Defect Detection in Textile Industry using Computer Vision

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Abstract—Fabric flaws are one of the most significant factors impacting fabric quality in the textile industry. In the textile industry, fabric defect identification is a difficult task as the cost of any fabric is directly dependent on its accuracy and efficiency. Earlier, manual human efforts were used to detect the flaws which lead to several limitations such as lack of discipline, human stress and required a lot of time. Computer Vision applications can solve this limitation. The paper proposes a new filter selection approach for detecting fabric flaws in which the Gabor functions are automatically tuned to match textural information. A new defect segmentation algorithm is created using the filter selection method. The Hash function is used on the textures to identify flaws in patterned textures images in both the horizontal and vertical orientations, as well as to maintain the user's authentication. By thresholding the output from the two directions, the region of flaws in the texture image can be identified. There are three sections to an algorithm being used. The first section is concerned with image normalization and correction of non-uniform light in the input image. The image processing approach, which finds probable anomalies in the normalized image, is covered in the second half. Finally, in the third section, the RoI, which is the exact location of the defect, is identified within the image.

Keyword - Fabric defect detection, Computer Vision, Histogram, Hash function, Mean Filtering, Segmentation, Thresholding, Yolo V3, ROI Region of Interest

I. INTRODUCTION

Textile industry is concerned with designing, production, and distribution of fabrics. In this industry, raw materials mostly used are cotton, wool, synthetic cotton, silk, etc which are easily available in nature and are also made in laboratories.

In the current world scenarios, the fabric industry has been upgraded a lot (in terms of technology). But the main problem which is still faced by this industry is manufacturing defects.

These defects are caused due to human mistakes as well as machine errors, which in return affects a particular company a lot. This can result in huge losses, batch replacement, etc. Due to this many companies and factories have been shut down since the 1950's.

To solve this particular issue many technologies have been implemented and also used in today's times. But also considering the fact that these technologies also lack in many scenarios. For example, some of the technologies require humans which also is a part of concern that humans can also make mistakes and in return it may affect companies. A machine was introduced to inspect defects in fabrics which required a human to inspect defects.

Later on, AI and Machine Learning technologies were introduced to this industry which helped fabric manufacturing industries to detect defects easily without any human intervention. But also, these technologies had a drawback is that these defect recognition scripts were only capable of detecting defects on white fabric and this system was of no use for detection on colored and patterned fabric.

The dataset used by these machine Learning scripts is called TILDA. This dataset was created around the late 19’s. As this industry has evolved it really needed an upgrade on the dataset. But right now, there is no good enough dataset available to replace TILDA. Also said by the industry experts this dataset is no longer useful. So therefore, a new dataset is must for better precision.

II. LITERATURE SURVEY

There are no practical implementations on this technology for the development of rural area people, there are many different implementations on smaller parts which can be accustomed into one to create a “Government fund tracking system for Schemes”.

TABLE 1. Literature Survey

Paper Title	Literature Survey		
	Objectives	**Drawbacks**	**Future Scope**
1.**"Survey of automated fabric inspection in textile industries"** R. Divyadevi, Prof. B. Vinodh Kumar	This paper makes a survey on material defect detection techniques machine-driven and computer vision examination of real material defects.	This method of the fabric inspection result in slow process that ended in poor output and much costlier	In future, Machine learning approach with machine vision will lead to fast and automated application in inspection of fabric
2.**Wavelet based methods on patterned fabric defect detection** HenryY.T. Ngana,Grantham K.H.Panga, S.P. Yungb,Michael K. Ng	The aim of this research is to develop an effective way to detect defects on patterned fabric, especially for Jacquard patterned fabric, where a flower or graphic logo may appear on the fabric.	The weakness of hash function is its sensitivity to noise and its inability to outline the shape of defect after detection. Another drawback is that it cannot match perfectly pixel to pixel between the test area and the golden template	In this the main focus is on DT method which is evaluated with 60 test images which shows 65% accuracy and for dot pattern fabric GIS method is robust and effective
3. **Computer vision-based fabric defect analysis and measurement** m Yu Zhang, A. KUMAR	The aim of this research is to develop thee Computer Vision based automated inspection technique for textile fabrics	Most of the textile fabric products for consumer use are colored and patterned. Such fabrics have complex patterns which are quite challenging for defect inspection	The development of smart sensing technologies will allow researchers to effectively exploit extended fabric features,
4.**Computer Vision-based Fabric Defect Detection: A Survey** Ajay Kumar	The objective of defect detection is to separate inspection images into the regions of distinct statistical behavior. An important assumption in this process is that the statistics of defect-free regions are stationary, and these regions extend over a significant portion of inspection images	High-resolution inspection images will require more computing power to inspect entire width but are desirable to detect subtle defects, computational requirements are low for low-resolution images	There has not been any prior survey on the fabric defect detection methodologies and the comprehensive survey presented in this paper will be useful in developing and analyzing new approaches.
5.**Patterned Fabric Defect Detection System Using Near Infrared Imaging** Azhar A. Hamdi and Mohamed M.Fouad, Mohammed S. Sayed, Mohiy M. Hadhoud	In this paper, a computer vision system that can detect fabric defects in patterned fabrics are proposed. The proposed system utilizes near-infrared imaging to overcome visual light source imaging drawbacks. It employs the non-extensive standard deviation filtering and minimum error thresholding method to detect defects.	Due to uneven illumination and at the at the same time, it does not dampen defected regions. The hidden defect behind the fabric cannot be seen.	
6.**Intelligent Real-Time Fabric Defect Detection** Hugo Peres Castilho, Paulo Jorge Sequeira Gonc,alves, Jo˜ao Rog´erio Caldas Pinto, and Ant´onio Limas Serafim	This paper presents real-time fabric defect detection based in intelli-gent techniques. Neural networks (NN), fuzzy modeling (FM) based on product-space fuzzy	. But it is not possible to reduce times for the fuzzy systems by decreasing the number of clusters, but it is not possible to get accuracy (AC).	As future work, the proposed approach for fabric defect detection should be opti-mized for speed and its robustness tested with fabrics with different

