An Effective Segmentation and modified Ada Boost CNN based classification model for Fabric Fault Detection system

Immadi Murali Krishna[#1], Pendem Durga Bhavani[#2], Tiriveedhi M S Madhuvani[#3], Vajja Poojitha[#4]

[1]*Associate professor, Department of CSE, PSCMR CET and Research Scholar,JNTUK, Andhra Pradesh, India*
[2] *UG Student, Department of CSE, PSCMR CET, JNTUK Andhra Pradesh, India.*
[3] *UG Student, Department of CSE, PSCMR CET, JNTUK Andhra Pradesh India.*
[4] *UG Student, Department of CSE, PSCMR CET, JNTUK, Andhra Pradesh, India.*

Abstract
By rapidly growing the production of fabrics in textile industry, fabric faults are most common slip-up in the fabric manufacturing process. Inspection of fabrics and finding defects in the fabrics are too difficult along with the speed of production. Fabric defect detection plays a major role in the quality control in textile industry. The major objective of our proposal is to produce the high quality fabrics in the shortest period of time using machine learning Techniques. By increasing the various data sets in the fabric fault detection, the conventional classification techniques are not able to produce the accuracy on predicting the fault with low inspection time. To improve the accuracy and to predict the fabric defect within the inspection time, we propose An Effective Segmentation and modified Ada Boost CNN based classification model for Fabric Fault Detection System.

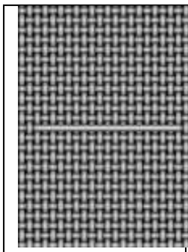
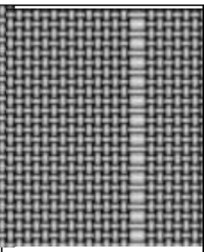
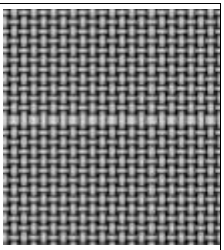
Keywords: *Ada Boost CNN, Morphological edge detection, Pre Processing.*

I. Introduction

Detection of defects on the fabric is very crucial part for the quality of the product. Now a days in textilemanufacturing industries defect detection is still depend on labor inspection. Inspectors will find out the defects in the fabric by direct observation, but extend observation will affect the human eyes and inspector will not able to find out the full defects on the fabric and not able to point out the mini defects on the fabric. In order to find out the mini defects on the fabrics we use classification technique. Classification is a technique which will divide the data in to number of classes to classify. In Machine learning son many classification techniques used to classify the fabric data in recent. Some of the most popular machine learning classification techniques 1. Kernel estimation (K-nearest neighbor (KNN)) 2. Linear Classifiers (Logistic regression, navie bayes classifier, Fisher's linear discriminant) 3. Support Vector Machine (SVM) 4. Decision trees (Random forests) is 5. Quadratic classifiers 6. Neural networks 7. Learning vector quantization. Up to now authors have used a K-nearest neighbors, learning vector optimization, Support vector machine, random forest, navie Bayes classifier, and linear classifiers.

An algorithm that maps the input data to a specific category. The data set may be simple data set or multiple data sets. There are so many data sets available for the fabric fault detection like TILDA data set we are using a textile defect detection master data set.

There was totally 70+ number of defects on the fabric they are horizontal lines, shade variation, Dirt stains, uneven dyeing, drop stitches, misprinting(off printing or absence of printing), crease marks, Barre, Neps/Knots, Abrasion marks, Splicing, Holes, Snags, Thick Place/thin place, Bowing and skewing, Needle lines, mixed lines, new lines, dirty or contaminated with lint, bent lines, worn lines, coarse pick, coarse end, broken pick or weft, broken end or warp, filling bar, missing end/end out, bad selvedge, loose warp,

		
Fabric Float defect	Fabric warp yarn defect	Fabric weft yarn defect

loose weft or snarl, double end, tight end, float of warp, Wrong end color, Miss pick, Double pick, Weft bar, Ball, Oil spot, Tails out, Temple mark, Reed mark, Slub, Thick, thin place, runner, sanforize pucker, puckered selvage, pin holes, open reed, needle line, broken pattern, iron marks, trails out, gout, neppy, pile less spot, bunching up , slough offend so on. Classification Techniques. In this paper proposed an efficient model to detect unseen and UN visible minor defects in the fabrics to improving the quality of a fabric with highest accuracy by using the Ada Boost Convolutional Neural Network and Image Segmentation techniques.

