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IoT Based Advanced Global Industrial Process Monitoring System with Feedback Control

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ABSTRACT: Internet of Things (IoT) is rapidly increasing technology because today's world is internet world. IoT is combination of communication system and embedded system which is used to connect hardware devices to the network or internet. IoT is used for transmission and reception of data. These systems are used to monitor industrial applications by implementing industry standard protocols using IoT. In this system small scale industrial applications like liquidlevel control, energy monitoring etc. can monitor wirelessly through wireless devices, mobiles and laptops. The main aim of this paper is to summarize importance of IoT which will monitor small scale industries. The parameter that is discussed to be measured are vibration, proximity which controls the motor speed depending on the level of vibration.

KEYWORDS*:* MEMS sensor, proximity sensor, ESP8266, Wi- Fi, MODBUS, MySQL, PHP, cloud computing and IoT.

I.INTRODUCTION

Nowadays, industrial monitoring has vital role in industrial area to monitor and control the industrial applications or equipments. Industrial monitoring is used to know dynamic condition of industrial devices or machines. Industrial Monitoring is used to accomplish fast processing, minimize power consumption, to improve quality , lessen expensive systems and global management of industry [1]. There are lot of methods that are available to monitor and control industrial processes like Zigbee, PLC-SCADA, WSN, Internet of Things (IoT) etc. Nowadays, "Internet of Things" is a most favorable technique for industrial process monitoring. IoT is combination of embedded system and communication system in which industrial equipments are connected to internet with the help of wireless sensor network and devices or industrial application can monitor and control through mobiles and laptops. British technology pioneer Kevin Ashton described the word "Internet of Things" in 1999. He described that any physical object in the world can be connected to internet via sensors [2].

Now variety of objects, sensors, devices and any physical object are connected to the internet very easily due to IoT. IoT is also used for exchange and collect of data from physical objects or devices and display it on IoT dashboard through certain communication protocols. IoT is consist of hardware devices like sensors, actuators and drivers which can be connected using zigbee, WSN, bluetooth, ethernet, wi-fi etc. to the internet. For local connectivity LAN, MAN, WAN networks are used as shown in fig.I.

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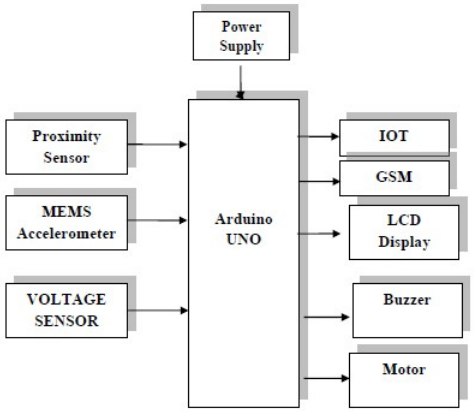

Fig.I. Basic Architecture of IoT

In this paper IoT network is implemented to monitor several common parameters used in industries such as energy, liquid level and DC motor speed control, color mixing using IoT and Programmable logic Controller (PLC) combination. In this paper, industrial process monitoring is done using IoT for different applications. In this proposed system ESP8266 wi-fi modules is used for collecting data from devices and transfer it into a wireless internet. ESP8266 is the most unified Wi- Fi module in the industry; it consists of inbuilt microcontroller and antenna with less expense. Industrial process monitoring system consists of four applications these are PLC based color mixing, liquid level control and monitoring, DC motor speed control and energy monitoring.

This paper consists of 5 sections. Section II describes related work of industrial process monitoring. Section III explains proposed system and section IV describes design and implementation of proposed system. Section V concludes the paper and mentions benefits of these system.

II. RELATED WORK

Cristian, Constantin, Zoltan, Adina, Florica commonly describes benefit and importance of PLC for controlling and monitoring industrial applications. In this system, concrete plant is supervised using Siemens PLC and SCADA software [3]. Ungurean, Nicoleta-Cristina, Gaitan presented a paper on industrial process monitoring using IoT depend on particular OPC.NET [4]. Kannamma, Chanthini, Manivannan presented a paper on industrial automation usng Zigbee. Zigbee system is based on wireless s ens or.

Energy monitoring in industries is really important for decreasing power consumption which is described by Collins, Mallick, Volpe and Morsi. This system consist of human machine interface for monitoring energy consumption of different workstations situated in industries [6]. Truong and Duc-Lung Vu presented a paper on a controlling and supervising a industrial processes or applications remotely using wireless circuitry and android pulpit for example CNC machine is monitored through wireless sensor network [7].

