# Textile Quality Detection through Image Processing Techniques

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***Abstract*—Textile industry is one of the most thriving industries; but with the immense success ratio of this industry, there are many other problems related to it - one of them being the quality of the textile after every production step. There are high possibilities of defects being caused due to machine defects, faulty yarns, machine spoils and extreme stretching, etc. which need to be looked for during the entire process. In this paper, we look onto 5 different types of defects - colour defect, cuts, holes, faulty threads, and metal contamination. Two different methodologies have been used to understand and analyse these defects through practical application by Fourier Analysis and Mathematical Morphological methods which in turn determine the quality of the textiles.**

***Index Terms*—Textile defects, quality, fourier transform, morphology**

## I. Introduction

Textile is one of the major sectors in the industrial market which is flourishing at a rapid speed with increasing technologies. The industry needs to keep its quality under constant assurance to keep up with the market competency.

With production going on at a colossal level there is a high chance that there may be defects after every stage of production. However, the major defect detection of a fabric is done through human visual inspection; according to certain studies human visual inspection can only detect 60% - 75% of the major defects [1] and could be exceedingly time consuming.

Textile defects usually result from processes such as machine defects, faulty yarns, machine spoils and extreme stretching, and most defects occur either in the direction of motion or perpendicular to it [2].

There are 5 different types of fabric defects that have been taken into account in this paper - colour defect, cuts, holes, faulty threads, and metal contamination which are shown in Fig.1. Colour defects (Fig.1(a)) could be caused due to combination or mismatch of dyes; cuts (Fig.1(b)) could be caused during the process of separating the fabrics into different sizes and shapes; holes (Fig.1(c)) can be a resultant of insect invasion or the fabric getting caught in some machinery during production; faulty threads (Fig.1(d)) could be due to individual warp thread floating over a group of weft threads; and metal contamination (Fig.1(e)) could be caused by lubricants or rust in the metal containers or machinery.

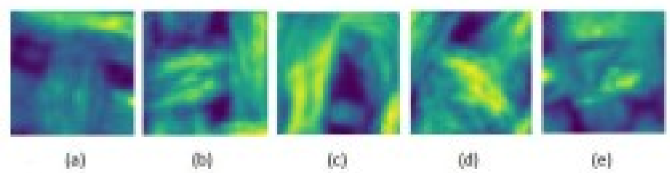


Fig. 1. Different types of defects: (a)Colour defect (b)Cuts (c)Holes (d)Faulty threads (e)Metal contamination

The different methodologies that have been used here are - (1) Fourier transformation and (2) Mathematical Morphology Methods.

The Fourier transform was originally presented by Imaoka to process the fabric image and estimate the fabric pattern [4]. Fourier transform analysis to measure fabric appearances.The key benefit of this method is that it is less sensitive to background noise and is more successful at detecting defects caused by dimensional changes in the fabric structure.

Morphological techniques are immensely used for image processing and computer vision applications. The approach of morphological image processing has its roots in texture analysis and the issues of determining texture attributes. Its underlying concept is to define the neighbourhood of points in a picture using a so-called structuring element [3].

## II. METHODOLOGY OF THE PAPER

### A. Fourier transforms

Fourier theorem states that any signal can be represented by the sum of sine and cosine wave with multiple amplitudes and frequencies. The discrete Fourier transform (DFT) transforms a finite sequence of equally spaced samples of a function into a sequence of the same length.

Fourier transform is a salient Image Processing tool that is used to convert images into frequency domain. The spatial frequency directly relates with the brightness of the image. The magnitude of the sinusoid directly relates with the contrast.

Fig.3 shows the workflow of detecting defects through fourier transformation; it includes (i) Inputting the fabric

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image; (ii) Image acquisition which transforms real-world optical image into an array of numerical data; (iii) Histogram Equalization which is a processing technique used to improve contrast of an image; (iv) Fourier Transform decomposes image into its sine and cosine components; and (v) Analysis of the quality of the fabric.