In preset generation the quality of the product is very important and people choose only to buy the good quality and price efficient products. Defects in the fabric clothes by using an Ada BoostConvolutional Neural Network and Image Segmentation.

II. RELATED WORKS

In present generation the quality of the product is very important and people choose only to buy the good quality and price efficient products. In traditional classification techniques to find the fabric faults are presented. Miao Guan [1] et.al proposed a Defect Detection and Classification for Plain Woven Fabric Based on Deep Learning investigated the defects in the fabric through VGG Model for testing the performance evolution. Miad Guan model will identify the faults in the fabric for the plain Woven fabric through Deep Learning, CNN and gives an accuracy of 92.44%. The future research effort will be devoted to the online realization of the algorithm.

Karunamoorthy [2] et.al presents an Automated Patterned Fabric Fault Detection Using Image Processing Technique in MATLAB look over the faults in the fabric using novel Image Decomposition method, Matlab R2009a. Karunamoorthy model will point out the defects in the fabric for the patterned fabric through ANN Learning and gives an accuracy 95%. In future we can use an automated visual inspection machine to identify the faults in the fabric.Farida S.Naraf [3] et.al proposed a Fabric Fault Detection using Digital Image processing to identify faults through edge detection system. Farida's model finding the fabric fault inspection defects through canny, edge detectors and provide an accuracy in an acceptable manner. Farida's model takes more time and it is less compatible to the present textile industry.Ajay Kumar [4] et.al presents a Defect Detection in Textured MaterialsUsing Gabor Filters to identify the faults through Gabor wavelet features. Ajay's model will find out the defects in the fabric through a multichannel filtering and provide an accuracy in an acceptable manner. Ajay's model will take more time and it is less compatible to the present textile industry.S.Priya [5] et.al proposed A Novel Approach to Fabric Defect Detection Using Digital Image Processing to detect the defects in the fabric, wood, paper, leather through bitplane decomposition and mathematical morphology. Priya's model will find out the defects in the fabric, wood, paper, leather through a gray scale image decomposition and gives an accuracy 90.5%. Priya's model is less compatible to the present textile industry.

