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Vibration Analysis for Engine fault Detection

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Abstract — ***The Vibration analysis for engine fault detection, Today's world growing fast and machinery part getting complex so it's difficult to find out fault in machine so here means in this paper we are explain how we are find out fault of machine with help of visualization it's easy to find out fault here we use angular.js, D3.js for visualization and use MQTT protocol for publish and subscribe sensor data. In automobile industries machine are main part how we find out fault yes we find out fault with help of sensor using sensor here we analysis the machine and using technology visualize graph and find out fault. MQTT protocol play important role here because with help of protocol getting data is easy.***

Keywords- Sensor, Protocol, Visualization, Fault detection, MQTT

I. INTRODUCTION

Automobile Science is progressing increasing with an astonishing speed and car manufacturing is competing with each other to reach more targets in markets. But to achieve target company manufacturing the product rapidly [1]. Because of the rapid production the machine may get some defect to it. It may be not visible to the eye, but that may result into serious accident to avoid such accident we are measuring the VIBRATION of the machine. Through vibration analysis of the machine/Engine behavior it's possible to screen the problematic or the doubtful machine. There are different type of engine fault like spark plug gap, valve clearance (inlet and outlet), air filter fault, piston ring fault, inlet and exhaust manifold fault and injector valve [2]. All machines with moving parts give rise to sound and vibration. Each machine has a specific vibration signature related to the construction and the state of the machine. If the state of the machine changes the vibration signature will also change. Most modern techniques for diesel engine diagnostics are recognized on the analysis of vibration signals collected from cylinder block or the head. A change in the vibration signature can be used to detect initial faults before they become critical [3]. In below we explain data flow diagram how actually data flow from sensor to dashboard.

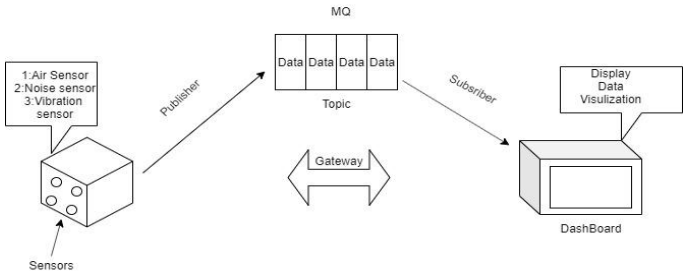

Fig 1: data flow diagram

A. Sensors: Engine Fault detection we need sensor for identify the fault in engine so there are different sensor which is list out below so basically this sensor sense the engine data like vibration data, Noise data and provide this data for fault detection there are some protocol we use here for getting data from sensor .This sensor data transfer from MQTT to using publisher and subscriber script.

- Vibration Sensor
- Noise Sensor
- Air Sensor

B. Protocol: MQTT is nothing but messing queue telemetry transport its work as gateway means its work as interface between sensor and dashboard MQTT as also known as broker have publisher and subscriber like sensor sense data of machine and then MQTT get this data and store it in database after subscriber put data on dashboard. This work as middle ware because sensor data collect in topic different topic like.

C. Dashboard: Dashboard basically Graphical User Interface for user .Dashboard is nothing but output window mean what user want they can request like if they want to show graphs there are different graphs like line, bar, pie chart etc.

II. LITERATURE SURVEY

1. DIESEL ENGINE FAULT DETECTION USING VIBRATION AND ACOUSTIC EMISSION SIGNALS

Authors: Prof. Dr. Sabry Allam, Mohammed Abdo and Dr. M. Rabie.

Publishing Details: Volume 4, Issue 12 December – 2018

Description:

In this paper, we find out how to get machine Engine fault signal through different sensor like vibration, Acoustic Emission and fault detection using Microphone used airborne sound signals. The audio signals from the IC engine are captured by using a simple carbon microphone placed in front of the engine head.

