FABRIC DEFECT DETECTION USING IMAGE PROCESSING TECHNIQUES

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1. ABSTRACT

Quality control is an important feature in textile industry. In textile industry, fabric pre-processing is important to maintain quality of fabric. In modern world most of the fabric pre-processing is still carried out manually using human visual inspection. This process is costly, time consuming and needs more labour work. Therefore, automated fabric inspection is required to identify fault present in the fabric. The main objective of this project is to create real time automated fabric fault detection system which will reduce industrial cost by 15-16%. Proposed system will find out fault using the technique of segmentation.

2. Introduction

Quality control is an important feature in textile industry. Fabric quality is achieved by eliminating fabric defects and measuring properties (Density, Yarns count per inch) of fabric. Fabric faults or defects are responsible for nearly 85% of the defects found bythe garment industry. Manufacturers recover only 45 to 65 % of their profits from seconds or off-quality goods. It is imperative, therefore, to detect, to identify, and to prevent these defects from reoccurring. Hence, expected quality cannot be achieved with manual inspection. Automated, i.e. computer based system to identify fault present in fabric is solution to the problems caused by manual inspection. Automated fabric defect inspection system has been attracting extensive attention of the researchers of many countries for years. The global economic pressures have gradually led business to ask more of itself in order to become more competitive.

Intelligent visual inspection systems to ensure high quality of products in production lines are in increasing demand of printed textures (e.g. printed fabrics, printed currency, wall paper) requires evaluation of colour uniformity and consistency of printed patterns, in addition to any discrepancy in the background texture, but has attracted little attention of researchers. Therefore, automated fabric inspection becomes important to improve fabric quality. Automated fabric fault detection system will deal with fabric defects such as hole, scratch, stretch, fly yarn, dirty spot, cracked point, misprints, colour bleeding etc. Fabric industries face loss if these defects are not identified

Types and Reasons

Fabrics are produced after passing many processing. Different machines and techniques are used during processing stages. So, fabrics are exposed to forces and stresses which cause defects. According to their forms and directions, defects take different names. The following descriptions summarize the most common fabric defects, and their reasons

- **Holes**

This is self-explanatory. Faults on weaving machines cause these defects

- **Oil Stains**

Oil smeared regions can defined on the fabric patterns. It is caused by much lubrication of machines or externally taints the oil on fabrics

- **Stitching**

Fabric regions that are not weave as a desired forms or disorder of fabric. It is caused by a result of any unwanted movements of weaving machines such as: shedding, picking, etc.

- **Tear**

Tear defects has similar structures with hole defects. But tears have irregular shapes. Cloth rolls can be torn with sharp edges or rigid object that use in manufacturing processes or damaged gears on machines.

3. Objectives

The main objective of this project is to ensure high quality of products in production lines and also ensures correct evaluation of colour uniformity and consistency of printed patterns. It also proposes to make an automated fabric system which reduces human efforts in finding defects and also makes the system fast. Hence manufacturers can earn huge amount of profits because of their quality goods and products. This model permits a detailed analysis of basic structural parameters of linear textile products as thickness, hairiness and number of twists. Technique also enables the estimation of other characteristic features of the external structure of linear textile products, such as twist parameter and linear density coefficient

4. Methodology

The digital analysis of two-dimensional images of fabric is based on processing the image acquirement, with the use of a computer. The image is described by a two-dimensional matrix of real or imaginary numbers presented by a definite number of bytes. The system of digital image processing may be presented schematically as shown in below Figure. The following operations are carried out during image quality improvement:

1. Image Acquisition
2. RGB to Grey Colour Conversion
3. Image Enhancement (Thresholding)
4. Defect Identification and Texture Analysis

