ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 5, Issue 1, January 2016

Fabric Inspection System using Artificial Neural Networks

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Abstract*— *Fabric inspection system is important to maintain the quality of fabric. Fabric inspection is carried out manually with human visual inspection for a long time. The work of inspectors is very tedious and consumes time and cost. To reduce the wastage of cost and time, automatic fabric inspection is required. This paper proposes an approach to recognize fabric defects in textile industry for minimizing production cost and time. The Fabric inspection system first acquires high quality vibration free images of the fabric. Then the acquired images are subjected to defect segmentation algorithm. The output of the processed image is used as an input to the Artificial Neural Network (ANN) which uses back propagation algorithm to calculate the weighted factors and generates the desired classification of defects as an output. This research implements a textile defect detector which uses computer vision methodology with the combination of multi-layer neural networks to identify the classification of textile defects and detect it with a real time configured mechanical system containing a microcontroller(ARM7),GSM Modem, LCD.

Keywords* — *Artificial Neural Network (ANN), Defect detection, Fabric Inspection,, Wavelet transform, Feature Classifier.

I. INTRODUCTION

Quality is an important aspect in the production of textile fabrics. Fabric quality is consisting of two components, i.e., fabric properties and fabric defects. Fabric property depends on the raw material, construction parameters and processing methods. Whereas a fabric defect can occur right from raw material selection to finishing stage, because of improper input parameters with respect to material, machine and man. Any variation to the weaving process needs to be investigated and corrected. Defects fall into this category. Since when they appear, repair is needed, this is time consuming and sometimes results in fabric rejection. Fabric defect detection has been along – felt need in the textile and apparel industry. Surveys carried out in the early 1975 shows that inadequate or in accurate inspection of fabrics has led to fabric defects being missed out, which in turn had great effects on the quality and subsequent costs of the fabric finishing and garment manufacturing processes.

It has been observed that price of textile fabric is reduced by 45% to 65% due to defects. Manual defect detection in a Fabric quality control system is a difficult task to be performed by inspectors. The work of an observer is very tedious and time consuming. They have to detect small details that can be located in a wide area that is moving through their visual field. The identification rate is only about 70%. Moreover, the effectiveness of visual inspection decreases quickly with Fatigue. Digital image processing techniques have been increasingly applied to textured sample analysis over the past several years. Wastage reduction through accurate and early stage detection of defects in fabrics is also an important aspect of quality improvement. The high cost, along with other disadvantages of human visual inspection has led to the development of automated defect inspection systems that are capable of performing inspection tasks automatically. The problem of textile web inspection is particularly complex, since there is a large variety of fabrics of different structures, compositions, colors, and other properties.

For fabric fault detection we are using PC, controller for processing all action, GSM for message sending and buzzer for indication. We will keep a standard design in database and check it with all fabrics. If the fabric we are checking and standard image of fabric is not match or any fault is detected, then message will transfer to concerned person through GSM that is, fabric fault detected. Buzzer will give indication of fault detection. After the completion of analysis all the fabric then when user will press the switch daily report of the fabric analysis will be send to admin or production engineer. We will going to use the neural network technique for analysis of the fabric fault we will extract the feature from the fault fabric give it to the neural net-work and when we pass the test image to the algorithm with help of neural network we well be able to analyze the fault. The detailed working of proposed system is given in following fig:

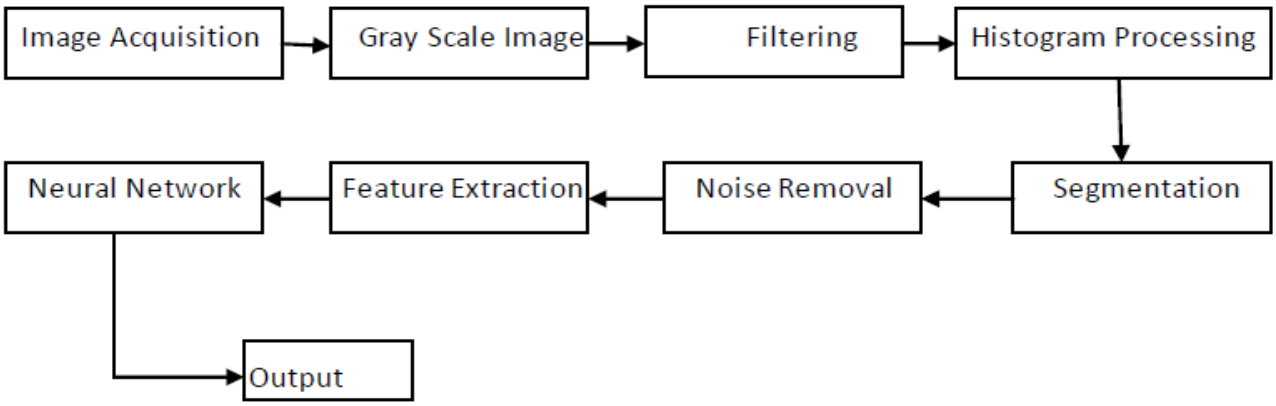

Fig 1: Functional block diagram of proposed system for fabric inspection system

Basic step include in this project are:

