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Knitted Fabric Surface Density Measurement by Image Processing Using of Smart Phone Technique

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Abstract: *In this paper ,A proposed image operation method of measuring the stitch density (course per inch and wale per inch) of a knitted fabric has been developed in this research. The stitch density of a knitted fabric measured by proposed image method which captured by a smart phone technique. The measured stitch density to be examined by the said algorithm. The method was tested using 5 knitted fabric samples with different densities. In order to validate the proposed method, The results were compared with the stitch density directly measured by conventional (The ASTM standards methods) methods. It has been found that the results between conventional and proposed image method are significant (with 0.95 & 0.99 significance value) with 97.30 %.*

Keywords: Smart phone, Image processing , Course per inch, Wale per inch , Stitch density

I. INTRODUCTION

Conventional methods of measuring knitted fabric density are mainly based on manual operations. One of these methods is to count the number of course and wales in a unit length with a textile analysis magnifying glass or pick counting glass.These methods are time-consuming and lab-intensive, to avoid mistakes must be required committed skilled or super skilled workers who have been in service for a long time. In most large scale producing knitted fabric countries are China ,India , Bangladesh , Vietnam. All of these countries are belongs to developing countries where huge number of working peoples are unskilled or semi-skilled, due to this situation's a massive mistakes happening for counting the textures i.e. course and wales the results is wrong parameters fabric construction . To minimize the mistakes ,we evaluated a method that counting the fabric texture through image processing technique. Shengxian et al. [1] focused on the estimation of the yarn density for the fabric organization analysis. The parameters related to the fabric yarn density are determined by a new technology, which is called Hilbert marginal spectrum based method. The proposed method transforms the underlying fabric image into warp-direction and weft-direction vectors and the simulation results show the estimation of Fabric yarn density. HÁJKOVÁ et al . [2] proposed method is based on image processing techniques parameters on technical fabrics. The technical fabrics are usually used as sieves for a filtration. it is necessary to extract the information about the quality parameters from a fabric image which have significant influence on a filtration process. The quality parameters of the technical fabric mean a weaving density, a number of pores and a size of the sieve pores. this method shows very good results in a comparison with results acquired from the subjective method. Li et al. [3] In this paper, yarn-dyed fabric samples are captured by the DigiEye system first, and then pattern images of the fabric images captured are simulated by pattern design software based on extracted structure parameters of the yarn-dyed fabric. For the simulated pattern image, an effective algorithm is proposed to retrieve these kinds of images by combining the colour moments method and perceptual hash algorithm. In the algorithm proposed, the colour moments method is adopted to extract the colour features, and the perceptual hash algorithm is utilised to calculate the spatial features of the simulated pattern images. In order to measure the retrieval efficiency of the method proposed, the accuracy rate and retrieval rate of image retrieval were computed in experiments using a PATTERN image database with 300 images. The experimental results show that the average accuracy rate of the method proposed is 85.30% and the retrieval rate – 53.51% when the weighted value of the colour feature similarity is fixed at 0.45 and the spatial feature similarity is 0.55. It is shown that the method presented is effective to retrieve pattern images of yarn-dyed fabric. Emadi et al. [4] investigated the image processing of surface uniformity and thermally bonded points uniformity in polypropylene spun bonded non-wovens. An image processing method based on the k-means clustering algorithm was applied to produce clustered images. The best clustering procedure was selected by using the lowest Davies-Bouldin index. The peaksignal-to-noise ratio (PSNR) image quality evaluation method was used to choose the best binary image. The uniformity of thermally bonded points was calculated through an image processing method based on morphological operators. The results of image processing and tensile behaviour showed that the surface uniformity and the uniformity of thermally bonded points have great impacts on tensile properties at the selected weights and non-uniformity levels. Çelik et al. [5] studied an alternative image processing technique has been proposed against the conventional wick ability measurement method of nonwoven fabrics especially used in the hygiene products. An average liquid spread area ratio of air laid nonwoven fabric was calculated with the developed algorithm and the accuracy of the proposed technology demonstrated. Behera et al. [6] studied the drape parameters like Drape coefficient, Drape distance ratio, Fold depth index, Amplitude to radius ratio and Number of nodes predicted by finite element analysis were correlated with those measured by Digital Image Processing method. The correlation between digital image processing method and finite element analysis proves to be very good. The R^2 value is found to be higher than 0.8. In particular maximum correlation (R^2=0.91) is found in case of drape coefficient. Shady et al. [7] evaluated the fabric structure characteristics and to recognise the weave pattern utilising a Wiener filter through a developed digital image processing approach .The approach developed decomposed the fabric image into two images, each of which included either warp or weft yarns. The results showed success in evaluating the surface fabric characteristics and detecting the fabric structure for types of fabrics having the same colors of warp and weft yarns. Aldemir et al.[8] Studied possibility of determining warp and weft yarn density of colored and figured plain and twill woven fabrics by Wiener filter, median filter, grey level co-occurrence matrix and gray line profile methods. Considering the spatial techniques, the most successful technique that determines warp and weft densities of plain and twill fabrics is the median filter method. The following successful techniques are Wiener filter and gray level co-occurrence matrix. On the other hand, it is obtained that Fourier analysis method, one of the frequency domain techniques, which depends on the counting of the harmonics of the yarns, provide more successful result than spatial techniques. Pan et al.[9] studied a method of inspecting the density of solid colour fabrics is discussed. The Hough transform is used to detect the skew angles of warp and weft yarns, and then the pixels in the fabric image are projected along the skew-direction. Warp and weft yarns can be segmented successfully by locating the true minimum values which indicate the interstices between the yarns. The density of solid colour fabric can be inspected by counting the yarns in a unit length in the fabric image. Wijayono et al. [10] In this research, a new method and software which could determine stitch per inch on fabrics using the image processing techniques have been developed. Stitch per inch measurement has been done using the box counting method (pixel) on image processing software. Stitch per inch in several fabrics (with different colors and structures) has been measured, which shows that the value of each method is equal. Rasheed et al.[11] reviewed article to present a detailed study about various computer vision-based approaches with application in textile industry to detect fabric defects. the proposed study presents a detailed overview of histogram-based approaches, color-based approaches, image segmentation-based approaches, frequency domain operations, texture-based defect detection, sparse feature based operation, image morphology operations, and recent trends of deep learning. the performance evaluation criteria for automatic fabric defect detection is also presented and discussed. The studied provides comprehensive details about computer vision and digital image processing applications to detect different types of fabric defects. Senthilkumar et al.[12] Studied an image processing approach for fabric weight measurement has been proposed and tested. The system involves digital capturing of image using a microscope and then its processing in simple steps using image processing software (MATLAB).The fabrics have been conventionally weighed using an electronic weighing balance, and digital images of the sample fabrics are obtained and processed. The process involves application of suitable filters to obtain weft count, warp count, EPI, PPI and yarn crimp. The results of the proposed method of image processing, based on fabric weight measurement, are well correlated with the results of conventional method of measurement. Patilet al.[13] Presented the fabric defect detection, which is based on image processing technique by using Raspberry pi controller. Camera module is used to capture images of fabric which will be used for processing. Yildiz et al.[14] presented a new approach for processing images of woven fabrics to determine the warp-weft densities. This approach includes three main steps, namely; image transformation, image enhancement, and analyzing signals of the image. The 19 different woven fabric images were scanned at a high resolution (2400 dpi); then these images were transferred to the MATLAB program. By using the vertical and horizontal frequencies of the textile image, the FFT analyses were carried out. Consequently with 97 % accuracy, the densities were predicted only by using the images instead of counting them by hand. Zhang et al.[15] reviewed describes the background of weave pattern recognition and its development based on an overview of many researches done before. The reported methods classified into five categories (diffraction analysis-based, photoelectric analysis-based, frequency domain analysis based, spatial domain analysis-based, jointed methods and other ones). Both the merits and demerits of frequency domain analysis-based and spatial domain analysis-based methods have been summarized and discussed. Ghassemieh et al.[16] studied the microstructural changes of non-wovens made by the hydro entanglement process. The validity of the image processing techniques has been ascertained by applying them to test images with known properties. The parameters in pre-processing of the scanning electron microscope (SEM) images used in image processing have been tested and optimized. The fibre orientation distribution is estimated using fast Fourier transform (FFT) and Hough transform (HT) methods. The results obtained using these two methods are in good agreement. Pan et al.[17] developed a density measurement of high-tightness woven fabrics, an efficient inspection method based on the structure relation. The structure relations of typical HTWF, twill and satin weave are analyzed and a calculation equation of warp density is given with the fabric weave, weft density and wale density. the weft and wale densities are measured with the Fourier transform, image reconstruction and threshold processing based on separately captured images. The warp density is finally calculated based on the mean value of wale and weft density and the given calculation equation constructed with the weave pattern. The experimental results prove that the automatic measurement density system can realize the precise measurement of high-tightness woven fabric density with satisfactory precision and can replace the current manual analysis method. Zhang et al. [18] developed a fabric density inspection method by utilizing fabric light transmittance, a method for two-dimensional discrete Fourier transform (2D DFT) analysis on the transmission fabric image. projection curves are generated from the reconstructed images and the number of yarns is counted according to the peaks and valleys to obtain the fabric density. the proposed method is effective for the density inspection of yarn-dyed fabrics with good robustness and great accuracy. Zhang et al.[19] proposed an effective image analysis method based on mathematical statistics of sub-images. This method consists of two main steps: rough measurement and precise measurement. The rough measurement is based on projection curve of the whole fabric image. The fabric image is converted into HSV model from RGB model firstly, and then the projection curve of value is gained directly. The number of yarns is obtained by counting the number of peaks in the curve roughly. The precise measurement is based on projection curves of the fabric sub-images. According to the roughly estimated yarn number, the whole fabric imageis divided into a certain amount of sub-images and the projection method is applied to all the sub-images, The results proved that the proposed method is effective for yarn-dyedfabrics and can satisfy the requirement for production practice. Hasani et al. [20] studied focuses on the evaluation of weft knitted fabric roughness using image processing. The SMD value of fabrics which refers to surface roughness has been measured by Kawabata surface tester. Images of samples have been taken by a high resolution scanner, converted to grayscale image and then been processed by Matlaba signal is obtained from each sample. Six different features have been extracted from the signals. The results of correlation test reveal that there is a good correlation between the wave lengths of obtained signal extracted from fabric images and the measured roughness by KES surface tester. Singh et al.[21] presented a critical review of the exhaustive work of digital image processing and analysis and their application to measure twist and its distribution in yarns, weave pattern, yarn colour. Techniques of spatial & frequency domain use to extract twist angle and orientation of fibre on yarn surface respectively. Characteristics of weave extracted by Obliqueness (OB) and Orthogonality (OR) and yarn color design obtained by transmitted and reflected images. Behera et al.[22] evaluated wrinkle behaviour of fabrics has been developed using digital image processing technique. Various fabric samples have been evaluated using this technique and the results are compared with the conventional AATCC method. The newly developed technique is found to have a very good correlation with conventional method.Bangare et al.[23] Proposed a technique of Fabric Fault Detection using Image Processing Method .Therefore, automated fabric inspection is required to identify fault present in the fabric. The main objective of this project is to create real time automated fabric fault detection system which will reduce industrial cost by 15-16%. Karnik et al.[24] studied a novel automatic method for the identification of woven fabric structure. This method is based on widely used digital image