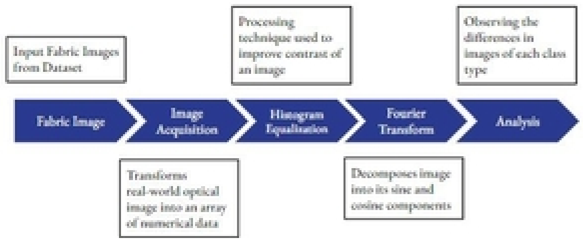


Fig. 2. Work flow of detecting defects through Fourier Transformation

*1) Approach:* The main approach that has been used for fabric defect detection is to perform fourier transformation on the given image and the threshold the image (or convert it to binary image).

After applying these operations on the image the defects in the fabric will be clearly visible in the histograms plotted Here we have take 5 images from each category (good,colour,cut,holes and metallic contamination, thread),and performed operation on them.

*2) Implementation:* Equalizing the image obtained from the dataset for improving the contrast of the image

equ1 = cv2.equalizeHist(img1)
cv2$_imshow(equ1)$

Applying the Fast Fourier Transform Functions

f = np.fft.fft2(equ1)
fshift = np.fft.fftshift(f)
ms = 20*np.log(np.abs(fshift))
ms1 = np.asarray(ms, dtype = np.uint8)
cv2$_imshow(ms1)$

Plotting a histogram to observe the deformities in the image of the fabric

histg = cv2.calcHist([ms1],[0],None,[256],[0,256])
plt.plot(histg)
plt.show()

*3) Observations and Conclusions:* Fig.3 and Fig.4 gives us a clear observation and conclusion on the different types of defects observed.

Class (good):
Does not have much defect as the number of white and black pixels occur simultaneously without any abrupt changes.

Class (colour):
Continuous black and white pixels are visible in the image.

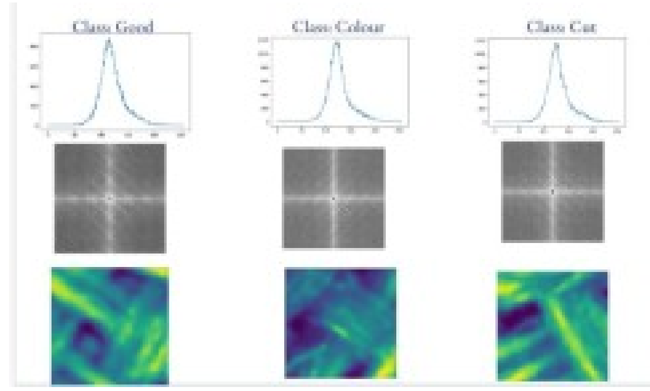


Fig. 3. Histogram, Fourier transformed image and Original image of classes good, colour and cut

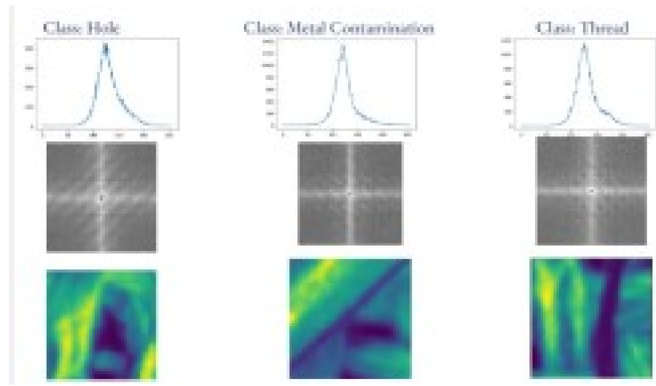


Fig. 4. Histogram, Fourier transformed image and Original image of classes hole, metal contamination and thread

Class (cut):
Sudden change at the peak with shifting of colour range.

Class (holes):
Sudden drop in the frequency of the pixel present.

