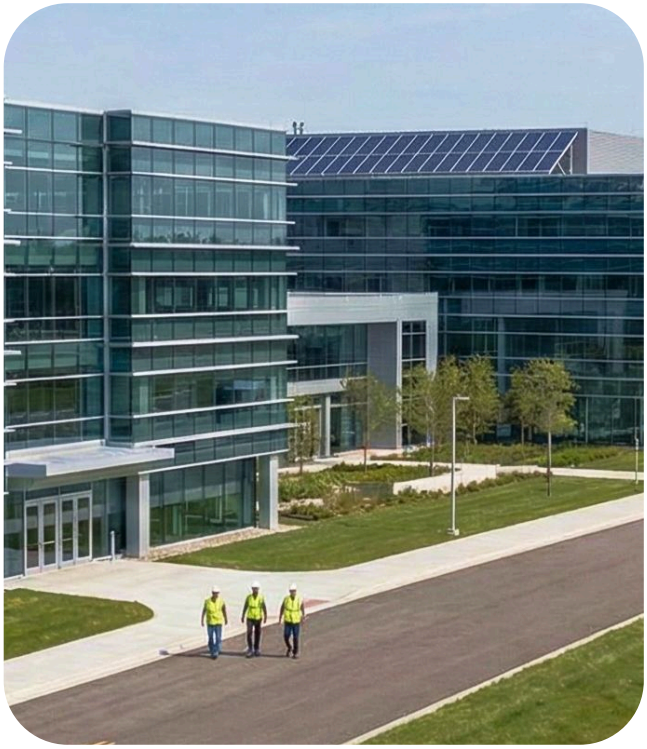
QBurst | A High AI-Q™ Company

AI-Powered Tire Inspection System

Automating tread depth inspection with deep learning to improve accuracy, speed, and vehicle safety.

Overview

- Designed a deep learning-based system to automate tire tread depth measurement via mobile image capture.
- Implemented a multi-stage CNN model for tire surface detection, groove segmentation, and depth estimation.
- Delivered ±1.5 mm depth accuracy on 90% of test images, reducing manual effort and warranty claims.



Client Profile

The client is the research and development center for the world's largest manufacturer of premium and commercial vehicles. Based in Germany, the center focuses on cutting-edge innovations in automotive safety, engineering, and digital transformation, with a mission to improve vehicle performance, quality, and customer experience.

Challenges: Quality Control Bottlenecks

- Manual inspections were slow, labor-intensive, and prone to inconsistencies.
- Lack of automated tools for capturing accurate depth measurements using mobile devices.
- Inability to standardize quality checks across tire types, patterns, and lighting conditions.
- Dependence on specialized equipment and operator expertise.

QBurst Solution in Automotive Diagnostics

QBurst developed a multi-stage deep learning solution to automate tire tread depth analysis using image data captured from mobile devices. The system leveraged Convolutional Neural Networks (CNNs) to detect edges, segment tread patterns, and predict depth with high precision. Built using AI frameworksTensorFlow and PyTorch, and powered by NumPy for numerical operations, the models delivered consistent performance across a wide range of tire types and imaging conditions. The solution comprised:

- **Tire Mask Model:** Identified tire boundaries to isolate relevant image areas.
- **Groove Mask Model:** Segmented tread grooves from the tire surface.
- **Groove Depth Model:** Predicted groove depth using relative depth maps generated from the previous stages.

Trained on a dataset of over 50,000 diverse images, the model delivered consistently accurate results across various conditions.

Technical Highlights

- Custom CNN architecture combining UNet and DenseNet for depth estimation
- Monocular image-based depth prediction at millimeter-level accuracy
- Multi-stage pipeline for segmentation and regression modeling
- APIs to auto-reject poor-quality images (e.g., low tire visibility, lighting issues)
- Designed for mobile-based image acquisition and cloud-based processing

Measurable Impact

- 66% improvement in inspection accuracy, significantly reducing defect rates
- Reduced warranty claims through early detection of tire wear

- Automated inspection workflows, cutting down manual labor and operational delays
- Improved vehicle safety via consistent, data-driven quality checks
- No specialized training required, enabling easy adoption in factory settings