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Mechanical Fault Diagnosis and Prediction using IoT

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Abstract – *Every Industry pays huge amount for their Machinery maintenance at respective period of time. If we start to monitor the functional properties and positioning of parts of the system, it will be easier to make the system efficient and it results in reduction of maintenance cost. This process of frequent monitoring also saves the machine from major defect and helps with finance management. This method is based on monitoring of industrial machines with various sensors that are suitable for particular system using IoT. Electrical machines are different from each other in every aspects. The fault detection system is designed based on their functional and physical properties. So here we use prototype with five different sensors. They are oil level, MEMS, vibration, oil wetness and temperature sensor. These sensors gather information from the system and transfers to real time system Microcontroller and then displayed in LCD and blynk app. If any fault detected buzzer alerts the person in charge and at the same time alerts the main system monitor which is main stream for maintenance. With help of this even a little defect can be overcome and prevent the machine from major fault. The system that we created is used in cotton and paper industry. This system can be used in car engine, bike, home appliances, industrial machines, etc..*

Key Words: **Fault detection, IoT, Sensor, Machines, Maintenance.**

1. INTRODUCTION

The Fault is the deviation in the condition of the system or component parameter from the healthy state. Thence, the faults of the industrial system dramatically affect the reliability, productivity, product quality, also unexpected security issues. Consequently, adopting efficient fault detection and diagnosis (FDD) techniques plays a crucial role in increasing the reliability, maintainability, and safety of these systems. Currently, various research groups are developing algorithms addressing the fault detection problem. These can be classified in different categories based on their methodology; these include model-based approaches, data-driven approaches, and finally, knowledge-based approaches. The observer is an estimated system based on the dynamic model of the engineering systems to estimate their states or parameters. The accuracy in the state estimation and the adaptation in the practical implementation led to the wide spreading of observer technique in the control and fault detection for the industrial applications.

2. HARDWARE AND SOFTWARE COMPONENTS USED

- Step down transformer
- Bridge rectifier
- Filter circuit
- IC7812
- IC7805
- Arduino uno
- Vibration sensor
- Temperature sensor
- Oil wetness sensor
- Liquid Crystal display
- Buzzer
- Blynk app
- Arduino IDE compiler

3. PROPOSED SYSTEM

The proposed project looks at developing an IoT based solution to monitor condition of the electrical machines for industrial applications. We are looking at monitoring the machine condition by acquiring real-time data on machine temperature, vibration, oil level, MEMS and oil wetness. The data will be acquired through the industrial grade sensors mounted on electrical machines connected to a microcontroller and an IoT gateway. The data will be made accessible through a user interface to any internet-connected device thereby providing real-time condition monitoring capability. In this proposed system we have connected various sensors such as temperature sensor, vibration sensor, oil level, MEMS and oil wetness detection sensor

