Machine Signature Analysis Using IoT

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***Abstract*—The proposed system aims at monitoring the electrical and vibration fault of single phase induction motor using Internet of Things. Induction motors are used for domestic as well as industrial purpose, therefore it is necessary to have safe and reliable operation between motor and other devices.Vibration related machine fault problems are main sources of high maintenance cost and these machine faults can lead to unwanted failure of system. There are various types of maintenance for machine such as periodic, preventive and predictive maintenance. Here, we are using predictive maintenance in the proposed system. If any fault occurs in the motor it can generate excessive downtimes which results into loss of productivity and revenue.Therefore early fault detection is needed for the protection of motor. The proposed system diagnoses the vibration and current variations, and then the data is stored on cloud. We can analyse data using CSV file. The possible faults are detected and alerts are sent to mobile devices. The key factor of the system is its ability to provide a real time alerts.**

***Keywords*—Current Transformer, Vibration Sensor, Rpi, Gateway, Scada, Wifi, Ubidots, Node-Red, Python.**

I. INTRODUCTION

In an industrial environment there are mechanical systems which are driven by electrical motors especially induction motors are used in production processes. Regarding the type of motors usually employed, about 90% are single phase and three-phase ac induction based, mainly due to its cost effectiveness and mechanical robustness. Various faults occur in induction motor. A variety of faults occur within the induction motor during the period of its normal operation. These faults can lead to a catastrophic failure if undetected. Moreover, a variety of conditions monitoring techniques have been developed for analysis of abnormal conditions. The major internal faults can be categorized into two groups first is electrical and another one is mechanical fault [1][6]. Electrical faults: These faults are very common in single and three phase induction motor while operating in industries. Mechanical faults: Common mechanical faults found in three phase induction motor are rotor eccentricity, bearing faults and Load faults, shaft misalignment.Rotor eccentricity can be Static or Dynamic or mixed eccentricity. There are many condition monitoring methods including thermal monitoring, chemical monitoring, vibration monitoring as well as acoustic emission monitoring. All these monitoring methods don't require expensive and specialized tools whereas current and voltage monitoring out of all measured by tapping into existing voltage and current transformer[2].

II. PROPOSED SYSTEM

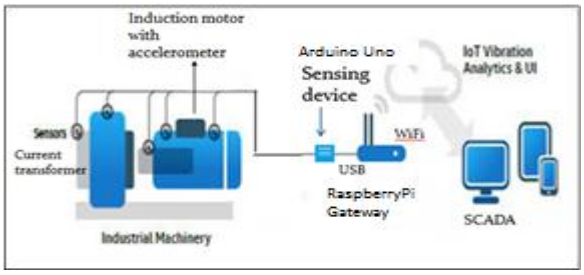


Fig. 1 Overview of application

The current and vibration sensor sense values of the motor under healthy working conditions. These standard values are set and are used as a reference value for the protection system. Control unit is the heart of the whole system; it controls the overall protection system. It takes the input from the current and vibration sensor sense through USB. It also indicates the condition of the motor. Also, it uploads the data on the Cloud via WIFI [4].

USB is used here to have a link between sensing unit and the control unit. AC or DC motor or any type of electrical equipment can be protected using this system. Monitoring induction motor, data are collected by a smart coordinator, which saves all data in the system for processing as well as for future use. The parameters will be entered in the data coordinator in software from induction motor including current, vibration. These parameters will be stored in database and analysed. Collected data will be displayed on the SCADA and Cloud server.

III. METHODOLOGY

1. *Block Diagram*

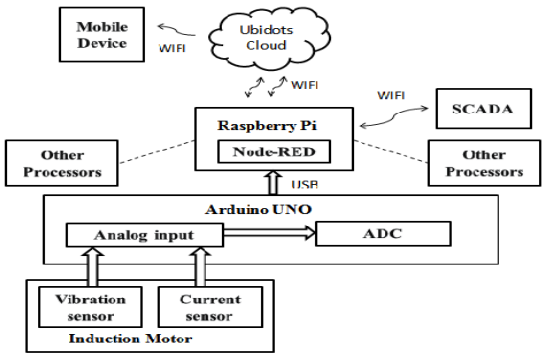


Fig. 2 Block diagram of the proposed system

2. Major Components

A. ACCELEROMETER

An accelerometer is a Micro-Electro Mechanical System (MEMS) sensor which measures static or energeticspeeding up in all three axes that is X, Y and Z. It measures level of increasing speed where it is mounted which empowers us to degreevibration/deceleration of question.Its working range is 1.8V to 3.6V supply voltage [5].

B. CURRENT TRANSFORMER

Commonplace applications of ACS712 are motor control, loaddetection and Management, switched-mode control supplies, and overcurrent faultsecurity. Device transmission capacity is set through the unused Filterp in and 5 µs yield rise time in response to step input current. It has 80 kHz bandwidth. The increment in output deviation 1.5% at Temperature = 25°C. it contains little footprint, low-profile SOIC8 bundle has 1.2 mΩ inner conductor resistance, 2.1 k VRMS least segregation voltage from pins 1-4 to pins 5-8. It has 5.0 V, single supply operation, 66 to 185 mV/A of output sensitivity, Output voltage corresponding to AC or DC streams.