Mukhopadhyay and Mukhopadhyay presented paper on home automization using IoT. IoT is forepart of this system to minimize human efforts. The main aspect of this system to monior and control the home appliances through mobiles and laptops [8][9]. Joshi, Jadhav, Mali, and Kulkarni presented a paper on real time monitoring of PLC data by using EPICS. In this System MODBUS or TCP protocols are used for transmission and receiving of data and also for displaying received data on a web browser [10].

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III.PROPOSED SYSTEM

IoT devices usually have some cloud service to manage the device from the web or mobile applications. The point of a device being networked and it can access effortlessly from anywhere through internet connection. online supervising of industrial process have become most considerable aspect for industrial growth and profit as it is used to decreases process time , and costs as well as their maintenance problem. In this system, industrial processes like energy meter monitoring, DC speed control, PLC based color mixing and liquid level control are monitored through android mobiles, laptops etc. using IoT. The basic block diagram for industrial process monitoring using IoT as shown in fig.II.

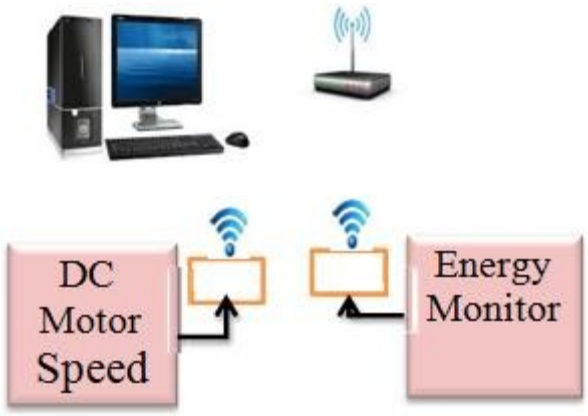

Fig.II. Basic Block Diagram of Industrial Process Monitoring Using IoT

Proposed system uses existing PLCs, industrial equipments and IoT wi-fi module ESP8266. Industry standard protocol is implemented on ESP8266 which acts as intermediate communication link. For demonstration four different industrial applications are taken under consideration out of which one application is focuses.

A. DC motor speed control

DC motor speed control in completely implemented on ESP8266 with use of motor driver. Due to the fast pursuance of DC motors, these motors are widely used in many industrial applications. The prime benefit of using DC motor is that capability to control speed and angle effortlessly. This project describes controlling the speed of DC motor by using ESP8266 module. DC motor speed control is achieved using PWM (Pulse Width Modulation) technique. ESP8266 can generate PWM signals on all I/O lines.

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Fig.III. IoT Dashboard for DC Motor Speed Control

Power is boosted using motor driver. PWM is a technique which is commonly used to control DC motor and analogwrite( ) function is used to generate PWM signal which gives digital pulses like 0 and 1 is used to control an analog circuit. If there is 00 or 11 pulses occur then motor get stop and if there is 01 or 10 pulses then motor will rotate in clockwise or anticlockwise direction respectively. Fig. III shows IoT dashboard for DC motor speed control from which speed and direction of motor can be control.

A. Energy Monitoring

Nowadays, industries understands the need of energy monitoring to achieve less power consumption and to improve economic growth of company .In this system, energy consumed by any devices is monitored using IoT and this can be achieved by implementing RS485 protocols on ESP8266 IoT module. Most of the industries use energy meter with RS485 interface for reading its data. Fig.IV. shows IoT dashboard for energy monitoring.

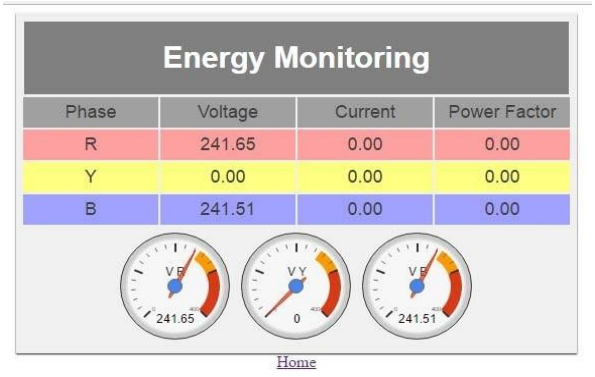

Fig. IV. IoT Dashboard for Energy Monitoring

An energy monitoring based on IoT is used to improve the energy management system in figure VI. The energy monitoring system based on IOT can resolve the problems of transmission and reception of data in by using a variety of techniques such as communication networks, MySQL databases and protocols [12].

