

# Non-Intrusive Motorcycle Engine Fault Diagnosis Using LSTM Network and Spectrogram-Based Audio Analysis

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Addressing the pressing need for motorcycle maintenance services in Sri Lanka, this study introduces a fault diagnostic system aimed at swiftly and accurately identifying various engine faults, including tappet issues, rod malfunctions, and timing chain problems. Utilizing advanced signal processing and machine learning techniques, the system conducts non-intrusive diagnosis analysis of engine sounds, enabling early detection of potential issues. By employing Mel-frequency cepstral coefficients (MFCCs) for resilient noise signal processing and implementing a Long Short-Term Memory (LSTM) neural network trained on a diverse dataset, the system demonstrates robustness and adaptability to real-world conditions. Bridging the domains of audio classification and fault detection, the research introduces a novel approach leveraging computer vision techniques on spectrograms for efficient sound analysis and fault detection. The developed model demonstrated exceptional performance, achieving an accuracy rate of 91% in diagnosing engine faults. Emphasizing the critical role of early detection of faults in mitigating risks, reducing maintenance expenses, and minimizing operational downtime, this study improves diagnostic accuracy, enabling early detection of engine faults and supporting better maintenance and reliability of motorcycle engines.

**Keywords:** fault diagnostic system, non-intrusive diagnosis, machine learning, MFCCs-LSTM, audio classification.