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Implementation of Fabric Fault Detection System Using Image Processing

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Abstract- This paper is based on the implementation work done by the authors and the results of fabric fault detection. Automatic fabric inspection is important to maintain the fabric quality. For a long time the fabric defects inspection process is still carried out with human visual inspection, and thus, insufficient and costly. Hence the automatic fabric defect inspection system is required to reduce the cost and wastage of time caused by defects. The development of fully automated web inspection system requires robust and efficient fabric defect detection algorithms. In this article we have proposed an effective method for inspecting fault. Here we are using segmentation and RGB to HSV techniques for image processing which would eventually result in better result of fabric fault detection. Report generated would eventually reduce the time for human inspection of overall daily work. To maintain accuracy we have created a proper ambience for image capturing process so that exposure and intensity of light would be constant throughout the day.

Index Terms- Gaussian Blur; Segmentation; Thresholding; HSV; Fabric fault.

1. INTRODUCTION

Automatic fabric fault detection is essential in today's world of business. Fabric faults are responsible for nearly 84% of the defects found by the Textile industry. Manufacturers recover only 45 to 65 % of their profits from seconds or off-quality goods [1][2].In 1975 surveys were carried out which shows that insufficient or inaccurate inspection of fabrics that resulted in fabric defects being ignored, which in turn had great impact on the quality and subsequent costs of the fabric finishing and garment manufacturing processes [2]. In this paper we have approached a system to detect fault in fabric produced in textile industry. It will tremendously reduce the work required for manual vision inspection of fabric being produced in run time scenario. An efficiency of a system is good as we are using a Segmentation approach so even microscopic faults can be detected in image processing , segmentation is the partitioning of a digital image into multiple regions called segments (sets of pixels), according to some homogeneity criteria.

Different approaches are suited to different types of images and the quality of output of a particular algorithm is difficult to measure quantitatively due to the fact that there may be much accurate segmentation for a single image. Region based Segmentation is the process of partitioning an image into non-intersecting or non-overlapping regions such that each region is homogeneous and the union of no two adjacent regions is homogeneous [4] [5] [6].

In our approach of fabric Fault detection, First of all we have to train system for a well suite example of fault free fabric. In the training process each pixel value of that segment is stored in a buffer as a standard pixel value of a fault-free fabric. After storing the standard dataset scanning can be performed on trained dataset. Camera will scan the image by fixed Resolution under the controlled environment. Once the image is captured next task is segmentation of image. Now system check values stores in buffer for segment of pixel with each of the available segments. If the total value of that segment defers then its marked as a fault in fabric. Here we also calculate the percentage of fault detected by simple dividing the number of faulty segments by total number of segments of that image. After generating the total percentage value a report of it is generated and sent to the central system (Quality checking Unit).

Automated fabric fault detection system will deal with fabric defects such as whole, scratch, stretch, fly yarn, dirty spot, cracked point, misprints, color bleeding etc. Fabric industries face loss if these defects are not identified [7] [8] [9].

2. LITERATURE REVIEW

Fabric defect detection in digital image process has received tidy attention throughout the past 2 decades and diverse approaches are projected in the literature.

Most prominent approach in automated fabric fault detection is, fabric defect detection using morphological filters proposed by K.L.Mak, P.Peng and K.F.C. Yiu. Defect detection system is based on morphological filters and proposed to handle the problem of automated defect detection for woven fabrics. Proposed scheme extracts texture features of the textile fabric using a pre-trained Gabor wavelet network. These texture features are then used to facilitate the construction of structuring elements in subsequent morphological processing to remove the fabric background and isolate the defects. Navneet Kaur et al projected a Gabor filter theme. A Gabor filter was chosen as an appropriate representative of this category of techniques. Optimized 2-D Gabor filters was successfully applied on the textile flaw detection and provided an additional support of their suitability for this task. By Xie Xianghua et al the techniques used to examine textural abnormalities are mentioned in four categories, applied math approaches, structural approaches, filter primarily based ways, and model primarily based approaches. This paper focuses on the recent developments in vision primarily based surface scrutiny victimization image process techniques, particularly people who are supported texture analysis ways. Due to rising demand and observe of color texture analysis in application to visual scrutiny, those works that are dealing with color texture analysis are mentioned on an individual basis. Priya has separating a digital image into its bit planes is beneficial for analyzing the relative importance contend by every little bit of the image. Rather than light grey level images, light the contribution created to total image look by specific bits is examined here [17] [18] [19] [20] [21] [22].

Mainly three defect detection techniques are developed for automated fabric defect detection namely, statistical, spectral, and model based [7]. Number of techniques has been deployed for defect classification. Among them, neural network, support vector machine (SVM), clustering, and statistical inference are prominent ones [8].The task of Scene analysis and feature extraction is challenging concern. The subsequent steps increase the complexity and the classification task becomes difficult by selecting an inappropriate feature set. Automated textile inspection begins with various type of different colored defective and non-defective fabric. Then each defect occurred should be analyzed properly [9].

