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Smart Dye Inspection System in Textile Industry

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Abstract: Inspection on the dyed material in the textile industry is facing a challenging task owing to the accurate measurement of the dye concentration added. Currently manual inspection is done. It consumes more time and less accurate. The proposed work provides a solution to above problem. The image of reference material (cloth) is captured and the features are extracted using image processing techniques. The color concentration of both the reference material and the test fabric is compared. If the dye concentration of the test fabric matches with the reference material, then it is a perfect dyed cloth whereas for mismatched samples, the concentration is to be adjusted is displayed. This smart dyeing inspection system reduces the manual operation and saves time and results in high accuracy.

***Keywords*: Dye inspection, feature reduction, Image Analysis, Image processing.**

I. INTRODUCTION

In the process of dyeing, there is a direct relationship among dyeing as well as degree of diffusion into fibre. A dye, which has a great relation with fibre, can also greatly perform the rate of surface deposition, moderate adsorption of surface as well as polymer chains to break, making the fibre low dye resisting. Based on fixation, the dye acts to fibre or intermit to physical forces. To guarantee complete shade of dye, its distribution should be uniform, regardless the mode of fixation, ie, physical or chemical. To free migrate as well as dye diffusion is needs that based on entirely as shape and size of pores, which implement way with molecules adsorbed. Speed as well as quality of dye greatly based on the bond of dye with fibre. It consists of six theories to forecast the bond theory: physical theory, chemical theory, physico-chemical theory, fibre-complex theory, solid solution theory as well as mechanical or pigment theory.

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The concept of part-time dyeing denotes a practical method by guarantee the relation of dye with fibre as well as feasible test may utilize with access dye compatibility.

General problem statement conveyed by the dying industries is verification of the color concentration in fabric materials by manual methods that leads to inaccuracy.These industries require basic requirement of different illumination setup for testing of sample material. In case of dissimilarities the concentration of dye adjustment is done by using specific manual calculations. An idea was implemented depend on elementary fabric structure employing Microsoft visual C++6.0 application advancement stage. Depend on fabric blending ratio, the computation of color blending effect to evolve a system that may quickly combine colors with warp as well as weft fabrics and changes in organizational structure. The outcome denotes, which software is simple to program as well as low pieces of weave fabric samples have tested its viability. But it has a major disadvantage of sample analysis using wave form graph method which is inaccurate and tedious process. Thus the proposed method aims to bring out a solution to this problem using image processing techniques.

II. PROPOSED METHODOLOGY

A. Process flow

The architectural diagram of proposal smart dyeing is displayed at figure.1.

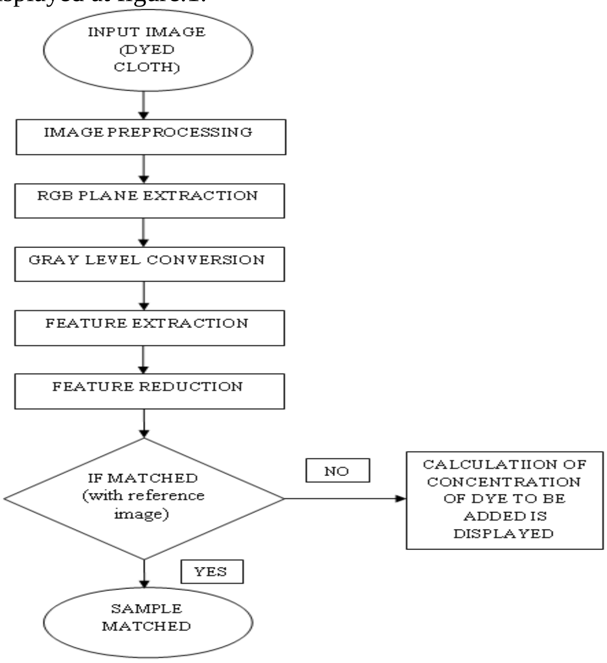

Fig.1. Architectural Diagram of Proposal Smart Dye Inspection Method

The image of the dyed cloth is captured under uniform lighting setup with high pixel camera .The image is then compared to the reference fabric material, if both the images matches the process stops. Else the concentration of dye to be adjusted is calculated and displayed.

B. Image preprocessing

The preprocessing aims to perform the data image, which conquer distortions as not wanted or perform few image behaviors significant to more processing. The dyed image is captured and subjected for median filtering. Median filter will remove the noise and enhance the foreground.

III. IMAGE PROCESSING

A. RGB plane extraction

The RGB plane is extracted for the captured image and is shown in the Fig.2 henceforth to find the appropriate color intensity of image.