C. ARDUINO UNO

Arduino Uno controller is single chip microcontroller. It is open source equipment board. Board outlined around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM. It has 14 digital input/output pins out of which 6 can be utilized as PWM outputs, 6 analog inputs, a 16 MHz ceramic resonator, a USB port, a control jack, an ICSP header, and a reset button. It is a simple USB interface. This permits to interface like this is a serial device. Basically interface it to a computer with a USB cable or control it with an AC-to-DC connector or battery.

D. RASPBERRY PI

Raspberry Pi (RPi) has SoC Broad communication port BCM2835 and Quad core 64-bit ARM Cortex A53 clocked processor at frequency of 1.2 GHz. CPU of Raspberry Pi is of 700 MHz center ARM11 family .It has GPU of Broad communication Video Center IV, Open 1080p30 h.264/MPEG-4 AVC high-profile decoder.Raspberry Pi having RAM of 512 MB. The Video yields of RPi are Composite video RCA and HDMI andSound yields are 3.5 mm jack, HDMI On board capacity is SD, MMC, SDIO card slot.It has 4 USB ports and inbuilt WIFI and Bluetooth 4.1 module. It works on power: 1mA at 5V, Serial USB Cable.

E. NODE-RED

Node-RED is a flow-based programming tool, original developed by IBM's Emerging Technology Services team and now a part of the JS Foundation. Node-RED consists of a Node.js based runtime that we can point a web browser at to access the flow editor. Within the browser you create your application by dragging nodes from your palette into a workspace and start to wire them together. With a single click, the application is deployed back to the runtime where it is run. The palette of nodes can be easily extended by installing new nodes created by the community and the flows we create can be easily shared as JSON files [3].

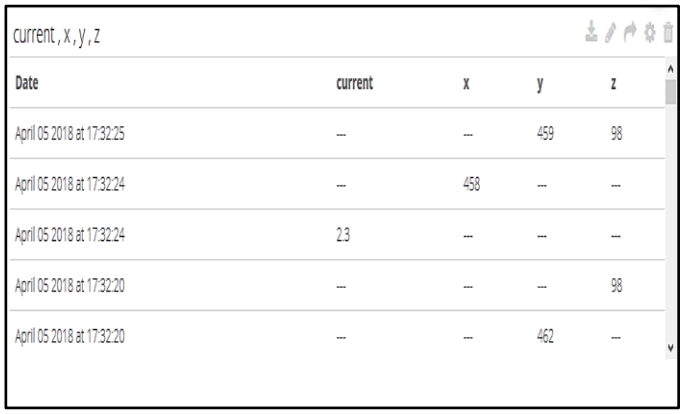
F. MQTT

MQTT permits devices to send or publishdata for a given topic to a server that capacities as an MQTT message broker. The broker at that point pushes the data out to those clients that have already subscribed to the client's topic. An MQTT session is partitioned into four stages: a. connection b.authentication c. communication d.termination. A client begins by making a TCP/IP association to the broker by either utilizing a standard port or a custom portcharacterized by the broker's administrators. When connecting, it is vital to recognize that the server might proceed an old session in the event given with a re-used client identity. The standard ports are 1883 for non-encrypted communication and 8883 for encrypted communication utilizing SSL/TLS [3].

G. Python

Python is an object-oriented, interpreted, high-level programming language used for general-purpose programming.The CSV (Comma Separated Values) format is used for import and export of spreadsheets and databases. There is no specific format for CSV files. Due to this, there is format difference between CSV files from different applications. Here, we are downloading the CSV file from Ubidots cloud with real time values. This CSV file will be compared later with the latest CSV file downloaded to perform comparison between values and provide real-time alerts. The difference between new values and the reference values will be considered as faulty condition. On positive difference, an alert will be sent.

IV.RESULT


current , x , y , z

Date	current	x	y	z
April 05 2018 at 17:32:25	--	--	459	98
April 05 2018 at 17:32:24	--	458	--	--
April 05 2018 at 17:32:24	23	--	--	--
April 05 2018 at 17:32:20	--	--	--	98
April 05 2018 at 17:32:20	--	--	462	--

figure.3: Values of accelerometer

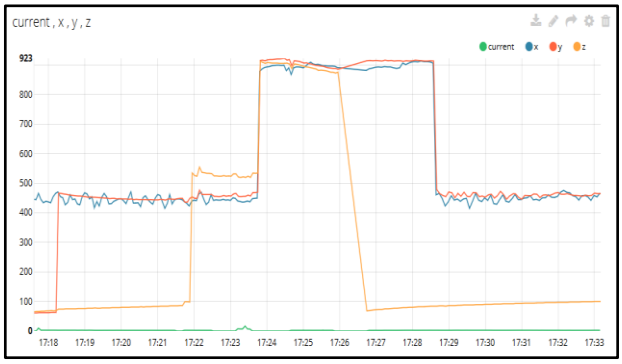


figure.4:.Graphical representation of accelerometer

V.CONCLUSION

This paper presents the concept of machine signature analysis using Internet of Things for the predictive maintenance of motor.The system has been designed and implemented using technologies like to prevent losses, as well as it will provide early faults detection. The monitoring of motor system presents the measurement of various parameters like vibrations and current consumption. The main goal of the design is for remote monitoring and controlling the induction motor. The data received by the nodes is stored and graphically presented in real time manner on Ubidots cloud. The proposed system can be easily upgraded if required. The system has high autonomy, easy installation as well as low maintenance cost.

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