4. BLOCK DIAGRAM

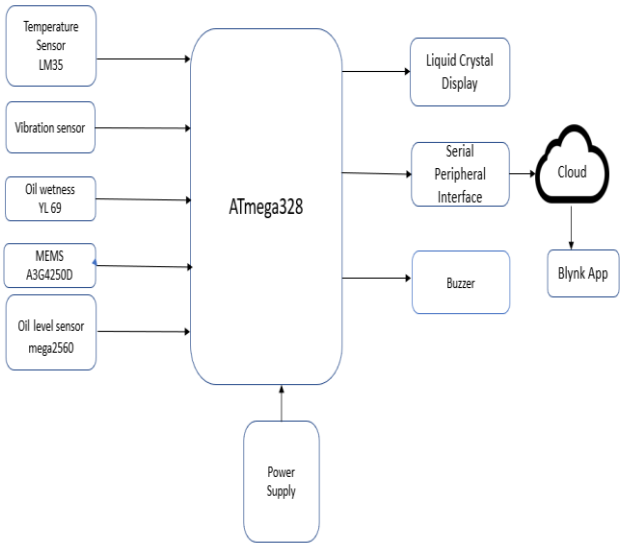

Fig -1: Fault detection system block diagram

5. SPECIFICATION OF COMPONENTS

a)Arduino UNO

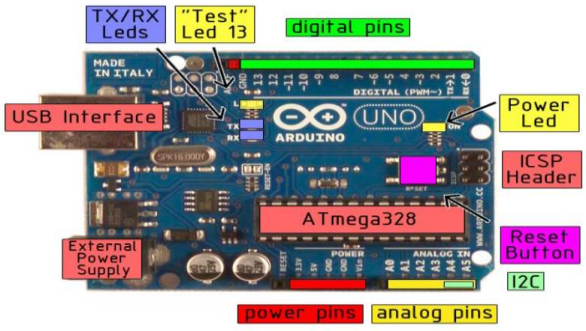

Fig -2: Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

b)Vibration Sensor

Fig -3: Vibration Sensor

Has a high sensitivity vibration sensor often used for security detector. This sensor is highly sensitive with extremely fast response time which could be used for security applications such as anti-theft system for vehicle. The sensor will output a low logic voltage when vibration is detected. The sensitivity can be adjusted with the onboard potentiometer.

C) Oil Level Sensor

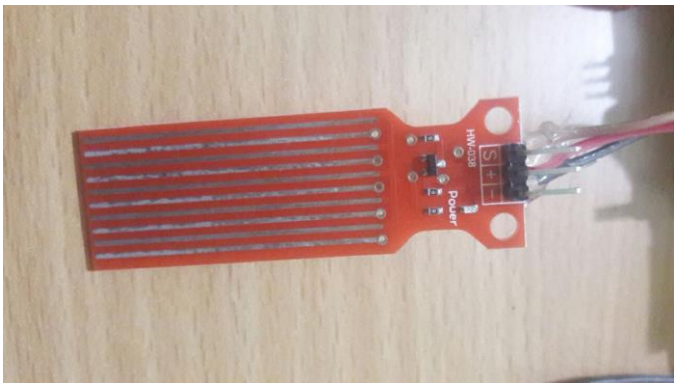

Fig -4: Oil Level Sensor

Level sensors are used to detect the level of substances that can flow. Such substances include liquids, slurries, granular material and powders. Such measurements can be used to determine the amount of materials within a closed container or the flow of level In open channels.

d)Temperature Sensor

Fig -5: Temperature Sensor

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.

e)Oil Wetness Sensor

Fig -6: Oil Wetness Sensor

The oil condition sensors measure
the moisture content of an oil in the same way as gas humidity. The measurements are output as absolute values in [ppm] or relative values as water content.

f)MEMS Sensor

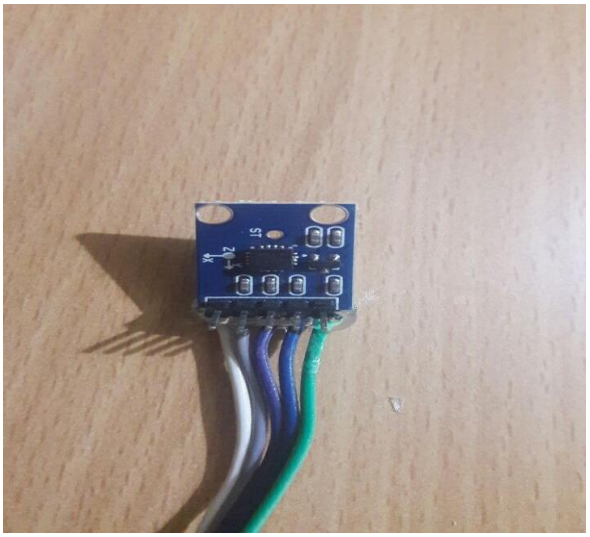

Fig -7: MEMS Sensor

The A3G4250D is a low-power 3-axis angular rate sensor able to provide unprecedented stability at zero rate level and sensitivity over temperature and time. It includes a sensing element and an IC interface capable of providing the measured angular rate to the external world through a standard SPI digital interface. The A3G4250D is available in a plastic land grid array (LGA) package and can operate within a temperature range of -40 °C to +85 °C

g)Buzzer

Fig -8: Buzzer

A buzzer or beeper is a signalling device, The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep.

