FABRIC TEXTURE ANALYSIS USING IMAGE PROCESSING TECHNIQUES

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Abstract : Textile fabric automation and manufacturing has been of great concern over the past decade. This is an interesting task due to the accidental changes of cloth material properties. Due to the increasing demand of consumers for high-quality textile products, an automatic and objective evaluation of the material texture appearance is important with reference to geometric structure characteristics, surface, and mechanical properties. The precise measurement of the material texture parameters, like weave structure and yarn counts find wide applications within the textile industry. The weave pattern and therefore the yarn count are analyzed and determined for computer simulated sample images and also for the scanned real fabric images. Image Processing algorithms are used to identify the accurate structure of the woven fabric and to determine the yarn count. They are used for segmenting the crossed areas of yarns and also to detect the defects like crossed area thanks to the random distribution of yarns. Grey Scale Algorithm is applied to convert the fabric image into a grey level image. Histogram Equalization is used to enhance the contrast. Spatial Domain Projection to individually recognize the each pixels in a fabric.

Keywords – Image Processing, Grey Scale Algorithm, Histogram Equalization, Spatial Domain Projection.

I. INTRODUCTION

The Process automation of textile and clothing manufacturing has been of accelerating interest over the decades. this is often still a challenging task due to the unpredictable variability of cloth material properties. there's a requirement for the event of more efficient computer techniques for the automated control of the material manufacturing process. additionally, thanks to the increasing demand of consumers for high-quality textile products, an automatic and objective evaluation of the material texture appearance is important with reference to geometric structure characteristics, surface and mechanical properties, and, not the smallest amount , aesthetic appearance. The accurate measurement of cloth texture parameters, like weave structure, yarn counts, and surface roughness, has wide applications not only within the textile industry but also in other areas, like virtual environments, e-commerce, and robotic telemanipulation.

Inexpensive computer vision and image-processing techniques for the measurement of geometric texture characteristics of woven fabrics. The paper propose a new method for the automatic recognition of the weave pattern and accurate measurement of yarn counts by analyzing 2-D fabric sample images. The system aims to solve the Texture detection of a fabric within short instance. This system will give the yarn count of a input fabric and the crossing area detection in the given fabric. So that one could easily analyze the fabric texture details such as crossing of wept yarn and warp yarn with the help of Image Processing Techniques.

II. LITERATURE REVIEW

The following research articles are selected for review, keeping in mind the traditional and conventional approaches of fabric texture recognition:

Jianqiang Shen proposed a method based on texture analysis and neural networks to distinguish the textile defects. Feature extraction is done designed based on Grey Level Cooccurrence Matrix (GLCM). A neural network is used as a classifier to recognize the fabric defects. [1]

Xin Wang proposed an 2-D wavelet transform is used to obtain low-frequency sub-image in order to reduce the analysis of fabric images. GLCM and Gabor wavelets are wont to extract the feel features of pre-processing fabric images. Probabilistic Neural Network (PNN) is used to classify the three basic woven fabrics. The experimental results show that the novel method can automatically, efficiently classify woven fabrics and acquire exact classification results (93.33%). [2]

Mahajan Archana B proposed a technique for textile defect identification and classification based on computer vision. Wavelet frames are used for feature extraction with the design of neural network classifier. Then sub-image based PCA method is applied for data classification. The defects are classified using neural networks. [3]

Azim, G.A. proposed a method based on texture analysis and neural networks to distinguish the textile defects. Feature extraction is done designed based on Gray Level Co-occurrence Matrix (GLCM). A neural network is used as a classifier to recognize the textile defects. [4]

Dandan ZHU et al. proposed a new detection algorithm for yarn-dyed fabric defect based on autocorrelation and GLCM. The autocorrelation function is employed to work out the pattern period of yarn-dyed fabric. GLCMs are computed with the specified parameters to portray the original image. Euclidean distances of GLCMs between detected images and the template image, which is selected from the detect-free fabric, are computed, and then the threshold value is given to realize the defect detection. Accurate detection of common defects of yarn-dyed fabric, like the incorrect weft, weft cracks, stretched warp, stain and holes might be known. [5]

