Textile Defect Detection for Fabric Material using Texture Feature Extraction

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Abstract- Textile defect detection has always been a challenging task for people associated with the textile industry. Defective textiles are normally sold at a lesser price directly hampering the revenues of the industry or sometimes they are rendered unusable because of the nature and impact of the defect. Since textile pattern in certain types of textiles exhibit a homogeneous nature, it can be taken into account as one of the features to distinguish between a defective and non defective textile. Textile defects occur during various stages like knitting, weaving, dyeing etc and if detected at an early stage can reduce the wastage of raw material and subsequently increase the quality of finished product.

Keywords – FFT, PNN, global threshold, Feature Extraction

I. INTRODUCTION

Nowadays Quality inspection[1] of textile products is an important activity for fabric manufactures because the clothing industry is continually pressing for higher product quality and improved productivity to meet both customer demands and to reduce the costs associated with quality since textile industry plays an important factor in Indian economy. Higher production speeds make the timely detection of garment defects more important than ever. Many segments of the industry are working towards just-in-time delivery and a poor quality production run can be disastrous [2] at different stages and processes. They can occur during Spinning, weaving, knitting, printing, dyeing, stitching etc. Many researchers [3, 4, 5, 6, 7] proposed a simulated fabric model to understand the relationship between the fabric structure in the image space and that in the frequency space. We have proposed an approach to detect defects in textile materials using PNN.

In general, inspection of defects can take place at several stages in the apparel pipeline .As in all quality assessment procedures, the cost impact of a defect can be greatly reduced by detecting it as early as possible in the production life cycle Carrying out detection and classification of defects in real time is computationally a very demanding process. Currently, there are a lot of new studies and researches in garment inspection techniques using computerizes scanning technology and use-friendly systems to detect garment defects. Little research has been carried out to detect and classify Knitted garment stitching. The quality of fabric stitching is one of the key factors to determine the quality of a garment. In the apparel industry, identifying the quality of fabric stitching through human inspection is not reliable. To increase the accuracy of fabric inspection, attempts are being made to replace manual inspection by automated visual inspection [8].

II. PROPOSED TECHNIQUE

2.1 Textile Feature Extraction with PNN –

An automated fabric defect detection model based on texture features, FFT and PNN is developed which detects

defects in stitches of garment. For implementation three types of fabrics i.e. knitted, yarn, woven and different types of fabric defects like hole, dropped stitch, press-off, scratch defects etc. are considered.
In image processing, feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input.
Feature extraction is the process of creating a representation for, or a transformation from the original data. There has been a philosophical difference in attacking the problem of effective and efficient feature extraction.
One is human perception centered approach, i.e., based on human visual perception and psychological experiments, compute the measurements of certain perception-based features (e.g., "smoothness" for texture), and then select the best mathematical representation for it.
The other is machine-centered approach, in which case a unified computing scheme is selected for extraction of certain *ad hoc* features (e.g., "co-occurrence features", or "wavelet moments" for texture). The emphasis is first put on the computing aspect to provide an efficient algorithm to compute the "numbers"; and then the effectiveness or the correlation between the "numbers" and human perception is established by experiments. Or, feature extraction from invisible bands for hyper-spectral image analysis, where there is no input to the human perception system at all. The below block diagram shows the different steps involved in defect detection.

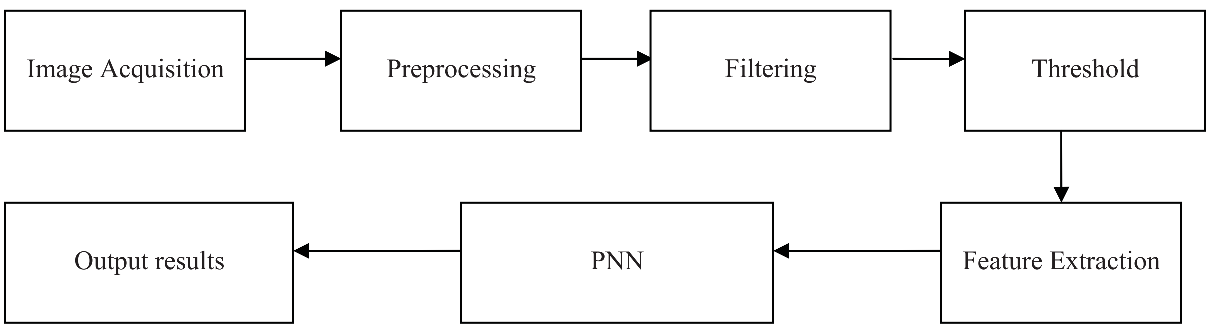

Figure1: Block diagram of textile defect detection

The different features that are extracted are shown below

1) Angular Second Moment:
Angular second moment is a measure of the homogeneity of an image. Hence it is a suitable measure for detection of disorders in textures.

