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ABSTRACT

This paper discussed an automated system for detecting fabric defects, which is a state-of-the-art solution to the problems associated with manual fabric inspection in the textile industry. The need for automated, dependable, and efficient quality control systems is increasing in tandem with the ongoing transformation of production processes. Traditional manual inspection methods are laborious and subjective, which leads to uneven defect detection. Defect identification is inconsistent due to the subjective nature and lengthy processing times of traditional hand inspection methods. Using sophisticated algorithms, the system initially examines high-resolution pictures of fabric samples in order to optimize characteristics and minimize variations in lighting and fabric textures. Using the ResNet architectures, the two CNN models created in this work had average accuracies of 89.84% and 93.45%, respectively, indicating statistically significant findings.

1. Introduction

The textile sector, which is experiencing a tremendous improvement in technology, is always looking for new and creative ways to improve manufacturing methods and guarantee the highest standards of quality. In this field, identifying and categorizing fabric defects is a crucial component of quality control. Conventional manual inspection techniques take a lot of time and are vulnerable to subjectivity, which makes it difficult to consistently find defects. In order to address these issues, this paper proposes Automated Fabric Defect Detection. This uses a combination of cutting-edge machine learning techniques to assess high-resolution fabric photos and automatically and reliably identify defects. Finding flaws such as holes, stains, or strange patterns helps keep defective products out of consumers' hands, cutting waste and preserving brand reputation. Comparing automated systems to manual inspection, efficiency and accuracy are also increased.

2. Methodology

2.1. Acquisition of Dataset:

To train and validate the AFDDS, a varied dataset of high-resolution fabric photographs was assembled. The dataset represented real-world production settings by including a range of fabric types, fault types, and severities.

2.2. Data Pre-processing

Extensive pre-processing approaches were used to improve the consistency and quality of the dataset before training the model. To account for differences in lighting, fabric textures, and defect sizes, this involved normalization, scaling, and augmentation. Moreover, noise reduction techniques were used to guarantee a clean input for further examination.

2.3. CNN Architecture Design

The intricate nature of fabric flaw identification was carefully taken into account when designing the Convolutional Neural Network (CNN) architecture. Several convolutional layers were used in the model to extract hierarchical features, and then densely linked layers were added to effectively classify defects. Iterative experimentation was used to tune hyperparameters while taking filter sizes, dropout rates, and learning rates into account.

2.4. Defect Categorization

The Automated Fabric Defect Detection uses a complex multi-label classification method for defect categorization. After accurately identifying fabric faults, the Convolutional Neural Network (CNN) further differentiates and classifies them according to their nature and severity. By offering in- depth insights into the type and significance of detected flaws, this nuanced classification enhances the system's output and makes a more thorough quality control evaluation possible. A significant factor in the AFDD's value in the textile manufacturing sector is its defect classification capability. It enables targeted responses to various defect types and supports the formulation of well-informed decisions for both production optimization and quality enhancement.