Class (metal contamination):
Very sharp peak formed.

Class (thread):
Lots of pepper noise present.

## *B. Morphology*

Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size.

*1) Types of Morphological Operations:*

- Dilation : Morphological dilation makes objects more visible and fills in small holes in objects. Lines appear thicker, and filled shapes appear larger.
- Erosion:
  Morphological erosion removes floating pixels and thin

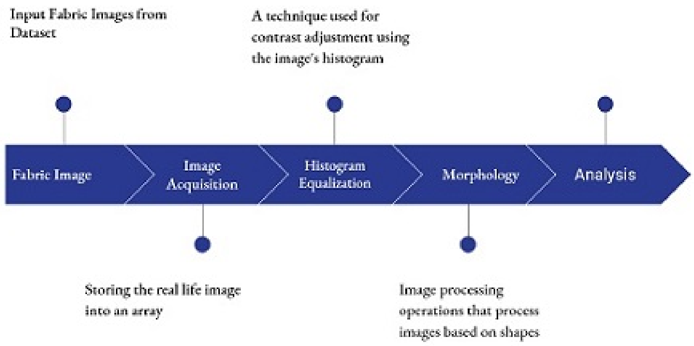


Fig. 5. Work flow of detecting defects through Morphology

lines so that only substantive objects remain. Remaining lines appear thinner and shapes appear smaller.

- Open:
  Morphological opening is useful for removing small objects and thin lines from an image while preserving the shape and size of larger objects in the image
- Close:
  Morphological closing is useful for filling small holes in an image while preserving the shape and size of large holes and objects in the image.

*2) Approach:* The main approach the has been used for fabric defect detection is to perform erosion operation on the given image and the threshold the image (or convert it to binary image),after applying these operations on the image the defects in the fabric will be clearly visible.
Here we have take 5 images from each category (good,colour,cut,holes and metallic contamination),and and performed operation on them.

*3) Implementation:* Loading the images from dataset :
plt.subplots(1,5,figsize = (20,20))
for i in range(5):
img$_{n}p = images[i]$
$plt.subplot(1, 6, 1 + i)$
$plt.imshow(img_{n}p[:, :, 0])$
$plt.show()$

Now , we convert the coloured images to grey scale and and perform histogram equalization on the grey scale image. Then we perform erosion on the resultant image after histogram equalization.
print('Input Image:')
cv2$_{i}mshow(equgood1)$
$print("Imageaftererosion:")$
$img_{e}rosion1 = cv2.erode(equgood1, kernel, iterations = 1)$
$cv2_{i}mshow(img_{e}rosion1)$
$print("Imageafterdilation:")$
$img_{d}ilation1 = cv2.dilate(equgood1, kernel, iterations = 1)$
$cv2_{i}mshow(img_{d}ilation1)$
$(thresh, th00) = cv2.threshold(img_{e}rosion1, 127, 255,$
$cv2.THRESH_{B}INARY)$
$cv2_{i}mshow(th00)$
$plt.show()$

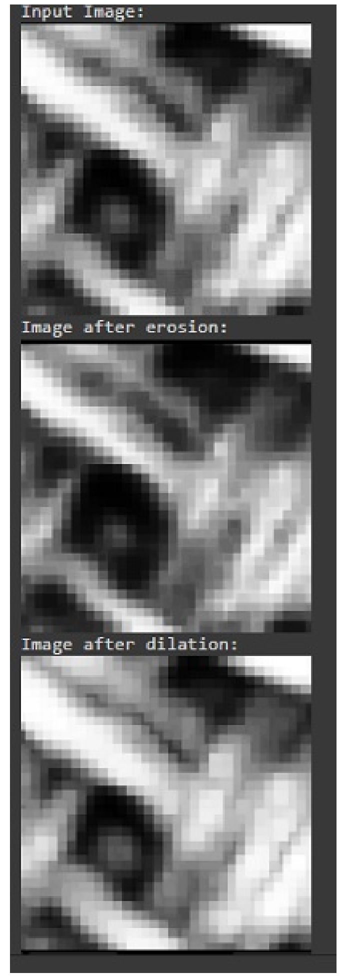


Fig. 6. (a)Histogram equalized image (b)Image after performing erosion operation (c)Image after performing dilation operation

Now we convert the eroded image into binary image So that we can visualise the image properly, that black pixels indicate that there is no fabric at that place and figure out the possible defects in fabric.

