As per UGC guidelines an electronic bar code is provided to seure your paper

Article

A Fabric Defect Detection Using Computer Vision & Template Matching Method

Swati Khokale [1], Veeksha V. Shetty [2], Hrushikesh S. Chaudhary [3], Pratik S. Sonar [1] and Bhavana R. Bhosale [1]

1 Department of Information Technology, Sandip Institute of Technology and Research Centre, Nashik, India.

* Correspondence: veekshashetty3@gmail.com;

Citation: Swati Khokale; Veeksha V. Shetty; Hrushikesh S. Chaudhary; Pratik S. Sonar and Bhavana R. Bhosale . A Fabric Defect Detection Using Computer Vision & Template Matching Method . *International Journal for Modern Trends in Sceicen and Technology* **2021**, *7*, 7008. https://doi.org/10.46501/IJMTST7008

Academic Editor: Debnath Bhattacharyya

Received: 29 April 2021
Accepted: 2 June 2021
Published: 6 June 2021

Publisher's Note: IJMTST stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract: This system proposes a computer vision-based strategy for the imperfection discovery on pictures with occasional fabrics. In this strategy, a fabric picture is portioned into grids as per variety routineness, and rectification is applied to lessen the impact of misalignment among cross sections. Additionally, deformity free grids are picked for building up a normal format as a uniform reference. Besides, the imperfection identification technique is made out of two stages, specifically, flawed grids finding and deformity shape laying out. Flawed cross sections finding depends on order for imperfection free and inadequate examples, which includes an improved OpenCV strategy with format based amendment and incorporated preparing, while deformity shape plotting gives pixel-level outcomes by limit division. In this paper we likewise present a few trials on texture deformity recognition. Test results show that the proposed technique is viable.

Keywords: Automation; KNN; Fabric; Raspberry Pi; Internet of Things.

1. Introduction

Computer vision and image classification-based models are used in various applied domains including industry-based problems [1–4]. Clothing is considered as one of the basic requirements for human life, and the history of textile industry is as old as human civilization. Fabric is considered as a main element for human clothing and is also used in many industrial products [5–8]. Natural elements such as wool, cotton, a composite of polyester, or nylon can be used to create textile fabric bib9 [8, 9]. Sophisticated machines are used in textile industry to create this fabric, and defects are located through the inspection process. Traditionally, inspection process is completed by using manual human efforts to ensure the quality of fabric [6, 10]. The price of fabric that is sent to the market depends on the number of co-occurrence of defects and price increase with the increase in the number of defects [9, 11, 12]. As a defect is detected, the production process is stopped and the details about the occurred defect are recorded with its location by the machine operator. The main drawbacks associated during manual inspections are as follows: (1) training of individuals is required to make them fabric inspector; (2) major defects can be detected while small defects can be ignored due to human carelessness; (3) lot of human effort is required to locate fabric defects; and (4) it is very difficult for fabric inspectors to keep focus on the production process for a time that is more than 10 minutes and all of this can lead to a low efficiency of production. According to research [3], 60–75% human accuracy is reported to detect fabric defects and the wastage due to fabric defects leads to the high price of product in market.

Due to these reasons, it is recommended to apply some automated processes to detect the fabric production defects and this process can save labor cost. Computer simulations are used for this purpose and textile products are refined through this process and can provide higher inspection quality. Computer vision and digital image processing plays a vital role in textile industry for this inspection process . The inspection of fabric is carried out during the production process that is considered as a real-time application. Automated inspection in textile industry is performed while using computer vision and digital image processing techniques.

According to the published research, more than 70 different possible fabric defects are reported and some common defects are . These defects are caused by different reasons and can be classified as major, minor, or critical defect (depending on the severity of the defects . Some of the frequently occurring major defects are broken pick, ends out, float, holes, stitches, knots, loose threads, starting mark, oil stains and marks, bad selvedge, double pick, snarls, cracks, and smash. Hole is classified as a major defect which is caused by many reasons such as by broken needle or due to defective machine. Oil stain is mainly caused due to excessive oil from the machinery. Multiple netting are minor defects caused when multiple broken threads are combined together. Broken end appears in the fabric when warp yarns break during weaving.