A. IMAGE CAPTURING

In real-time automated inspection systems CCD (charge-coupled device) cameras, or a CMOS (complementary metal-oxide semiconductor) cameras and a frame grabber used for image acquisition process .The cameras are used in two different type; line scan camera or area scan camera. Area scan camera uses a system of area array photo sensors, which can capture images without the aid of a transport encoder. As a result, the image resolutions are not affect from transport speed in both directions. A line scan camera uses linear array photo sensors systems, so linear array photo sensors systems provides a higher resolution and can inspect a larger portion of an inspected product. The disadvantages of these systems are need for a system which usually has to be used to synchronize the camera scan rate with the transport velocity of the product. With a line scan camera, a complete 2D image can be created up from multiple line scans. In real-time automatic inspection systems, resolution is a significant detail for detecting of defects. Image resolution depends on the hardware used and the distance between the camera and the product being inspected. Small image resolution usually leads to a fast inspection but causes to overlook the details and as a result possibility of missing small defects. In contrast, large image resolution leads to detect all the details but decrease the inspection speed

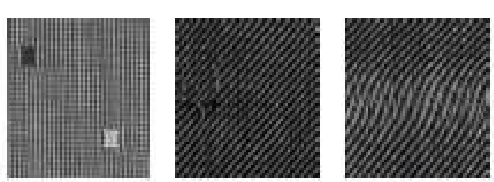

Fig. 1 Fig. 2 Fig. 3

Different Fabric/Textile Images

Originally, the images are acquired at RGB colour scale. The images then are converted to gray scale using rgb2gray function in MATLAB.

B. IMAGE THRESHOLDING

Histogram equalization method is adopted to enhance the contrast of the fabric surface. Histogram Equalization algorithm works good in this case as the fabric texture. Below figures show the result after Histogram equalization algorithm for thresholding.

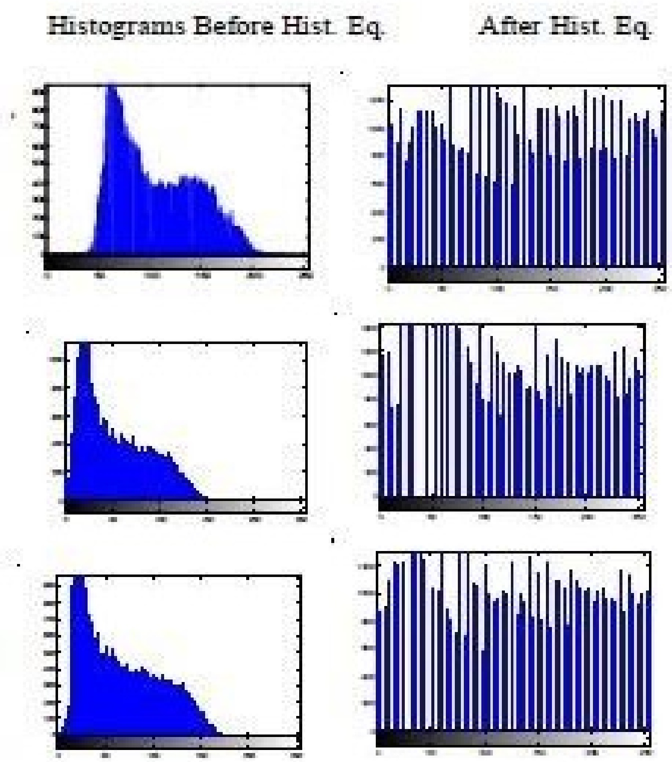

Fig. 4, 5 and 6 show the after application of the Histogram Equalization algorithm. Fig. 7, 8 and 9 show the histogram of the above respective images before and after histogram equalization

C. DEFECT IDENTIFICATION

K means clustering

The technique is called K means clustering. We have to specify the number of clusters we want the data to be grouped into. The algorithm randomly assigns each observation to a cluster, and finds the centroid of each cluster. The algorithm iterates over following steps:

- Compute the mean of each cluster.
- Compute the distance of each point from each cluster by computing its distance from the corresponding cluster mean. Assign each point to the cluster it is nearest to.
- Iterate over the above two steps till the sum of squared within group errors cannot be lowered any more.

