measuring machines. The acquired image probably cover noise signals, if it holds noise signals, then some prior processing methods are required in the image. The noise should be removed from the image by the noise reduction technique [9].

B. Gray Image Conversion

Converting an image to a grayscale is important because continuous processing of the system should be performed only on gray images. A RGB image is a three layered image having red scale, blue scale and green scale. Similarly a gray scale image is a single layered image. A gray digital image is an image where the value of each pixel is a single sample. The Image intensity values range from 0 to 255.To convert RGB image to gray scale image a function called “RGB2GRAY()” is available in MATLAB [10].

C. Noise Removal And Filtering

Mostly noise produces at the time of capturing or image transmission. The noise means that the pixels in the image show different intensities from the true pixel values obtained from the images. The noise removal algorithm is the process of removing or reducing the noise in the transformed image.

D. Threshold And Histogram Equalization

In the perspective of image histogram processing, images are usually referred to as histograms of pixel intensity values. This histogram is a graph that gives you an idea about the number of pixels in an image at each value of the different intensities contained in that image. In simple terms, it signifies the number of pixels for separately intensity value measured. Histogram equalization is used to enhance the contrast. Contrast is the variation in color that makes an object distinguishable from other objects in the same field of view moreover it is a computerized image processing method utilizes to get better image contrast. It is achieved by distributing the most common intensity values effectively. Extend the image intensity range. This method typically enhances the contrast of the global image when its available data is represented by close contrast values. This permits the local low-level regions to achieve high contrast.

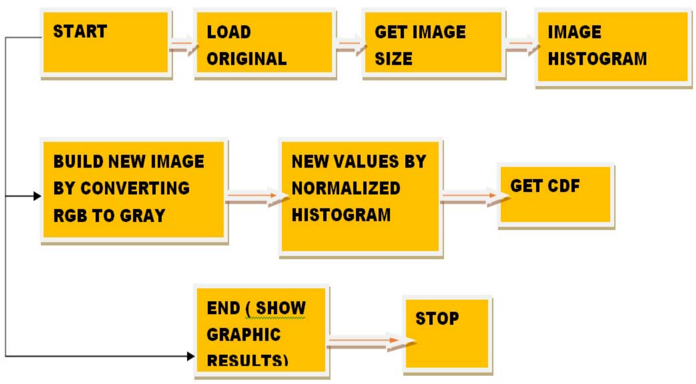

Fig. 3. Flow chart of histogram equalization

Table 1. Histogram equalization table

Gray Level	nK	PDF	CDF	(L-1)*CDF	ROUND OFF VALUES
0	780	0.119	0.109	1.3	1
1	1093	0.225	0.404	3.0	3
2	852	0.261	0.650	4.5	5
3	655	0.106	0.810	5.6	6
4	320	0.018	0.809	6.2	6
5	244	0.016	0.905	6.6	7
6	111	0.003	0.908	6.8	7
7	92	0.012	1	7	7
	4092				

Table 2. CDF calculation

GRAY LEVEL VALUE	CDF	CDF* LEVEL-1
0	0.110	0
1	0.21	3
2	0.54	3
3	0.60	4
4	0.77	7
5	0.86	6
6	0.92	6

The purpose of leveling or thresholding is to remove those pixels from a number of images that represent objects (such as a graphical map). This method can be determined by looking at the image intensity histogram. There are two fundamental types of thresholding discussed in this research work

- Global thersholding
- Local thresholding

Global level settings have an intensity value (threshold), so every unit with an intensity value below the threshold belongs to one stage, the remainder belongs to one. The global level is as good as the degree of intensity separation between the two peaks in the image. Basic-level adapters are only used to convert pixels from grayscale to black and white pixels. Normally, pixel value 0 is white and 255 is black, with numbers 1 through 254 signifying different levels of gray. Unlike the global thresholding technique, local adaptive thresholding selects altered threshold values for each pixel in the image based on an analysis of its neighboring pixels. This is to allow images with fluctuating contrast levels where a global thresholding technique will not work adequately. Different forms of adaptive thresholding algorithms have been reported in the image processing literature.

IV. RESULTS

The following test image was used to see the defects in the fabric. The picture has been presented to histogram equalization calculation for threshold, where the uneven weaving is identified as spots.

```
I = imread('sample01.jpg');
img_mat = rgb2gray(I);

[m,n] = size(img_mat);

bitlevel = 8;

bit_comb = (2^bitlevel);

hist_data = zeros(1,bit_comb);

%Histogram
for i = 1:m
    for j = 1:n
        val = img_mat(i,j)+1;
        count = hist_data(val) + 1;
        hist_data(val) = count;
    end
end


%streching
max_pix_vec = max(img_mat(1:m,1:n));
min_pix_vec = min(img_mat(1:m,1:n));

max_pix = max(max_pix_vec);
min_pix = min(min_pix_vec);

for i= 1:m
    for j = 1:n
        streched_img(i,j)    =    (img_mat(i,j)    -
min_pix)*((bit_comb - 1)/(max_pix - min_pix));
    end
end

hist_data_new = zeros(1, bit_comb);

for i = 1:m
    for j = 1:n
        val = streched_img(i,j)+1;
        count = hist_data_new(val)+1;
        hist_data_new(val) = count;
    end
end

max_pix_vec_new = max(streched_img(1:m,1:n));
min_pix_vec_new = min(streched_img(1:m,1:n));

max_pix_new = max(max_pix_vec_new);
min_pix_new = min(min_pix_vec_new);

old_con = max_pix - min_pix;
new_con = max_pix_new - min_pix_new;

figure(1);
subplot(2,2,1)
stem(0:bit_comb-1, hist_data)
title('old image')

subplot(2,2,2)
imshow(img_mat)
title('old image')
```

```
subplot(2,2,3)
stem(0:bit_comb-1, hist_data_new)
title('image histogram')

subplot(2,2,4)
imshow(streched_img)
title('new image')
```

