

Fabric Deconvolution Wiener Filter and Feature Extraction Regionprops for Locating Defects.



P.Banumathi, P.R.Tamilselvi

Abstract: The core of this paper is to locate the defects in fabric by using image processing system. Automatic visual inspection methods are genuinely necessary in Textile industry, particularly when quality control of item enters into the industry. In the manual inspection method just less measure of defects are being identified while Automatic inspection method will increment to most extreme number. Here the rule detection used to distinguish the defects in fabric through deconvolution wiener filter algorithm. The deconvolution can be done with early known PSF (Point Spread Function) value. This will remove the unnecessary noise in images and producing a noiseless enhanced image. The given image is binarized and thresholded to get the desired output. After the filtering process is over the morphological transformations are done to extract the defected portion in the fabric. Then the features are extracted through the method regionprops and GLCM (Gray Level Co-Occurrence Matrix). Finally by extracting the features the classification of textile defects are done. The Experimental result shows that accuracy rate high compared to existing methods.

Keywords: Automated; deconvolution; fabric; image processing; Wiener filter;

I. INTRODUCTION

Earlier the fabric defects to fix, or evacuate is tedious, fabric issues is one of the obligatory assignments required by all textile producers. Un-recognized defect cause numerous issues downstream in the generation line and result in finished results with lower quality, making a cost weight and non-beneficial items. While automatic systems offer great choices to customary human fabric review with PC vision frameworks that break down fabric in an orderly way and go for steady execution. The effectiveness of these computerized methods, anyway relies upon numerous parameters and shifts as indicated by the nature of the equipment and the investigation calculation.

The Mohammed et.al pointed out the methodology using entropy filtering and minimum error thresholding in which threshold is estimated and applied the threshold to binarize

the image and morphological operation has been done to remove the erroneous components [1].

Recently various methodology has been proposed to detect the defects in fabric. Jun Feng Jing, Huanhuan Zhang, pengfei li proposed improved Gabor filter with two scales and six orientations [2]. J.L. Raheja et.al identified the defect based on the GLCM and Gabor filter. The author extracted the GLCM texture statistics and plotted the signal graph against inter pixel distance of GLCM. The filtering technique is used with convolution mask, different scales and orientations [3].

F.Lin, C.Jin presented an improved deconvolution wiener filter for microscopic images. The author used a high-resolution transmission electron microscopy images as an input and reduced the noise using improved filter and simultaneously removed the modulation transfer function and with that confirming this as improved wiener filter than wiener filter [4]. L.Tong et.al developed a Gabor filters for identifying defects. Author defined this model for woven fabric inspection in textile industry. Here the composite Differential evolution technique (CODE) has been used for the optimization purpose [5].

C.S.C Tsang et.al proposed a fabric inspection based ELO rating Method. The spirit of sportsmanship is used to achieve the defect detection. That is used for between partitions on an image in fair matches [6]. There are lot of commercial product available for identifying the defects. They are listed further as Barco Vision Cyclops, I-TEX inspection System from Elbit Vision Systems, and Zellweger Uster's Fabricscan. System. The defects can be identified with speed of 100m/min in the I-TEX inspection system. Although Each System has its own pitfalls and limitations. The commercial Inspection system available are broadly classified into Manual Inspection System and Automatic Inspection system (Fig.1).



Fig. 1. Automatic Inspection System used in Industry

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With all the discussed systems in one hand on the Other hand our proposed work, which uses Deconvolution wiener filter algorithm to evaluate the homogeneity features of the image in the one part. In order to improve the competence of the algorithm and to overcome the problem occurred during detection of errors, the thresholding technique is integrated with the deconvolution wiener filter. Though this filter, is able to detect only the real defects and their region are highlighted. To extract the exact region where the defect is identified. The morphological operations are executed through which desired result can be seen.

