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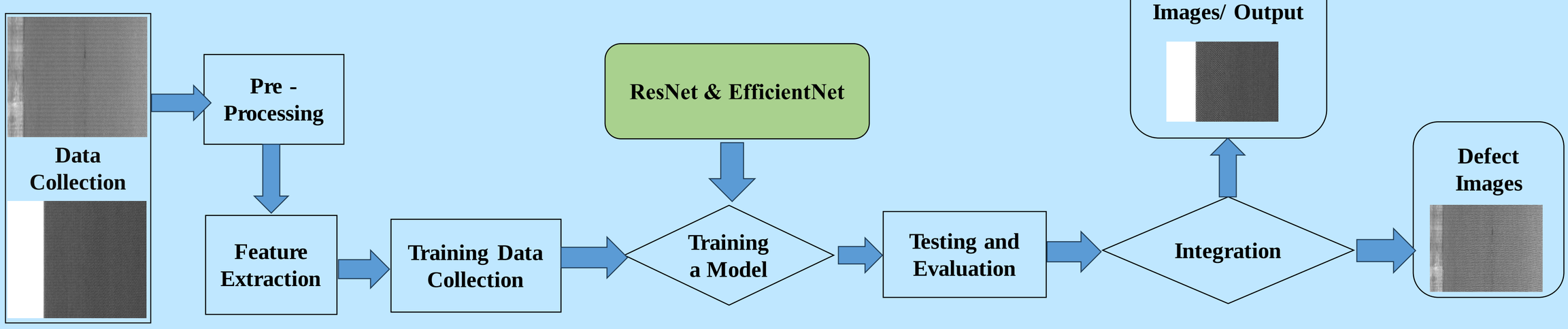
Analysis and Performance of ResNet to Detect Synthetic Fiber Defects in Textiles in Comparison with EfficientNet

INTRODUCTION

- Defect detection in synthetic fiber production, potentially reducing financial losses associated with flawed processes in textile manufacturing by identifying defects such as: “broken end, dimensional irregularities, broken yarn, hole, thin bar, thick bar, broken pick, warp ball, weft crack, nep, and knots.”
- The aim of this research is to improve the quality of textiles in manufacturing for customer satisfaction by enhancing the effectiveness of synthetic fiber defect detection.
- In this research , ResNet algorithm is compared with EfficientNet to enhance better performance and accuracy and can be attributed to its advanced feature extraction capabilities and deeper architecture, enabling it to effectively identify synthetic fiber defects.
- These techniques are implemented in textile manufacturing companies to reduce defects in textiles and to produce the fabrics with high quality. EfficientNet makes use of residual connections to increase its depth, while ResNet focuses on compound scaling to increase both depth and width of the model in a balanced way.
- The implementation of advanced defect detection algorithms like ResNet and EfficientNet in textile manufacturing will not only improve the quality of textiles but also lead to a reduction in manufacturing costs.
- By identifying and rectifying defects earlier in the manufacturing process, companies can avoid the expenses associated with faulty products, thereby increasing their overall profitability.

Synthetic Fiber Defects In Textiles

MATERIALS AND METHODS



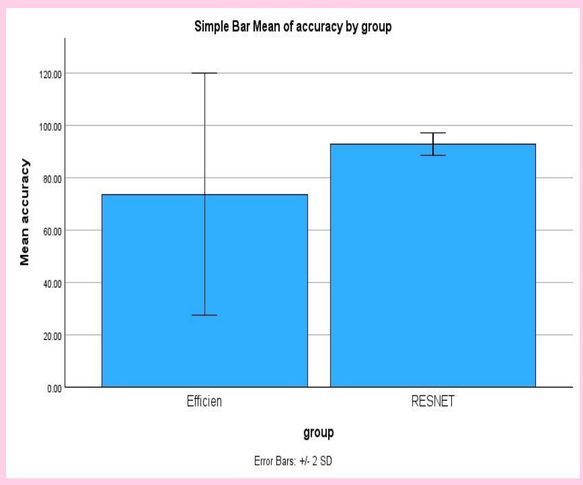
Synthetic Fiber Defect Detection In Textiles

RESULTS

- In contrast, EfficientNet faces challenges in generalizing across different fabric types and requires a considerable amount of labeled data, which can hinder its practical deployment in defect detection within the textile industry.
- This disparity highlights the superior predictive capability of the ResNet approach, emphasizing its efficacy as a reliable tool for accurate detection and classification in the context of synthetic fiber defect detection.
- The research suggests that ResNet can be a cost-effective solution as it can provide accurate detection and classification even on a limited amount of labeled data.
- ResNet performs better than EfficientNet in terms of accuracy, ResNet demonstrates its suitability and applicability in identifying synthetic fiber defects, providing reliable insights for the textile industry.

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
	EfficientNet	20	73.6420	23.12153	7.31167



Accuracy Comparison between EfficientNet and ResNet

DISCUSSION AND CONCLUSION

- A statistical analysis was conducted to compare the performance of ResNet and EfficientNet algorithms in synthetic fiber defect detection, using a T-test with a confidence level of 95%.
- The results of the analysis revealed that there is a significant difference in prediction accuracy between ResNet and EfficientNet algorithms with 0.011 ($p < 0.05$).
- ResNet was found to have a superior performance in detecting synthetic fiber defects, achieving an accuracy rate of 92.73%. On the contrary, EfficientNet exhibited a comparatively lower prediction accuracy rate of 73.64%.
- Further, a graphical representation was created to compare the prediction accuracy between the two algorithms. The graphical representation illustrated a significant difference in their performance.
- The analysis results suggest that the performance difference between ResNet and EfficientNet is not entirely attributable to the algorithms themselves, but also influenced by the characteristics and distribution of the dataset used for analysis.
- Overall, the study found that ResNet algorithm is a highly effective method for detecting synthetic fiber defects and can potentially lead to improved product quality and reduced financial losses in the textile industry compared to EfficientNet algorithm, which could face challenges concerning generalization and practical deployment.

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