	clustering and adaptive network .		patterns.
7.**Fabric Defect Detection Adopting Combined GLCM, Gabor Wavelet Features and Random Decisio n Forest** **Nilesh Tejram Deotale • Tanuja K. Sarode**	Provides some useful information about the security and performance of various parameters such as block size, distribution time etc.	These only provide the strategic insights based on the analysis done through the framework.	Does Not have any implementatio n tool in the government infrastructure.
8.**Automatic Fabric Fault Detection Using Image Processing** Engr.Anum Khowaja, Engr.Dinar Nadi**r**	This paper provides an overview of automatic fabric fault detection approaches that have been developed in recent years. It aims to identify and paint defects on the surface of stained fabric at the stage of production.	Images with fluctuating contrast levels are those where global thresholding technique will not work adequately.	In the textile industry, damage can be detected by wireless consent. Here MATLAB is used , but new software such as SDL, Virtual LB and Computer Vision may be used in the future.
9.Exploring Faster RCNN for Fabric Defect Detection Authors: Hao Zhou, Byunghyun Jang, Yixin Chen, and David Troendle	The project's goal is to create a fabric defect detection (FabricNet) network based on vanilla Faster RCNN that enhances the accuracy and speed of defect detection.	Some faults are found using several boxes, while others are disregarded.	No fabric flaws go undetected. Even the tiniest flaw must be discovered.
10.**Fabric defect detection based on saliency histogram features** **Min Li, Shaohua Wan, Zhongmin Deng, Yajun Wang**	This work introduces a new visual saliency–based defect detection system that can find defects in both non patterned and patterned fabrics	We discovered in this paper that using CA saliency maps does not improve the system's classification performance.	In the future, they intend to use the GraphCut method to automatically segment the problematic region. Also to reduce computational time, to build a more

	automatically.		efficient visual saliency model.
11.**Classificatio n of knitted fabric defect detection using Artificial Neural Networks** **Subrata Das, Thulasiram N, Amitabh Wahi, Keerthika S**	This paper describes a classification approach for detecting faults in knitted fabric, such as holes and thick spots.	The drawbacks included appropriate length of the feature vector from the image samples to improve classification accuracy	The future work for this paper included exploring large no of image samples with other defects in the knitted fabrics.
12.**Fabric defect detection using Discrete Curvelet Transform**	To enable computerised examination of woven textures, the proposed plot includes Curvelet Transform (CT), Gray-Level Co-event Matrices (GLCM), surface examination, and k-closest neighbour.	It is just a paper which is based on the survey so it lacks some practical implementati on	The algorithm is very resistant to white noise. The high information capacity of curvelet features, as well as the combination of GLCM and CT, could account for these future scope
13..**Sequential Detection of Image Defects of Patterned Fabrics**	Using existing picture inpainting methods, the new proposed automatic defect location approach can tackle the problem of deficiency caused by manual fault algorithms	This method can only find the defect contour in a rough manner, not accurately.	Defect detection and image inpainting may be merged in the future to improve defect image location and inpainting.
14.**Yarn-dyed Fabric Defect Detection with YOLOV2 Based on Deep Convolution Neural Networks**	To reduce labor costs for manual extract image features of yarn-dyed fabric defects,a method based on YOLOV2 is proposed for yarn-dyed	The drawback of this paper is that it lacked in accuracy as it has limited samples	Future work is mainly aimed at optimizing the loss function and improving the evaluation results.

	fabric defect automatic localization and classification.		

