

## IC ENGINE FAULT DIAGNOSIS BY SOUND

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**Abstract** - Motorcycles are the favorite mode of transport in India. Two-wheelers registered a growth of 15.80% during April–August 2015. Diagnosis of different types of faults that arise in vehicle engines is very critical in subject of repair and maintenance of a vehicle. The trial and error approach has been applied to detect the fault and therefore engine may get more damaged instead of getting repaired.

**Key Words:** Internal Combustion Engine, Mel-Frequency Cepstral Coefficients, Linear Predictive Coding, Hidden Markov Model, Artificial Neural Network.

### 1. INTRODUCTION

Engine faults are major faults which takes place inside the engine, diagnosis of these faults is highly related to the technical expertise of the person and results in low success rates. Distinguished sound pattern generated by different faulty engines contains features of the particulars related to the corresponding faults. A fault detection and diagnosis method for an engine's comprises of collecting a sensor signal from an acoustic of bike engine, extracting a feature set from the sensor signal using Mel-Frequency Cepstral Coefficients (MFCC) algorithms.

#### 1.1 Different Faults

A brief description of the faults considered in this work is given below:

1. Valve setting: Any deviation of between 5–10° in valve opening/closing causes a considerable rise in peak combustion chamber pressure, which leads to a change in engine sound.
2. Chain fault: The main function of the timing chain is to operate the valves. A loose chain vibrates and results in a change of sound.
3. Oil fault: This may occur when quality of engine oil degrades and not able to provide smoothing motion to piston of engine that leads harsh sound of piston.

4. Filter fault: This may occur due to not proper working of filter which is inside the silencer.

#### 1.2 Different Algorithms

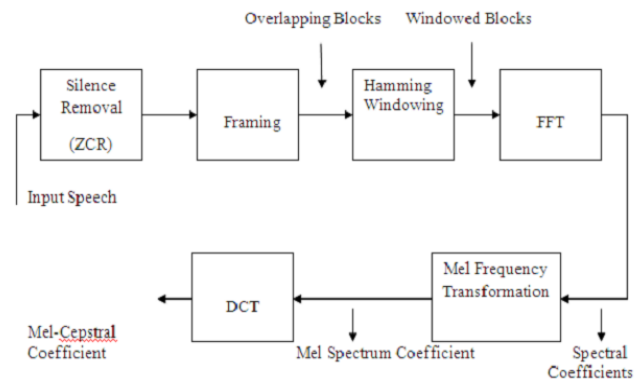
Here are some algorithms such as LPC, HMM, ANN:

ANN-It is having self-adoptive study ability. It has good capacity of nonlinear mapping. Number of neuron nodes on buried layer and set of transfer function have direct effect on accuracy and efficiency.

HMM- If it combines modeling of stationary observation process and the temporal relationship among the process together in a well-defined probability space.

MFCC-The Mel spectrum coefficients are logarithmic having real numbers, we can convert them to the time domain using the Discrete Cosine Transform (DCT).

#### 1.3 MFCC Algorithm



**Fig-1:** Block diagram of MFCC algorithm

The most widely used feature in speech recognition is Mel frequency coefficients, which are mainly focused to model vocal tract while extracting feature coefficients from the speech, Mel frequency cepstrum coefficients apply Mel scale to power spectrum of speech in order to imitate

human hearing mechanism. Filters are used to emphasize some of the frequency contents like ear does which is also called perceptual weighting. More filter banks process the spectrum below 1 kHz since the speech signal contains most of its useful information such as first formant in lower frequencies. The central frequency of each Mel filter bank is uniformly spaced below 1 kHz and it follows a logarithmic scale above 1 kHz.

## 2. BLOCK DIAGRAM

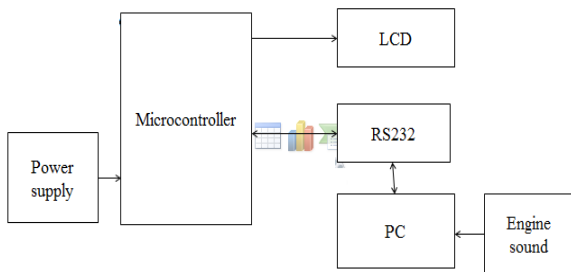


Fig-2: Block diagram of project

### 2.1 Block Diagram Explanation

Block diagram contains microcontroller, LCD display, power supply, Max 232, PC and engine sound. We are giving the input of engine sound to pc on which we are having MATLAB software. On MATLAB we will process the engine sound by MFCC algorithm and through max232 we will give result to microcontroller. Using PIC18F4520 microcontroller we are going to display the result on LCD.

### 2.2 Specification of Major Devices

PIC18F4520:

- It is 8bit controller
- 5 I/O port for interfacing.
- 2MB program space for user.

LCD:

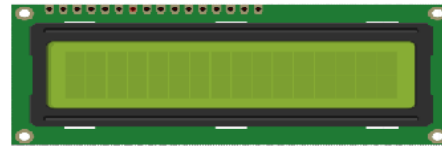


Fig-3: Image of LCD

- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle

RS232:

- Operates upto 120 kbits/sec.
- Low supply current typically 8 mA.
- 2 drivers and 2 receivers.
- Operates from a single power supply of 5v.

### 2.3 CIRCUIT DIAGRAM

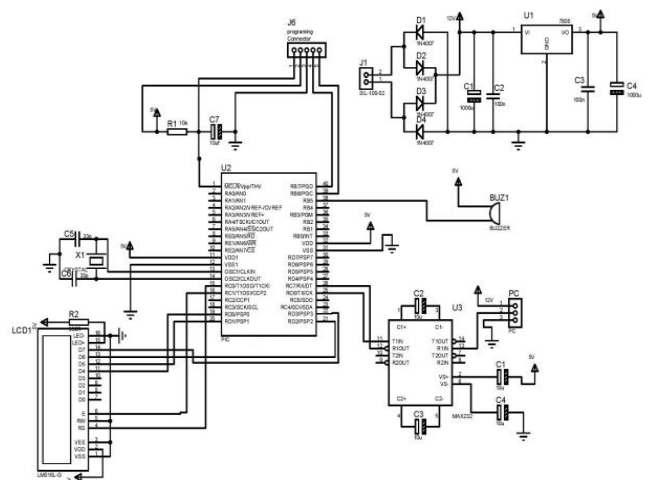


Fig-4: Circuit diagram of project

### 3. PROPOSED RESULT

- Detect the fault at an early stage so that the component can be replaced before its failure.
- Fault should be detected successfully .
- At second stage it should be displayed on LCD.

### 4. ADVANTAGES

- Exact diagnosis of fault.
- Fault can be detected within less time.
- Improvement in efficiency of the engine.
- Improvement of life of the engine.

### 5. CONCLUSIONS

In this paper, a technique for fault diagnosis in IC engine by sound has been proposed. It indicates whether the sample is healthy or faulty in the first stage, and it indicates the type of fault in the second stage. The result showed high accuracy when simulation was performed.

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