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analysis techniques. It allows automatic warp yarn and weft yarn cross area segmentation through a spatial domain integral projection approach. texture features based on grey level occurrence matrix are studied and developed by applying principal component analysis. The optimized texture features are analyzed by fuzzy c-means clustering for classifying the different cross area states. The texture orientation features are calculated to identify the exact state of cross area. Finally, woven fabric structures are automatically determined.Behera et al.[25] developed and designed a drape meter based on image processing technique for complete analysis of the drape profile of apparel fabric. Image processing helps to determine some new drape parameters. Multiple regression equations for drape parameters have been developed from low stress mechanical properties of fabric to predict the drapability and the results are compared with the drape value obtained from image processing method. A very good correlation has been found with bending and shear properties of the fabric. Jarrett[26] reviewed of the comprehensive work of digital image processing and analysis and their application to portion twist and its distribution in yarns, weave pattern, yarn color. Procedures of spatial & frequency domain use to citation twist angle and orientation of fiber on yarn surface correspondingly. Characteristics of weave extracted by Obliqueness (OB) and Orthogonality (OR) and yarn color design gained by diffused and replicated images. Rudy et al. [27] developed a method of measuring the stitch density (course per inch and wale per inch) of a knitted fabric. The stitch density of a knitted fabric measured by capturing a digital image of the knitted fabric to be examined by means of a digital microscope, converting the image into digital image information, storing the digital image information in a digital memory and converting said information by a central processing unit into the stitch density information. The method was tested using 3 knitted fabric samples with different densities. the results were compared with the mean stitch density directly measured from the standards methods. the results between conventional and proposed method are not significantly different with 0.95 significance value.Li et al.[28] proposed a fabric defect detection with less obvious features such as dense road and sparse road, a Gaussian hybrid clustering algorithm. Firstly, the image is pre-processed by means of mean filter, and then a Gabor filter and Gaussian mixture clustering algorithm are used to identify the defects of the image to be detected. The experimental results show that compared with other defect detection methods, the method is effective in detecting the defects of fabrics such as dense road and sparse fabric, and some practical value in defect detection. Abdelkader[29] measured the yarn's diameter and its individual fibers diameter based on image processing algorithms that can be applied to microscopic digital images. Image pre-processing such as binarization and morphological operations on the yarn image were used to measure the diameter automatically and accurately compared to the manual measuring using Image software. In addition to the image pre-processing, the circular Hough transform was used to measure the diameter of the individual fibers in a yarn's cross-section and count the number of fibers. The algorithms were built and deployed in a MATLAB environment. The proposed methods showed a reliable, fast, and accurate measurement compared to other different image measuring softwares, such as Image. Fabijanska et al.[30] developed a image processing and analysis algorithms for an automatic determination of yarn hairiness are presented. The main steps of the proposed algorithms are as follows: image pre-processing, yarn core extraction using graph cut method, yarn segmentation using high pass filtering based method and fibres extraction. The developed image analysis algorithms quantify yarn hairiness by means of the two proposed measures such as hair area index and hair length index, which are compared to the USTER hairiness index—the popular hairiness measure, used nowadays in textile science, laboratories and industry. The algorithms are compared with computer methods previously used for yarn properties assessment. Statistical parameters of the hair length index are calculated. The obtained results are analyzed and the presented algorithms can be successfully applied in different vision systems. Wu et al.[31] investigated the impact of weave repeat on the characterization of woven fabric texture. Firstly, the test samples were represented by over-complete dictionary in the least squares sense. Secondly, the two indexes-PSNR value and RMSE were introduced to evaluate the representation performance. Thirdly, the image entropy was used to quantify the fabric surface texture, and then the samples were categorized according to the two indexes. Experimental results showed that our algorithm can approximate fabric texture very well and weave pattern has great impact on fabric texture reconstruction. Eight kinds of weaving patterns are classified into three categories, of which the basket fabric shows the best performance. The findings may be helpful in classification and automatic inspection of woven fabric texture.