2. REAL TIME MACHINE HEALTH MONITORING AND VIBRATIONAL ANLYSIS USING FFT APPROACH

Authors: Himanshu K. Patel, Dhagash Shah, Avani Raghuwanshi

Publishing Details: Volume-8 Issue-5, June 2019

Description:

The authors proposed in these paper overviews the generalized health monitoring concept for machines and present the health monitoring of a rotating machine based on vibration Data Analysis using an enhanced Fast Fourier Transform Approach.

3. FAULT DETECTION AND PREDICTION OF FAILURE USING VIBRATION ANALYSIS

Authors: R.Megala, Dr. V.Eswaramoorthy

Publishing Details: Volume: 05 Issue: 06, June-2018

Description:

The authors proposed in these paper industrial applications, the uptimes of machines are enhanced through equipment monitoring. This is minimized the risks of unpredicted failures and consequent plant outages. Since, all failure modes can cause an increase in machine vibrations, monitoring this area is the predominant and most widely used method to determine equipment condition, and to predict failures. The objective of this paper is to detect faults in rotating equipment with the use of vibration analysis.

4. RESERCH TRENDS IN FAULT DETECTION AND ANALYSIS OF THREE PHASE INDUCTION MACHINE

Authors: Tejas K. Rathod, Prof. V.P. Patel

Publishing Details: Volume 6, Issue 3, March 2017, ISSN: 2278 -7798

Description:

Proposed induction motors are used compared to other types of motors and so fault detection in induction machine is became a major task to avoid the uncertain break downs and delay in production. Here the main concentration is applied on induction motor's vibration monitoring and signal conditioning using various signal processing techniques. This paper deals with the Literature survey of signal processing techniques (DFT, FFT, STFT, and DWT) used for various types of fault detection and for vibration signal's analysis (on time and/or frequency domain). The evaluation of the signal processing technique and platform mostly used to achieve above target has been proposed.

5. TECHNIQUES OF VIBRATION SIGNATURE ANALYSIS

Authors: Summit Kumar Sar, Dr. Ramesh Kumar

Publishing Details: Vol. 4, Issue 3, March 2015

Description:

Proposed in these paper recent developments of techniques, based on vibration signature analysis to detect the fault in a machine. This paper shows vibration signature analysis implemented to detect fault in various machineries such as gear, rolling element bearing, journal bearing, induction motor, centrifugal pump and beam. The authors do not intend to provide an exhaustive discussion about machine faults but only detailed overview of rotating parts vulnerable to fault.

III. ARCHITECTURE DIAGRAM

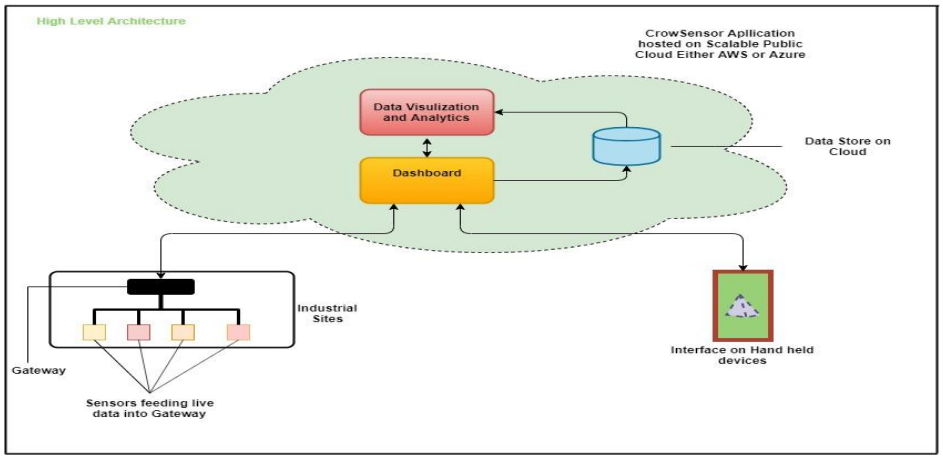

Fig 2: Architecture diagram

A. **First Layer**: In the first layer there are different types of sensors like vibration, sound sensor etc. This sensor is connected to engine to find out the fault this sensor reading data of engine, here we use gateway to accessing data from sensor using MQTT protocol mqtt is work as messaging queue where we get sensor data as topic format publisher and subscriber are play important role here publisher publish topic data and then subscriber subscribe data depend on topic like what user want which topic they want vibration, sound topic

.

