Fault Detection and Diagnosis for Internal Combustion Engines

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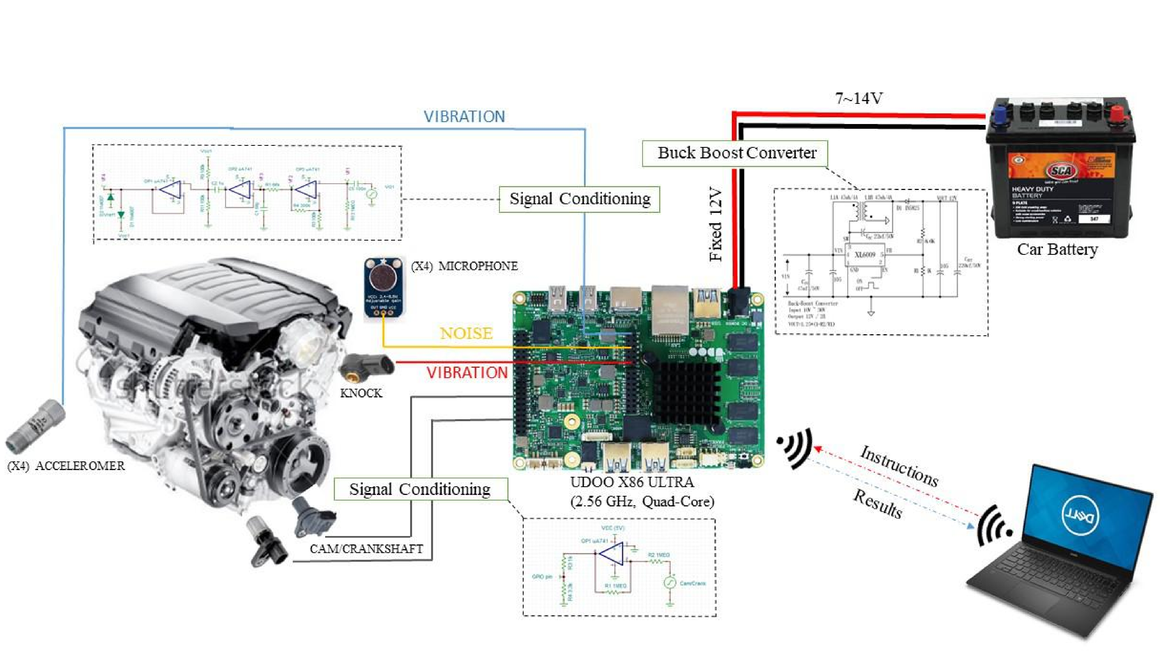
INTRODUCTION

This project pertains to the development of a Fault Detection and Diagnosis System (FDD) that that facilitates the detection, isolation, and identification of different fault signatures in the Internal combustion engine (ICE).

DETECT THE FAULT → ISOLATE + LOCALIZE THE FAULT → IDENTIFY THE FAULT

FDD systems should provide real-time diagnosis of a running ICE while being affordable, portable, and user Friendly.

THE SENSORY SYSTEM (Hardware)



CAD-IEMSPCA (Signal Processing Software)

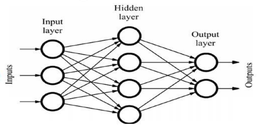
The system uses the Industrial Extended Multi-Scale Principle Components Analysis (IEMSPCA) Algorithm that analyses signals in both time and frequency domains to detect any deviations from baseline measurements. If there is a deviation, The software generates faults signatures used to diagnose the fault type.

RAW DATA → NOISE FILTER → CRANK ANGLE DOMAIN → WAVELET TRANSFORM → PCA ANALYSIS

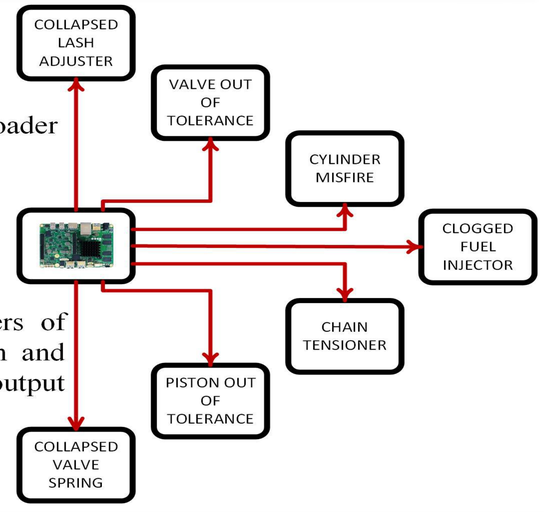
- Collection of the raw data from all analog sensory inputs
- Filtering background noise to improve the accuracy of the final results
- Transformation of time domain to CAD domain in order to account for the periodicity of the faults
- The concurrent analysis in both CAD and frequency domain.
- Detection of changes in both CAD and Frequency domains that results in PCA coefficients

DEEP LEARNING AI (Classification Software)

- **Deep learning** in Neural Networks is part of a broader family of machine learning methods.

PCA COEFFICIENTS → 

- In its core, it uses a cascade of multiple layers of nonlinear processing units for feature extraction and transformation. Each successive layer uses the output from the previous layer as input.



RESULTS

- Small, light, and modular Sensory System
- Cloud based API to maximize the learning throughput from many cars
- Expandability over both Hybrid and Electric car models

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