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II. MATERIALS AND METHODS

2.1 Materials

In this study [32] four yarns with different specifications shown in the Table-1 are used to produce five weft knitted single jersey fabrics with different machine gauge ,yarn count, raw material, loop length and stitch density . The investigated fabrics are knitted on a circular UNITEX weft knitting machine. The fabric fundamental characteristics are given in Table-2.

TABLE 1. YARNS SPECIFICATIONS

Sample	Raw material	Count
1	100 % Cotton	40/1 s
2	100 % Cotton	34/1 s
3	100 % Cotton	50/1 s
4	100% Lycra	20 d

TABLE 2. FABRICS SPECIFICATIONS

Sample	Fibre type	Yarn count	Machine gauge	Course /inch	Wale/inch	Loop shape factor CPI/WPI	Stitch Density (per inch^2)
S1	100% Cotton	34/1	28	78	50	1.56	3900
S2	100% Cotton	40/1	24	84	52	1.62	4368
S3	100% Cotton (94%)/ 20 d lycra (6%)	50/1 s, 20/1 d	28	84	80	1.05	6720
S4	100% Cotton	34/1	24	80	50	1.6	4000
S5	100% Cotton	40/1	28	84	56	1.5	4704

2.2 Methods

In this study , the experimental work has been carried out by ASTM standard methods ,All the methods and the corresponding units are given in Table -3 .The fabric images are captured by a smart phone (Device name- OnePlus Nord 2, Model-DN2101 , Operating System: OxygenOS 11.3(based on Android™ 11) , Main Camera - Sony IMX766,Megapixels: 50M). Knitted fabric structures are used in this study. The six samples are consist of five samples are single jersey knit structure and one sample interlock knit structure , which are selected for evaluating the performance of the proposed method. The characteristics of each fabric samples are shown in Table 4.

TABLE 3. STANDARD TEXT METHODS USED

Sl. no.	Parameters	Standard used	Unit
1	Yarn Count	ASTM D2260-96	Ne

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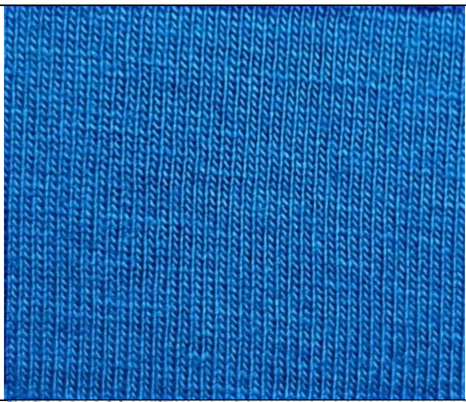
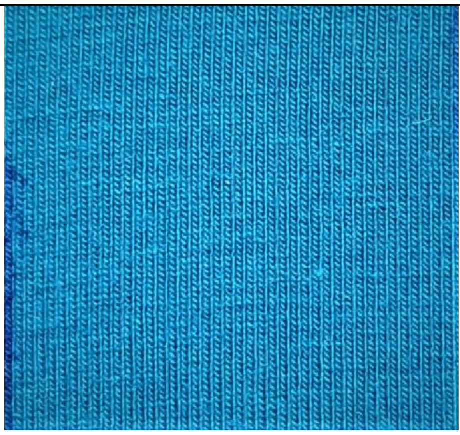
2	Fabric Texture	ASTM D8007-15	per inch
3	Stitch Density	ASTM D3887-2008	per inch2
4	Standard Image Capture	ASTM D-2255	Grades A (best), B, C and D (worst)

TABLE 4. CHARACTERISTICS OF KNITTED FABRIC SAMPLES

Sample code	Type of capturing image	Fabric sample	Structure	Pattern
SM1	Smart phone capturing image		Single jersey	Solid
SM2	Smart phone capturing image		Single jersey	Solid
SM3	Smart phone capturing image		Single jersey (Lycra-cotton blend)	Solid

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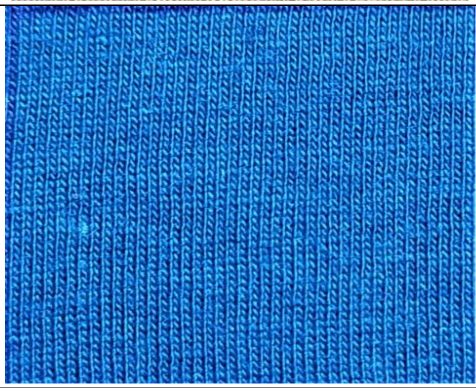
SM4	Smart phone capturing image		Single jersey	Solid
SM5	Smart phone capturing image		Single jersey	Solid

2.2.1 Methodology

At first, a particular square inch area need to be taken at the face-side of the dyed fabric and mark the area by a visible line. Then the fabric need to be placed in under a D65 or similar light where the line area evidently visible.