Thick and thin bar defects appear when variations occur in yarn. Broken weft appears when in weaving filling yarn is broken. Wrong weft defect appears when the process weaving does not follow a schematic pattern during weft insertion. There are various categories of fabric defects and many ways to classify them such as common fabric defects or classification based on fabric color. In this article, mostly grayscale fabric defect detection algorithms and classification models are discussed in detail. Most of the computer vision algorithms are designed for grayscale images and use different feature extraction approaches to create discriminative image representations. Other than this, the grayscale image processing can extract descriptors more easily as compared to the color images and the grayscale image processing can reduce the computational complexity. The colored fabric defects have their own importance and detection models for example misarranged warp yarns fabric defects.

2. Literature Survey

1. Yi-Fan Chena , Fu-Sheng Yangb , Eugene Suc , and Chao-Ching Ho, "Automatic Defect Detection System Based on Deep Convolutional Neural Networks" IEEE Transaction on textile Institude,2019. The main purpose of this paper is to identify the scratches within the textured surface with high roughness not easy to observe, even if the error rate of manual detection is not low, Features are too narrow that will disappear after CNN reduces spatial resolution. Our classifier can efficiently solve this problem with the consideration of the feature width compare to the whole image. Using the con-

cat layer can also effectively extract the contour features of the front layer. The deeper learning network architecture is useless without proper information of the features. Therefore, the first step in the application of deep learning technology in automatic optical inspection is to prepare an appropriate dataset. The quality of the dataset depends on the optical design architecture. When the image acquisition of the automated optical inspection system can retain more physical features through the optical architecture, a higher detection accuracy can be achieved.

2.Dr.R.S.Sabeenian,M.E.Paramasivam,P.M.Dinesh ,"Detection and Location of Defects in Handloom Cottage Silk Fabrics Using MRMRFM and MRCSF" The inspection of real fabric defects is particularly challenging due to the large number of fabric defect classes. Fabric defect detection is of great importance for the quality control in the textile industry. It is reported that the price of fabric is reduced by 45%-65% due to the presence of defects, which results in the emergence of intelligent inspection systems to ensure the high quality of products. This paper mainly focuses on detecting various kinds of defects that might be present in a given fabric sample based on the computer vision of the fabric, with more emphasis for silk fabrics.

3 .Dr.R.S.Sabeenian, M.E.Paramasivam, "Defect detection and Identification in Textile Fabrics using Multi Resolution Combined Statistical and spatial Frequency Method", IEEE 2nd International Advance Computing Conference,2010. Automatic fabric inspection is valuable for maintenance of fabric quality. Defect inspection of fabric is a process which accomplished with human visual look-over using semi-automated way but it is labor prone and costly. To reduce time and cost wastage due to defects, the automatic inspection system for defect detection is used for this purpose. Artificial neural network, threshold segmentation, structural, statistical and model based approaches, computer vision method with the consolidation of multi-layer neural networks, are the method to identify the detect defects of fabrics. Empirical outcome spectacles that visualized approach has benefit of greatly analyzing speed, easy utilization, pleasant noise immunity and highly meeting the requirements for automatic fabric defects inspection.

4. Mr.Vaibhav V.Karlekar,"Fabric Defect Detection Using Wavelet Filter", IEEE International Conference,2015.Fabric defect detection is now an active area of research for identifying and resolving problems of textile industry, to enhance the performance and also to maintain the quality of fabric. The traditional system of visual inspection by human beings is extremely time consuming, high on costs as well as not reliable since it is highly error prone. Defect detection classification are the major challenges in defect inspection. Hence in order to overcome these drawbacks, faster and cost effective automatic defect detection is very necessary. Considering these necessities, this paper proposes wavelet filter method. It also explains in detail its various techniques of getting final output like preprocessing, decomposition, thresholding, and noise eliminating.

5. Agilandeswari.V, Anuja.J, Elizabeth Dona George, "Fabric Quality Testing Using Image Processing" IEEE Transaction on textile Institude,2014 The main purpose of this paper is to identify the damaged cloth which may contain defective yarns, colour bleeding, and pores that may be mingled with the good cloth materials at areas such as textile

fabric industries, garments, and weaving factories. Automated defect detection for fabrics based on filters is proposed to manage the problem of human visual inspection. The monitoring process is done by a web camera, to capture the details of the cloth. A pre-trained Gabor wavelet network is used to extract the important texture features in the textile fabric. In this defect detection, few specific filters are used to process each frames of the cloth which is being captured by the web camera.