II. METHODOLOGY

The overview of the proposed work has been discussed in fig2.usually, the First step in image processing technique is to acquire the image.so here also the images are acquired from the online dataset. After acquiring process are over then the RGB images are converted to Gray scale image. Then the advanced image processing methodology are used such as the filter, segmentation, morphological processing, GLCM, Regionprops are used to extract the final output. The main concept used here is the deconvolution wiener filter which is used to remove the noise in the image. The deconvolution wiener filter is the low pass filter which attenuates the frequency highly. Then the image is thresholded to extract the defected portion encoded into pixel while suppressing the background noise. The morphological operation erosion and dilation are done, then the bwareaopen function is used to delete the smaller components. At the last features are extracted by using Gray level co-occurrence Matrix and Regionprops method. Let the discussion starts with methodology used on the proposed method.

A. Wiener Filter

It is an image rebuilding procedure from the earlier known PSF. Generally the deconvolution wiener filter uses the early known PSF value. It does inverse filtering and noise smoothing simultaneously. That is it actually does both the high pass filtering and low pass filtering. It is used to minimize the mean square error. This can be used as a performance criteria of the filtered image and original image. The filter is usually connected in the frequency field given a foggy picture $g(x, y)$ takes the discrete Fourier transform to acquire $G(u, v)$ the real picture range is analysed by doing the convolution of $G(u, v)$ with the given wiener filter $W(u, v)$ [7, 8].

The reverse DFT is then used to get the real image from its

$$F(u, v) = G(u, v) W(u, v) \quad (1)$$

spectrum .The wiener Filter can be expressed as follows:

$$W(u, v) = H^*(u, v) / |H(u, v)|^2 + P \quad (2)$$

Here the $H(u, v)$ is the PSF (point spread function) of Fourier transform. The $W(u, v)$ is the pulse to deliver the likelihood when $H(u, v)^2$ line of attack zero. The P to avoid the situation.