Chi-ho Chan [6] et.al proposed a Fabric Defect detection by Fourier analysis to detect the defects in the fabric through gray level statistical and morphological methods. Chi-ho chan's model will find out the defects in the fabric for the textile industry through Fourier analysis.Pandia Rajan [7] et.al proposed a computer vision for automatic detection and classification of fabric defect employing deep learning algorithm through a CNN. Pandia's model will find out the defects in the fabric through SVM-based classifier and provide an accuracy of 96.55% .Mohammed Alawad [8] et.al proposed a Stochastic Based Deep Convolutional Networks with reconfigurable logic fabric through an Convolutional neural network. Mohammed Alawad's model through a Deep learning algorithm, multi-dimensional convolutional through these we will achieve the much higher robustness and provide an accuracy of 86.77%. The future research effort will be devoted to harmful over fitting and slight duration of accuracy.Chunleilli [9] et.al presents a Fabric Defect Detection based on biological vision modeling through the lower rank representation technique for the plain fabric and twill fabric. Chunleilli's model will detect the defects in the fabric through biological vision modelling and dictionary learning with an accuracy of 75%. Chuneleilli's model takes more time and it is less compatible to the present textile industry.Shuang [10] et.al proposed a Automatic Fabric Defect Detection with a Multi-Scale Convolutional Denoising Auto encoder Network Model through an pixel wise detection automated optical inspection method. Shuang's model was based on a multi-scale convolutional denoising autoencoder network with a capacity to synthesis a results from the multiple pyramid levels. Shuang's model will provide an accuracy of 86%. These model takes more time and it is less compatible to the present textile industry.Guang [11] et.al presents anautomated defect detection in textured materials using wavelet-domain hidden Markov models through an traditional segmentation techniques. Guang's model was based on HMT approach for the detecting the defects in a homogeneous texture and provide an accuracy with an acceptable manner. Guang's model takes more time and it is less compatible to the present textile industry.Vladimir [12] et.al proposed a Automated Control System of Fabrics Parameters that Uses Computer Vision through an open cv. Vladimir's model was based on computer vision, vision system automation provides an accuracy with an acceptable manner. Vladimir's model takes more time and it is less compatible to the present textile industry.J.G. Campbell [13] et.al presents a linear flaw detection in woven textiles using model-based clustering for the torn thread fabric through a 3-sigma detection limit. J.G. Campbell's model finding the fabric fault inspection defects through a model based clustering, Bayesian cluster analysis, and pattern recognition which provides an accuracy with a acceptable manner. J.G. Campbell's model take more time and it is less compatible to the present textile industry.Ratna Safitri [14] et.al proposed a "Optimizing Woven Fabric Defect Detection using ImageProcessing and Fuzzy Logic Method" for the woven fabric through an Convolutional neural network. Ratna Safitri's model will find out the defects for the woven fabrics through a Fuzzy logic with MATLAB optimizing, Image processing which provides an accuracy with a acceptable manner. Ratna's model will need to improve the accuracy and has to reduce the inspection time.Gorbunov Vladimir [15] et.al proposed a "Automatic Detection and Classification of Weaving FabricsDefects based on Digital Image Processing" for an weaving loom fabrics through an convolutional neural network. Gorbunov's model was inspected the defects in the fabric through a digital image processing with a accuracy of 95% and it is 50% faster than the human vision in fabric density.Shalaka Subhash Patil [16] et.al proposed a "Defect detection in fabric using image processing" for the weaved fabrics to recognize the defects in textile industry for minimizing production cost and time. Shalaka's model goes through an automated online detection of weaving defects by computerized system weaved fabrics which provides an accuracy with a acceptable manner. Shalaka Subhash Patil's model will need to improve further to increase the accuracy and has to reduce the inspection time and error rate.Wenbin Ouyag [17] et.al presents aFabric Defect Detection Using Activation Layer Embedded Convolutional Neural Networkthrough a PPAL-CNN for the motif fabric. Wenbin outag's model will inspect the defects in the fabric through a convolutional neural network for the imbalanced dataset which provides an accuracy is above 95%. Wenbin's model will need tom improve further to increase the accuracy and has to reduce the inspection time.Huosheng Xie [18] et.al proposed a "Fabric Defect Detection method combing Image pyramid and Direction Template" to inspect the defects in the fabric through an image pyramid. Huosheng's model identify the defects in the fabric through an stack de-noising convolutional auto-encoder with an accuracy of 80.65% F-measure for TILDA dataset with achieves defect localization at block level further Huosheng's model will need to improve by detecting defects at pixel level.

Min Li [19] et.al presents a "Fabric defect detection based on saliency histogram features" to detect the defects in the fabric through an histogram feature and saliency map. Min Li's model will inspect the faults in the fabric through an support vector machine and provides an accuracy with an acceptable manner for both the patterned and un-patterned fabrics. For further work, Min Li's model will plan the segment the defective region automatically by using the GraphCut algorithm. We would also like to construct a more efficient visual saliency model to decrease the computational time.

III. PROPOSED MODEL

In this model first we take the set of images as a data set and applying the pre-processing technique to the images and extracting the features of the images by using the Ada Boost CNN and display the output the fault of the fabric name and defect in the fabric and the accuracy of the defect in the fabric. This model of finding defects on the fabric system consists of two phases that is a training process and a testing process. There was four modules in the training process. The block size of each image was 32 x 32 there was a positive samples and the negative samples in the training set of data.

Convolutional Neural Network is a four layered concept i.e., Convolutional, ReLu, Pooling, and Full Connectedness.