6.Fabric Fault Detection using Image Processing Method S. L. Bangare, N. B. Dhawas IJARCCE,Vol. 6, Issue 4, April 2017. In textile industry, fabric pre-processing is important to maintain quality of fabric. In modern world most of the fabric preprocessing is still carried out manually using human visual inspection. This process is costly, time consuming and needs more labour work. 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%. Proposed system will find out fault using the technique of segmentation.

7. Textile Fabric Defects Detection and Sorting Using Image Processing,Prof. P. Y. Kumbhar, Tejaswini Mathpati,INTERNATIONAL JOURNAL FOR RESEARCH IN EMERGING SCIENCE AND TECHNOLOGY, VOLUME-3, ISSUE-3, MAR2016. For a long time the fabric defects inspection process is still carried out with human visual inspection, and thus, insufficient and costly.Therefore, automatic fabric defect inspection is required to reduce the cost and time waste caused by defects. The development of fully automated web inspection system requires robust and efficient fabric defect detection algorithms. The detection of local fabric defects is one of the most intriguing problems incomputer vision. Texture analysis plays an important role in the automated visual inspection of texture images to detect their defects. Variousapproaches for fabric defect detection have been proposed in pastand the purpose of this paper is to categorize and describe these algorithms. This paper attempts to present the survey on fabric defect detection techniques, with a comprehensive list of references to some recent.

8. Fabric Defect Detection Using Activation Layer Embedded Convolutional Neural Network, WENBIN OUYANG, BUGAO XU,2169-3536 2019 IEEE. In this paper,a deep-learning algorithm was developed for an on-loom fabric defect inspection system by combining the techniques of image pre-processing, fabric motif determination, candidate defect map generation, and convolutional neural networks (CNNs). A novel pairwise-potential activation layer was introduced to a CNN, leading to high accuracy of defect segmentation on fabrics with intricate features and imbalanced dataset. The average precision and recall of detecting defects in the existing images reached, respectively, over 90and 80% at the pixel level and the accuracy on counting the number of defects from a publicly available dataset exceeded 98%.

9. Automatic Fabric Fault Detection Using Image Processing,Engr.Anum Khowaja,Engr.Dinar. Nadir,2019 13th International Conference on Mathematics, Actuarial Science. Fabric fault detection is very popular topic of automation moreover quality control is one of the important features in textile industry. The performance of the projected idea is evaluated by using different techniques of patterned fabric images with

different types of common fabric defects. Moreover detection methods were also evaluated in real time using a model automation specification system. This research paper will be useful for both researchers and practitioners in the field of image processing and computer vision to understand the uniqueness of the different defect detection methods. The recognition receives a digital fabric image from the image acquisition device and transforms it to a binary image using the restoration and threshold methods. This research presents a technique that decreases physical exertion. This image processing method was performed using "MATLAB 7.10". Therefore, this study uses a textile fault detector with a systematic vision approach for image processing.

10. A Novel Approach to Fabric Defect Detection Using Digital Image Processing,S.Priya ,T. Ashok kumar. This paper presents a novel approach to the fast detection and extraction of fabric defects from the images of textile fabric. Automated visual inspection systems are much needed in the textile industry, especially when the quality control of products in textile industry is a significant problem. In the manual fault detection systems with trained inspectors, very less percentage of the defects are being detected while a real time automatic system can increase this to a maximum number .Thus, automated visual inspection systems play a great role in assessing the quality of textile fabrics. For the detection of fabric defects, we first decompose the image into its bit planes. The lower order bit planes are found to carry important information of the location and shape of defects. Then we find the exact location by means of mathematical morphology

11.. Fabric Defect Detection System Using Stacked Convolutional Denoising AutoEncoders Trained with Synthetic Defect Data, Young-Joo Han and Ha-Jin Yu , These methods are effective but require a large number of actual defect data. However, it is very difficult to get a large amount of actual defect data in industrial areas. To overcome this problem, we propose a method for defect detection using stacked convolutional autoencoders. The autoencoders we proposed are trained by using only non-defect data and synthetic defect data generated by using the characteristics of defect based on the knowledge of the experts. A key advantage of our approach is that actual defect data is not required, and we verified that the performance is comparable to the systems trained using real defect data.