- Image Acquisition
- Gray Scale Image.
- Filtering and Histogram Processing.
- Segmentation.
- Noise Removal.
- Feature Extraction
- Artificial Neural Network

As shown in figure 1. The first stage of any vision system is the image acquisition stage. Different types of camera can be used for this application such as CCD (Charged Coupled Device) camera, CMOS (Complementary Metal Oxide Semiconductor) camera, Digital camera, etc. The pixel value of these cameras is around 320 * 420 pixels. After the image has been obtained, various methods of processing can be applied to the image to perform different tasks. The acquired image must be converted into gray scale to eliminate the hue and saturation information while retaining the luminance. Segmentation involves partitioning an image into groups of pixels which are homogeneous with respect to some criterion. Digital images consist of many types of noise. Noise is the result of errors in the image acquisition process. There are several ways that noise can be introduced into an image, depending on how the image is created.

Feature Extraction is a method of capturing visual content of images for indexing retrieval.

1) Feature construction.
2) Feature subset generation.
3) Evaluation criterion definition.
4) Evaluation criterion estimation.

Textures can be rough or smooth, vertical or horizontal etc generally they capture patterns in the image data. Example repetitiveness and granularity.

Texture features are:

- Statistical measures.
  - Entropy.
  - Homogeneity.
  - Contrast.

-Wavelets.
-Fractals.

Using neural networks as a classifier requires two phases a training phase and a testing phase. In the training phase, the neural network makes the proper adjustment for its weights (W) to produce the desired response. When the actual output response is the same as the desired one, the net-work has completed the training phase (i.e. it has acquired knowledge). In the testing phase the neural network is asked to classify a new set of images and its success is evaluated. In this work the neural networks were trained by the back propagation algorithm to detect and classify the weaven fabric defects. The feature vectors were used as the input vectors to the Neural Network.

II. Image Analysis Technique:

A. Image Acquisition:

The first stage of any vision system is the image acquisition stage. Different types of camera can be used for this application such as CCD (Charged Coupled Device) camera, CMOS (Complementary Metal Oxide Semiconductor) camera, Digital cam- era, etc. The pixel value of these

cameras is around 320 * 420 pixels. After the image has been obtained, various methods of processing can be applied to the image to perform different tasks. If the image has not been acquired satisfactorily then the intended tasks may not be achievable. The following are the various methods for image acquisition. Laser Ranging Systems Structured Light Methods Moiré Fringe Methods Shape from Shading Methods Active and Passive Stereoscopic Methods

B. Gray Scale Image:

The acquired image must be converted into gray scale to eliminate the hue and saturation information while retaining the luminance.

C. Filtering Histogram Processing:

A filter is defined by a kernel, which is a small array applied to each pixel and its neighbors within an image. In most applications, the center of the kernel is aligned with the current pixel, and is a square with an odd number of elements in each dimension. The process used to apply filters to an image is known as convolution, and may be applied in either the spatial or frequency domain. The CONVOL function Performs this convolution process for an entire image.

D. Segmentation:

Segmentation involves partitioning an image into groups of pixels which are homogeneous with respect to some criterion. Different groups must not intersect each other and adjacent groups must be heterogeneous. The groups are called segments. Most digital images exist on a rectangular grid. This is primarily due to the arrangement of image sensors on camera and scanning equipment.

E. Noise Removal:

Digital images consist of many types of noise. Noise is the result of errors in the image acquisition process. There are several ways that noise can be introduced into an image, depending on how the image is created. If the image is scanned from a photograph made on film, the film grain is a source of noise. Noise can also be the result of damage to the film, or be introduced by the scanner itself. If the image is acquired directly in a digital format, the mechanism for gathering the data (such as a CCD detector) can introduce noise. Electronic transmission of image data can Introduce noise.

F. Feature Extraction:

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Texture features are:

- Statistical measures.
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  - Homogeneity.
  - Contrast.