The mark line square area image need to be captured clearly through the used of a smart phone. After captured to the image quality need to be checked , only good quality images (grade A or B) need to be taken and edited or cropped. Finally , after edited or cropped image need to transferred to the desktop , through zoom course and wales need to be counted (through smart phone may be counted) randomly.

2.2.2 Algorithm and flow chart

A algorithm and flow chart indicating the different steps involved in planning process in general for stitch density detection by measuring course and wale from knitted fabric image can be represented by the following figure 1.

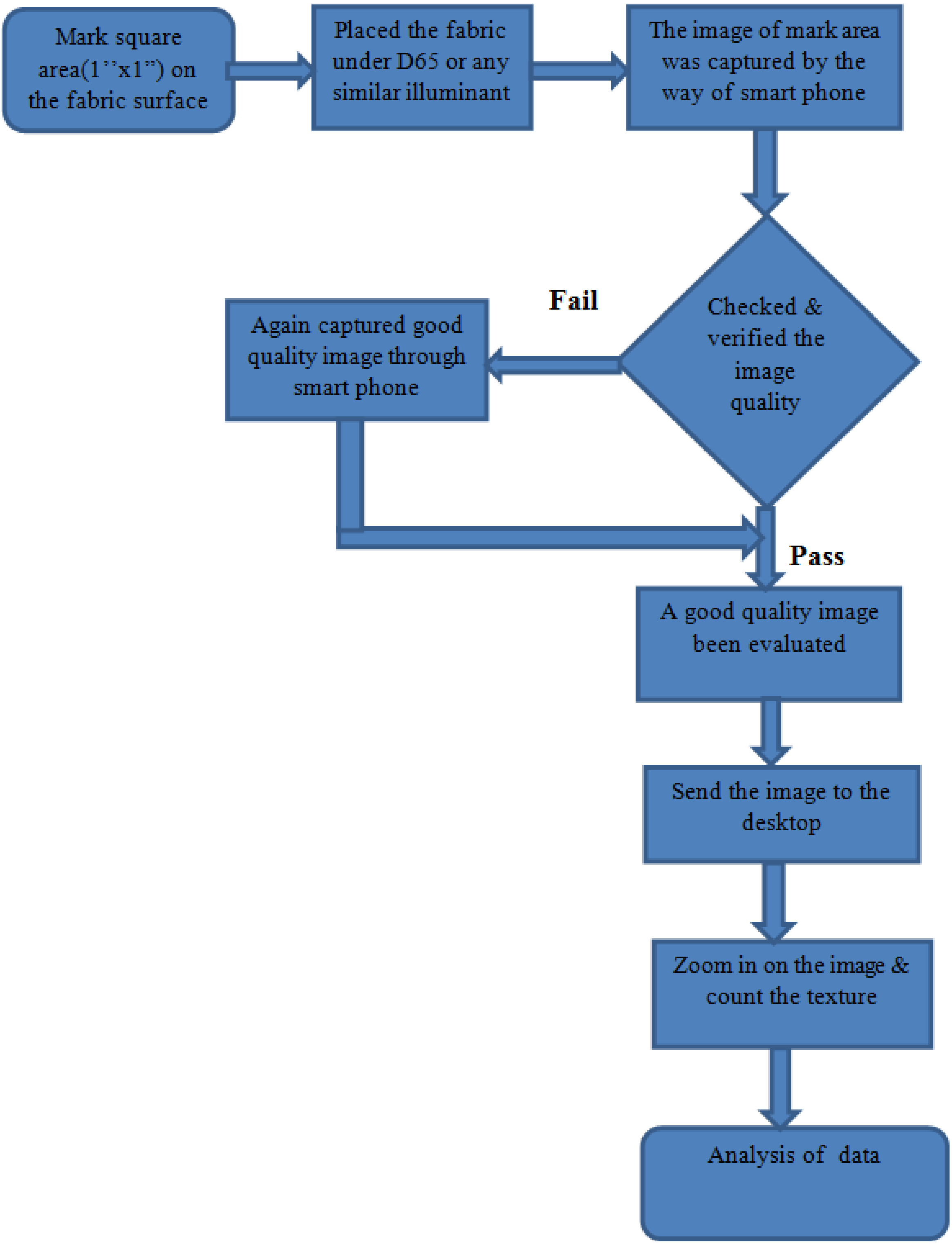


Figure 1 : Flow chart fabric surface density image evaluation method

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III. RESULTS AND DISCUSSIONS

3.1 Experimental Results

The results of each methods are compared (manual operation and image counting operation) in this research. The comparison of stitch density between both methods (manual operation and image counting operation) for the fabrics are shown in Table 5.

TABLE 5. Comparison Of Manual And Image Processing Operation's Values Of The Samples

Sample	Operation		Operation		Operation		Operation	
	Manual	Image Processing	Manual	Image Processing	Manual	Image Processing	Manual	Image Processing
	Course /inch	Course /inch	Wale/ inch	Wale/ inch	Loop shape factor CPI/WPI	Loop shape factor CPI/WPI	Stitch Density (per inch2)	Stitch Density (per inch2)
SM1	78	77	50	52	1.56	1.48	3900	4004
SM2	84	82	52	51	1.62	1.61	4368	4182
SM3	84	86	80	81	1.05	1.06	6720	6966
SM4	80	79	50	49	1.6	1.61	4000	3871
SM5	84	84	56	54	1.5	1.56	4704	4536

The experimental results have been statistically evaluated by using Analysis of Variance (ANOVA) with t test methods of the significance level of = 0.05 and 0.01,We evaluated the results based on the t test and the probability of the P(T> t) two tailed method. The lower the value of t represents it is the stronger the contribution and the more significant between manual counting operations and image counting operations. The experimental results in this experiment are tabulated in table-6. Table-6 summarizes the statistical significance analysis for all the data obtained and in this ANOVA analyses the manual counting and image counting operations are including course , wale, loop shape factor and stitch densities. the correlation co-efficient among the all operations are shown in the table-7 and the correlation co-efficient between the manual and image processing operations are shown in the table-8.