12.. Classification of Fabric Defects Based on Deep Adaptive Transfer Learning, Yang Dafu, 978-1-7281-4094- 0/19 This paper proposes a method based on deep adoptive transfer learning for cloth defects detection. In this paper, collected cloth images are cut, marked to create the datasets, and the image classification method is used to determine the defects of the cloth. The experimental results show that the proposed method has outstanding performance on classifying the cloth defects. The classification accuracy of 95.53% and 93.82% is achieved on the InceptionV3 and DenseNet121 transfer learning models respectively. By feature learning heat map of samples, it verifies that the models have strong learning ability and generalization ability for the characteristics of the cloth defects.

13. Tajeripour et al. used local binary compression (LBP) to detect defects in fabric. In this work, a training phase was first performed by applying the B-slide to the non-disabled tissue image. The disadvantages are found in the new image using the correct level. However, the convenience of these methods is restricted to uniform (non-patterned) textures. Chan and Pang used Fourier analysis to detect defects in the gray images .

14. Kumar and Pang used a variety of filters that controlled and trained to detect defects in textured materials. However, the Gore technique usually requires a lot of computation, while the integration of different channels is still an open question.

15. Recently, Nan et al. used wavelet transforms to detect gaps in patterned textures. This method can detect defects for different types of textures. However, it does use a sensitivity level that is manually locked. More recently, used independent finite element analysis (IRA) to detect block-level errors in texture images. This method works best with uniform gray level texture. However, this does not summarize the model with good texture and many disadvantages are not found in this method.

3. Proposed System

In this we use the Raspberry pi model for interfacing of whole system. The DC motor is used is to drive the conveyor belt. DC motor is driven by the motor driver. The +5V and +12 V supply is given to the Motor driver.

The motor driver is interfaced with Raspberry pi's GPIO pins. The camera is used to acquire images of fabrics.This camera is interfaced with the GPIO 1 GPIO 2 of Raspberry pi. Raspberry pi has built in port for camera interfacing. After getting the image of faulty fabric by camera the motor driver stops running.

Thus DC motor also stops and conveyor belt too. After detection of fault it gets classified by classier. The buzzer or LED can be used to inform the user about occurrence of the fault. The buzzer or LED is also interfaced with the Raspberry pi. We are using Raspberry pi tool as the interfacing is easy with this system.

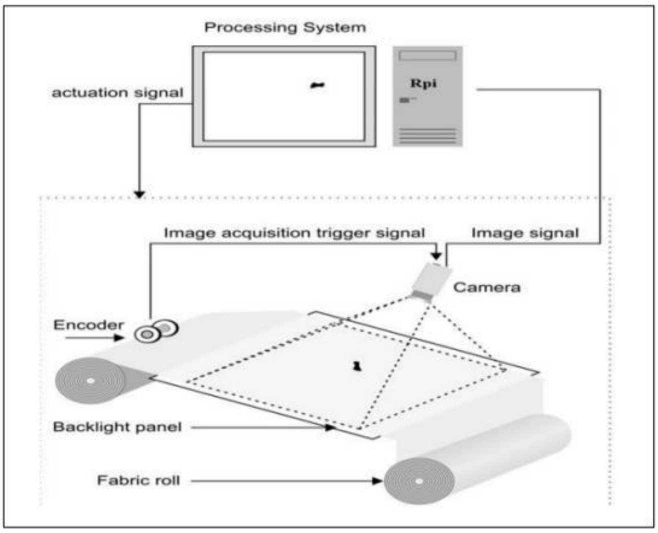

Fig. System Architecture

4. System Modules

1. Fabric roller In this module we built the roller for move the cloth from top to bottom. For this we use two dc motors. When we start the system the roller will start moving the cloth from top to bottom. DC motors are used to move the fabric on the roller. The dc motors are connected to the Ardiuno Microcontroller. This will control the fabric movement on roller.

