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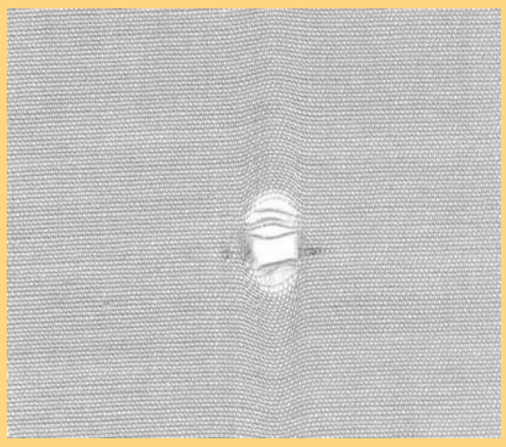
Comparative Performance Evaluation of ResNet and Innovative Feedforward Neural Network for Synthetic Fiber Defect Detection in Textiles

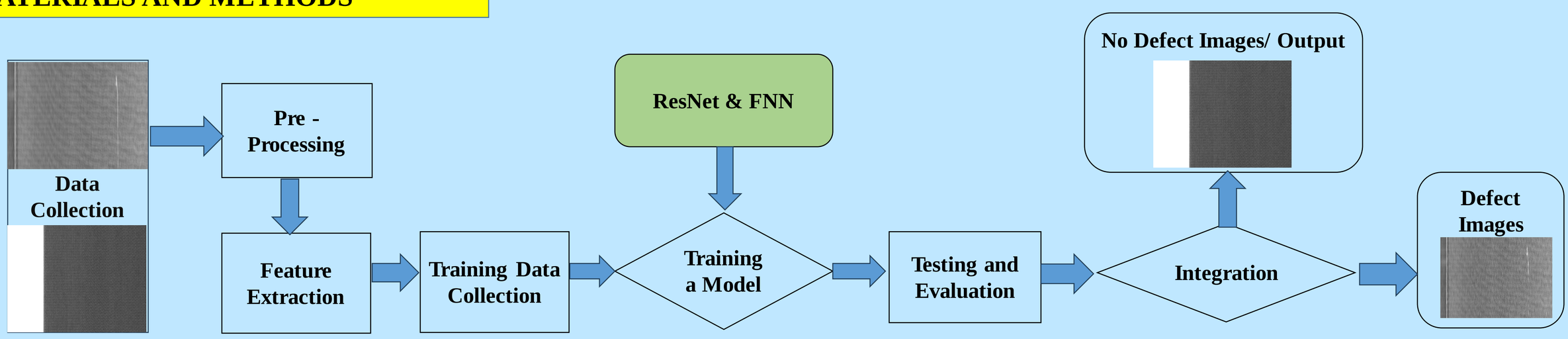
INTRODUCTION

- Detecting flaws in the production of synthetic fibers is of utmost importance as it has the potential to minimize financial losses in the textile manufacturing industry.
- These flaws encompass a range of issues, including broken ends, dimensional variations, torn yarn, holes, areas of varying thickness, broken picks, warped balls, cracked wefts, and knots.
- Detecting flaws in synthetic fiber production can not only reduce financial losses but also significantly contribute to reducing waste and promoting sustainability in the textile manufacturing industry.
- By identifying and addressing defects early during the production process, manufacturers can decrease the amount of synthetic material that is discarded or recycled, ultimately reducing the overall environmental impact of synthetic fiber production.
- Within this research, a comparison is made between the ResNet algorithm and a Feedforward Neural Network (FNN) in order to enhance performance and accuracy by elevating the quality of textiles during the manufacturing process.
- ResNet algorithm for synthetic fiber defect detection in textiles has it's depth facilitates in the identification of complex patterns in the data. This allows it to identify subtle defects that may go unnoticed by other methods.
- Feedforward Neural Network (FNN) has its computational efficiency. It is particularly useful in cases where the available hardware or computational resources are limited, allowing for quick and accurate detection of flaws in the synthetic fiber production process.



Synthetic Fiber Defects In Textiles

MATERIALS AND METHODS



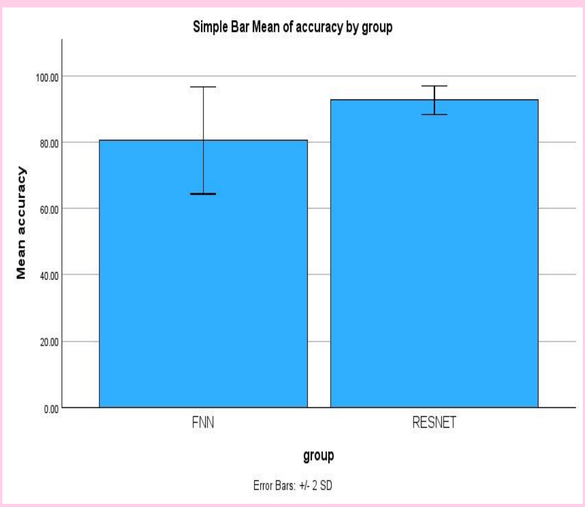
Synthetic Fiber Defect Detection In Textiles

RESULTS

- The ResNet model achieved a high accuracy rate of 92.73% in synthetic fiber defect detection, highlighting its effective utilization of neighboring data points.
- ResNet's robust performance underscores its suitability for the task, as it can adapt well to various patterns in the dataset without relying on assumptions about data distribution.
- In contrast, the Feedforward Neural Network (FNN) model showed a lower accuracy than ResNet with 80.51% in defect identification.
- FNN has limited ability in capturing and extracting high-level features from complex and large-scale datasets and it may struggle to learn intricate representations.

Table presents Statistical Computation Values of Algorithms

Group Statistics					
	Group	N	Mean	Std. Deviation	Std. Error Mean
ACCURACy	ResNet	20	92.7380	2.14472	0.67822
	FNN	20	80.5190	8.04828	2.54509



Accuracy Comparison between FNN and ResNet

DISCUSSION AND CONCLUSION

- The T-test analysis revealed a significant difference (p=0.043) between the detection accuracy of Group 1 and Group 2. This implies that there is a statistically significant variation in performance between the two groups.
- The FNN algorithm demonstrated an average detection accuracy of 8.04% ± SD. This suggests that the performance of the FNN algorithm in synthetic fiber defect detection was moderate.
- On the other hand, the ResNet algorithm achieved an average accuracy of 2.14% ± SD. This indicates that the ResNet algorithm outperformed the FNN algorithm in detecting synthetic fiber defects.
- The lower accuracy of the FNN algorithm highlights the importance of considering alternative models, such as ResNet, for improved performance in synthetic fiber defect detection. This suggests that ResNet can offer a more practical and effective approach to detecting and classifying defects in synthetic fiber production.
- The significant difference in accuracy between the two algorithms underscores the superiority of ResNet in synthetic fiber defect detection. Its ability to handle complex patterns and variations makes it a more reliable and practical choice for implementation in the textile industry.
- Based on these findings, it can be concluded that ResNet is a better choice for accurate and efficient detection of defects in synthetic fiber production. Implementing ResNet can lead to improved product quality, reduced financial losses, and enhanced customer satisfaction in the textile industry.

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