

Predictive Maintenance and Condition Based Monitoring of Machine using IIoT Sample

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Abstract -- *This paper presents a IIOT (Industrial Internet of Things) based solution for condition monitoring and predictive maintenance of Industrial Machine set by establishing a communication between Electronic Hardware and Cloud Computing, IIOT used e for online and real time monitoring Generally Motor suffers from abnormal conditions such as over loading, temperature, Current, an IIoT based system is proposed to avoid unnecessary shutdowns. In the implementation of IIOT based system, different sensors such as current sensor, temperature sensors, oil level sensor, oil temperature sensor are used to capture some essential parameters to monitor health condition of Machine. Faults are being simulated using IIOT based hardware. The captured data are transmitted using Node MCU to the cloud and Receiver device was received the data from the cloud, Data stored in database, the characteristics of data are monitored using webpage*

Keywords -- *Industrial Internet of things, Machine, sensors, Node MCU.*

I. INTRODUCTION (SIZE 10 & BOLD)

Automation is the creation of technology and it is used to control and monitor the production or process with reduced human work. Automation has some advantage such Automation is the creation of technology and it is used to control and monitor the production or process with reduced human work. Automation has some advantage such as increased productivity, improved quality, improved safety, reduced factory lead time. The task that takes place in hazardous environment beyond human capabilities can be done by machines, as machine can operate even under extreme temperature. Industry 4.0 is current trend of automation in manufactures industry. It includes Internet of Things, cloud computing, cognitive computing. Industry 4.0 is called as a smart Factory.

IoT and IIoT have similar characteristic like intelligent, availability and connected device. The main difference between them is where they based. IoT is most commonly used for general purpose and IIoT is used for industrial purpose.

IIoT is developed to handle critical machines whereas IoT uses a simpler application with low risk impact.

In olden days, controlling and monitoring of industrial machine is PLC, VFD controllers or microcontroller. In olden days, controlling and monitoring of industrial machine is PLC, VFD controllers or microcontrollers based. But now it is done through NODEMCU Device. PLC, VFD controllers and Microcontrollers can be used in limited type of application, and it also have some disadvantages. The separate power is required to operate the PLC system, it also manufactures only a close loop architecture, VFD reduced the service factor of the motor, Number of additional modules must be added to maximize flexibility and performance.

Before MODBUS, Ethernet is a IEEE standard for connecting a number of computer systems, temperature but it does not hold good for real time and interactive applications and not suitable for client-server architecture. Ethernet has largely replaced competing wired LAN technologies such as Token Ring and FDDI and ARCENT. The original Ethernet use twisted pair and fiber optic links in conjunction. The internet protocol is commonly carried over Ethernet and so it is considered one of the key technologies that makeup the internet. In Ethernet is difficult to troubleshoot the problem. So, after they are go for MODBUS protocol. It also has some disadvantages. It is a serial bus communication, to transmit the data in master to slave device.

Previously MODBUS protocol is used in industry to communicate between machine to machine communication. This protocol was transmitting the data only a particular distance, the maximum distance is obtained the data does not transmit the master device. NODEMCU is special device designed for industrial applications. NODE MCU EPS8266 is a controller as well as data transmitting device. A set of instructions are programmed and executed by the user. NODEMCU controls the machines-based specification given in the program. Sensors are used to monitor the crucial parameters. NODEMCU have a major advantage such as high speed of data transmitting because of the

operational speed of for NODEMCU program is very fast, high reliability because of it is made of integrated components on PCB board, NODEMCU EPS8266 have a inbuild Wi-Fi module, Controlling and maintenance of NODEMCU is easy, maintenance cost is very low and it can be used in harmful environment and NODEMCU can be programmed.

A NODEMCU device operation can be seen during operation on Arduino IDE. TCP/IP protocol was used to transmit the data and data rate of the Wi-Fi is 25mbps – 50 mbps. It is a open source IoT platform. While the transmission of the data through the NODEMCU EPS8266, a data will pass to the cloud. Cloud Computing is a major part of Industrial Internet of Things. Data can be easily accessible using Internet. Cloud computing developed by Information Technology; Previously Cloud used for only a IT application but now a days cloud used in any industrial application. It is used to monitoring a machine parameter in Real Time Systems. After sending, the receiver will receive the data from the cloud. The characteristic of data monitored using webpage.