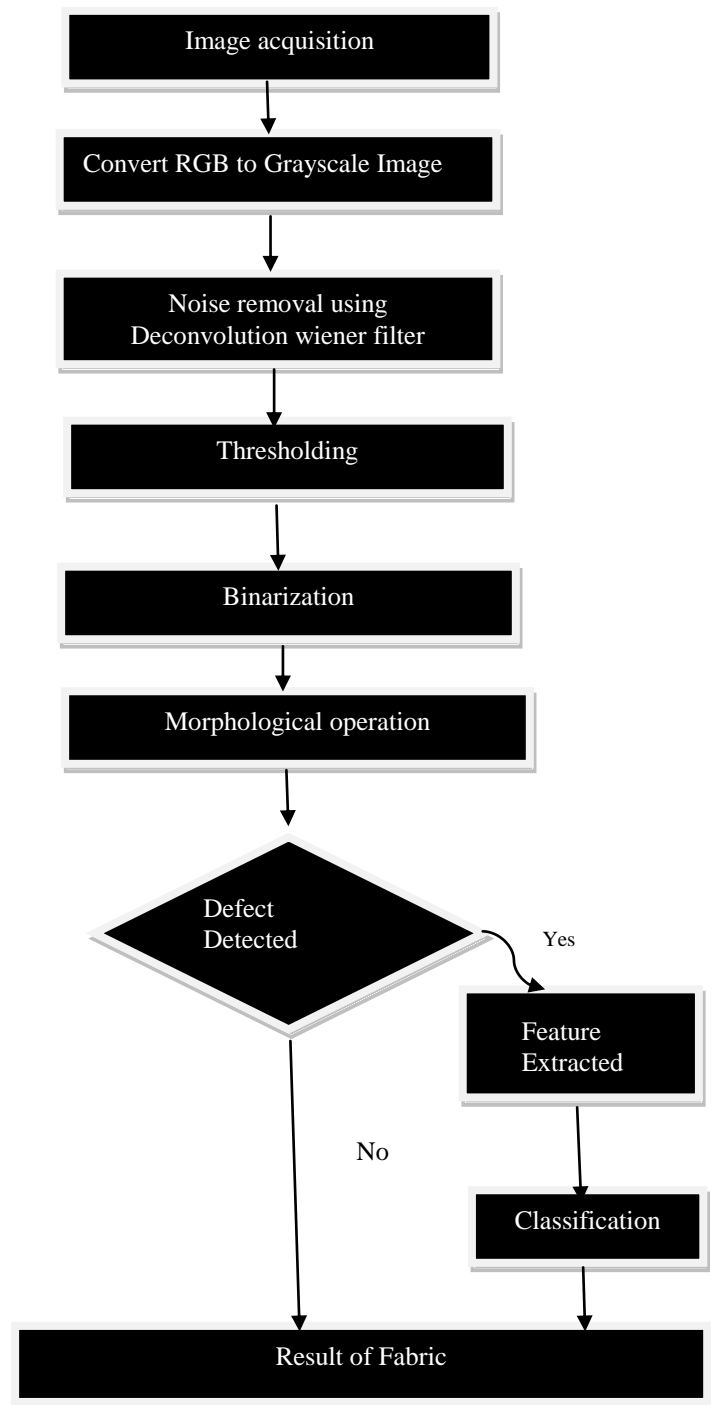


Fig 2.Overall Methodology of Proposed Inspection System

B. Thresholding

The thresholding is the easiest partitioning process. Several image areas are consequently arranged by persistent reflectivity or light retention of their surfaces; an intensity constant or threshold can be resolved to fragment object and foundation. Thresholding is cheap and quick procedure and it is the traditional segmentation strategy utilized in straightforward applications; [7, 8].

$$R_i \quad R_i \quad R_j = 0, \quad i = j. \quad (3)$$

I=1

A complete segmentation of a fabric image R is a limited set of areas R_1, \dots, R_s .

Complete segmentation can result because of thresholding in straightforward procedure. Thresholding is the given an original image f to a yield (segmented) binary image g as pursues:

$$g(i, j) = \begin{cases} 1 & \text{for } f(i, j) \geq T \\ 0 & \text{for } f(i, j) < T \end{cases} \quad (4)$$

Where is the threshold $g(i, j) = 1$ are elements of objects, and $g(i, j) = 0$ are elements of background (for vice versa).

C. Morphological transformations on images

Morphology was characterized in this paper as an important image processing operation that is used to do some operation on images depending upon the shapes. Dilation and erosion are very basic operations on morphology. Dilation which adds pixels to the boundaries of object in an image while on the other side erosion expels pixels on boundaries of objects.

i) Dilation

Mathematical Morphology is one of the most beneficial area. The mathematical morphology substance which depends on set theory [7, 8].

The dilation \oplus by utilizing vector addition consolidate two sets (or Murkowski set addition e.g. $(a, b) + (c, d) = (a + c, b + d)$). The dilation $X \oplus B$ is the point set of all conceivable vector additions of sets of elements, one from each of the sets X and B.

$$X \oplus B = \{p \in \mathbb{Z}^2: p = x + b, x \in X \text{ and } b \in B\} \quad (5)$$

Dilation with an isotropic 3x3 structuring element may be portrayed as a transformation which changes all background pixels adjoining the nearby object pixels.

ii) Erosion

Erosion it converges sets utilizing vector subtraction of elements and it is the dual operator of dilation. Both are not an invertible transformation [7, 8].

$$\text{If } X \subseteq Y \text{ then } X \oplus B \subseteq Y \oplus B \quad (6)$$

The given image is tried for each point P; for which all possible $p+b$ are in X, is the consequences of erosion for point P. Erosion is utilized to make straightforward arrangement of nearby objects or parts with width same to one will vanish. In this way decay tough objects into a few less hard ones.

iii) Opening and Closing

Erosion and dilation are same transformations, if an object in an image is dilated and then eroded, the real image is not re-acquired again. Instead, the outcome is a streamlined into less comprehensive form of the real image [7, 8].

$$X \varepsilon B = \{p \in \mathbb{Z}^2: p = x + b, x \in X \text{ for every } b \in B\} \quad (7)$$

Erosion pursued by Dilation makes a significant conversion named opening. The opening of an image X by the structuring element B is meant by $X \circ B$ and is defined as

$$X \circ B = (X \varepsilon B) \oplus B \quad (8)$$

Dilation pursued by Erosion is a conversion named closing. The closing of an image X by the structuring element B is by $X \cdot B$ and is characterized.

$$X \cdot B = (X \oplus B) \varepsilon B \quad (9)$$

IV EXPERIMENT RESULT

In the proposed work TILDA dataset [10] have been used. Totally 350 images have been used for experimental purpose. Out of that 335 images have given a True detection and remaining 15 images have given a false detection. The application of Deconvolution wiener filter which reduces noise in the image and still obtains a foggy image. Then it is followed by threshold operation which also gives output as the foggy image. The Filter ensures whether the noise are removed in such a way to do the thresholding operation which segment the object clearly. The smoothing is performed by eliminating the all local structures. Hence the performed output give the image without any noise. At the meantime, the noiseless image is used for thresholding operation to select the defected portions in the image. After thresholding operation is over still there are little holes are seen in the image. So the noisy image with single small regions should be removed to find the exact portions of the image. Large regions should be placed as such.