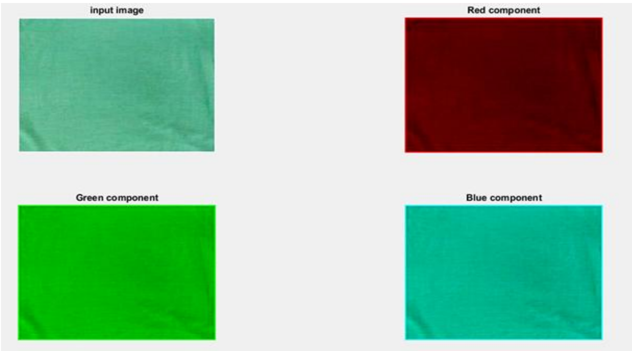

Fig.2. RGB Plane extraction

B. RGB -gray level conversion

To extract the gray level features, RGB plane extracted images are subjected to gray scale conversion as shown in the Fig.3.

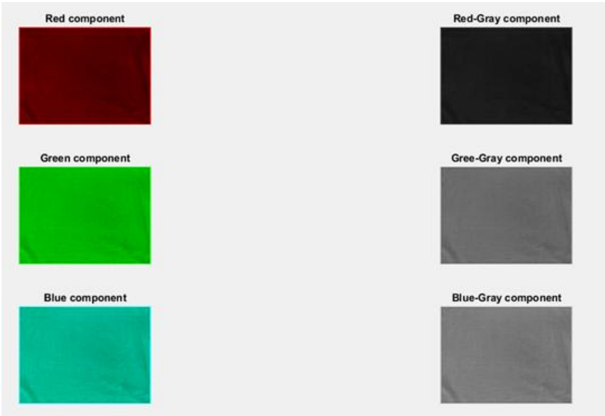

Fig.3. RGB-GRAY Level Extraction

C. Feature extraction

Feature extraction begins for starting set of scaled data as well as creates the values derived (characteristics) deliberated with informative as well as non-redundant, which facilitates the following learning as well as generalized steps, based on few cases leads with best human interpretations. Gray level co- occurance matrix (GLCM) is obtained from gray level image. From GLCM matrix sixteen Haralick features are extracted and listed in the Fig. 4.

			Image-1(Hue-Green)			Image-2(Hue -Green)			Image-3(Hue -Green)	
		RED Plane	GREEN Plan	BLUE Plane	RED Plane	GREEN Plan	BLUE Plane	RED Plane	GREEN Plan	BLUE Plane
Autocorrel	AUTOC	1.01014925	9.05824876	9.09968159	1.14393305	16.0188792	16.7898694	3.46113039	19.1019305	20.3903115
Contrast	CONTR	0.0039005	0.01703483	0.02654726	0.02468619	0.02033726	0.05768987	0.00696023	0.01310279	0.015117
Correlation:	CORRM	0.99996541	0.9999855	0.99997678	0.99957086	0.99998844	0.99996775	0.99981479	0.99999267	0.99999232
Correlation	CORRP	-1.1714858	-1.2340104	-1.2341535	-1.1718428	-1.2678446	-1.2707478	-1.1951904	-1.2780501	-1.2833537
Cluster Pro	CPROM	3.12E+06	8.54E+06	8.56E+06	3.19E+06	1.30E+07	1.34E+07	4.86E+06	1.47E+07	1.56E+07
Cluster Sha	CSHAD	-7.42E+04	-1.58E+05	-1.58E+05	-7.55E+04	-2.16E+05	-2.22E+05	-1.03E+05	-2.38E+05	-2.48E+05
Dissimilarit	DISSI	0.00370149	0.01106468	0.01516418	0.01829593	0.01600101	0.0458476	0.00696023	0.01310279	0.01511707
Energy: mat	ENERG	0.9886991	0.97977782	0.97318222	0.92166604	0.94555181	0.81825056	0.69986012	0.38864502	0.41859293
Energy	ENTRO	-0.6864024	-0.6810655	-0.677118	-0.6462262	-0.660554	-0.5838741	0.52135147	-0.3246909	-0.3428174
Homogenei	HOMOM	0.99818242	0.99537811	0.99399768	0.99191708	0.9927222	0.97904674	0.99651988	0.99344861	0.99244147
Homogenei	HOMOP	0.99816915	0.99506468	0.99354498	0.99149106	0.99243312	0.97826043	0.99651988	0.99344861	0.99244147
Maximum p	MAXPR	0.99432836	0.98983085	0.98648756	0.95981996	0.97232154	0.90289083	0.81805672	0.43951179	0.54586973
Sum of sqa	SOSVH	0.98096927	8.97299227	9.01901031	1.12314417	15.9042638	16.6911952	3.40831647	18.9690103	36.5507224
Sum averag	SAVGH	0.00451741	4.01715423	4.0280995	0.08052491	6.00180043	6.17684798	1.63611344	6.63493678	6.92824379
Sum varian	SVARH	0.00908891	15.6381068	15.5889488	0.2114474	34.2749791	33.6379378	2.75672777	33.0699352	36.5507224
Sum entrop	SENTH	0.013885	0.06820221	0.0908849	0.13366618	0.15304541	0.40782612	0.1642851	1.04823439	1.03860064
Difference v	DVARH	0.0039005	0.01703483	0.02654726	0.02468619	0.02033726	0.05768987	0.00696023	0.01310279	0.01511707
Difference e	DENTH	0.02431649	0.05450481	0.06827115	0.08609676	0.07895781	0.18455802	0.04151121	0.06981624	0.07837193
Information	INF1H	-28.485496	-15.932642	-12.720135	-5.8053533	-7.4925661	-3.9159272	-3.1014386	-2.3279685	-2.3530228
Informaiton	INF2H	0.87838328	0.8884661	0.89414178	0.92773432	0.91381504	0.95292758	0.97240084	0.99488665	0.99471744
Inverse diff	INDNC	0.99959093	0.99883488	0.99843365	0.99803812	0.99827029	0.99503733	0.99922664	0.99854413	0.99832033
Inverse diff	IDMNC	0.99994026	0.99974841	0.99961654	0.99962889	0.99969301	0.99912863	0.99989292	0.99979842	0.99976743