TABLE 6. STATISTICAL ANALYSIS OF TEST RESULTS

Parameters	df	At 95 % confident level			At 99 % confident level		
		Critical two tail value (T)	t value	P value	Critical two tail value (T)	t value	P value
Manual & image processing operations of course counting	8	2.306	0.194	0.851	3.355	0.194	0.851

Manual & image processing operations of wale counting	8	2.306	0.024	0.981	3.355	0.024	0.981
Manual & image processing operations of loop shape factor counting	8	2.306	0.013	0.990	3.355	0.013	0.990
Manual & image processing operations of stitch density counting	8	2.306	0.034	0.973	3.355	0.034	0.973

From table-6 the results implies that the values of "Prob>T" less than 0.0500 & 0.0100 indicate the relation between manual and image processing operation term is significant for all cases i.e course ,wale , loop shape factor and stitch density. The exact percent chance that here is a true significant relationship between stitch density manual counting operation and stitch density image counting operation is 97.30 % in of 0.95 and 0.99 at significant value.

TABLE 7. CORRELATION CO-EFFICIENT AMONG ALL OPERATIONS

	Manual Operation CPI	**Image Processing CPI**	**Manual Operation WPI**	**Image Processing WPI**	**Manual Operation LSF CPI/WPI**	**Image Processing LSF CPI/WPI**	**Manual Operation Stitch Density (per inch2)**	**Image Processing Stitch Density (per inch2)**
Manual Operation CPI	1	0.921	0.526	0.438	-0.410	-0.259	0.612	0.524
Image Processing CPI	0.921	1	0.791	0.720	-0.714	-0.574	0.848	0.786
Manual Operation WPI	0.526	0.791	1	0.993	-0.989	-0.950	0.995	0.999
Image Processing WPI	0.438	0.720	0.993	1	-0.994	-0.980	0.977	0.995
Manual Operation LSF CPI/WPI	-0.410	-0.714	-0.989	-0.994	1	0.977	-0.970	-0.989
Image Processing LSF CPI/WPI	-0.259	-0.574	-0.950	-0.980	0.977	1	-0.915	-0.955
Manual Operation Stitch Density (per inch2)	0.612	0.848	0.995	0.977	-0.970	-0.915	1	0.993
Image Processing Stitch Density (per inch2)	0.524	0.786	0.999	0.995	-0.989	-0.955	0.993	1

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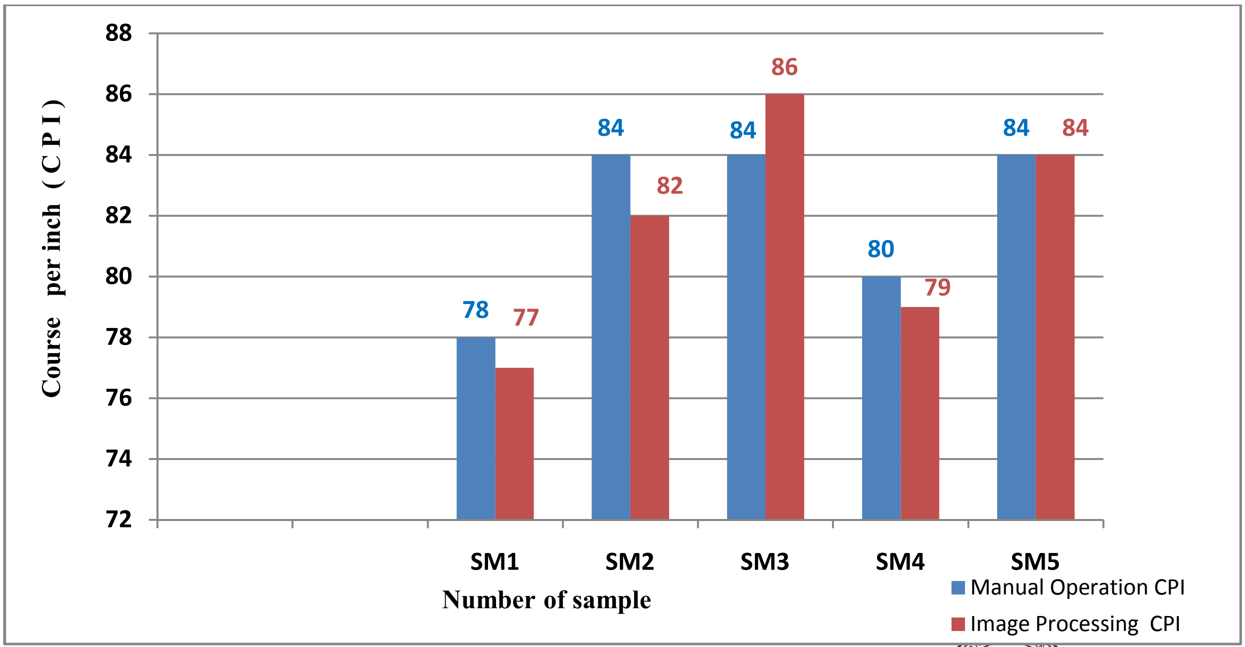
TABLE 8. CORRELATION CO-EFFICIENT BETWEEN MANUAL AND IMAGE PROCESSING OPERATIONS

	Image Processing operation of CPI	Image Processing operation of WPI	Image Processing operation of LSF CPI/WPI	Image Processing operation of Stitch Density (per inch2)
Manual Operation of CPI	0.921	0.438	-0.259	0.524
Manual Operation of WPI	0.791	0.993	-0.950	0.999
Manual Operation of LSF CPI/WPI	-0.714	-0.994	0.977	-0.989
Manual Operation of Stitch Density (per inch2)	0.848	0.977	-0.915	0.993

According to the table-8 found there are positive correlation co-efficient among manual and image processing operations are manual operation CPI : image processing CPI, manual operation CPI : image processing WPI , manual operation CPI : image processing stitch density, manual operation WPI : image processing WPI , Manual operation WPI: image processing stitch density, Manual Operation LSF: image processing LSF, Manual Operation of stitch density : image processing CPI , Manual Operation of stitch density : image processing WPI , Manual Operation of stitch density : image processing stitch density .And in some cases are found to be in order negative correlation co-efficient among manual and image processing operations are manual operation CPI : image processing LSF, manual operation WPI : image processing LSF , Manual Operation LSF: image processing CPI , Manual Operation LSF : image processing WPI , Manual Operation LSF : image processing stitch density , Manual Operation of stitch density : image processing LSF. At here, positive correlation co-efficient indicated that there are proportional relationship between two parameters and negative correlation co-efficient indicated that there are inversely relationship between two parameters.