Decreasing the undesirable portion of the binary image and locating regions of interest is the next step of process in the proposed method to identify the defects. Then all the connected regions are extracted. Then the smaller components are deleted using bwareopen function. Again select proper structuring element of dilate to probe and expand the shapes in selected region.

Then the regionprops and GLCM methods are employed to extract the features. Through these methods locating the defect and classifying the defects are done correspondingly. The fabric can be of any type like with defect or without defects. Here in TILDA dataset the fabric classes are silk, wool, small pattern print and large flower patterned print. Here for the experiments only the silk type fabric has been chosen.

The defect classes are no defects, mechanically included holes and cuts, oil stains, color defects, missing thread, foreign objects on the fabric, creases in fabric, lighting Variation in fabric, affine distortion by camera skew. The five

Defect classes are examined and results are given in Fig. 3. The Fig. 3. (a) represent the fabric input images, (b) gives the output for wiener filter, (c) the result of morphological operation and (d) their corresponding output.

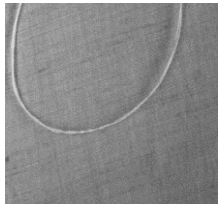
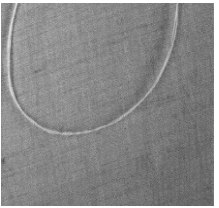
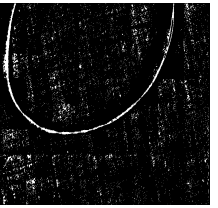



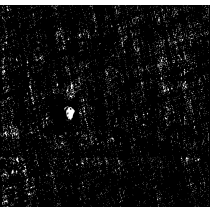

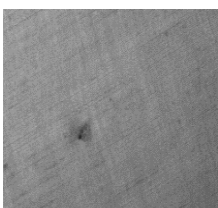
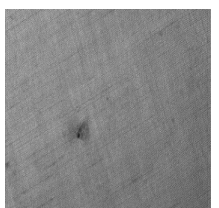
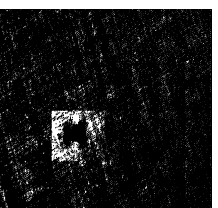

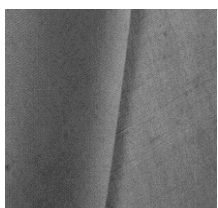
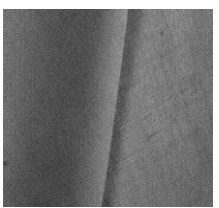




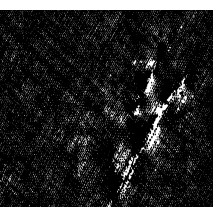
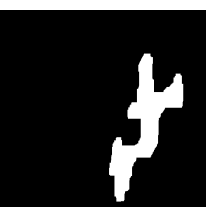

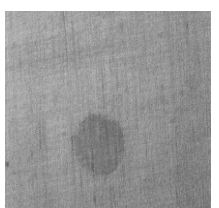
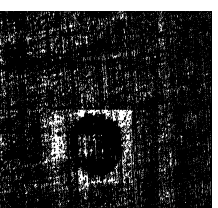

INPUT IMAGES(a)	WEINER FITER(b)	MORPHOLOGICAL OPERATION(c)	OUTPUT(d)
			
			
			
			
			
			

Fig .3 Example of a Fabric Defects and corresponding outputs

A.Feature Extraction

The feature are extracted using GLCM which provide a method for analyzing the texture. The features extracted are Energy, Homogeneity, Correlation, Contrast, Mean, Standard Deviation, Variance and Inverse difference moment (IDM).