The initial assignment of points to clusters can be done randomly. In the course of the iterations, the algorithm tries to minimize the sum, over all groups, of the squared within group errors, which are the distances of the points to the respective group means. Convergence is reached when the objective function (i.e., the residual sum-of-squares) cannot be lowered any more. The groups obtained are such that they are geometrically as compact as possible around their respective means. Using the set of feature images, a feature vector is constructed corresponding to each pixel (e(a,b) ,e2(a,b) …..en(a,b)) where d is the number of feature images used for the segmentation process. The K-Means can then be used to segment the image into three clusters - corresponding to two scripts and background respectively. For each additional script, one more cluster is added. Here, each feature is assigned a different weight, which is calculated based on the feature importance as described in the previous Section. The distance between two vectors is computed. Once the image has been segmented using the K-Means algorithm, the clustering can be improved by assuming that neighbouring pixels have a high probability of falling into the same cluster. Thus, even if a pixel has been wrongly clustered, it can be corrected by looking at the neighbouring pixels.

5. Conclusion and Future directions

The method proposed for local defect detection is a useful tool for inspecting industrial materials with periodic regular texture. As we intended, a general improvement and enlargement of the vision system capabilities can be achieved by using the proposed algorithm to detect local defects in regular textures. The versatility of the method has been demonstrated not only by its applicability to different regular textures but also, for a given texture, the method allows to detect a variety of defects. The method does not need human supervision nor previous knowledge about the texture or defect.

We tend to make the system more precise and defects will be visible more clearly, we will also try to make it more efficient if possible which will not only increase the profit of manufacturers due to quality of goods but it will also reduce the time of production. As well as reduce the manual labour which would intern cost more labour as well as time.

Output

Example 1

Histogram Equalization

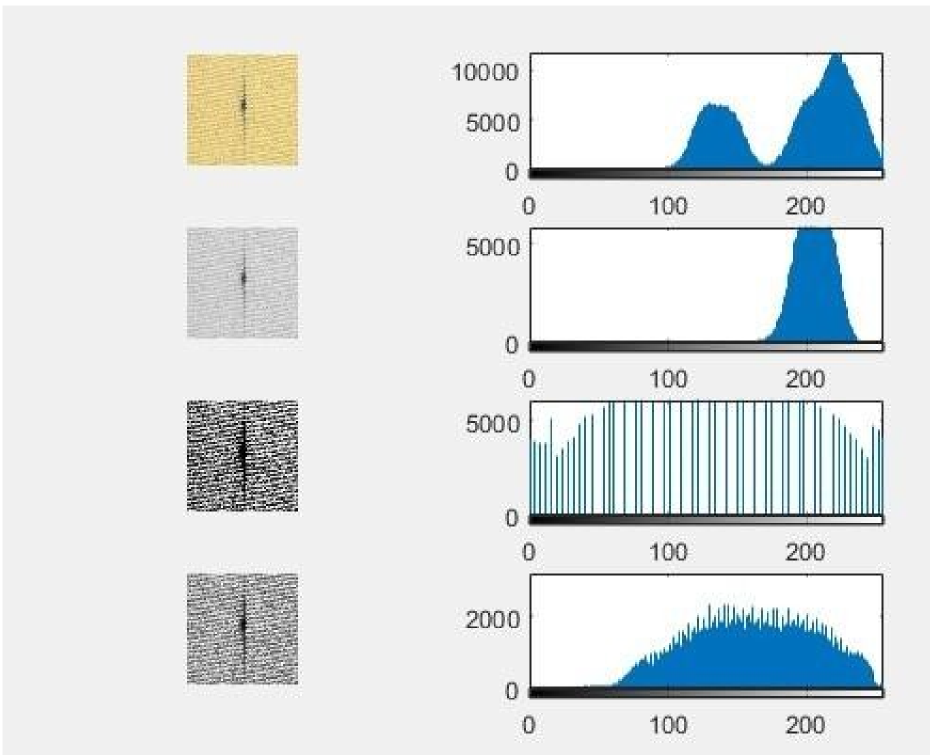

Figure 1
After adding noise and then applying noise removal filter and then using k means