3.2 Graphical Representation

3.2.1 Manual counting operation vs Image processing counting operation of course per inch (CPI) of the samples :



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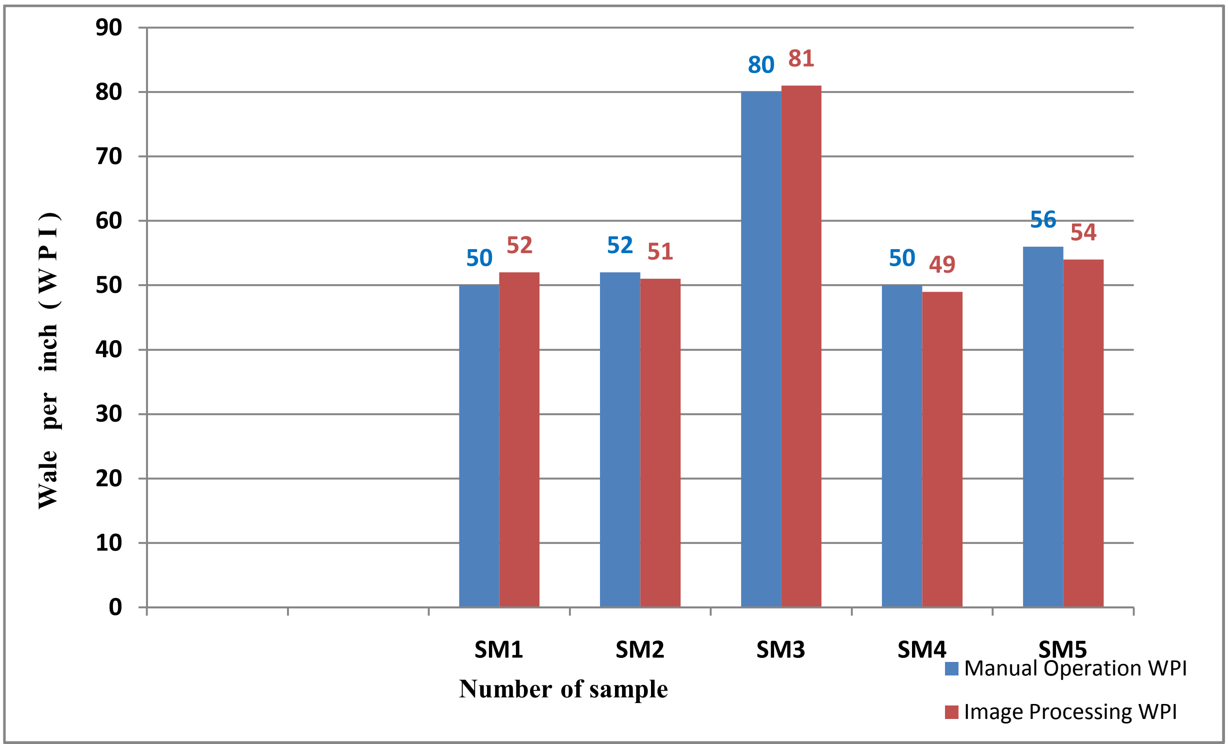
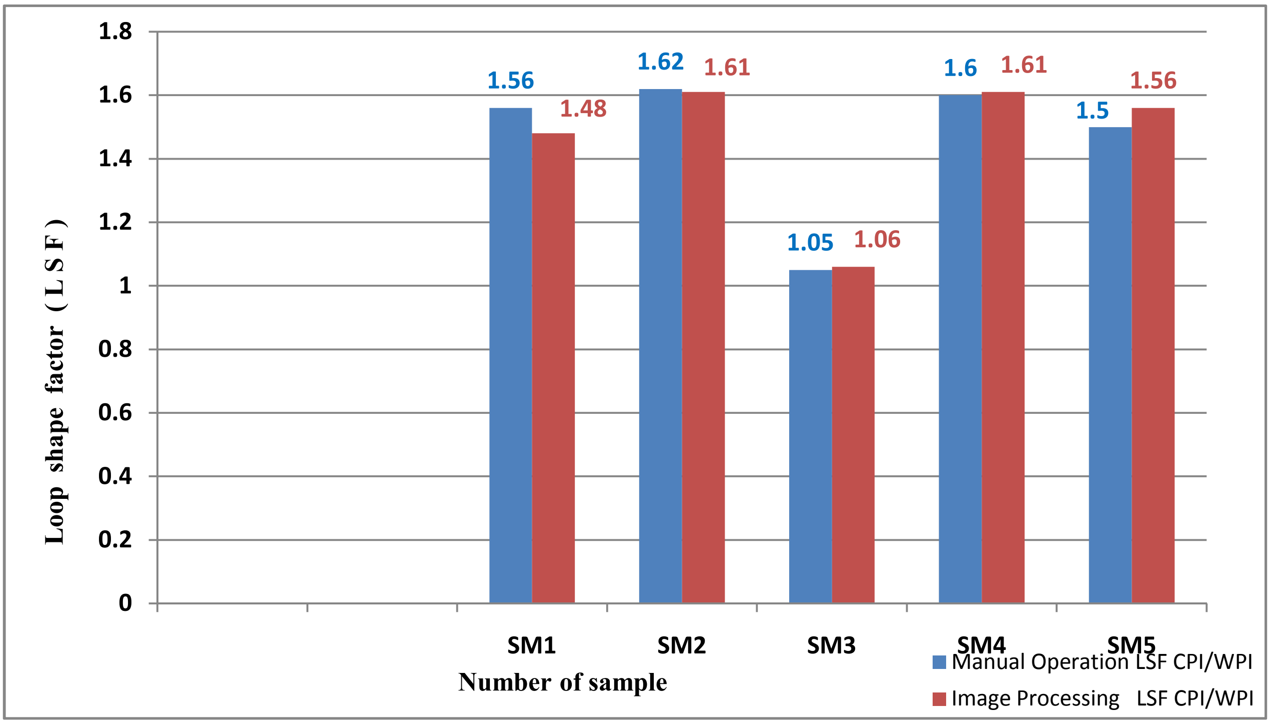
3.2.1 Manual counting operation vs Image processing counting operation of wale per inch (WPI) of the samples :



