Performance Evaluation of AI Models for Monitoring Automotive Component Traceability Data

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Abstract. In the era of Industry 4.0 and smart manufacturing, ensuring the accurate traceability of automotive electronic components has become a central challenge for maintaining quality, compliance, and operational efficiency. This study conducts a comparative evaluation of three unsupervised artificial intelligence models Isolation Forest, One-Class Support Vector Machine (SVM), and Autoencoder for anomaly detection within IoT-enabled traceability systems. To this end, a simulated production environment was developed to replicate an automotive upstream supply chain, integrating IoT technologies such as RFID sensors, barcode readers, and real-time tracking systems. To mimic realistic industrial disruptions, controlled anomalies including sequence breaks, duplicate scans, and batch misallocations were systematically injected into the dataset. Experimental results demonstrate that the Autoencoder achieves the highest recall rate (85%), making it particularly suitable for contexts requiring exhaustive anomaly detection, while the Isolation Forest delivers the highest precision (85%), minimizing false positives in high-throughput environments. These findings underscore the trade-offs between sensitivity and accuracy, providing actionable insights into selecting the most appropriate model based on industrial priorities, and paving the way for the deployment of AI-driven monitoring solutions in real-world IoT-based traceability systems.

Keywords: Traceability, Automotive Supply Chain, Internet of Things (IoT), Artificial Intelligence (AI).