P. Palisson, N. Zegadi, F. Peyrin, and R. Unterreiner introduced an idea of applying of 2D continuous wavelet transform (WT) to texture analysis in 1994. A overall set of wavelets is defined from an isotropic mother wavelet called the Mexican hat , the image is decomposed into different pixels. Simple orientation texture features were computed on an analyzing window moving through the final images, so on characterize each region of the image by a feature vector. A multiresolution clustering method, supported Kohonen's self-organizing map, was wont to group regions into homogeneous areas, consistent with the similarity of their feature vectors and showed that the best image segmentation is achieved with a variable size window, counting on the size of study. [6]

A. Lachkar, T. Gadi, R. Benslimane, and L. D'Orazio proposed a new and fully automatic method based on Fourier image-analysis techniques in 2003 to solve crossed-points-detection problems. This automatic woven-fabric recognition aimed at how to detect the areas of interlacing warp and weft yarns. The algorithm was evaluated visually by superposing the detected grid image on the initial woven-fabric image. All the detected crossed-points were displayed independently and were saved as file-format images for further processing. [7]

M. Rallo, J. Escofet, and M. S. Millan in 2003 decsribed a method in which a convolution model and an additive model, in both the spatial and frequency domains, are combined to extract information about the fabric structure by image analysis. The method allows the analysis of the optimal weave repeats, their size in terms of number of yarns, their interlacing patterns, and their patterns of repetition. It was applied to fabrics with the pattern of square and nonsquare conventional weave repeat. [8]

B. S. Jeon, J. H. Bae, and M. W. Suh introduced neural network and image processing technology for classifying woven fabric patterns in 2003. An autocorrelation function was used to determine one weave repeat of the fabric. The reflected fabric image is captured and digitized by the pc system. The learning vector quantization algorithm enables recognition of woven fabric types. Three basic weave types were defined accurately, and structural parameters like yarn spacing, its variance, and therefore the ratio of warp spacing to weft spacing were also obtained. But this approach was very sensitive to the selection of the set of training data used for the learning algorithm. [9]

C. F. J. Kuo and C. C. Tsai proposed a method to recognize the fabric nature and type of the main weaving texture in 2006. First, the color scanner captures the material image and saves it as a digital image then the wavelet transformation is employed to display the image texture. The co-occurrence matrix is applied to analyse the feel characteristics, like angular moment, entropy, homogeneity, and contrast, and finally, the training vector quantization networks (LVQN) are used as a classifier to categorize the material nature and therefore the sort of weaving texture. Variations in the lighting condition and the image scale may lead to a failure of the classifier. [10]

III. Proposed System

The proposed system ranks over the traditional Fabric Texture detection techniques in terms of better time-complexity, automation, reducing human-dependencies and much more. Hence, it integrates various components to proceed with the operations and meet the above advantages. The Fabric sample image is provided by the user then it undergoes into following operations. Initial step is to convert the original image into a grey scale image and apply the Histogram Equalization to enhance the image to find the crossing of wept and warp yarn. Later the spatial Domain Projection finds the yarn counts present in given fabric Image.

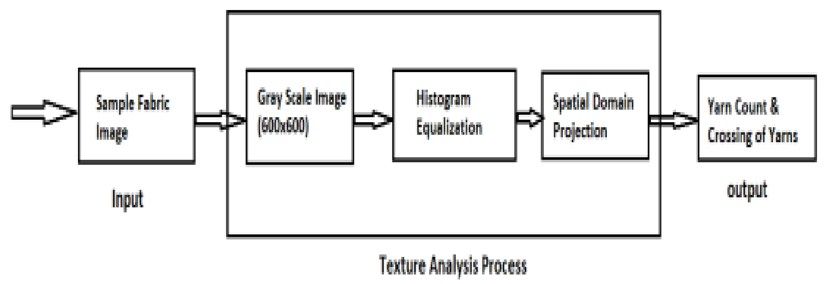

Figure 3.1 : System Architecture

The real fabric images scanned using HP scanner with a resolution of 2400 dpi is shown in Figure 2. For real fabric scan, it is necessary that the warp and the weft yarns are arranged properly along the x- and y- directions to achieve the best performance for the cross-area detection.

Figure 3.2 : Scanned Real Fabric Images

To convert the real fabric image into a Gray scale image :
Gray = (Red + Green + Blue) / 3
For each pixel in Image {
Red = Pixel.Red
Green = Pixel.Green
Blue = Pixel.Blue
Gray = (Red + Blue + Green) / 3
Pixel.Red = Gray
Pixel.Green = Gray
Pixel.Blue = Gray
}

Histogram Equalization is used to enhance contrast. Let's start histogram equalization by taking this fabric image below as a sample image.

