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Yarn Quality detection for Textile Industries using Image Processing

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ABSTRACT: -

In textile industry, estimating Yarn's Quality becomes difficult task. In common cases; the task is completed manually. A Microscopic investigation for yarn quality estimation necessitates significant amount of physical efforts as well as timing, as well as compromise on quality judgment uniformity. It's nevertheless, a classic challenge during Yarn-based studies, whereas accurate yarn's quality manufacture is determined using mathematical Yarn attributes such as length, and Diameter among others. In Previous researches, it is observed that Yarn Quality is calculated only depends on Yarn's Length and Diameter. However, these criteria alone do not allow for many mixing permutations and combinations in order to make v arious quality variant Yarns. We suggested in this paper to develop more Yarn characteristics from yarn (cotton) with much more precision, like Yarn's regularity throughout the yarn thickness, hairiness, small colour change, or contaminants.

Keywords: - Image processing; quantitative analysis; segmentation; thresholding; Yarn hairiness measurement; Yarn contaminants;

1. INTRODUCTION: -

Apart from key features like as length, strength, fineness, and colour, contamination plays a critical role in determining Quality of Yarn. Infectivity, evenif it is only single foreign fibre, can resulting the down-gradation of fabric, yarn, or clothes, and/or complete refusal of full manufactured batch's and can impair the connection between farmers, ginners, merchants, spinners and textile /clothing factorie s in irreversible ways.[1,9].

The current state of Textile Industry raises the bar for Fabric Quality. Uneven effects can arise at any stage of the production cycle, affecting the manifestation of cloth or/and lowering its marketable value. Majority of the times, however, they are produced by faults in Yarn used to weave the cloth. Image analysis methods are employed not-only in Thread and Warp Quality analysis, but also to calculating the dimension's of Yarn-end links and Yarn structure repetition, both of which have an impact on Fabric's Quality. [1, 2]

Quality Inspection Methods:-

Yarn Quality is determined by factors such as hairiness, yarn thickness, and yarn colour. The following techniques are used to measure these metrics.

a. Yarn Hairiness: -

Hairiness of the yarn is a complicated parameter. Different measures for evaluating yarn hairiness have been already developed. It is most usually defined as the quantity, length, shape, and other features of protruding fibres per unit core throughout the length.
Although there are several methodologies for determining yarn hairiness, picture processing and analysis algorithms are constantly being developed. A number of image-based ways to assessing

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yarn qualities have already been proposed. However, these methodologies use a variety of Threshold methods for Yarn core Segmentation and protruding fibres. [2,8]