3.2.1 Manual counting operation vs Image processing counting operation of loop shape factor (LSF) of the samples :



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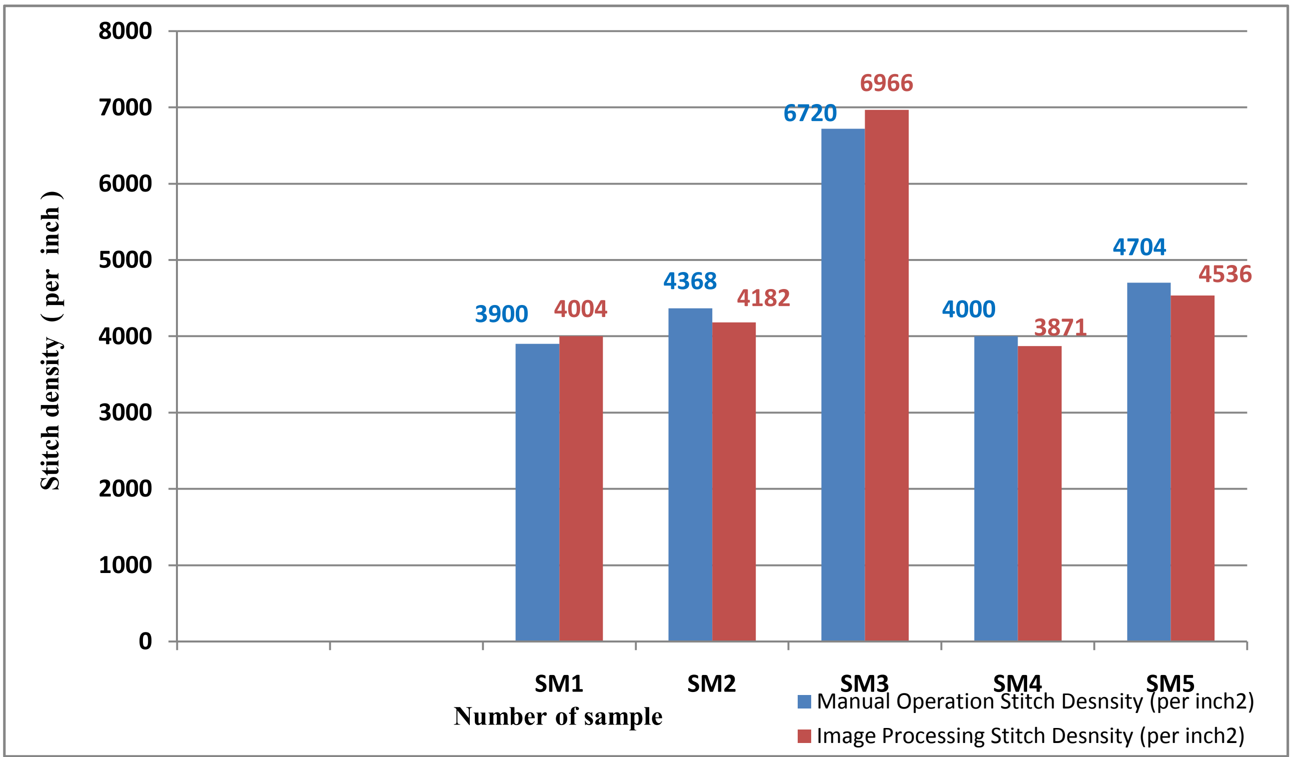
3.2.1 Manual counting operation vs Image processing counting operation of stitch density (per inch) of the samples :



IV. CONCLUSION

In this paper, We have first discovered that the image analysis proposed method using smart phone technique and a calculation of the stitch density is presented. It has been found that the fabric CPI , WPI , LSF and stitch density measurement results between conventional and proposed image method are significant with 85.10 % , 98.10 % , 99.00% & 97.30 % (under 0.95 & 0.99 significance value) . The correlation co-efficient of stitch density between conventional and proposed image method is found to be 0.993. The performance of image counting method to find the stitch density is very reliable to computed . The result of image processing proposed method measurement shows equal result with the conventional operation measurement. Above all, the image proposed method which is not cost & time-consuming nor tiring, can be an alternative in measuring the stitch density of knitted fabrics. In near future the fabric stitch density conventional measurement system can be replaced by the image counting proposed method with the help of smart phone.

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REFERENCES

[1]. Wang Shengxian & Yuan Yea, “Estimation of the Fabric Yarn Density Based On Hiblert Marginal Spectrum”, Beijing Institute of Fashion Technology, Beijing 100029, China, published by Elsevier Ltd. 2011.

[2]. Lenka Hájková & Maroš Tunák, “Extraction of quality parameters of technical fabrics using image processing”, Technical University of Liberec, International Journal of Advanced Computational Engineering and Networking, ISSN: 2320-2106, Volume-5, Issue-7, Jul.-2017.

[3]. Zhongjian Li, Jun Xiang, Lei Wang et.al, “Yarn-Dyed Fabric Image Retrieval Using Colour Moments and the Perceptual Hash Algorithm”, Jiangnan University, Wuxi, Jiangsu, China, 214122, DOI: 10.5604/01.3001.0013.2900.