The comparison between the noise removal by wiener filter and k median filter

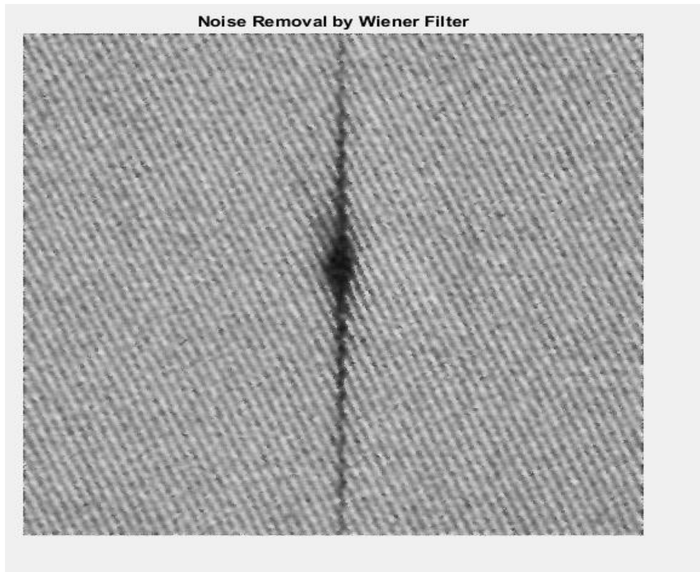

Figure2

Noise removal by wiener filter

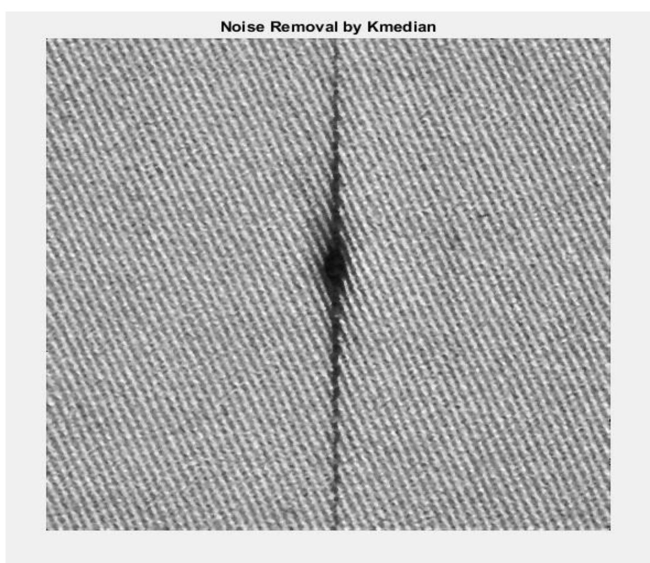