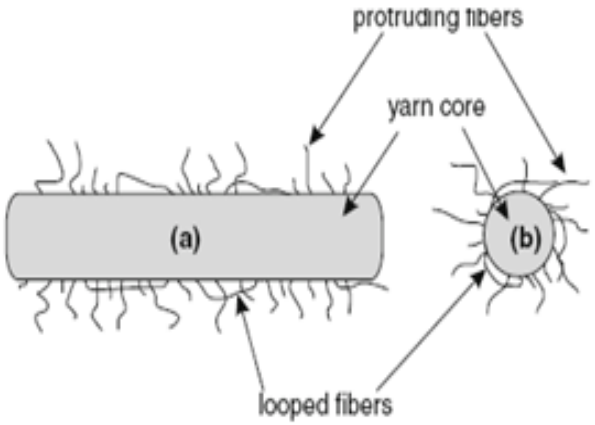

Figure 1: Yarn Hairiness

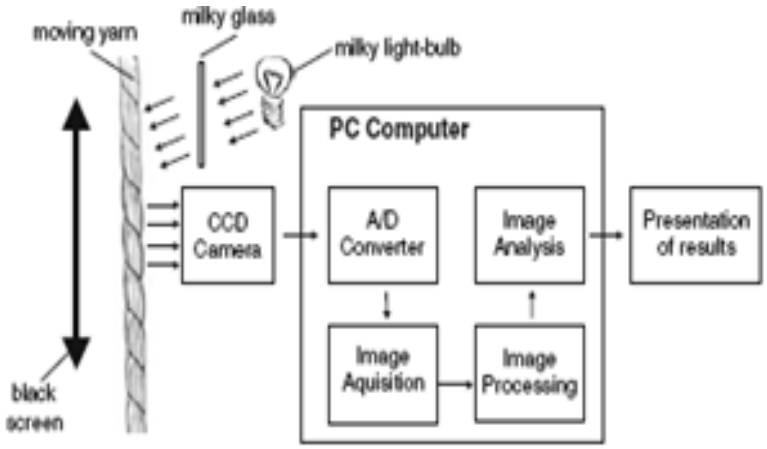

Figure 2: Yarn Hairiness measurement System

Its overall structure is depicted in Figure 2. The system includes -

- an area scan CCD monochromatic camera,
- equally illuminated coated screen in black velvet,
- light source,
- yarn mover,
- Computer.

b. Yarn Thickness: -

There are two stages to hair segmentation procedure. Initial step is to locate probable hair's centerline. A skeletonized hair mask is the result of this stage.

The second step takes the skeletonized mask and reconstructs the hair while also removing the spurious centre lines tha t were discovered in phases one. Algorithm is depicted in Figure 4 as a visual representation [3].

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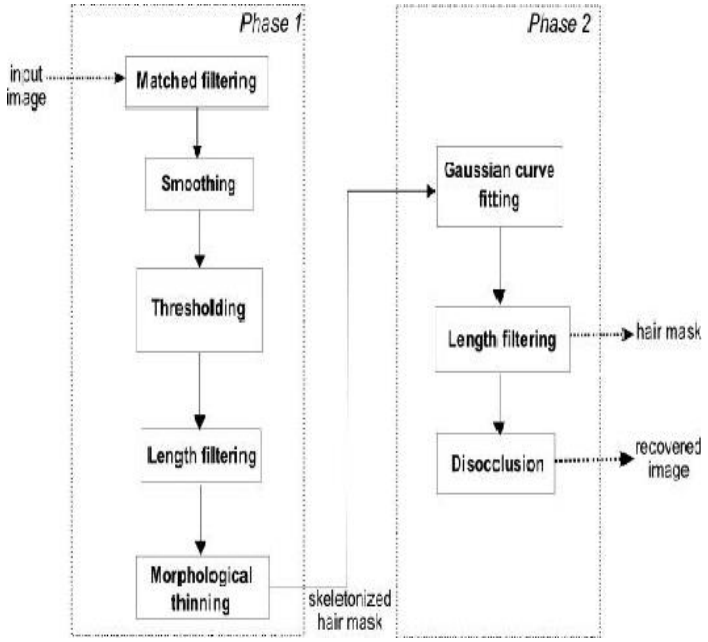

Figure 3: Yarn Thickness measurement- Algorithm steps

c. Yarn Color: -

The main goals of our work are to identify minor colour changes or impurities in Yarn with greater clarity than was previously feasible in the YCbCr and HSI colour spaces. After obtaining three separate images Y, Db, and Dr, our proposed approach translates RGB colour into Y-Db-Dr colour which yields Luminance Component (Y) and Chrominance Components (Db, Dr). For image binarization of these images (Y, Db, and Dr), iterative threshold approach will employed. After Binarization, these 3 images(binary) are fused to get final (fused) im age. [2]