2) Entropy: Entropy gives a measure complexity of the image or Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image.
3) Contrast: Contrast feature is a measure of the image contrast or the amount of local variations present in an image.
4) Inverse Difference Moment: It refers to the normalized entry of the co-occurrence matrices.
5) Correlation - A statistic representing how closely two variables co-vary.
The above features can be obtained from the following equations

1. Energy

It is the third criteria .It measures the image homogeneity. More homogeneous is the image larger is the value. It is given by $\sum_{a,b} P^2_{\varnothing,d}(a,b)$ ……………………….1

2. Entropy[

$\sum_{a,b} P_{\varnothing,d}(a,b) \log_2 P_{\varnothing,d}(a,b)$ ……………………………………………………2

3. Co-occurance Matrix[62]

It calculates a matrix of relative frequencies PØ,d(a,b) describing how frequently 2 pixels with grey levels a,b appear in the window separated by a distance d in direction Ø. The different values of relative frequencies are calculated as follows.

$P_{Ø,d}(a,b)=\{[(k,l),(m,n)] € D: k-m=0, l-n=d, f(k,l)=a, f(m,n)=b\}$……………………………3

$P_{45,d}(a,b)= \{[(k,l),(m,n)] € D: k-m=d, l-n=-d, f(k,l)=a, f(m,n)=b\}$…..................................4

$P_{90,d}(a,b)= \{[(k,l),(m,n)] € D: k-m=d, l-n=-0, f(k,l)=a, f(m,n)=b\}$…………………………..5

$P_{135,d}(a,b)= \{[(k,l),(m,n)] € D: k-m=d, l-n=d, f(k,l)=a, f(m,n)=b\}$…………………………..6

4. Angular Second Moment

$\sum i \sum j \ \{P(i,j)\}^2$

5. Variance

$\sum i \sum j \ (i-\mu)^2 \ p(i,j)$

6. Inverse Difference Moment

$\sum i \sum j \ 1/(1+(i-j)2) \ \ p(i,j)$

The features extracted are used as an input to train the neural networks. These features provide information regarding the change in homogeneous property of the textile material. The property of the defective material will show variance compared to the non defective material.

III. EXPERIMENT AND RESULT

Table 1: FFT with adaptive threshold for checked and striped

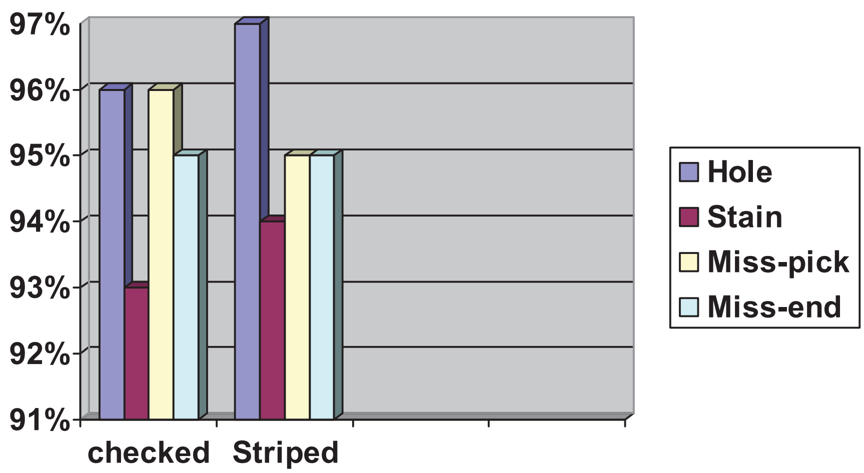

Figure 2: FFT with adaptive threshold for checked and striped

Defect	checked	Striped
Hole	96%	97%
Stain	93%	94%
Miss-pick	98%	98%
Miss-end	96%	98%

Table 2: NN for adaptive for checked and striped

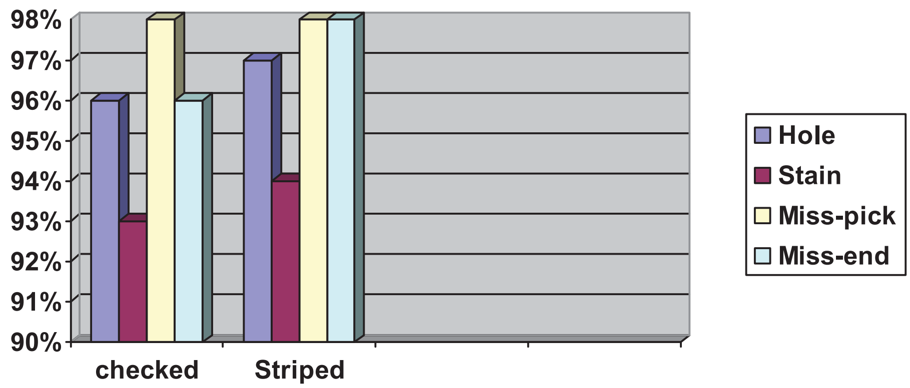

Figure 3: NN for adaptive for checked and striped

IV CONCLUSION

The results are slightly better for satin and twill when local threshold is used. The results are satisfactory for checked and striped material using fast Fourier transform but can be improved further by using other techniques such as neural networks. The results are obtained taking few samples of the selected defects into consideration.

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