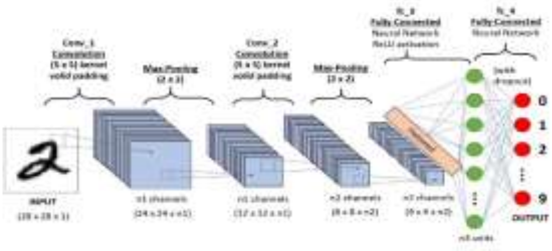
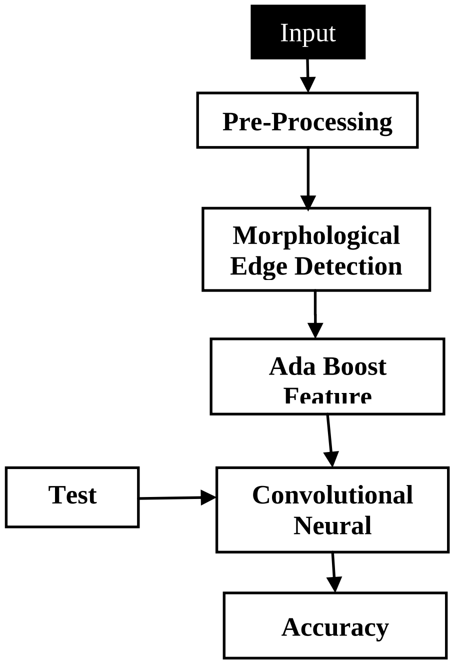


Fig 3.1 Architecture of four layers Conventional neural network

AdaBoost stands for Adaptive Boosting which is performed to select a small set of discriminative features automatically. Finally, CNN do not suffer from the problem of local minimum and are computationally simpler to train,so CNN is selected as the optimistic classifier to classify the fabric faults. The input image provided to the system will be the real image and will be compared with the database available with the system.

The steps involved in this proposed model are



A. Pre-Processing of Input image:

We perform the data preprocessing in order to remove the noisy of data and making as a raw and making it suitable for a machine learning. The very most crucial step for creating a machine learning model. Bicubic interpolate is used to remove the noisy data on image data set and improve the contrast. In the preprocessing the original image is converted in to a binary format through the gray scale format of Bicubic. Why we perform preprocessing? In our data there was lot of noisy data, missing values, and may be unusable format which cannot be used for machine learning models. So, we perform the preprocessing to improve the efficiency and accuracy of machine learning model by cleaning the data. In this paper performed preprocessing model on image data and label data in feature extraction phase. they are encoding categorical data , Feature scaling, remove of noisy data, eliminate sparsity to achieve better accuracy.

B. Morphological Edge Detection

What is Edge Detection? Edge Detection is for looking a neighborhood with strong signs of change in a image. In Machine learning Prewitt Operator, Sobel Operator, Robinson Compass Masks, krisch Compass Masks, laplacian Operator, morphological Edge Detection are types of edge detectors perform horizontal, vertical and diagonal. In our model we are using a morphological edge detectors which will give an accurate result by eliminating the de-noising of data. Performing morphological edge detection to extract the features from the image in the process of segmentation. Firstly, the image which we taken was an RGB colored image that will range between 0 to 6 pixel convert in to gray scale image range between 0 to 255. After that the gray scale image was converted in to binary image each pixel will range between 0 or 1. For the binary image we will perform boundary extraction which will extract the shape of an object with the linked edges by using a formula called A= A- (AΘB). A simple method of performing gray scale edge detection in morphology is to take the difference between an image and its erosion image generated by a structuring element.

C. Ada Boost Feature Extraction

Feature Extraction is a process of dimensionality reduction by which an initial set of raw data is reduced to more manageable groups for processing. A characteristic of these large data sets is a large number of variables that require a lot of computing resources to process. Feature extraction is the name for methods that select and /or combine variables into features, effectively reducing the amount of data that must be processed, while still accurately and completely describing the original data set.