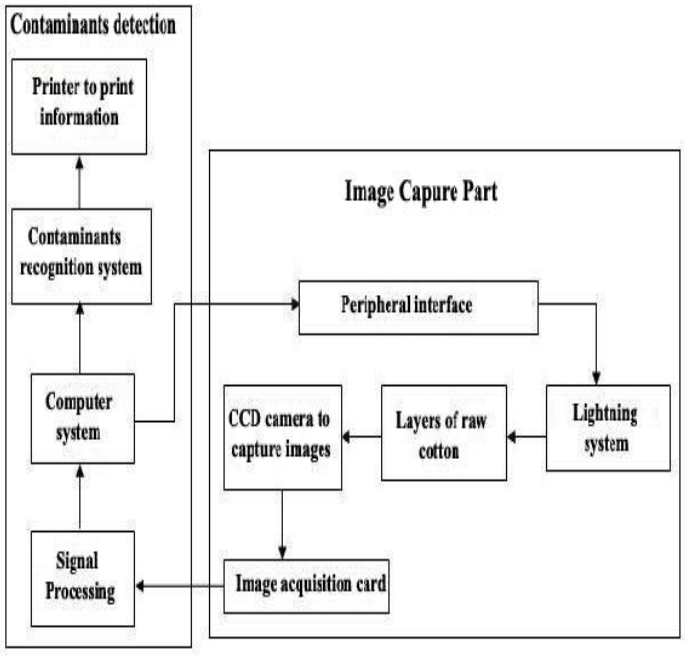

Figure 4: Diagram of cotton color change detection system

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We discovered that, in Normal (natural) lighting condition, Grey value of cotton fiber is white or mostly varies around it, after analysing a large numbers of cotton impurities photos.
Cotton fibre pixel positions differ in colour space due to differences in lighting intensity, cotton fibre characteristi cs and levels.

Under certain lighting conditions, Pixels in colour space meet particular specific variation. The distributions of common foreign fibre contamination in colour space are as follows.

a) Colors that is darker than black and have a low grey value, such as black hair and cottons-eed particles, etc.
b) Colors such as fibre (plastic) and mulch are lighter and easier to reflect with high brightness.
c) Color is Impure, but deviates into a type of colour, e.g. coloured cotton thread and polypropylene fiber.
d) Colored fibres, such as wool and white hair, are similar to cotton fibre.

YDbDr is made up of three parts: Y color space, Db color space, and Dr Color space. The Luminance Component (Y), while Chrominance Components (Db, Dr). These 3 elements were made using RGB. The combined weighted values of Red, Green and Blue yield a single Y component, which represents overall Luminance, of that spot. The Db is formed by removing 'Y' from original RGB's blue color and scaling it, whereas the Dr color space is created by subtracting the 'Y' from the Red components and scaling it by different factors. This formula is an approximation of the RGB to YDbDr colour space conversion.

$$R,G,B,Y \in [0,1]$$

$$Db, Dr \in [-1.333,1.333]$$

RGB to YDbDr :

$$\begin{bmatrix} Y \\ D_B \\ D_R \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ -0.450 & -0.883 & 1.333 \\ -1.333 & 1.116 & 0.217 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

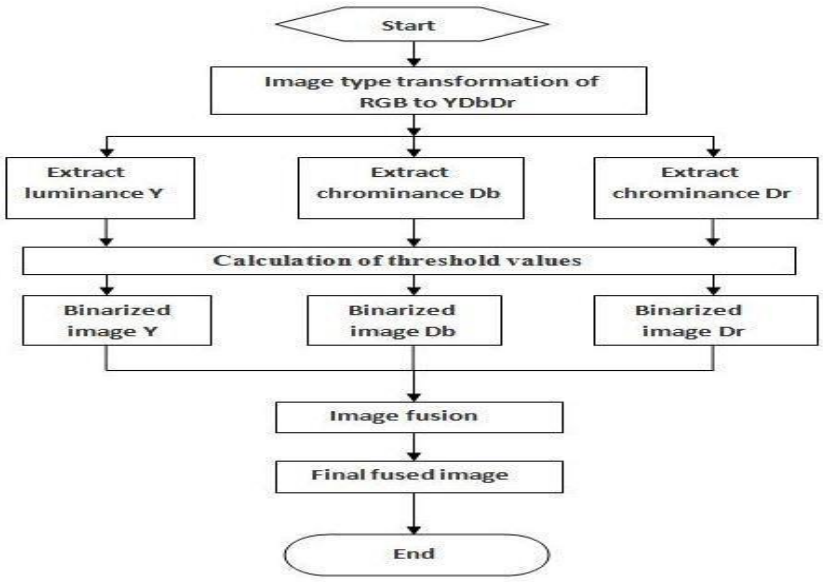

Figure 5: - Flowchart of cotton color change detection algorithm.