II. EXISTING TECHNOLOGY

Programmable Logic controller is defined as a Specialized computer used for the control and operation of manufacturing process and machinery in industry. A VFD is a device used in a drive system consisting of three main sub system

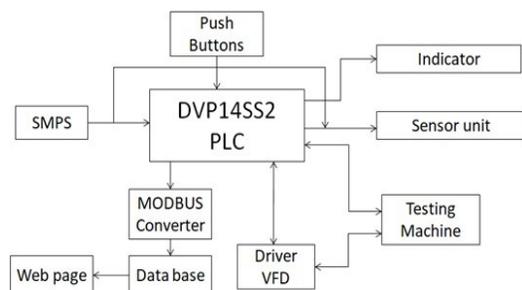


Fig. 1 Block Diagram

The three different sub systems are used for control the speed of the motor due to depends on the load factor. These controllers have some drawbacks, the service factor of the motor was reduced if PLC is used. It is based on manual operation to switch on the PLC controller Device. MODBUS protocol was used to Communicate with controller unit to computer unit, MODBUS is a Serial Bus communication to transmit the data from transmitter port to receiver port. Limited number of devices only allowed. In this System, collection of Data about the Machine condition can be obtained, when realizing solid monitoring of current and voltage of industrial machines the data does not retrieved from the hazardous location. Now we are proposed to

avoid the above-mentioned drawbacks with a help of Industrial Internet of Things.

Ethernet is used to communicate with machinery part to computer port. It not suitable for Real time Monitoring systems. The machine suffers any abnormal condition like as high voltage, this system does not control the voltage. The data transmission done with a help of MODBUS protocol, but this system does not transmit the live data. It takes few seconds to transmit the data to receiver device It caused collision in data compression while transferring data. VFD provide a support to the PLC controller and it was operated by separate power. VFD reduced the service factor that is life time of a Machine is less. Proximity sensor is used to sense the data from the machine that is voltage current. Without physical contact the data can be measured. Proximity sensor detect the voltage and current in only a metal surface, but major disadvantage is any metal interrupt acquired between a machine to sensor unit, it does not monitor the machine parameter and does not transmit the data to receiver port. PLCs manufacturers offer only closed loop architecture. Number of optional modules must be added to maximize flexibility and performance.

III. MATERIALS AND METHODS

A. Hardware Materials

NODE MCU EPS 8266: NODE MCU EPS 8266 is a open source IIoT platform. It is not only like a transmitting device but also act as a controller. It has inbuild Wi-Fi module. Using internet, the data to be transmitted to the cloud all the sensors are connected with a NODE MCU, the data directly captured the machine parameter and transmitted without latency.

NODE MCU EPS 8266:

Node MCU is a open source firmware and development kit. NODE MCU have a multiple GPIO port. Multiple sensors are easily integrated with NODE MCU. It is based on EPS8266. It has a low cost wi-fi microchip with transmitting protocol TCP/IP stack and microcontroller capability NODE MCU figure shown in Fig 2. Input voltage of NODE MCU is 7-12 V and operating voltage is 3.3 V. Clock speed of NODE MCU is 80 MHZ



Fig. 2 NODE MCU EPS 8266

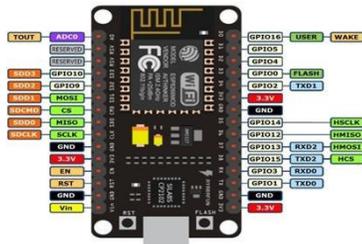


Fig. 3 Pin configuration of NODE MCU EPS 8266

B. Sensor:

The health condition of the machine can monitor with a help of capturing some parameters using sensors. The parameters like oil level, oil temperature, machine temperature, current value. The all parameters are sensed with equivalent sensors, the details of the sensors shown in below.

Temperature sensor:

The oil temperature and machine temperature were measures using DALLAS DS18B20. It is a digital thermo probe or sensor used to measure the temperature of oil as well as machine. DS18B20 sensor shown in fig 4 It have a three terminal that is VCC, Output, Ground. Range of the temperature is -55°C to +125°C it can be measured. Thermo probe was does not required the power to operate that sensor.



Fig. 4 DALLS DS18B20

Current sensor:

Current sensor is used to measure the how much amount of power is flow through the machine. ACS 712- 5A sensor is used to measure the current value. ACS 712-5A sensor figure is shown in fig 5. It is a three terminal device that are VCC, Ground, Output. It measures the both AC and DC current and measuring range is -5A to +5A. it is available in 5A, 20A and 30A. easy to integrate with NODE MCU. It is working in HALL EFFECT principle. It have some disadvantage that is low-offset, precise and linear hall circuit sensor connected with a copper conduction path to the machine it measure the flowing of current value.

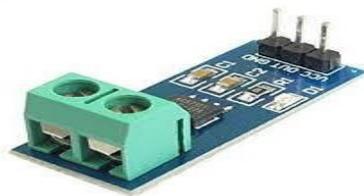


Fig. 5 ACS712-5A Current sensor

Ultrasonic sensor:

Ultrasonic sensor is used to measure the how much amount of oil dropped from the machine. It has a four terminal device that is VCC, ground, Echo and trigger signals. Figure 5 shows the ultrasonic sensor. Operating voltage is +5V. Ultrasonic sensor have two eyes one is transmitter another one is receiver. Basically, this sensor used with microcontroller as well as processor. Trigger and Echo pin act us a both input and output pins. It measuring range is 20cm to 120 cm.