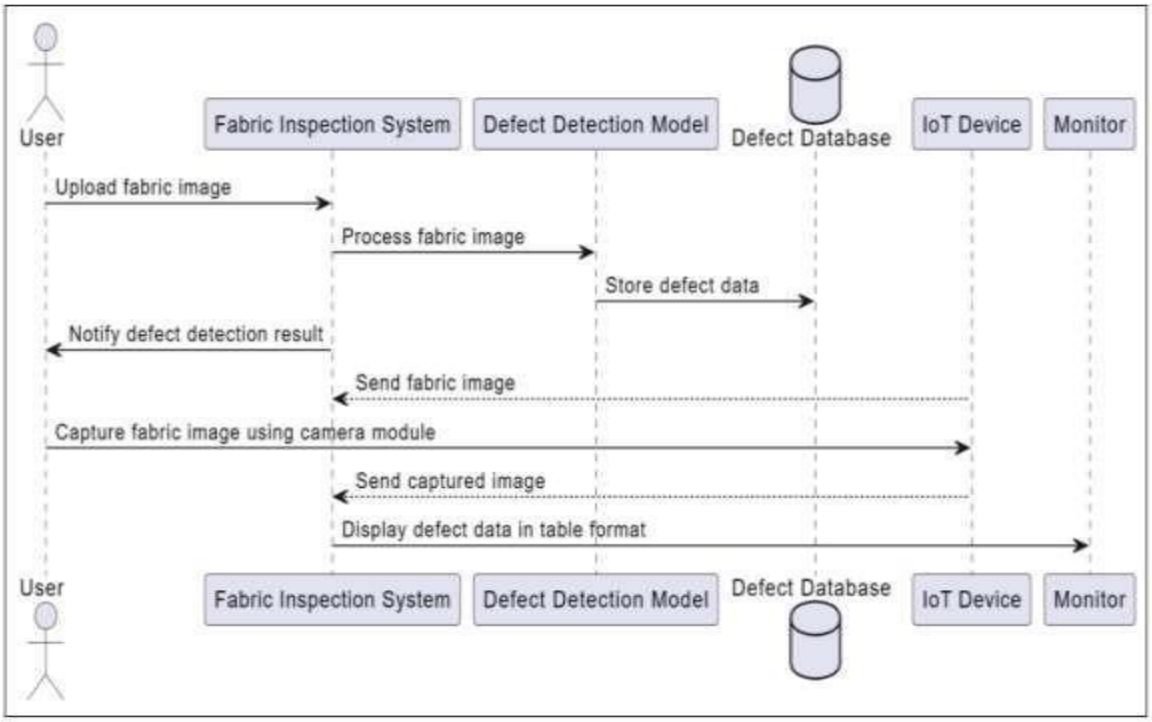

Fig 1. Sequence Diagram

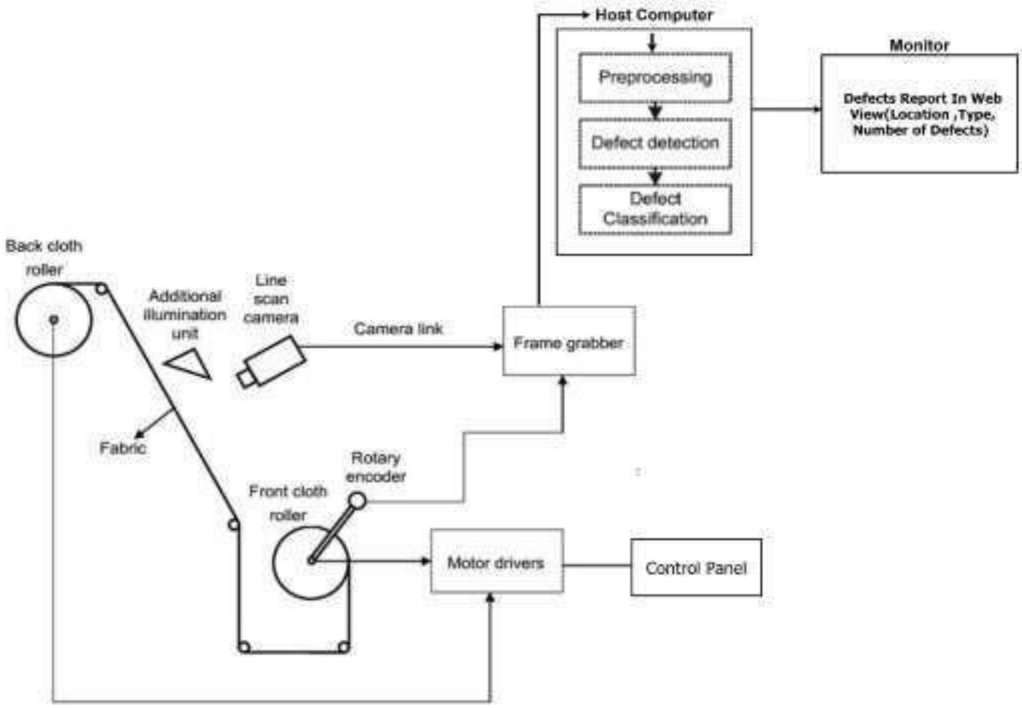

Fig 2. Architecture Diagram

3. Results

3.1. Performance Metrics

Across a range of assessment parameters, the Automated Fabric Defect Detection showed strong performance. These included the metrics that are frequently used to assess the efficacy of defect detection systems.

3.2. Accuracy

It was determined that the Automated Fabric Defect Detection overall accuracy in identifying fabric flaws was 89.87%. This metric shows how well the system identified faulty regions in fabric samples when compared to ground truth annotations.

3.3. Comparative Analysis

Comparative analysis reveals that the Automated Fabric Defect Detection is faster and more accurate than standard manual inspection techniques. Defect identification by the system was consistently faster than by manual inspection, saving a great deal of time for quality control withoutsacrificing accuracy. The aforementioned comparison highlights the potential of the AFDD to transform the methods in the textile sector to identify flaws in the cloth.

Fig 3.User Interface

Fig 4. UI after detecting the defected area

4. Conclusions

An innovative method that revolutionizes quality control in the textile manufacturing sector is Fabric Defect Detection Process Automation. By combining computer vision and machine learning technologies in a seamless manner, the AFDD has demonstrated remarkable accuracy in recognizing and classifying fabric defects, outperforming manual inspection techniques. It greatly improves our understanding of the manufacturing process by offering nuanced insights into defect types and severities. This enables focused interventions and optimizations.

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