Fig.4. Feature Extracted

D. Feature reduction

Among the 16 features extracted, only the four. Features based on their range of variance are considered. The reduced features are,

- Autocorrelation
- Sum variance
- Sum of square
- Sum average

Table-1: Range of Reduced Feature

REDUCED FEATURES	RANGE											
	IMAGE 1 (Hue: Green)			IMAGE 2 (Hue: Blue)			IMAGE 3 (Hue: Red)			IMAGE 4 (Hue: Yellow)		
	R	G	B	R	G	B	R	G	B	R	G	B
Autocorrelation	1-4	9-20	9-20	1-5	1-17	1-26	2-9	1-5	1-5	8-9	9-25	9-26
Sum of squares	0-4	8-19	9-37	0-5	0-17	0-26	2-9	1-5	1-5	8-9	9-24	9-24
Sum average	0-3	15-35	5-37	0-4	0-36	0-63	1-16	0-5	1-7	15-16	14-64	14-64
Sum variance	0-2	4-7	4-7	0-3	0-7	0-9	1-4	0-3	0-3	3-4	4-8	4-8

IV. FEATURE RANGE ESTIMATION

From all the listed reduced features, the range of R, G and B component for various reference samples are framed. Table 1 shows the feature range.

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V. RESULT AND DISCUSSION

With the prior knowledge (feature range of reference image), the image of the test sample is captured and the procedure is repeated. If the feature obtain matches, then the test is passed else the error value is calculated and proportional amount of dye to be adjusted is displayed. A GUI using MATLAB is developed based on the above said proposed idea. The image of the reference material and the test sample is to be captured. GUI will yields either matched or the percentage of dye to be adjusted (added or removed) will be displayed. Fig.5 shows the GUI and the result of the proposed work.

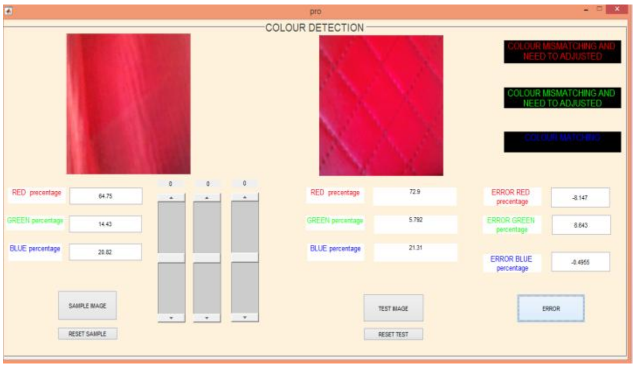

Fig.5. GUI Developed For Smart Dyeing System

VI. CONCLUSION

The general problem statement conveyed by the dying industries is verification of the color concentration in fabric materials by manual methods that leads to inaccuracy. Incase of dissimilarities the concentration of dye adjustment is done by using specific manual calculations. This results in excess time consumption and also manual needs. Using matlab GUI application code we can reduce all the above mentioned problems.

This application can be easily implemented under various situations. We can add more number of colours when we require. Deep learning techniques can be used for getting more accuracy.

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