III. PROPOSED SYSTEM

A. SYSTEM REQUIREMENTS

These are a few tools and frameworks that you need to install.

- Jupyter Notebook
- MatplotLib
- Numpy
- Scikit Learn
- Xampp Server
- PHP

B. WORKING

Fabric image feature Extraction

A printed fabric inspection image is transformed into a grayscale image. To minimize noises and smooth the image, the converted image is filtered using mean filtering which takes less time to compute.

Then it will undergo the histogram equalization to increase the contrast. Hash function will generate two signatures (row and column) of a test image. They are then subtracted by the two signatures of a golden template of one repetitive unit from a reference image. Then, any unusual jump is often segmented out by thresholding. The average upper bound and average lower bound for all the rows and columns is the threshold value. The image is now transformed into a binary image using this threshold value to check if the image is faulty or free of defects. A vector of the function is generated by measuring a number of defect characteristics. This function vector is then entered into a neural network that has been previously equipped with a variety of function vectors to identify the defect.

YOLOv3 continues to use CNN for feature extraction based on the validity of the technique. To construct the network structure for feature extraction, YOLOv3 combines YOLOv2, darknet-19, and ResNet. The 33% and 11% convolution layers with greater performance are employed.

Instead of using the pooling layer, the convolution step of the convolution layer is set to 2. Darknet-53 is the name given to the feature extraction network since it comprises 53 convolution layers. When comparing the performance of darknet-53 to that of other ImageNet members, the Top-1 test result is 77.2 percent. Finally, the network is tested with the samples and the output is finally obtained.

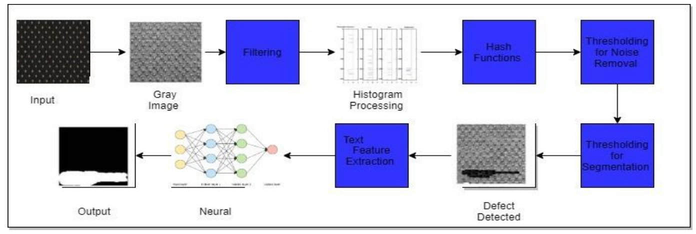
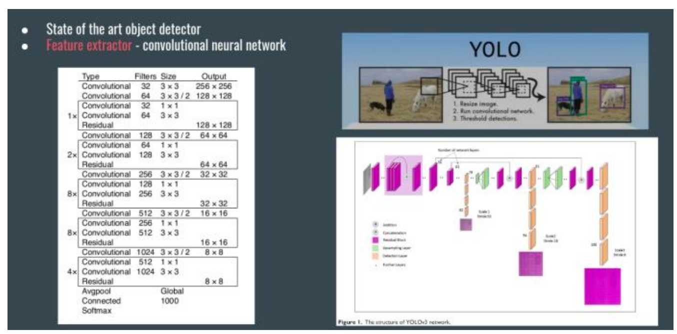


Fig:1 Block Diagram

C. Modal Training

We have used YOLO object detector to implement the feature extraction module and defect localization and classification module. YOLO uses a Deep Convolutional Neural Network as the feature extractor.



D. ALGORITHM

1. Threshold For Noise Removal

This method treats a picture as an array of pixel values and uses a level set approach to follow the evolution of iso-intensity contours. The main idea is represented by a "min/max" speed function of the type F = min(K,0) or F=max(K,0), where K is the curvature and F is the normal speed. A switch determines whether the min or max is used, and it is based on the local average pixel value at any point.

2. Hash Function

Hash functions were first applied in cryptography to ensure that files were not corrupted. The MD5 cryptographic hash function is employed to keep the system secure. Hash functions are used to detect defects in patterned textures.

3. Histogram

To improve contrast, the input pictures will be subjected to histogram equalisation. Histograms can be used to determine whether noise in pictures has been correctly eliminated, and 3D Histograms can be used to identify fabric colour.

4. YOLO V3

A single Convolutional Neural Network underlying YOLO. The CNN divides an image into regions and then predicts each region's boundary boxes and probabilities. It predicts several bounding boxes and probability for each class at the same time. During training and testing, YOLO sees the complete image, thus it implicitly encodes contextual information about classes as well as their appearance.