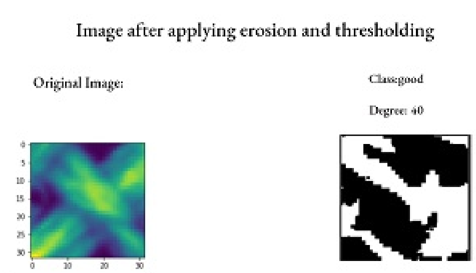


Fig. 7. Image after applying erosion and thresholding

*4) Observations:* Fig.7 belongs to class good and is at a rotation of 40 degrees; Fig.8 belongs to class cut and is at a rotation of 100 degrees; Fig.9 belongs to class hole and is at a rotation of 80 degrees; and Fig.10 belongs to class metal contamination and is at a rotation of 100 degrees show us the images after thresholding is performed. Here, we can clearly observe the irregularities in the fabric images, where the black portions represent the absence of fabric.

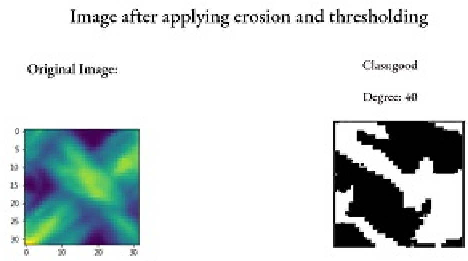


Fig. 8. Image after applying erosion and thresholding

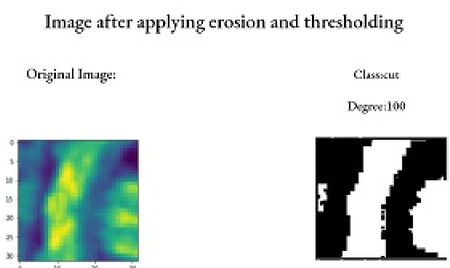


Fig. 9. Image after applying erosion and thresholding

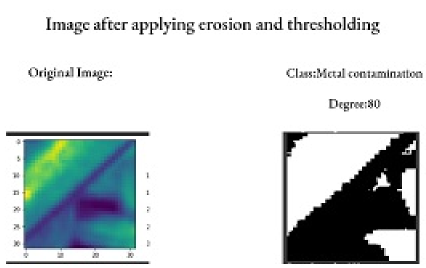


Fig. 10. Image after applying erosion and thresholding

### *C. Conclusion*

class (good):
does not have much defect as the number of white and black pixels occur simultaneously.
class(cut):
Clearly lines of black and while pixels visible in the image.
class(holes):
The image contains holes (formed by pixel value 0).
class(metal contamination):

Fig. 11. Image after applying erosion and thresholding

Continuous black and white pixels are visible in the image.

## References


[1] K. Schicktanz, ”Automatic fault detection possibilities on non-woven fabrics,” Melliand Textilberichte, vol. 74, pp. 294-295, 1993.

[2] Hanbay, K., Talu, M. F., Özgüven, Ö. F. (2016). Fabric defect detection systems and methods—A systematic literature review. Optik, 127(24), 11960-11973.

[3] Datta, Asit Chandra, Jayanta. (2010). Detection of Defects in Fabric by Morphological Image Processing. 10.5772/10470.

[4] Imaoka H, Inui S, Niwaya H, et al. Trial on Automatic Measurement of Fabric Density. J Society of Fiber Science Technology. 1988;44(1):32–39