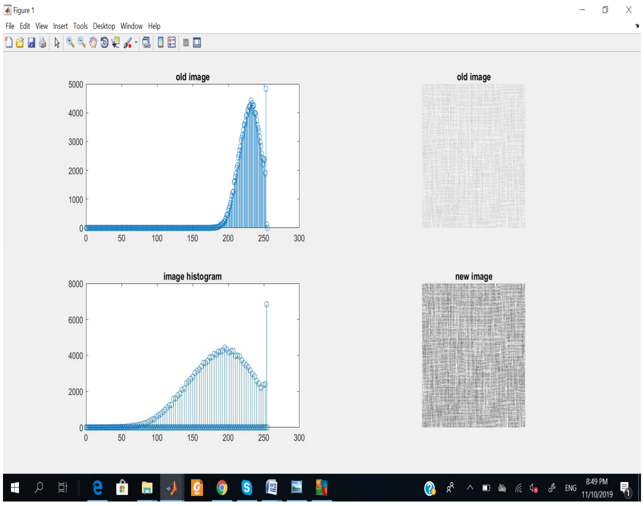

Fig. 4. Histogram output

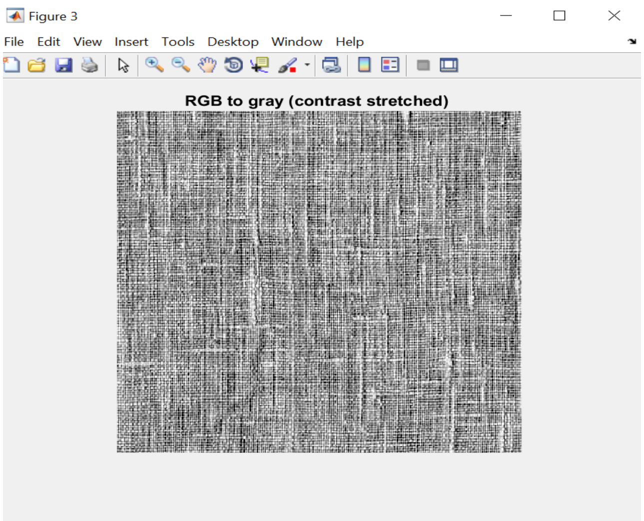

Fig. 5. RGB to gray contrast stretched

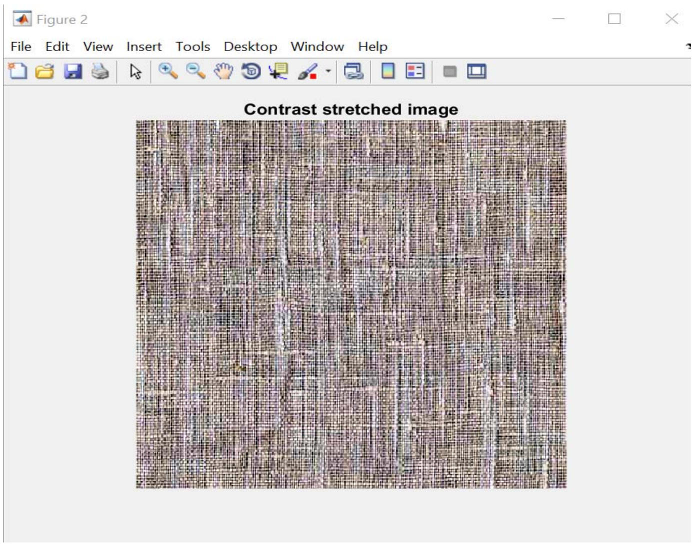

Fig. 6. Contrast stretched image

V. CONCLUSION

It is easy to see defects in an image using this method. Manually inspecting textile quality usually goes through the inspection of the human eye. Monitoring one's vision is a tedious task that involves observing, paying attention, and attempting to accurately detect the occurrence of failure. The system can detect tissue defects with greater accuracy and efficiency. In the textile industry, we can detect the damage in the real picture and we can repair the damage with the help of advanced management systems. In the textile industry, damage can be detected by wireless consent. We used MATLAB in this file, but new software such as SDL, Virtual LB and Computer Vision may be used in the future. The method which is used in this research work categorizes 90% of faults in the cloth. Improvement and enhancement of visual system performance can generally be done with the proposed algorithm to detect common defects in normal textures. In addition, it can be applied to models combining different light elements without much adaptation. The flexibility of this method is verified not only by the availability of different common textures, but also of the texture, the method allows for the detection of different defects.

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