Predicting Faulty Tires Using Deep Learning and Traditional Machine Learning

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Introduction

In this project, we aim to predict faulty tires in manufacturing processes using deep learning and traditional machine learning techniques. The quality of tires is crucial for safety and performance in vehicles, making accurate detection of defects essential.

Design Choices

We utilized a dataset comprising images of good and defective tires sourced from a manufacturing facility. The dataset was split into training and validation sets using an 80-20 split.

For our deep learning model, we designed a Convolutional Neural Network (CNN) with two convolutional layers followed by max pooling layers, flattening, and dense layers with dropout for regularization. The output layer uses a sigmoid activation function to classify images as either 'good' or 'faulty'.

In addition to the CNN, we implemented traditional machine learning models: Logistic Regression, Decision Tree Classifier, and Random Forest Classifier to compare their performance against the CNN model.

Performance Evaluation

The CNN model achieved a validation accuracy of 0.67% after training for 10 epochs. The following results were obtained for traditional models:

- Logistic Regression: 0.62%

- Decision Tree: 0.65%

- Random Forest: 0.74%

The CNN outperformed traditional models due to its ability to learn complex patterns in image data.

Future Work

Future work could focus on:

- Increasing the size of the dataset to improve model robustness.

- Implementing data augmentation techniques to enhance training data variability.

- Exploring transfer learning with pre-trained models like VGG16 or ResNet for potentially better performance.

- Developing a user-friendly application for real-time tire defect detection.

Conclusion

This project demonstrates the effectiveness of deep learning techniques in detecting faulty tires compared to traditional machine learning methods. The findings underscore the importance of leveraging advanced technologies in quality control processes within manufacturing industries.