Figure 3.3 : Input Image

Histogram of this image has been shown below.

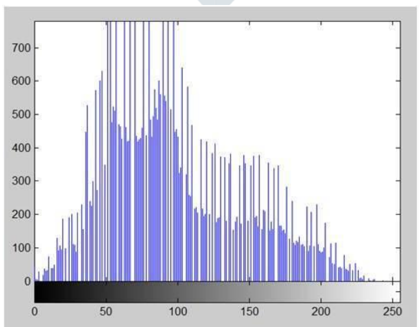

Figure 3.5 : Histogram of Input Image

PMF: First we have to calculate PMF(probability mass function) of all the pixels in this image.
CDF: our Next step involves calculation of CDF(cumulative distributive function).

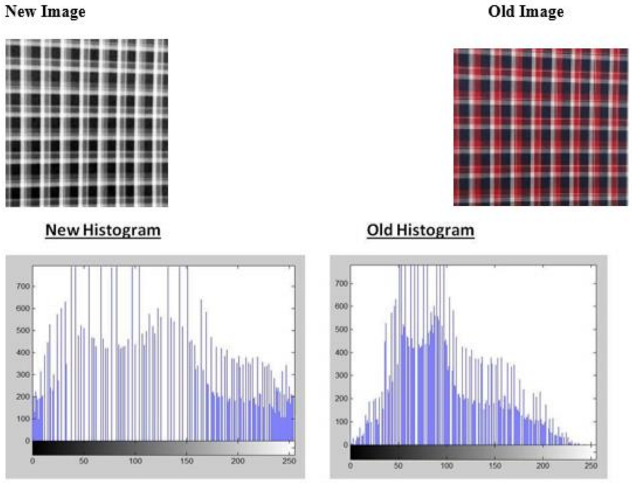

Figure 3.6 : Histogram Equalization

Digital image is a grid of pixels. A pixel is that the smallest element in a picture . Each pixel corresponds to anybody value called pixel intensity. Now the intensity of a picture varies with the situation of a pixel. Let II be an image and (x,y)(x,y) is the location (or coordinate) of any pixel then the image is represented as a function of location : I(x,y), I(x,y), where xx and yy are integers. Integers. Thus an image I(x,y)I(x,y) is a matrix of pixels. The term spatial refers to space. In a picture , this space may be a 2D plane (xy-plane). So, the spatial domain refers to the image plane itself and methods in spatial domain are supported directly modifying the worth of the pixels. Spatial domain processes are represented as:
I1(x,y)=T[I(x,y)]I1(x,y)=T[I(x,y)]
Where I1I1 is modified image and the value of a pixel with coordinates (x,y)(x,y) in I1I1 is the result of performing some operation TT on the pixels in the neighborhood of (x,y)(x,y) in the original image II.

IV. Results And Discussion

This Section depicts the entire working of Fabric texture Recognition. All the screenshot attached shows the process of fabric texture analysis.

Following are the screenshots in the orderly manner.