This will enable selection of the features for classification. Proper justification of every feature is necessary in terms of their discriminatory qualities and complexities to extract them, which is also very challenging. This results in a suitable feature set, which will make the automated system's performance good. For design in UML and software engineering methods work was also studied [13] [14] [15] [16].Some Machine Learning related work was also studied [23] [24] [25] [27]. S. L. Bangare *et al* have done research work in the image processing [30] [31].

3. METHODOLOGY

3.1 Block Diagram (Software)

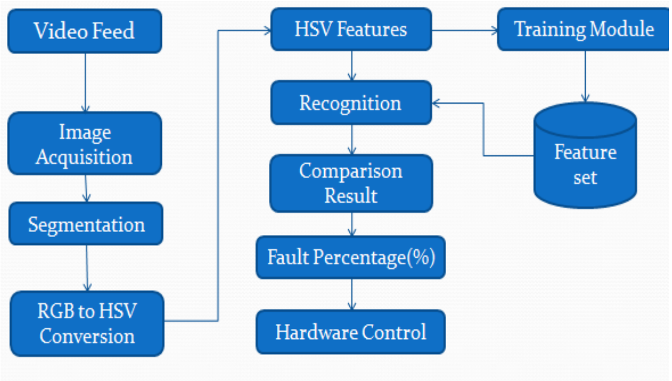

Fig.1. Block Diagram

3.1.1 SEGMENTATION

Segmentation of image is the process of separating a digital image into multiple segments. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (edge detection).Each pixels in the region are similar with respect to some characteristic or computed property, such as color, intensity or texture. S. L. Bangare *et al* have described the methods in their work [10] [11] [12].

There are predefined existing techniques which are used for image segmentation. These all techniques have their own accuracy and algorithms. These all techniques can be derived from two basic approaches of segmentation i.e. region based or edge based approaches. Every approach can be applied on various types of images to perform required segmentation. These all techniques can be further classified into three categories which are

1 Structural segmentation techniques
2 Stochastic segmentation techniques
3 Hybrid techniques

In our system we have used region based segmentation technique. We break the image into equal number of segments depending upon the similarity between the pixels. After the image being separated in segments, value of pixels of either one of the standard segment is stores in training dataset. At the runtime when image is captures it is separated in segments. Separated segments are then compared with the matching segment in training dataset. Segments differ in value are considered as faulty segments. As segments gives binary value of pixel the overall efficiency of system increases as every pixel is compared for the fault present in pixel.

3.1.2RGB to HSV

Color vision can be exploited or separated using RGB color space or HSV color space. RGB color space describes colors in terms of the pixel's value in terms of Red, Green and Blue color. HSV color space describes pixel's color in terms of the

Hue, Saturation, and Value of a every pixel. In situations where color description plays an vital role, the HSV color model is often more preferably used over the RGB model. The HSV model describes the image exactly as human eye has tendency to see the image. RGB defines color in terms of a complex addition of primary colors(RGB), whereas, HSV describes color using more detailed comparisons such as color, saturation of image and the shade of colors.

Once the camera has read these values of RGB, they are converted to HSV values. The HSV values are then used in the code to determine the feature of each pixel and then stored in a buffer.

Formulas used for RGB to HSV conversion are as follows

R' = R/255
G' = G/255
B' = B/255
Cmax = max(R', G', B')
Cmin = min(R', G', B')
Δ = Cmax - Cmin

Hue calculation:

$$H = \begin{Bmatrix} 0°, & \Delta = 0 \\ 60° \times \left(\frac{G' - B'}{\Delta} mod6\right), & C_{max} = R'; \\ 60° \times \left(\frac{B' - R'}{\Delta} + 2\right), & C_{max} = G'; \\ 60° \times \left(\frac{R' - G'}{\Delta} + 4\right), & C_{max} = B'; \end{Bmatrix}$$

Saturation calculation:

$$S = \begin{Bmatrix} 0, \ C_{max} = 0 \\ \frac{\Delta}{C_{max}}, \ C_{max} \neq 0 \end{Bmatrix}$$