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2. ALGORITHM FOR PROPOSED WORK:

In this proposed system, a methodology is developed to study Yarn (cotton) based on Yarn images' features. The proposed System that is being presented as:

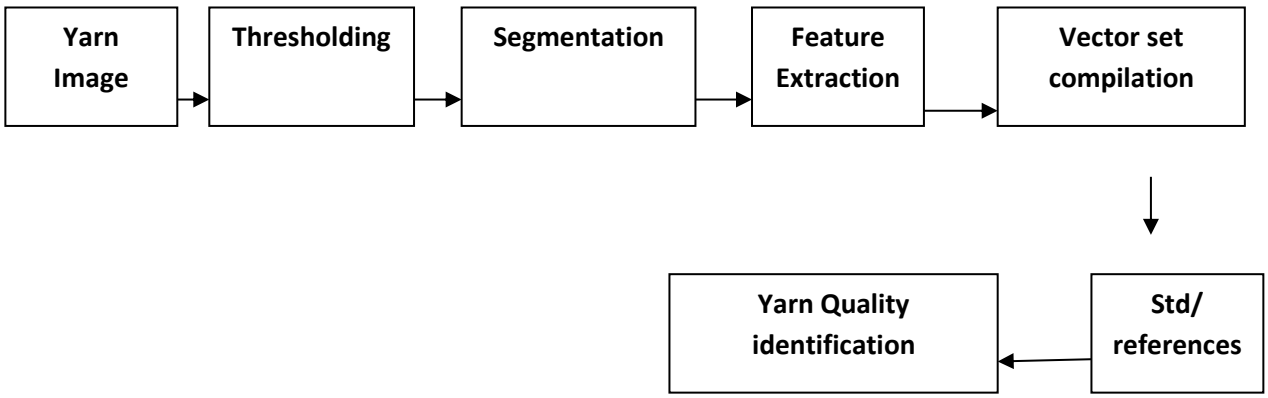

Figure 6- Proposed methodology

Compilation of Feature Vector Sets –

The following parameters can be used to create a Feature Vector Set: -

a) The figure aspect may reveal Yarn's Avg thickness. Alternatively, figure aspect can be used to get a general indica tion of the evenness;
b) Yarn Diameter, evenness are estimated using minimum radii in each quadrant;
c) Yarn area is indicated by the area of test yarn;
d) Radius standard deviation also shows yarn thickness uniformity;

3. RESULTS AND DISCUSSIONS : -

1. Yarn Hairiness:

The yarns have a wide range of qualities, such as low or high Hairiness, low or high Bulkiness, high or low Yarn-core Density, and so on.

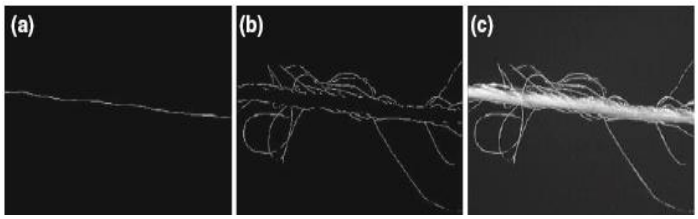

Figure 7:- Skeletonization Yarn **a.** skeleton of Core, **b.** Protruding and Looped fibers skeleton, **c.** comparison with original image.

2. Yarn's Thickness: -

The yarn features as extracted are shown in the table below.