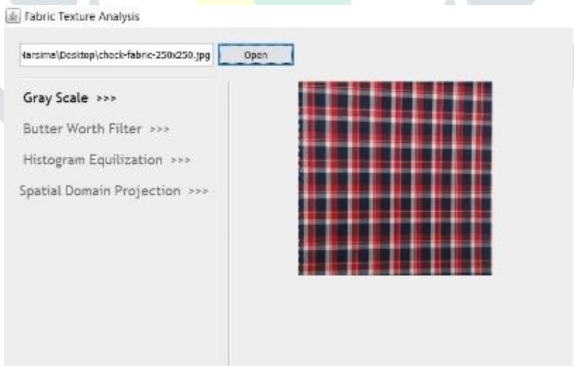

Figure 4.1 : Input of Fabric

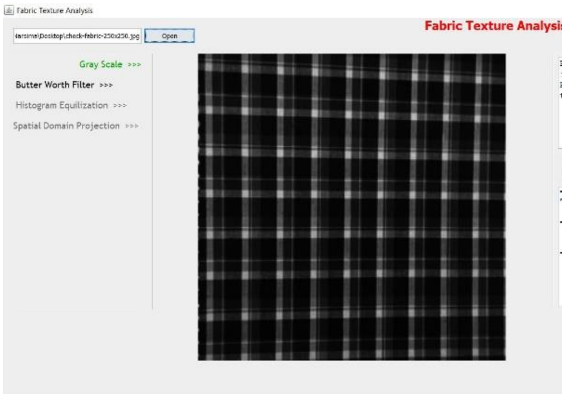

Figure 4.2 : Conversion into Gray Scale

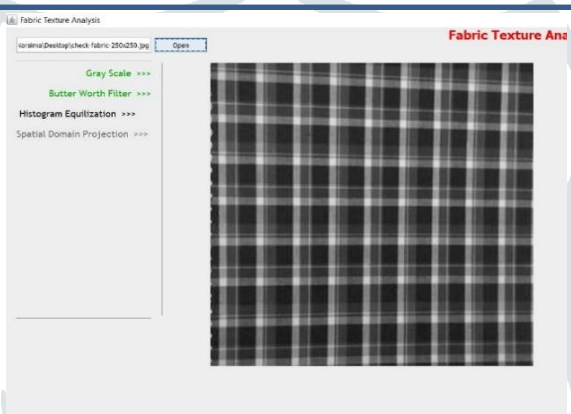

Figure 4.3 : Conversion in Butter Worth Filter

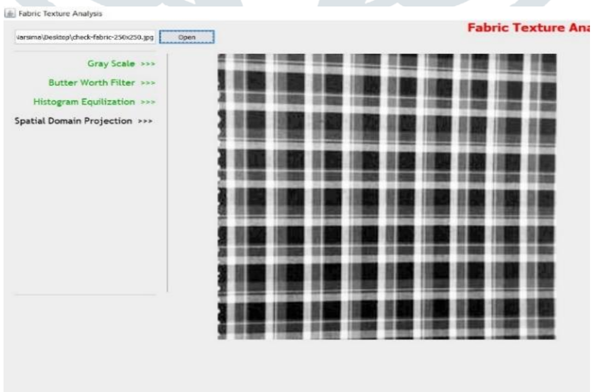

Figure 4.4 : Conversion into Histogram Equalization

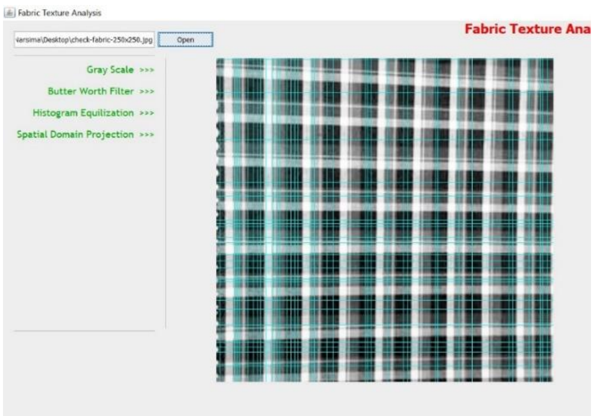

Figure 4.5 : Conversion into Spatial Domain Projection

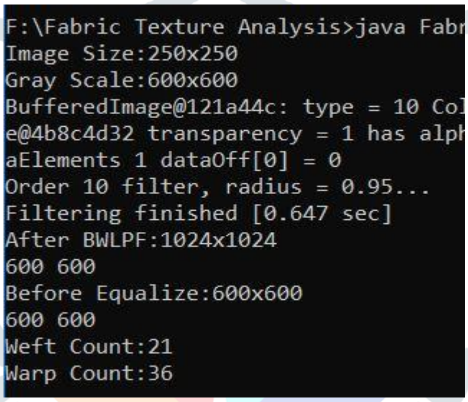

Figure 4.6 : Detected Yarn Count

V. Conclusion

The proposed method is used to detect yarn counts in the weave pattern in fabric samples. The technique is tested by using both image processing algorithms on real woven fabric images. The test samples with various thread counts, view, and weave types are chosen for analyzing. All weave patterns of the material samples tested are successfully recognized, and computed yarn counts are found to be according to the manual counts. Hence it are often concluded that this recognition method allows automatic recognition of basic weave pattern and precisely measure the yarn count.

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