[4]. Mina Emadi, Mohammad Ali Tavanaie & Pedram Payvandy, "Measurement of the uniformity of thermally bonded points in polypropylene Spunbonded non-wovens using image processing and its relationship with their tensile properties", Yazd University, Yazd, Iran, AUTEX Research Journal, Vol. 18, No 4, December 2018.
[5]. H. İbrahim Çelik, Elif Gültekinm & Serkan Nohut," Development of an Algorithm to Determine the Liquid Spreading Area of Air-laid Nonwoven Fabrics by Image Processing Method", Turkey, VOL: 30, NO. 2 DOI: 10.32710/tekstilvekonfeksiyon.585336.
[6]. B K Behera, Ajit Kumar Pattanayak & Rajesh Mishra," Prediction of Fabric Drape Behaviour using Finite Element Method", Indian Institute of Technology, New Delhi-110016, India, The Textile Machinery Society of Japan, accepted for publication 19 May 2008.
[7]. Ebraheem Shady, Khadijah Qashqary, Mounir Hassan & Jiri Militky," Image Processing Based Method Evaluating Fabric Structure Characteristics", Fibres and Textiles in Eastern Europe, January 2012.
[8]. Erdoğan ALDEMİR, Hakan ÖZDEMİR & Selçuk KILINÇ," Kumaş Sikliklarinin Görüntü İşleme Teknikleri İle Otomatik Olarak Belirlenmesi", İzmir, Türkiye, Journal of Textiles and Engineer, Accepted 30 Nov 2016.
[9]. Ruru Pan, Weidong Gao, Jihong Liu & Hongbo Wang," Automatic Inspection of Woven Fabric
Density of Solid Colour Fabric Density by the Hough Transform", Wuxi, Jiangsu, China, Fibres & Textiles In Eastern Europe 2010, Vol. 18, No. 4 (81).
[10]. Andrian Wijayono & Valentinus Galih Vidia Putra," Stitch Per Inch Measurement Using Image Processing Techniques", Bandung, Indonesia, accepted 17 December 2018.
[11]. Aqsa Rasheed, Bushra Zafar et.al," Fabric Defect Detection Using Computer Vision Techniques: A Comprehensive Review", Mirpur-10250, AJK, Pakistan, Hindawi, Mathematical Problems in Engineering Volume 2020, Article ID 8189403, 24 pages.
[12]. M Senthil Kumar, L Ashok Kumar et.al," Design and development of an instrument for non- destructive fabric weight measurement", Indian Journal of Fibre & Textile Research Vol. 40, September 2015, pp. 329-333.
[13]. Pallavi A. Patil & Kumbhar," Fabric Defect Detection Using Image Processing Technique", Rajarambapu, Institute of Technology (India), international journal of advanced research in science and engineering, Vol. no. 6, issue no. 4 April 2017.
[14]. Kazım Yildiz, Volkan Yusuf Şenyürek, Zehra Yildiz & Mustafa Sabri Özen," A New Approach to the Determination of Warp-Weft Densities in Textile Fabrics by Using an Image Processing Technique", Kadıköy, İstanbul, Turkey, Journal of Engineered Fibers and Fabrics, Volume 9, Issue 1 – 2014.
[15]. Jie Zhang, Binjie Xin2 & Xiangji Wu3," A Review of Fabric Identification Based on Image Analysis Technology", Shanghai, 201600, China, Textiles and Light Industrial Science and Technology (TLIST) Volume 2 Issue 3, July 2013.
[16]. E Ghassemieh, M Acar and H Versteeg," Microstructural analysis of non-woven fabrics using scanning electron microscopy and image processing. Part 1: development and veri cation of the methods", Mechanical and Manufacturing Engineering, Loughborough University, Loughborough, UK, Proc Instn Mech Engrs Vol 216 Part L: J Materials: Design and Applications.
[17]. Ruru Pan & Jie Zhang et.al," Applying Image Analysis for Automatic Density Measurement of High-tightness Woven Fabrics", Wuxi, Jiangsu, China, Fibres & Textiles In Eastern Europe 2016, Vol. 24, 2(116).
[18]. Jie Zhang, Ruru Pan and Weidong Gao," Automatic inspection of density in yarn-dyed fabrics by utilizing fabric light transmittance and Fourier analysis", Wuxi 214122, China, 1 February 2015 Vol. 54, No. 4 Applied Optics.
[19]. Jie Zhanga, Ruru Pana, Weidong Gaoa & Dandan Zhua," Automatic inspection of yarn-dyed fabric density by mathematical statistics of sub-images", Jiangnan University, Wuxi, China, The Journal of The Textile Institute, 2015 Vol. 106, No. 8, 823–834.
[20]. Hossein Hasania & Sanaz Behtaz," Measuring the roughness of knitted fabrics by analysis of surface signals obtained from image processing", Isfahan University of Technology, Isfahan, 84166-83111, Iran, Indian Journal of Fibre & Textile Research, Vol. 38, March 2013, pp. 101-105.
[21]. Singh JP, Anuhbav G, Aprajita A, Himanshi S and Vandana J," Digital Image Processing Techniques: A Versatile System for Textile Characterization", Department of Textile Technology, U.P. Textile Technology Institute, Kanpur, India, J Textile Sci Eng, ISSN: 2165-8064 JTESE, Volume 4 Issue 3 1000156.

[22]. B K Behera & Rajesh Mishra," Measurement of fabric wrinkle using digital image processing", Department of Textile Technology, Indian Institute of Technology, New Delhi 110 016, India, Indian Journal of Fibre & Textile Research Vol. 33, March 2008, pp. 30-36.

[23]. S. L. Bangare, N. B. Dhawas2 et.al," Fabric Fault Detection using Image Processing Method", India, IJARCCE, Vol. 6, Issue 4, April 2017.

[24]. Ravina D. Karnik & L.S. Admuthe," Density Evaluation and Weave Pattern Classification of Fabric Using Image Processing", Department of electronics, DKTE's textile and engineering institute, Ichalkaranji, India, International Journal of Engineering Research and Technology. ISSN 0974-3154 Volume 10, Number 1 (2017).

[25]. B K Behera & Ajit Kumar Pattanayak," Measurement and modeling of drape using digital image processing", Department of Textile Technology, Indian Institute of Technology, New Delhi 110 016, India, Indian Journal of Fibre & Textile Research, Vol. 33, September 2008, pp. 230-238.

[26]. Jarrett Radbourne," A Versatile System for Textile Characterization", NC State University, Raleigh, SSRG International Journal of Polymer and Textile Engineering (SSRG – IJPTE) – Volume 3 Issue 1 Jan to April 2016.

[27]. Ryan Rudy & Andrian Wijayono2 et.al, "Knitted Fabric Density Measurement Using Image Processing Techniques", Politeknik STTT Bandung, Proceeding Indonesian Textile Conference, ISSN : 2356-5047, 3rd Edition Volume 1 2019.

[28]. Dejun Li, Han Fang, Liwen Zheng, Changjun Ji & Haoran Yuan, Wuhan Textile University electronics and electrical engineering, hubei wuhan 430200, China, IOP Conf. Series: Earth and Environmental Science 252 (2019) 022077.

[29]. Mohamed Abdelkader, "MATLAB Algorithms for Diameter Measurements of Textile Yarns and Fibers through Image Processing Techniques" Technical University of Liberec, 46117 Liberec, Czech Republic, Materials 2022, 15, 1299, Accepted: 8 February 2022.

[30]. Anna Fabija´nska & Lidia Jackowska-Strumiłło, "Image processing and analysis algorithms for yarn hairiness Determination", Technical University of Lodz (TUL), 18/22 Stefanowskiego Str, 90-924 Lodz, Poland, Machine Vision and Applications (2012) 23:527–540, Accepted: 19 January 2012.

[31]. Y Wu, J Wang, Z Zhan and L Q Li, "Investigation the effect of weave repeat on woven fabric texture characterization using sparse representation", Shanghai, 201620, China, IOP Conf. Series: Materials Science and Engineering 254 (2017) 162012.

[32]. Kumar Ghosh, "An Investigation of Bursting Strength on Single Jersey Weft Knitted Fabrics", Textile Department, Rupa and Company Limited, India, IOSR Journal of Polymer and Textile Engineering (IOSR-JPTE) e-ISSN: 2348-019X, p-ISSN: 2348-0181, Volume 9, Issue 5 (Sep. – Oct. 2022), PP 09-20 Accepted 14 Oct 2022.