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## Pattern Recognition based On-line Vibration Monitoring System for Fault Diagnosis of Automobile Gearbox

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### Abstract:

Gearbox is an important equipment in an automobile to transfer power from the engine to the wheels with various speed ratios. The maintenance of the gearbox is a top criterion as it is prone to a number of failures like tooth breakage, bearing cracks, etc. Techniques like vibration monitoring have been implemented for the fault diagnosis of the gearbox over the years. But, the experiments are usually conducted in lab environment where the actual conditions are simulated using setup consisting of an electric motor, dynamometer, etc. This work reports the feasibility of performing vibrational monitoring in real world conditions, i.e. by running the vehicle on road and performing the analysis. The data was acquired for the various conditions of the gearbox and features were extracted from the time-domain data and a decision tree was trained for the time-domain analysis. Fast Fourier Transform was performed to obtain the frequency domain which was divided into segments of equal size and the area covered by the data in each segment was calculated for every segment to train decision trees. The classification efficiencies of the decision trees were obtained and in an attempt to improve the classification efficiencies, the time-domain and frequency-domain analysis was also performed on the normalised time-domain data. From, the results obtained, it was found that performing time-domain analysis on normalised data had a higher efficiency when compared with the other methods. Instantaneous processing of the acquired data from the accelerometer enables faster diagnosis. Hence, online condition monitoring has gained importance with the advent of powerful microprocessors. A windows application that has been developed to automate the process was found to be essential and accurate.

**Keywords:** vibration monitoring; automobile gearbox; pattern recognition; on-road; real-time; time-domain; frequency-domain.

### 1. Introduction:

Automobiles have become an important entity in our day to day life owing to the fast-paced world. The gearbox in the automobile plays the vital role to transfer power. But, the gearboxes are prone to a lot of failures as they are subjected to immense wear and tear. Gears and bearings are susceptible to failure in a gearbox. Gears operate under extreme conditions like poor lubrication, high torque and are susceptible to installation problems. Under extreme stress, it develops surface defects which in turn will cause tooth breakage [1]. A case study of a failed helical gear of a gearbox in a bus has concluded that misalignment of the gear and pitting in the tooth were the reasons for tooth breakage in the helical gear [2]. The bearings are expected to run smooth and resist the transient and heavy loads generated by a machine. During operation, a sizeable part dislodges from the contact surface and these localised

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