Figure 3

Noise removal by kmedian filter

Error detection

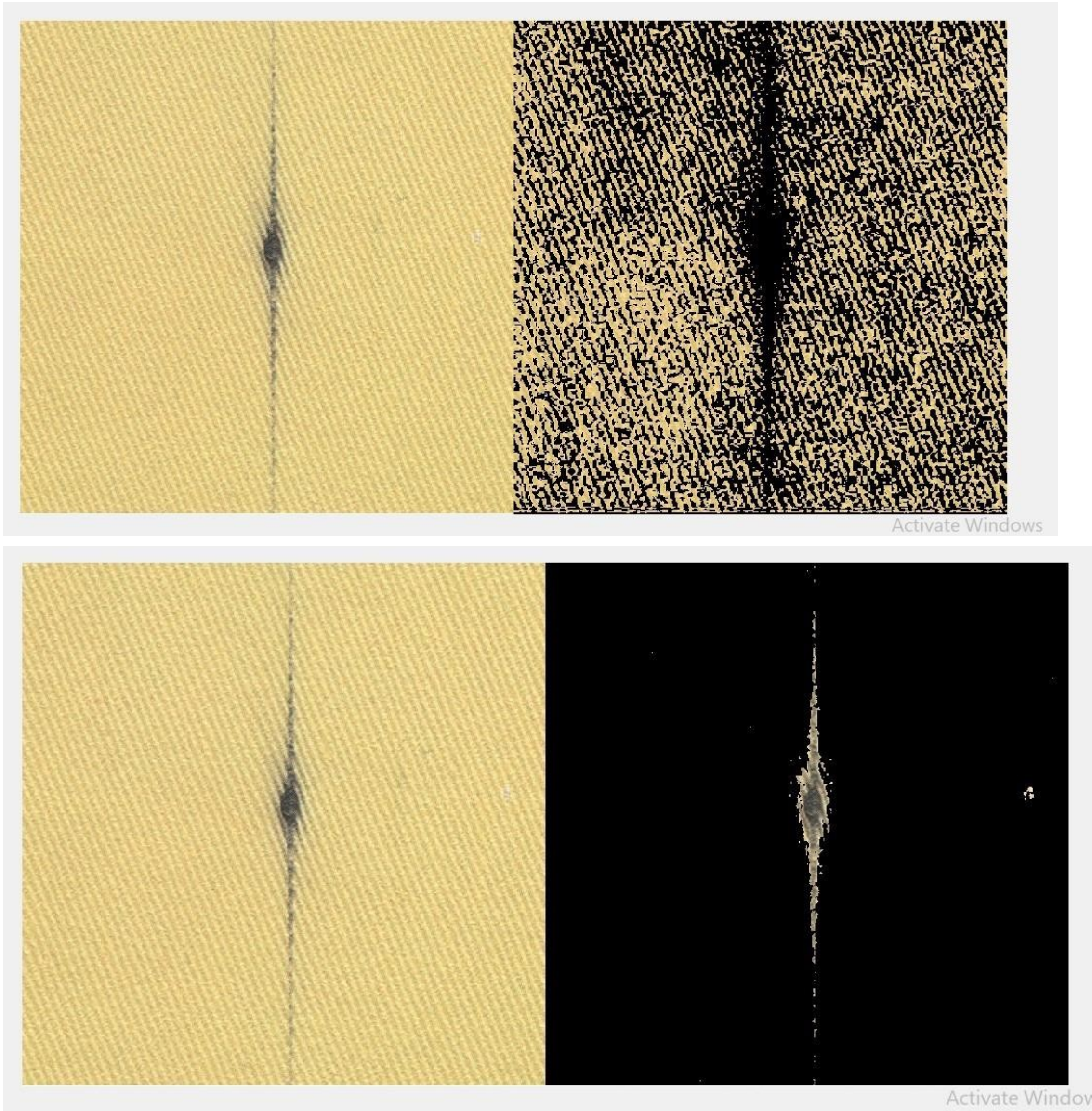

Figure 4

After adding noise and then applying noise removal filter and then using k means

EXAMPLE 2:

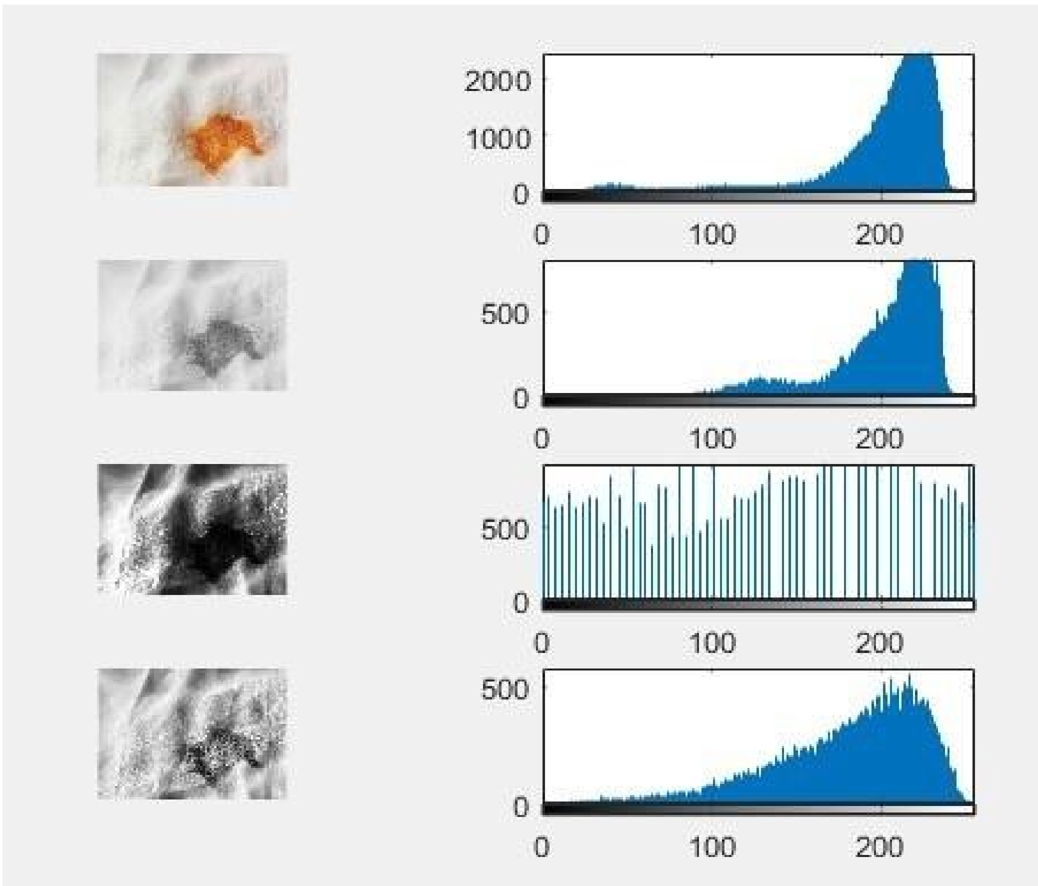

Figure 5

The images after histogram equialisation and their respective histograms

The comparison between the noise removal by wiener filter and k median filter

Figure 6
Noise removal by wiener filter

Figure 7
Noise removal by kmedian filter

Figure 8

The defect detection in the image after applying the k means algorithm

CODE:

```
A = imread('E:\image pro project\pic5.png');
I = rgb2gray(A);
J = histeq(I); C = adapthisteq(I); subplot(4,2,1);
  imshow(A); subplot(4,2,2); imhist(A);
  subplot(4,2,3); imshow( I ); subplot(4,2,4); imhist(I);
  subplot(4,2,5); imshow(J); subplot(4,2,6); imhist(J);
  subplot(4,2,7); imshow(C); subplot(4,2,8);
  imhist(C); figure;

N1 = imnoise(C,'gaussian',0,0.025); K1 =
wiener2(N1,[5,5]); imshow(K1);
title('Noise Removal by Wiener Filter'); figure;

N2 = imnoise(C,'salt & pepper',0.02);
K2 = medfilt2(N2); imshow(K2);
title('Noise Removal by Kmedian');

input_im=imread('E:\image pro project\pic5.png'); sz_im=size(input_im);

cform = makecform('srgb2lab'); lab_he =
applycform(input_im,cform); ab =
double(lab_he(:,:,2:3)); nrows =
size(ab,1); ncols = size(ab,2); ab =
reshape(ab,nrows*ncols,2);
 nColors = 3;
 [cluster_idx, cluster_center] = kmeans(ab,nColors,'distance','sqEuclidean',
'Replicates',3);

pixel_labels = reshape(cluster_idx,nrows,ncols);
```

```
segmented_images = cell(1,3); rgb_label =
repmat(pixel_labels,[1 1 3]); for k = 1:nColors
color = input_im; color(rgb_label ~= k) = 0;
segmented_images{k} = color; end
for k=1:nColors

title_string=sprintf('objects in cluster %d',k);

en
d
finalSegmentedImage=segmented_images{1};
 close all;

Icombine = [input_im finalSegmentedImage]; imshow(Icombine);

[segment_idx, segment_center] =
kmeans(ab,nColors,'distance','sqEuclidean','Replicates', 3, 'start', seeds);
rng(123); numReplicates = 3;
ind = randperm(size(ab,1), numReplicates*nColors);

seeds = permute(reshape(ab(ind,:).', [2 nColors numReplicates]), [2 1 3]);

[segment_idx, segment_center] =
kmeans(ab,nColors,'distance','sqEuclidean','Replicates', numReplicates,
'start', seeds); rng(123); numReplicates=
3; ind = randperm(size(ab,1)); ind =
ind(1:numReplicates*nColors);

seeds = permute(reshape(ab(ind,:).', [2 nColors numReplicates]), [2 1 3]);

[segment_idx, segment_center] =
kmeans(ab,nColors,'distance','sqEuclidean','Replicates', numReplicates, 'start', seeds);
```

7. References

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