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VibeCheck: AI-Powered Motor Quality Control

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Machine Learning & AI | Industrial Automation


Motor Testing System

For a hidden champion of gear motors and drive technology, Motius developed VibeCheck - an intelligent acoustic testing system that transforms manual motor quality control into automated AI-driven defect detection, achieving breakthrough accuracy in identifying gear damage and bearing faults.

This demonstrates how technical fabric manufacturers like Koenig & Bauer can implement advanced predictive maintenance solutions to enhance quality control and reduce manufacturing defects.

The Challenge

This leading manufacturer operates 21 quality control cells in continuous two-shift operation, where skilled workers manually assess each electric motor for acoustic anomalies. This process faced several critical limitations:

- **Manual dependency**: Quality assessment relied entirely on human expertise and subjective judgment
- **Scalability constraints**: Worker availability limited testing capacity and consistency
- **Detection variability**: Different operators might classify the same motor differently
- **False negative risk**: Undetected defects could reach customers, causing field failures

The company needed to maintain their rigorous quality standards while eliminating the bottlenecks and inconsistencies of manual testing.

Technical Innovation

Sensor Technology Development

Motius developed and validated interchangeable sensor solutions:

- **3-axis body sound microphone**: Primary contact-based vibration sensor for precise defect detection
- **Laser vibrometry validation**: Proven as interchangeable alternative enabling full automation
- **Non-contact measurement**: Laser system allows motors on AGVs to be tested without manual sensor placement
- **Inverter data integration**: Correlating electrical parameters with mechanical defects

Advanced Signal Processing

The system processes complex acoustic signatures to identify:

- **Gear tooth damage**: Detecting scratches and meshing irregularities (2.5-3% defect rate)
- **Bearing faults**: Identifying grinding and clacking anomalies
- **Brake malfunctions**: Recognizing dragging and chattering sounds
- **Excessive vibrations**: Measuring amplitude deviations beyond tolerance

Machine Learning Classification

A specialized ML pipeline was developed featuring:

- **Vibration pattern analysis**: Processing 3-axis sensor data to identify defect signatures
- **Edge deployment**: Real-time inference on industrial-grade single-board computers
- **LabVIEW integration**: Seamless workflow integration with existing testing infrastructure
- **Continuous learning**: Model refinement based on operator feedback and rework data

Implementation Results

Performance Metrics

- **>90% accuracy** in OK/Not OK classification
- **Optimized false negative minimization** to prevent defective units reaching customers
- **Real-time processing** with <2 second classification response
- **100% integration** with existing LabVIEW testing framework

Operational Impact

- **Eliminated subjective variability** in quality assessment
- **Enabled full automation pathway** with laser vibrometer deployment on AGV systems
- **Reduced manual intervention** to only motor connection, with future automation planned
- **Enhanced defect localization** identifying specific gear stages and bearing positions
- **Streamlined workflow** allowing continuous testing without worker positioning sensors

Technical Architecture

- **Edge computing deployment** for real-time inference without cloud dependency
- **RESTful API integration** enabling seamless LabVIEW communication
- **Interchangeable sensor technology** supporting both contact and non-contact measurement
- **AGV-compatible laser system** enabling fully automated testing workflows
- **Scalable infrastructure** ready for deployment across all 21 quality cells

Strategic Value for Technical Fabrics

This project demonstrates critical capabilities relevant to Koenig & Bauer's manufacturing excellence:

Quality Control Innovation

Advanced AI systems can transform manual inspection processes, delivering consistent quality assessment across complex manufacturing operations.

Predictive Maintenance Integration

Multi-sensor data fusion enables early detection of equipment degradation, preventing costly failures and optimizing maintenance schedules.

Manufacturing Intelligence

Real-time defect classification provides immediate feedback loops, enabling rapid process adjustments and continuous improvement.

Scalable Automation

Edge-deployed AI solutions deliver enterprise-grade performance while maintaining data sovereignty and operational independence.

Technical Fabric Applications

The VibeCheck methodology directly applies to Koenig & Bauer's operations:

- **Weaving machine monitoring**: Acoustic detection of loom irregularities and tension variations
- **Fabric quality assessment**: AI-powered defect identification in textile production lines
- **Equipment health monitoring**: Predictive maintenance for industrial weaving and finishing equipment
- **Process optimization**: Real-time feedback systems for maintaining consistent fabric specifications

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Project developed in partnership with a leading drive technology manufacturer's innovation team, demonstrating Motius's expertise in industrial AI and predictive maintenance solutions.