5. DarkNET

Darknet is a C and CUDA-based open-source neural network framework. It's quick to set up and supports both CPU and GPU computing. It is a quick and highly accurate framework for real-time object detection (accuracy for custom trained models is dependent on training data, epochs, batch size, and other factors) (also can be used for images).

IV. RESULTS

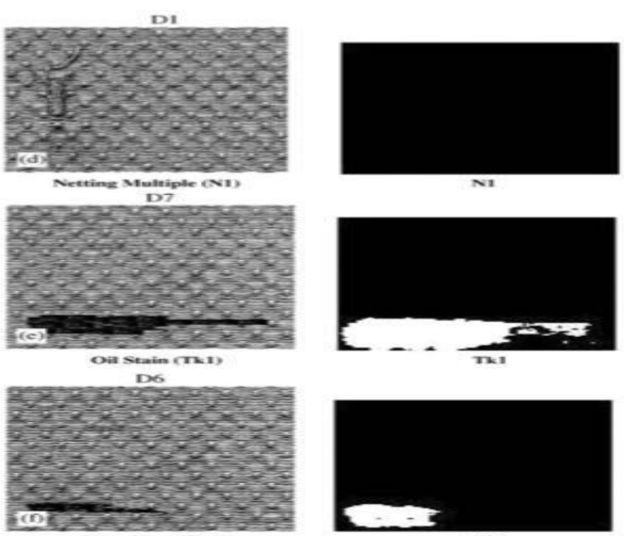


Fig. 2 Defect Types

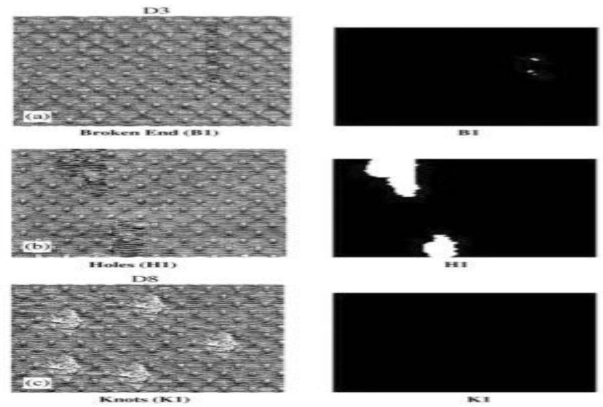


Fig.3 Defect types

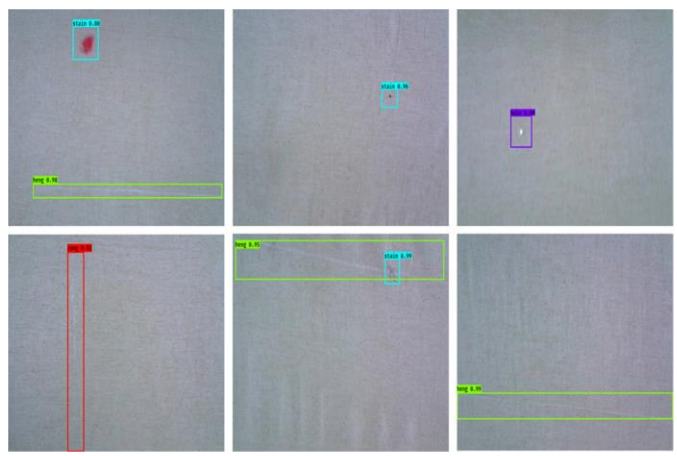


Fig. 4 Detection results on plain fabrics

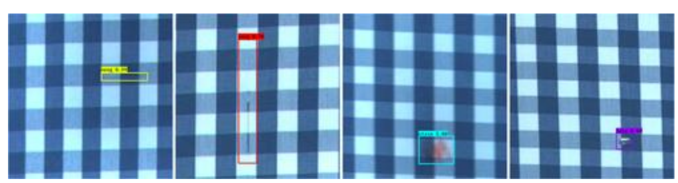


Fig.5 Detection results of patterned fabric

V. CONCLUSION

Due to the presence of the fabric flaw, fabric will be sold at a lesser price and resulting in a significant value loss for the organisation.At a time, when industries such as textiles are constantly in need of modernization, it is completely obvious that the textile sector presence throughout the high-tech domain of high-performance computing-based verification is essential, and automated visual system is more than a requirement.Through this paper we have presented an appropriate set of features in order to address the problem of defect classification.In this paper, we proposed an adequate set of features to address the problem of defect categorization.

VI. Scope

For a competitive advantage and to create effective methodologies for fabric defect identification and classification, quality assurance for fabrics generated from the production line is critical. The creation of innovative technologies that could make low-cost, reliable flaw detection an actuality for the textile industry.

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