IV.DESIGN AND IMPLEMENTATION

The project has been accomplished with the help of PHP, MySQL, Apache software and Arduino IDE. Apache is open source server software. Cloud server is based on Apache. Programming of cloud server is done in

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Notepad like software Sublime text with combination of various web development languages such as HTML, PHP, Jquery and Cascade style sheets.

MySQL is used to record data coming from IoT devices. It is accessed using PHP in HTML web pages for front end GUI. Data is sent to the server using

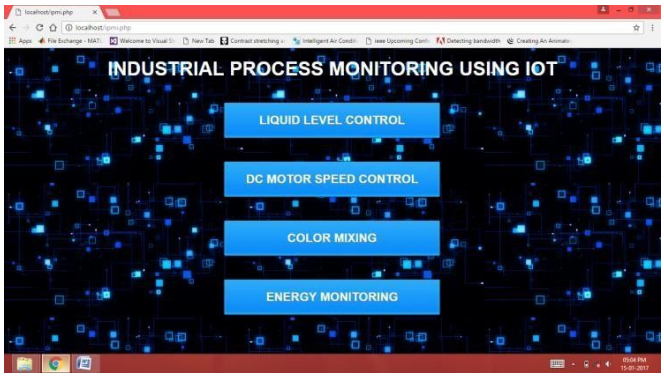

Fig. V. IoT Dashboard of Proposed System

HTTP GET requests and IoT module keeps pooling of server data whenever it requires using same HTTP GET requests. GUI is shown in Fig.II.

Hardware consists of several units for each type of application. Energy monitoring application is implemented using ESP8266 and IC MAX485. It is shown in fig. 4.Major part of this project is to make IoT devices compatible with old industry standard bus i.e. MODBUS. RS485 level conversion is done using MAX485 level converter IC and few external components. Energy meter is connected with IoT module using RS485 bus and in ESP8266 MODBUS protocol is implemented using Arduino IDE C++ language. ESP8266 gives appropriate commands to energy meter to read its energy, electrical parameters such as voltage, current and power factor. ESP module reads the meter using MODBUS and sends data to server using HTTP GET protocol. The get request is decoded using PHP and data is logged in MySQL. It is read back when user request the dashboard page and it is continuously updated on the users web browser.

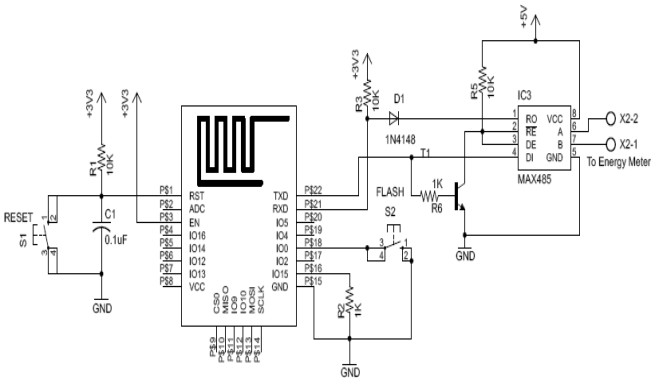

Fig. VI. Circuit Diagram of Energy Monitoring

Power supply requirement for ESP8266 is 300mAmps 3.3V. It is constructed using LM7805 and LM1117-3.3V. 5V is required for RS485 level converter IC MAX485. 5V is generated using LM7805

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and 3.3V using LM1117-3.3. 3.3V is given to ESP8266 IoT module. Circuit diagram for power supply is as shown in fig.VII. With similar type of communication other applications are developed.

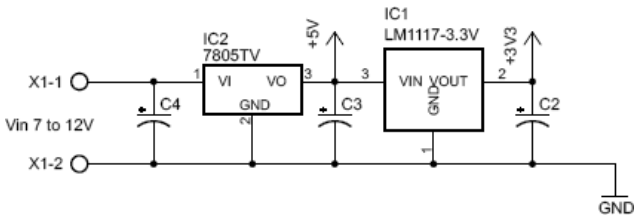

Fig.VII. Circuit Diagram of Power Supply

V.CONCLUSION

The proposed system introduces an IoT based industrial monitoring system by implementing industry standard protocols on IoT module, and data conversion mechanisms for different industrial applications. The processing part of system deals with large amount of data and communication protocols like MODBUS, TCP etc. using ESP8266 wi-fi module. The same system can be used for monitoring different real time applications in industries as per there requirement.

Benefits of use IoT in industry

- Modularity in system
- Ease of maintenance
- Web based remote monitoring
- Elimination of long wiring
- Immediate action on failures

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