As Raheja et.al discussed with the four features Energy, homogeneity, Contrast and Correlation comparison of these with horizontal offset can be made with the Non-defective and Defective images. And the defective images can be identified. With the horizontal correlation and vertical correlation the weft and warp yarn missing can be identified and classified. The Table-I. Shows the feature extracted using GLCM. The F1, F2, F3, F4, F5, F6, F7, F8, F9 gives the Contrast,

Correlation, Energy. Homogeneity, Mean, Standard deviation, Entropy, Variance, IDM. Saeed hosseinzadeh hanzaei and ahmad afsar pointed out in automatic defect classification of the ceramic tiles' surf ace defects that the geometric feature can be extracted to quantify the defects [9].

The second order method used to extract feature is regionprops method through which the area, perimeter, minor axis length, major axis length, centroid, eccentricity, for shapes.

By calculating the property area and perimeter of image regions the hole and pinhole defect variation can be classified. Accordingly by calculating the minor axis and major axis

length the thin bar and thick bar defect variation can be identified. The Table-II. Shows the feature extracted from regionprops.

Table- I: Features Extracted Using GLCM

Image/pr operties	F1	F2	F3	F4	F5	F6	F7	F8	F9
Img1	0.901328	0.003038	0.978014	0.858816	0.998481	0.074715	0.26293	0.383276	130.3073
Img2	0.846221	0.000632	0.982246	0.963799	0.999684	0.018089	0.133274	0.130574	0.139219
Img3	0.914983	0.00057	0.9726	0.978612	0.999715	0.010506	0.101957	0.084127	99.20529
Img4	0.742011	0.001329	0.988309	0.884978	0.999335	0.06043	0.238282	0.329149	449.928
Img5	0.916341	0.002266	0.985898	0.837029	0.998867	0.088005	0.283302	0.429776	156.0666
Img6	0.989399	0.001329	0.973867	0.947809	0.999335	0.02608	0.159373	0.174334	0.097049
Img7	0.973867	0.947809	0.999335	0.02608	0.159373	0.174334	0.023049	0.999902	0.097049

Table- II: Features Extracted Using Regionprops

Image/propertie s	Area	Centroi d	Perimete r	Minor axis length	Major axis Length	Eccentricit y
Img1	2937 9	286.7017	203.5162	2234.592	931.7494	403.5747
Img2	7113	240.7603	475.7852	473.601	159.9662	85.23514
Img3	4131	259.8216	248.6107	299.029	120.5988	48.66063
Img4	2376 2	284.3451	321.7775	890.272	251.2163	168.4124
Img5	3460 5	537.2129	292.0094	1399.85	419.5221	167.9765
Img6	1025 5	559.3529	173.4962	793.184	342.2722	49.70625
Img7	1278 6	480.4188	148.64	806.151	350.387	56.9941

Using the below chart fig. 4 the exact size and location of the defect can be identified easily. If the property area and perimeter value is large then the fabric defect is also large. And if it is less then the fabric fault is also small. And using the four point grading system used in the textile industry whether the fabric can be accepted or rejected can be identified. According to the defect length the penalty points can be assigned.

The acceptance criteria for fabric should be less than 40 penalty points for hundred square yards. The penalty point greater than 40 are considered as rejected [11]. This Four point grading system is mutually used by the purchaser and supplier. This calculation of area and perimeter property is possible for only directional defects. If it is an un-directional defects then more than one area and perimeter value is seen. So with that length of defect cannot be calculated. This can be a challenging task

Table- III: Four point grading system [11].

Defect length	Upto 3 inches	Upto 3 inches	Upto 3 inches	Upto 3 inches	Upto 3 inches	Upto 3 inches
Penalty points	1	2	3	4	2	4

The Fig. 4 Defect size Analysis chart pointed about the size of defect which can be identified easily using the chart. In the chart series1, series2, series3, gives the value of area, centroid and perimeter correspondingly. Using the property centroid value the location of defect can be detected.

The horizontal axis gives the images and vertical axis gives the offset value.so, using regionprops method the exact location and size of the defect can be identified accurately. If the total penalty point is greater than 40 for the fabric 100 square yards then the fabric roll is rejected.