h)Power Supply

Power supplies for electronic devices can be broadly divided into linear and switching power supplies. The linear supply is a relatively simple design that becomes increasingly bulky and heavy for high current devices; voltage regulation in a linear supply can result in low efficiency. A switched-mode supply of the same rating as a linear supply will be smaller, is usually more efficient, but will be more complex.

i)LCD

Liquid crystal cell displays (LCDs) are used in similar applications where LEDs are used. These applications are display of display of numeric and alphanumeric characters in dot matrix and segmental displays. A liquid crystal display (LCD) is an electronically-modulated optical device shaped into a thin, flat panel made up of any number of color or monochrome pixels

filled with liquid crystals and arrayed in front of a light source (backlight) or reflector.

Fig -9: LCD

6. WORKING

Sensors are connected to detected the exact fault location in the machines. Vibration sensor detects the specific parts which goes to abnormal shaking may cause internal damage. Mems sensor is used to find the position of devices which present inside the machinery, it will detects any abnormal position. Temperature sensor connected to detects the coolant level of the heavy running parts which leads to heavy heat.

Coolant oil tank is placed inside or outside of the machine to supply the oil to required parts, in such case level detector sensor will indicates the oil level present in the tank, it helps to fill the tank before it gets dry state. Oil moisture sensor is connected to find the required Grease oil on the shafts or Rotating pulleys or connecting Screws. if no proper maintenance, it leads to mechanical damage.

All these devices are connected in Arduino Microcontroller and programmed according the project specification. Here embedded C language is used for programming. Sensor values are displayed in the Liquid crystal display as well as in IOT updation, user can view machine health from anywhere through the IOT application and buzzer units alarms to alert the workers before any damages occurs.

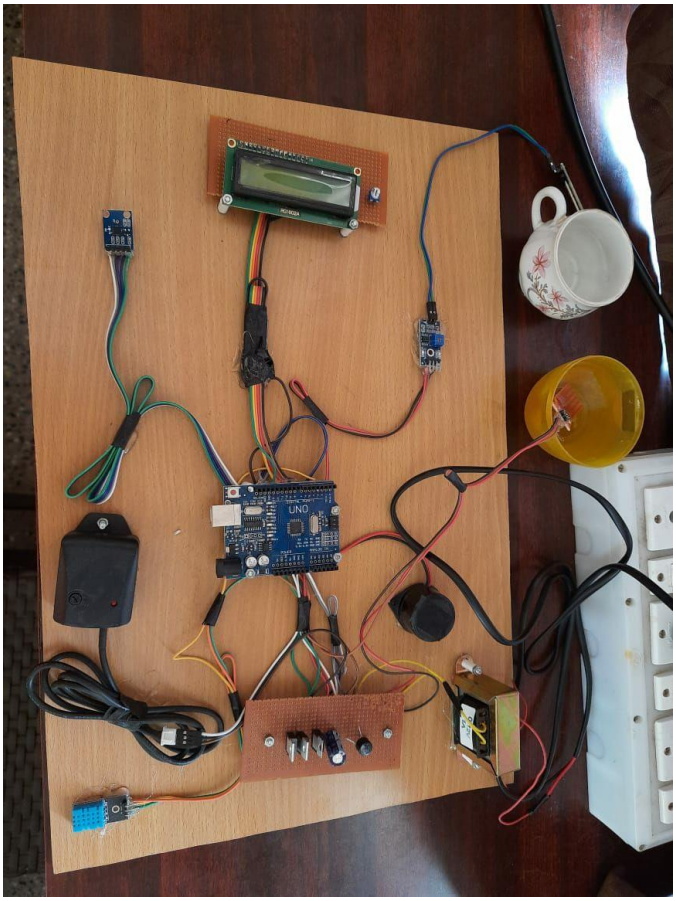

Fig -10: Fault detection system

7. CONCLUSION

Machine fault has been a drastic problem in industries. This idea of detecting the fault at the earliest will not lead to the severe damage to machine. This is cheaper and efficient method of finding defects.

This will play a major role in industrial and electrical applications.

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