Feature Extraction aims to reduce the number of features in a dataset by creating new features from the existing ones (and then discarding the original features). These new reduced set of features should then be able to summarize most of the information contained in the original set of features. In this way, a summarized version of the original features can be created from a combination of the original set.For the feature extraction of our system we are using an Ada Boost. Ada Boost is the “adaptive boosting” algorithm. The goalof boosting is to improve the accuracyofany given learning algorithm. First, weak classifier with an accuracy on the training set greater then a chance is created, and then new component classifiers are added to form an ensemble whose joint decision rule has arbitrarily high accuracy on the training set. In Ada Boost each training pattern receives a weight that determines its probability of being selected for a training set for an individual component classifier. If the training pattern is accurately classified; then its chance of being used again in a subsequent component classifier is reduced.

$$f(x) = sign(\sum_{m=1}^{M} \Theta_m f_m (x))$$

The training of Ada Boost was done by calculating the misclassification rate traditionally, this is calculated as:

Error = (Correct-N)/N

Conversely, if the pattern is not accurately classified, then its chance of being used again is raised. In this way, the Ada Boost focuses in on the difficult patterns. Specifically, we initialize these weight across the training set to be uniform. It focuses on classification problems and aims to convert a set of weak classifiers into a strong one.

Algorithm Name: adaBoost classification algorithm

Input: datasets $=\{x_i , y_i\}_{, i=1,2,\ldots,m,} y_i \in Y, Y= \{c^1, c^2, \ldots, c^k\}$, c^k is label, T is the number of iterations, I is a classifier, Z_t is normalization factor that make sure D_{t+1} is a distribution.

1.Initialize sample learning coefficient $D_1 (x) =1/m$;

2.For t=1, 2,… T

3.Trainclassifier (S_t, D_t), get a weak assumption $h_t = X \rightarrow \{c_1,c_2, \ldots,c_k\}$;

4.Calculate the classification error rate $e_t = \Sigma_{i=1}^{m} D(i) [y_i \neq h_t (x_i)]$;

5.Ife_t> 0.5 then break

6.Classifier weight $\alpha_t = ½ \ln((1 - et)/et)$;

7.Update sample learning coefficient

$$D_{t+1} (i) = D_t(i)/z_t \times \begin{cases} \exp(-\alpha t), \text{if } y\, i = ht(xi) \\ \exp(-\alpha t), if\ yi \neq ht(xi) \end{cases}$$

8. End

9. Normalized classifier weight $s_t= \alpha t / \Sigma 1T\ ax$;

Output: $H(x) = sign (\Sigma^{T}_{t=1} S_t h_t (x))$

IV. Experimental Results

Proposed model experimental results for the Fabric Fault detection is performed on TILDA databases which are an open access Fabric fault imagefreely available to the scientific and research community. The dataset comprises a collection of different types of fabric faults like slub, stitching, Hole, Rust Strain, wrapper, weft curling.In the fabric defect classification is Multi-Scaling averaging Schema in CNN system the split of data is done by using the average schema which gave the accurate results but if the split of data was done in an even format and the accurate result was weaker. This Average Schema was formed from three different data sets using a full connected unsupervised CNN Classifier with an error rate of 3.24%. In the Proposed model we are using an effective segmentation based Ada Boost Classifier which will automatically select a small set of discriminative features with an accuracy of 97.03% .The figures 1 and 2showed experimental results of detection of fabric faults weft and wrapper and produce optimize accuracy 97.20%

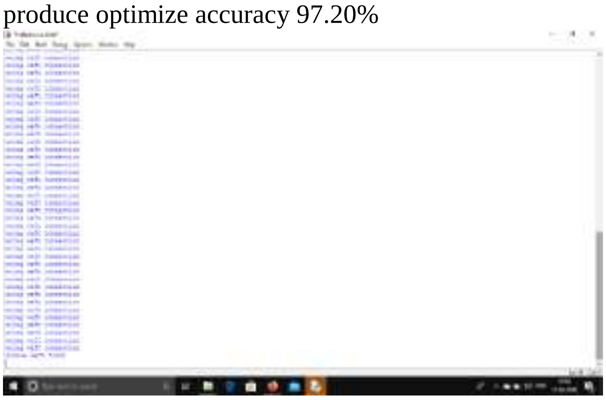


Fig 1 Runtime Experiment result to detection of multiple weft in fabric.