2. Image filtration and fault detection When the camera detect the fault on the fabric. It will capture the picture of that particular frame so it will easily detect the fault and show the exact location where the fault actually detected. This fault will be denoted by the red or green marker.

3. Video capture

In this module we start the recording the video of the cloth. When the roller starts the camera will record the video so that the fault will be recorded. The high quality camera is connected to the Raspberry pie. The camera will capture the images of moving fabrics.

4. Alert notification and image storage When the system detects the fault on the fabric the user will be notified by the alert sound or beep as well as the automated mail will be sent to the user. After the alert notification the particular video frame or image will be get stored in the storage that will be used for future to user.

5. Conclusion

We proposed a new fabric defect detection system which can deal with various types of fabrics. Our method does directly use the original image as input. Instead. Our algorithm achieved an average accuracy of 90% for results, which can achieve accurate detection of common defects in yarn-dyed fabric, such as Thin Bar, Scratch, Knots, Stain, and Holes. Compared with traditional shallow learning approaches, the experimental results demonstrate that our proposed method can effectively learn defect features by adaptively adjusting the parameters. In addition, our method can improve efficiency, shortening the time of obtaining an accurate defect image. In the future, we will focus on two directions of research. One direction involves the defect segmentation. The other direction is to automate the period of the texture process using deep learning methods.

References

1. Eugene Su, Yuan-Wei You and Chao-Ching Ho, ”Machine Vision and Deep Learning Based Defect Inspection System for Cylindrical Metallic Surface”, *Instruments Today 2018 Q2 Artificial Intelligent*, ISSN: 1019-5440, page 46-58
2. Xian Tao , Dapeng Zhang, Wenzhi Ma, Xilong Liu and De Xu, “Automatic Metallic Surface Defect Detection and Recognition with Convolutional Neural Networks”, Appl. Sci. 2018, 8, 1575
3. Young-Jin CHA, Wooram CHOI, Oral “Deep learning-based crack damage detection using convolutional neural networks ”. Computer-Aided Civil and Infrastructure Engineering, 2017, 32.5: 361-378.
4. K. He, X. Zhang, S. Ren, J. Sun, “Deep Residual Learning for Image Recognition”, *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2016.
5. Szegedy, V. Vanhoucke, S. Ioffe, “Rethinking the Inception Architec- ture for Computer Vision,” IEEE Conference on Computer Vision and Pattern Recognition, 2016, PP. 2818–2826.
6. K. He, X. Zhang, S. Ren, “Deep Residual Learning for Image Recog- nition,” 2015.
7. Mahure, Jagruti, and Y. C. Kulkarni. "Fabric faults processing: perfections and imperfections." International Journal of Computer Networking, Wireless and Mobile Communications (IJCNWMC) 1.4 (2014): 101-106.

8. K. Simonyan, A. Zisserman, "Very Deep Convolutional Networks for Large-Scale Image Recognition," Computer Science, 2014.
9. Alex KRIZHEVSKY, Ilya SUTSKEVER, Geoffrey E. HINTON. "Imagenet classification with deep convolutional neural networks". In: *Advances in neural information processing systems*. 2012. p. 1097-1105.
10. A. Kumar, "Computer-Vision-Based Fabric Defect Detection: A Survey," IEEE Transactions on Industrial Electronics, 2008, PP. 348–363.
11. GonzalezR. C., &WoodsR. E. (2002). Digital Image Processing, 2nd Ed. Upper Saddle River, N.J.
12. T. S. Newman and A. K. Jain, "A survey of automated visual inspection," Computer Vision Image Understanding, vol. 61, no. 2, pp. 231–262, Mar. 1995.
13. A. D. H. Thomas, M. G. Rodd, J. D. Holt, and C. J. Neill, "Real-time industrial inspection: A review," RealTime Imaging, vol. 1, no. 2, pp. 139–158, Jun. 1995.
14. I.-S. Tsai, C.-H. Lin, and J.-J. Lin, "Applying an artificial neural network to pattern recognition in fabric defects," Textile Research Journal, vol. 65, no. 3, pp. 123–130, 1995.
15. X. F. Zhang and R. R. Bresee, "Fabric defect detection and classification using image analysis," Textile Research Journal, vol. 65, no. 1, pp. 1–9, 1995.