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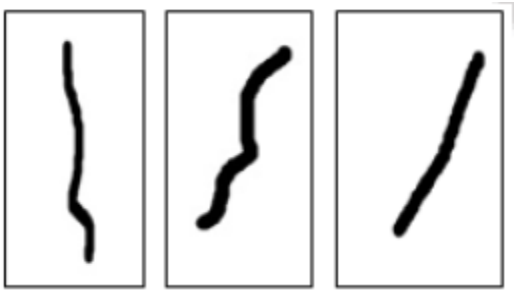

Figure a Figure b Figure c

Figure 8- Thickness of Yarn

Figure No.	Mean Dia Pixel Uni	Std Dev.
a	5	0.00337
b	7	0.00233
C	8	0.00173

Table 1- Thickness measures

The Yarn's diameter is measured in pixels and can be confirmed using the actual scale, i.e. pixel size in millimetres. The standard deviation was determined to the first decimal place in previo us studies. However, we consider the Standard Deviation up to the second decimal point, which would improve the com putation accuracy. The values, on the other hand, will be mostly determined by yarn quality.

3. Yarn Color : -

Figure 9- RGB to YDbDr Converssion

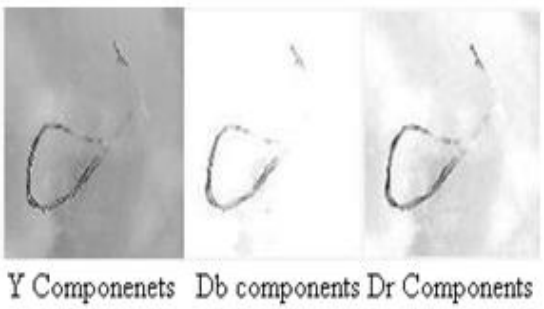

Figure 10- Sepration of Y, Db and Dr componets

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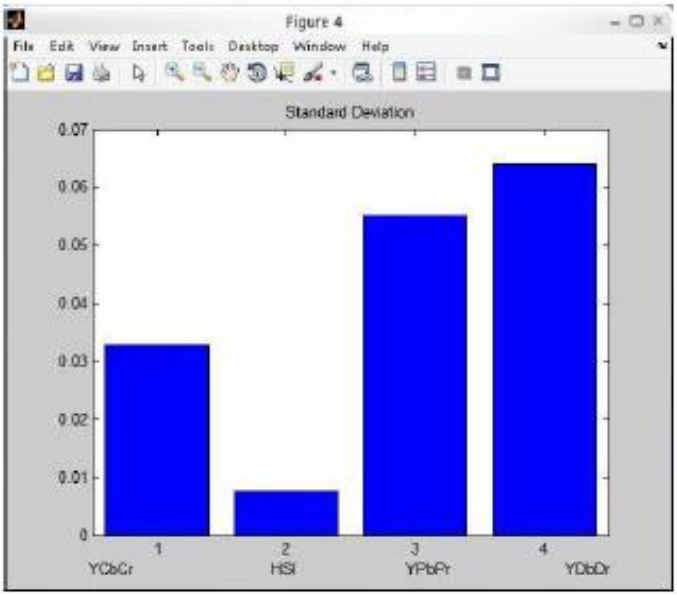

Figure 11 - Standard Deviation difference between all color spaces.

CONCLUSION:

We determined the Mean of Diameter as well as Standard deviations of Yarn's radii in the suggested work. The Lower the value, implies that the Yarn Diameter is consistent all over its length. The Higher the value, the greater non-uniformity in Yarn Diameter throughout the length of the yarn and the lower the Yarn's Quality. This proposed system can be use to create an key for estimating Yarn quality as well as a standard for yarn quality. The above (figure 11) graph compares these four colour spaces based on standard deviations, demonstrating that YDbDr is superior t o the other three colour spaces. Figures also indicates that tiny colour changes and impurities in Yarn may be re cognised more precisely in YDbDr Color space.

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