Fig 2 shows the accuracy of proposed model to detect multiple fabric faults.

Table I
Illustrates the experimental results to detect wrap, single and multiple weft fabric fault detection.

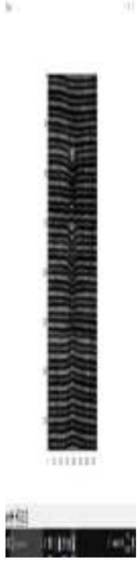
		
Experiment result of detection of Double Weft Fabric Fault	Experiment result of detection of Double Weft Fabric Fault	Experiment result of detection of Wrap Fabric Fault

Table II
Illustrates the performance inform of accuracy of the proposed model to the existing models concerned.

Model	**Author**	**Proposed year**	**Accuracy**
Fabric Defect Detection by Fourier analysis	Chi-Ho Chan, G.K.H. Pang [6]	2019	81%
Defect detection and classification for plain woven fabric based on deep learning	Miao Guan.et.al [1]	2019	80%
computer vision for automatic detection and classification of fabric defect employing deep learning algorthim	PandiaRajanJeyaraj Edward [7]	2019	96.55%
Stochastic Based Deep Convolutional Networks with reconfigurable logic fabric	Mohammed Alawad,Mingjie Lin [8]	2018	86.77%
Fabric Defect Detection based on biological vision modelling	CHUNLEI LI.et al[9]	2018	75.00%

Automatic Fabric Defect Detection with a Multi-Scale convolutional DenoisingAutoencoder Network Model	Shuang Mei, Yudan Wang and Guojun Wen [10]	2018	86%
Automated Patterned Fabric Fault Detection using image procesing technique in matlab	B.Karunamoorthy et.al[2]	2018	95%
Linear flaw detection inwoven textiles using model-based clustering	J.G. Campbell, C. Fraley, F. Murtagh A.E. Raftery [13]	2018	80%
Optimizing Woven Fabric Defect Detection using Image Processing and Fuzzy Logic Method	Ratna Safitri,Tatang [14]	2018	97%
Automatic Detection and Classification of Weaving Fabrics Defects based on Digital Image Processing	Gorbunov Vladimir, IonovEvgen, Naing Lin Aung,[15]	2019	95%
Our proposed Model			**97.20%**

From the table, it is observed that the proposed model has less runtime and better accuracy compared to the traditional models for fabric fault detection using TILDA Data sets.

V. Conclusion

In this paper, Our proposed Ada Boost based CNN with segmentation Fabric defect detection system detects the faults on the fabric which will help for the industrial to improve the better quality of production. Our detection framework is sensitive to texture features and can detect defect regions very quickly. For the extracted defect regions, we normalize and put them into the designed network for training. This innovative way greatly reduces the computational complexity of the network training and improves the detection speed. Finally, the experimental results show that our method has great advantages in comprehensive performance compared with the existing methods. The average detection accuracy with a higher rate of 97.20%, and the single image detection speed was very fast compared to previous algorithms. Of course, this detection framework only has a good effect on the texture features. In the future, we will consider optimizing the framework structure and studying the application of CNN in texture defect segmentation, so that our framework has a larger application further which will help for the textile industrial to improve much better production.

References

[1] Kalavathi P "*Thresholding Method for Color Image Binarization*" Department of computer science and applications, Gandhigram Rural Institute Tamil Nadu India 2014.

Engineering and Electronic Information, China University of Geosciences, Wuhan 430074, China.

[12] Guang-Hua Hu, Guo-Hui Zhang, Qing-Hui Wang "*Automated defect detection in textured materials using wavelet-domain hidden Markov models*" South China University of Technology, School of Mechanical and

[2] Mia Guan, ZhaozhunZhong, YannianRui, HongijingZheng "*Defect detection and classification for plain woven fabric based on deep learning*" The 802 Institute of Shanghai Academy of Space Flight Technology The Eighth Academy of China Aerospace Science and Technology Corporation, Shanghai, China.