-Wavelets.

-Fractals.

Entropy: Entropy shows the amount of information of the image that is needed for the image compression. Entropy measures the loss of information or message in a transmitted signal and also measures the image information. Entropy is given by:

ENTROPY=

$$\sum_{i=0}^{Ng-1}\sum_{j=0}^{Ng-1} -P_{ij} * logP_{ij}$$

Homogeneity: Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal. Homogeneity is 1 for a diagonal GLCM computation of entropy. Homogeneity is given by:

Homogeneity =

$$\sum_i \sum_j \frac{P_d(i,j)}{1+|i-j|}$$

Contrast: Measures the local variations in the gray-level co-occurrence matrix. Contrast is 0 for a constant image[.The contrast is given by:

Contrast =

$$\sum_i \sum_j (i-j)^2 P_d(i,j)$$

G. Artificial Neural Network:

Artificial Neural networks have been developed as generalization of mathematical models of human cognition and showed promise for solving difficult problems in areas such as pattern recognition and classification. A neutral network consists of a group of simple elements called neurons (as shown in the figure) which process the input information. These neutrons are connected to each other with links carrying the signals between them. There is a weight for each connection link (W) which acts as a multiplica-tion factor the transmitted signal (∑Θ). An activation function (F) is applied

to each neurons input to determine the output signal (O) as shown in the figure. Bias terms can be presented to solve specific problem with obvious result-tendencies. Using neural networks as a classifier requires two phases a training phase

And a testing phase. In the training phase, the neural network makes the proper adjustment for its weights (W) to produce the desired response. When the actual output response is the same as the desired one, the net-work has completed the training phase (i.e. it has acquired knowledge). In the testing phase the neural network is asked to classify a new set of images and its success is evaluated. In this work the neural networks were trained by the back

propagation algorithm to detect and classify the weaven fabric defects. The feature vectors were used as the input vectors to the Neural Network.

III. RESULTS

In the proposed algorithm, through our project we will going to find out the fault in the textile such as oil spot, horizontal and vertical effect. We will go to send the message of the fault result to the Product Engineer.

Fig 3.1Gray scale image of salt and paper noise

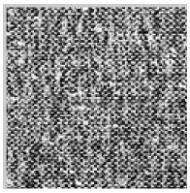

Fig 3.2 Equalized histogram image.

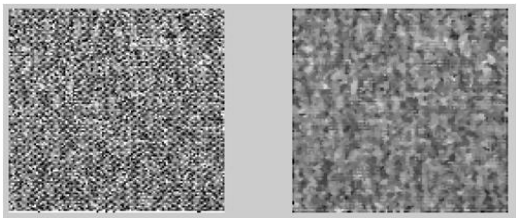

Fig 3.3 Salt and paper noise removal using filtering

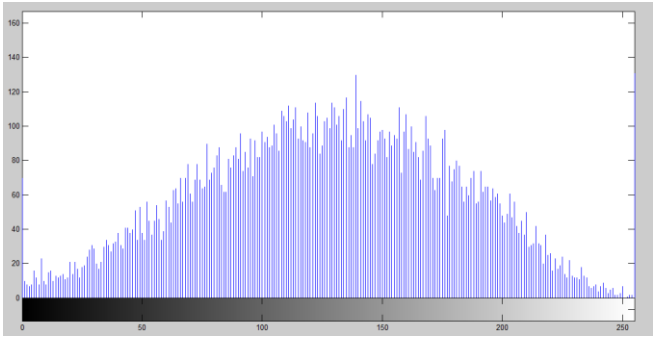

Fig 3.4 Histogram processing

IV. CONCLUSION

In most of the textile garment factories the defects of the fabrics are detected manually. The manual textile quality control usually goes over the human eye inspection. Notoriously, human visual inspection is te-dious,tiring and fatiguing task, involving observation, attention and experience to detect correctly the fault occurrence. The accuracy of human visual inspection declines with dull jobs and endless routines. Sometimes slow, expensive and erratic inspection is the result. Therefore, the automatic visual inspection protects both: the man and the quality. Here, it has been demonstrated that Textile Defect Recognition System Is capable of detecting fabrics defects with more accuracy and efficiency.

In this paper, a new intelligent and a fabric defect inspection system based on texture feature and back propagation was presented. In this paper a artificial neural network based fabric defect detection system was demonstrated. The problem is to identify and locate the defects in the fabric by using necessary image analysis techniques. The results obtained by our proposed system indicate that a reliable fabric inspection system can be created for textile industries.

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