Fig. 5 Ultrasonic sensor

Technology Used

In this paper industrial machine is monitored using industrial Internet of Things technology (IIoT) and data received from the cloud

Industrial Internet of Things (IIoT):

Industrial Internet of Things refers the interconnection of sensors networking together with a computer or mobile due to industrial application. It is used in industry 4.0. Major purpose of IIoT is to monitor the machine in Real time application. IIoT system can improve some quality of the industrial machine that is connectivity, efficiency, time saving, scalability and cost.

Cloud Platform:

Cloud Computing is used in data retrieved in any hazards location. Also used in data storage. Suitable for 24*7 monitoring. Data are stored in a cloud using ip address. Machine learning is basic concept of cloud computing. In future Industrial process are automated in cloud computing

IV. PROPOSED BLOCK DIAGRAM

The system proposed to condition based monitoring of the machine using Industrial Internet of Things and used to monitor the health condition of the machine. Major component of the project is MODE MCU EPS 8266, its operates on 5V power supply. 230V power supply is converted into 5V using adapter and feed to the NODE MCU EPS 8266. Using MODE MCU we are monitor the machine parameters, Arduino IDE software was used to dump the sensor coding. The oil level, oil temperature, machine temperature, current can be measured with a help of sensors. ACS 712-5A sensor is used to monitor the how much amount of current flow through the machine. Lamp indicates the device is on condition and it placed between current sensor and machine main supply. Two

DALLS DS18B2 temperature sensor directly connected with a NODE MCU. DALLS DS18B2 is a digital temperature probe used to measure the machine temperature as well as oil temperature. Ultrasonic sensor is used to measure the oil level. Ultrasonic sensor has four terminals it is directly connected to the NODE MCU. Using sensor all captured data are transmitted to the cloud with a help of TCP/IP protocol. It is a working of transmitter device

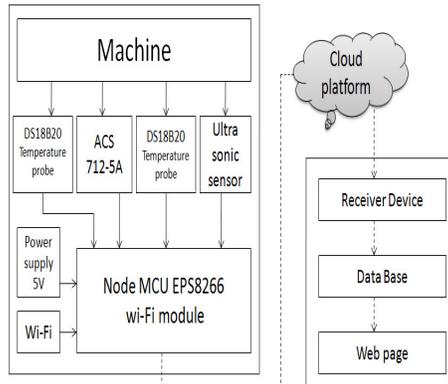


Figure 6: Block diagram of proposed method

Receiver received the data from the cloud in the form time domain values. Time domain value is converted in to frequency domain value using FFT algorithm. Every 30 sec the webpage is automatically refreshed, the machine parameters not only show in frequency domain but also shown the time domain values. The numeric display is refreshed within 5 sec. The webpage is developed using PHP and HTML. HTML coding used to make up the webpage frontend process. PHP is used in backend process. MYSQL was to create the data base, it stored the data.

V. RESULTS AND DISCUSSION

Fig 8 shows the complete setup. The entire Project has been tested with a help of Industrial Motor. The live parameter of the machine can be monitored using webpage.

These data are retrieved from the cloud in the form of time domain as well as frequency domain format. Every 30 seconds the webpage was automatically refreshed and shown the at present data taken from the machine



Fig. 7 Login Page

Fig7 represent the login page. Generally, Login page is used to enter the specific page, application, webpage. A Login is used to track

the user while connected the site. Php was used to create the login page. Login page have a main advantage that is while a login ID and password is correct, next page will be displayed or else data will be protected. Main purpose is the industrial person only handle that data monitoring.

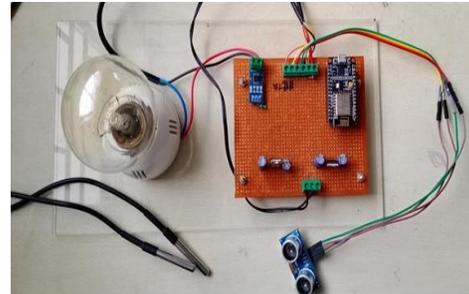


Fig. 8 Entire Project setup



Fig.9 Output in Time domain



Figure 10: Output in Frequency domain

Fig 10 shows the output in frequency domain. In graphical form the four different parameters can monitored in four different colors. Red color represented an oil level, green color represented a machine temperature, yellow color represented an oil temperature and Blue color represented a current level.

VI. CONCLUSION AND FUTURE ENHANCEMENT

With this system remote collection of data about the machine condition can be obtained. Solid monitoring of current, oil level, oil temperature and machine temperature were realized using web interface. The data retrieved from any hazardous location. The data can refresh within 30 sec and automatically update the current data. It was easily monitored

The updating information or the state of industrial machine can be known as with a help of IIoT application. Number of machines

monitored using IIoT application. In future, Condition Based Monitoring can improve by the invention of Artificial Intelligence and Machine learning concepts

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