B. **Second Layer**: In the second layer Visualization part comes under where visualize sensor data using D3.js and Angular.js technology. Visualize data on dashboard Visualization is nothing but graphical representation of data, data visualize in different graph like Bar, Line and scatter plot. It is providing the visualization of data through the different types of graphs it needs to be representing it on any platform. So as shown in the diagram dashboard is provided for it. In dashboard user will able to login and can see it

.

C. **Third Layer**: This is last layer this layer comes under in storing data showing how to collect data through sensor and store data on cloud and also store visualization data on cloud .After getting sensor data store this data on cloud. Cloud providing different services like accessing data where user can access data easily.

IV. WORKING PROCEDURE

A. Data Collection: First the sensors will be connected to the machine so it can generate the data. After that the data is send through the MQTT queue through the publisher. Publisher will be publishing the data to the MQTT queue and MQTT will hold the data and send it to the subscriber who will subscribe through the topic name.

Example: Consider these duplicate data.

- Input from the sensor to the MQTT

  [Publishing]Topic=STVOM-4f7788
  Message={"Gx":-11,"Gy":197,"Gz":-150,"ThetaX":32,"ThetaY":- 65,"Temp":27}

- Output from the MQTT to the subscriber through topic name

  Topic=STVOM-4f7788
  Message= {"Gx":103,"Gy":-193,"Gz":- 67,"ThetaX":2,"ThetaY":88,"Temp":31}

B. Data visualization: In data visualization the data is taken from the sensor through the mqtt queue and visualized in the form of graph like line graph, bar graph, and scatter plot. To plot this graph we used the d3 library and angular framework

.

C. Data storing: The data will be store on the cloud database. But all the data will be not stored on the cloud. The data is crossing the threshold values only that data will be store on the cloud database.

V. OUTPUTS

- Input from the sensor to the MQTT

  [Publishing] →Topic=STVOM-4f7788
  Message={"Gx":-11,"Gy":197,"Gz":-150,"ThetaX":32,"ThetaY":-65,"Temp":27}

- Output from the MQTT to the subscriber through topic name

  Topic=STVOM-4f7788
  Message={"Gx":103,"Gy":-193,"Gz":-67,"ThetaX":2,"ThetaY":88,"Temp"

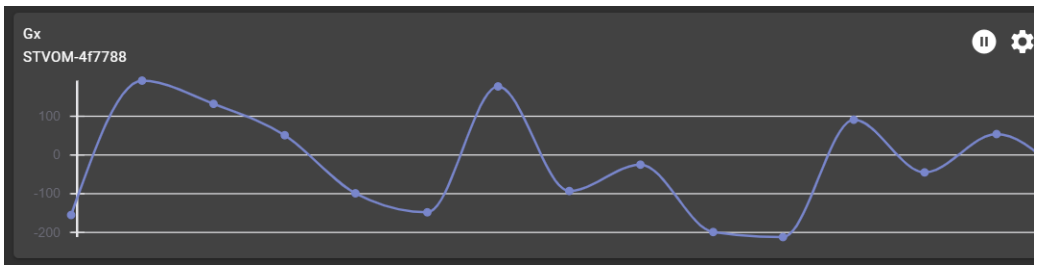

Fig 3.1: Gx (vibration sensor)

In Fig 3.1 Represent sensor data in line graph. Here Gx we considering Vibration sensor data which in numeric form it may be positive value or negative value X-axis represent time period and Y-axis represent range of vibration sensor. Range (0,200) and if range is above zero means positive value and below its negative. We get data through MQTT using topic=STVOM-4g7788 and see the output Gx:"103" its continuous data comes from sensor.