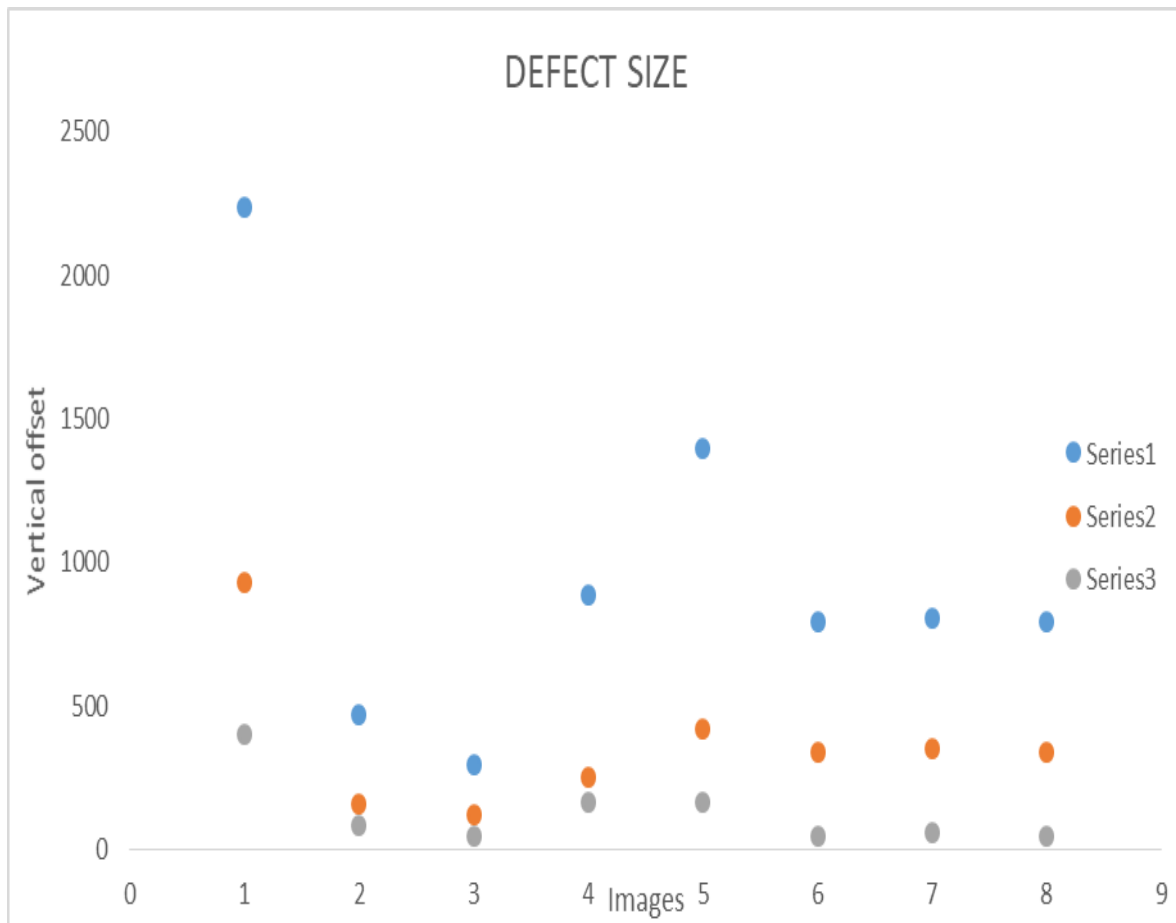


Fig .4 Defect size Analysis

V. CONCLUSION

When a fabric is came out from a fabric mill for production it should be checked fully then only a piece of fabric can go for cutting, sewing and embroidery line etc. So if the fabric left to these lines then there should not be any defect. If it is with defect then there are lot of pitfalls like cost reduction, and fabric is also waste.So we need an automatic defect detection system to exactly identify the location and type of defect easily. The deconvolution wiener filter algorithm which is able to identify even the microscopic size defects.so here this algorithm has been employed. It locate the defect with high accuracy compared to other system. Also classification has also done accurately with proposed work. The detection accuracy rate is 95.7%.

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