[3] B. Karunamoorthy, Dr.DSomasundares, S.P. Sethu "*Automated patterned fabric fault detection using image processing technique in matlab*" Kumaraguru College of Technology, Coimbatore, Tamil Nadu, Department of Electronics and Communication Engineering, SNS College of Technology, Coimbatore Tamil Naidu.

[4] Farida S. Nadaf, NayanaP.Kamble, RohiniB.Gadekar "*Fabric Fault Detection Using Digital Image Processing*" International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169 Volume: 5 Issue: 2

[5] Ajay Kumar "*Defect Detection in Textured Materials using Gabor filters*" IEEE Transacctions on industry applications, Vol 38, No.2, March/April 2002

[6] S. Priya, T. Ashok Kumar, Dr. Varghese Paul " *A Novel Approach to Fabric Defect Detection Using Digital Image Processing*" Asst. Professor Dept of computer science and engineering, Ernakulam, Kerala, India.

[7] Chi-ho Chan, "*Fabric Defect Detection by fourier Analysis*" IEE transaction on industry applications, Vol 36, No.5, September/October 2000.

[8] PandiaRajanJeyaraj and Edward Rajan Samuel Nadar "*Computer vision for automatic detection and classification of fabric defect employing deep learning algorithm*" Department of Electrical and Electronics Engineering, MepcoSchlenk Engineering College, Sivakasi, India.

[9] Mohammed Alawad and Mingjie Lin "*Stochastic Based Deep Convolutional Networks with reconfigurable logic fabric".* Department of Electrical and Computer Engineering, University of Central Florida, Orlando, FL.

[10] Zhoufeng Liu, Baorui Wang, Chunleili, Miao Yu, Shumin Ding "*Fabric Defect Detection based on biological vision*" supported by the National Natural Science Foundation of China.

[11] Shuang Mei, Yudan Wang, Guojun Wen "*Automatic Fabric Defect Detection with a Multi-Scale Convolutional Denoising Autoencoder Network Model*" School of Mechanical

Automotive Engineering, WushanRD,Tianhe District, Guangzhou 510640, China.

[13] Vladimir Gorbunov, VladislavBobkov, Nyan Win Htet, EvgenyIonov "*Automated Control System of Fabrics Parameters that Uses Computer Vision*" National Research University of Electronic Technology (MIET), Zelenograd, Moscow, Russia.

[14] J.G. Campbell, C. Fraley, F. Murtagh, A.F Raftery "*linear flaw detection in woven textiles using model-based clustering*" Signal and Image processing Group, Interactive Systems Center, University of Ulster, Magee College, Londonderry, Norther Ireland.
[15] Ratna Safitri, Tatang Tatang Mulyana "*Optimizing Woven Fabric Defect Detection using Image Processing and Fuzzy Logic Method*" Proceedings of the 2018 International Conference on Industrial Enterprise and System Engineering .
[16] Gorbunov Vladimir, lonov Evgen, Naing Linn Aung "*Automatic Detection and Classification of Weaving Fabrics Defects based on Digital Image Processing*" Department of Corporate Information Technologies and Systems National Research University of Electronic Technology (MIET)
[17] Shalaka Subhash Patil1, Dr.V.T.Gaikwad "*Defect Detection in Fabric using Image Processing Technique*" Student, Department of Electronics & Telecommunication, Sipna College of Engineering and Technology, Amravati, Maharashtra, India..
[18] Wenbin Ouyang, BugaoXu,JueHou, and Xiaohuiyuan, "*Fabric Defect Detection Using Activation Layer Embedded Convolutional Neural Network*" Department of Computer Science and Engineering, University of North Texas, Denton, TX 76203, USA
[19] S.Sahaya Tamil Selvi, Dr.G.M.Nasira "*Effective Segmentation in Plain woven Fabric Defect Detection by using Digital Image Processing*". International Journal of Computer Trends and Technology (IJCTT) V59(1):8-14, May 2018