Value calculation:

$$V = C_{max}$$

3.2 Hardware Description

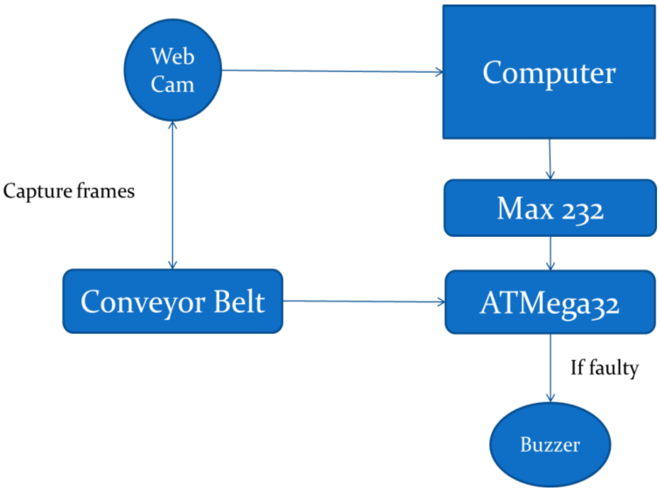

Fig.2. Hardware Description

3.2.1 Conveyor Belt

Conveyor belt carries manufactured fabric. The infrared sensor is used to detect whether there is cloth present on conveyor belt. If present then camera takes video feed.

3.2.2 Web Camera

Web camera grabs frames of fabric present on conveyor belt. Pixel values of frame are sent to computer via JMyronlibrary. It grabs 10 frames per second.

3.2.3 Microcontroller

ATMega32 microcontroller is used to control hardware system. Buzzer raises the alarm if fault is detected in the fabric. Motor used in conveyer belt is driven by L293D motor driver IC.

3.2.4 Max 232

Max 232 is used for serial communication. A special open source library called RxTx is to be used for serial port interfacing.

4. EXPERIMENTS AND RESULT

Total 26 defected and non-defected fabrics were tested. Images are of size 400×400 captured using camera at real time. Since it is difficult to obtain defected piece of fabric from fabric industries most of the defect are made by hand. The experimental result shows that one fabric defect was not detected. Below figure shows result of fault detection system.

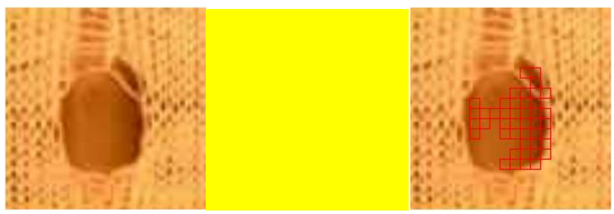

Fig 3.1 hole Fig. 3.2 Hue Fig 3.3 Result

Fig 3.4 hole2

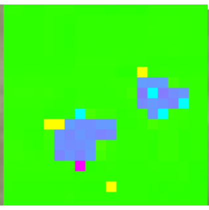

Fig 3.5 Hue

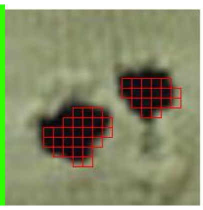

Fig 3.6 Result

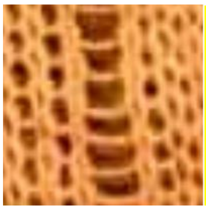

Fig 3.7 Broken Needle

Fig 3.8 Hue

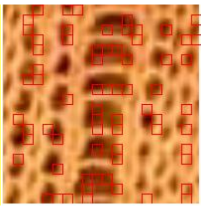

Fig 3.9 Result

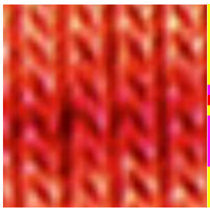

Fig 3.10 Stain

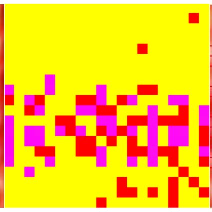

Fig 3.11 Hue

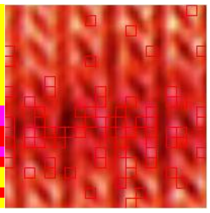

Fig 3.12 Result

In proposed system we calculated the overall fault percentage in image of a fabric. For the convenience of quality control team, the system itself will generate the fault percentage report for the whole day and forward it to the android based application available at the user end. This approach reduces the manual work required for the quality control team to manually calculate the overall production rate for each day.

Report will comprise of percentage of faults occurred during the period of time. If the fault percentage present is higher than the threshold value set for the company standards then the whole batch is discarded. Quality production and time management are the main motives behind this report generation approach. The quality of the software is needed to be maintained so S. L. Bangare *et al* [28] [29] some work was studied.

5. CONCLUSION

Proposed method was developed and fabric faults were detected with an accuracy of 96.15%. Algorithm is trained by extracting image features by selecting any block of image. Testing is done by dividing image into segments and comparing extracted features with segments. This approach is efficient and can be used in fabric industries by creating proper ambience while detecting defect. Daily reports are generated and sent through android application which can be applied in fabric industry where manufacturer gets the report.

6. FUTURE SCOPE

In future classification of fabric can be done by developing sensors. Quality of the fabric can be identified, can perform segregation on good and bad fabric, 3D cameras can be used to achieve better fault identification.

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