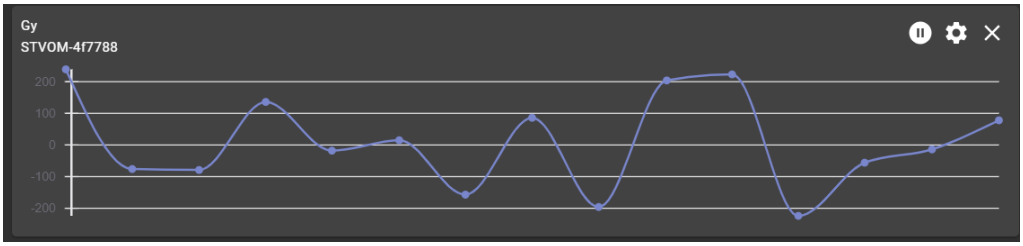

Fig 3.2: Gy (noise sensor)

In Fig 3.2 Represent Gy sensor data we consider it Noise sensor this sensor also gives data in numeric form it may be positive or negative. X-axis represents time period and Y-axis represents range of noise sensor. See the Noise sensor data Gy:"-193" flow of data is continuous.

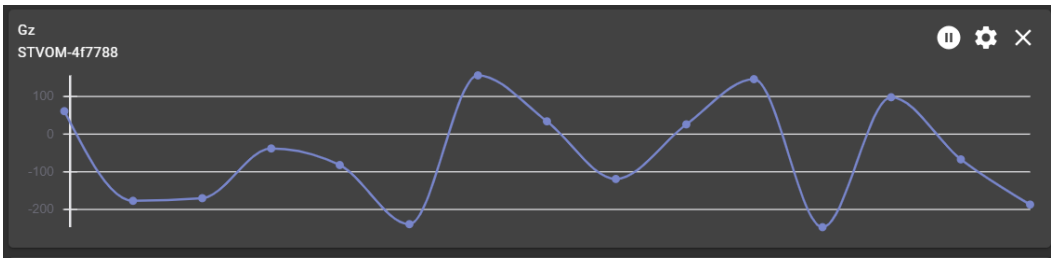

Fig .3:3 Gz (temperature sensor)

In Fig 3.3 Represent Gz sensor we consider it Temperature sensor X-axis showing time period same as other sensor and Y-axis showing range of data between 0 to 200 and flow of temperature sensor data is continuous manner like Gz:"-67".

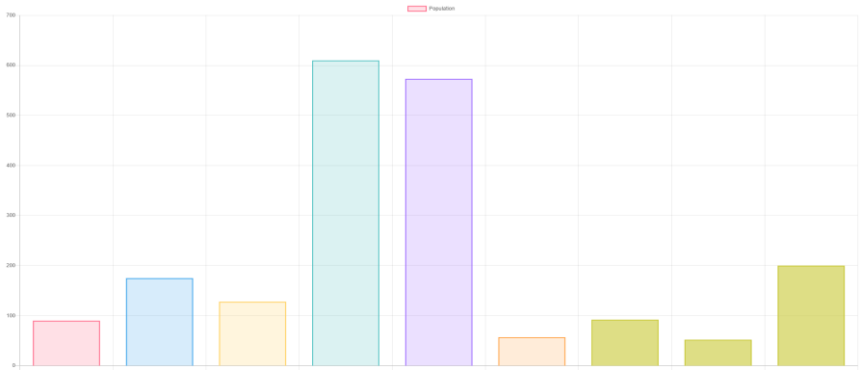

Fig 3.4: Bar graph

As shown fig 3.4 outputs of sensors in bar graph and on Dashboard there are different types of graphs like bar, line, scatter etc. In this fig3.4 X-axis showing multiple sensors like vibration, Noise, Temperature, Air with help of bar on X-axis and Y-axis showing the range of sensor and range is numeric form this is how we can analysis the sensors data by specific period of time (e.g. by day, by moth) with help of bar graph this graph represented with help of D3.js and Angular.js.

V. CONCLUSION

The work done in this paper allows computing the different value of the machine to identify the fault if any. This will help in the risk management to the industry and to prevent the accident. Using the feature rather than checking the machine manually one can check it without stopping the machine on the computer monitor and if will predict the condition of the machine.

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