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Design And Implementation Of Industrial Automation Using IOT And Bluetooth LE

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Abstract— **This paper is for monitoring and control Industrial parameters such as speed, torque and protection of single phase induction motor from overload by implementing Bluetooth Low Energy (BTLE) based wireless sensor network. The design of the system maintains security, provides high reliability and are susceptible to many types of faults. The system has transmitter and receiver section which are controlled by PIC16F877A Microcontroller. The communication between those sections are made by Bluetooth LE transmitter and receiver section. The parameters such as voltage, current, speed and torque of induction motor were monitored. The monitored values are displayed in LCD and also sent to the server using Internet of Things (IOT) technology. If overload condition occurs, relay driver circuit will open and makes the motor to turn OFF. Thus input values are maintained within the limit and speed of the motor will be in a controlled manner.**

Index terms: **IOT Technology, Bluetooth Low Energy, Induction motor, Overload protection, Speed monitoring,**

I. INTRODUCTION

The Internet of Things (IOT) is a network of physical objects are embedded with devices, sensor, network connectivity are provided with unique identifiers and the ability to automatically collect and transfer data over a network without requiring human-to-human or human-to-computer interaction. IOT has evolved from the convergence of wireless technologies, micro-electromechanical systems and the Internet. The internet of things also called an Internet of objects. Online monitoring system for continuous casting equipment is established based on IOT sensing technology and communication technology. And data transmission protocols, it will lead to a large amount of heterogeneous data of different sensors current and voltage values and the data is difficult to integrate with applications in upper layer. The Internet of Things as connecting heterogeneous devices rather than heterogeneous networks. Automation networks will suggest efficiency improvements. The Internet of Things in automation will increase operational efficiency, lower costs, and improve productivity. The increase in productivity will lead to a growth in labor and wages which lead to higher standards of living.

This strategy of control is ensured by the use of wireless serial Universal Asynchronous Receiver Transmitter (UART) communication protocol in PIC microcontroller. The proposed motor control system is phase control method, the relay is used to ON\OFF the motor and the relay is controlled by the relay driver. The system makes the relay circuit in open condition. Thus the common switch of relay is in contact with NO (Normally Open) switch which makes the induction motor to turn OFF. The motor parameters like temperature and speed is sensed using temperature and speed sensor respectively. Current transformer senses the current flow in the circuit, thus over load occurs the CT sense the current and make the relay to off. The sensors senses the motor parameters like temperature, speed, over current. The overload condition will be displayed in the LCD (Liquid Crystal Display).

II. EXISTING SYSTEM LIMITATIONS

ZigBee wireless network

The wide range of technologies has delayed new deployments and integration with existing sensor networks. There must be some limitations in scalability and number of devices to be used. ZigBee technology uses BPSK modulation which can easily jam in a heavy RF environment. The main disadvantage of ZigBee will be low data speed and high cost.

III. PROPOSED SYSTEM ARCHITECTURE

A. *FEATURES OF THE PROPOSED SYSTEM*

The proposed system uses BTLE for sharing the data between main control unit and of sub units which can be more than one units. This also has following advantages

- Low power consumption
- Low cost
- BTLE uses a frequency hopping spread spectrum that is inherently more robust to jamming in RF environment.

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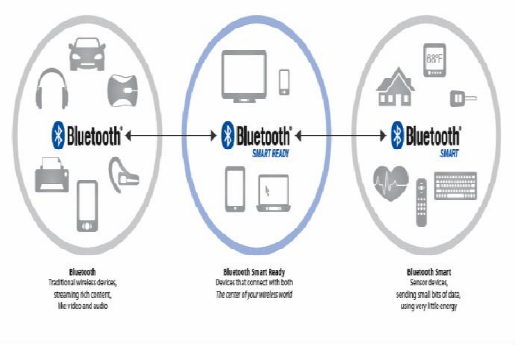
- 128-bit Advanced Encryption Standard (AES) with Counter Mode CBC-MAC and application layer user defined

IV. BLUETOOTH LOW ENERGY (BTLE)

Bluetooth Low Energy (BTLE) is an emerging wireless technology developed by the Bluetooth Special Interest Group (SIG) for short-range communication. In contrast with previous Bluetooth flavors, BLE has been designed as a low-power solution for control and monitoring applications. BLE is the distinctive feature of the Bluetooth 4.0 specification.

The advent of BLE has occurred while other low-power wireless solutions, such as ZigBee, 6LoWPAN or Z-Wave, have been steadily gaining momentum in application domains that require multihop networking. However, BLE constitutes a single-hop solution applicable to a different space of use cases in areas such as healthcare, consumer electronics, smart energy and security.

The widespread use of Bluetooth technology (e.g., in mobile phones, laptops, automobiles, *etc.*) may fuel adoption of BLE, since implementation of the latter can leverage similarities with classic Bluetooth. According to published forecasts, BLE is expected to be used in billions of devices in the near future. In fact, the IETF 6LoWPAN Working Group (WG) has already recognized the importance of BLE for the Internet of Things. As of the writing of this article, the 6LoWPAN WG is developing a specification for the transmission of IPv6 packets over BLE.



V. SYSTEM IMPLEMENTATION

B. *System Hardwares*

In system organization each component contains one or more hardware units and their base execution unit is microcontroller. Below section describes about hardware unit in each component

Master Unit is constructed with

a. PIC 16F877A – 8bit microcontroller,
b. BTLE – RF transceiver
c. ESP8266 –Wi-Fi Transceiver
d. Temperature Sensor LM-35
e. IR Based Speed sensor
f. Current transformer and Voltage transformer
g. Relay driver unit
h. LCD Display unit

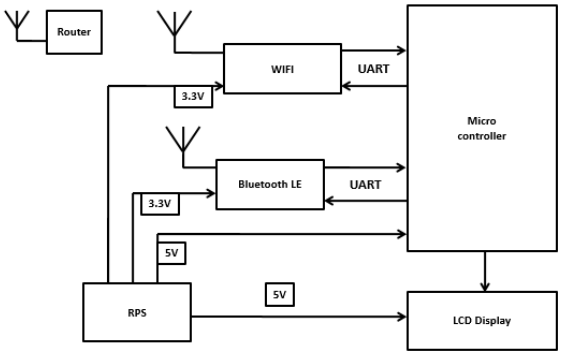


Figure1: Main Control Unit

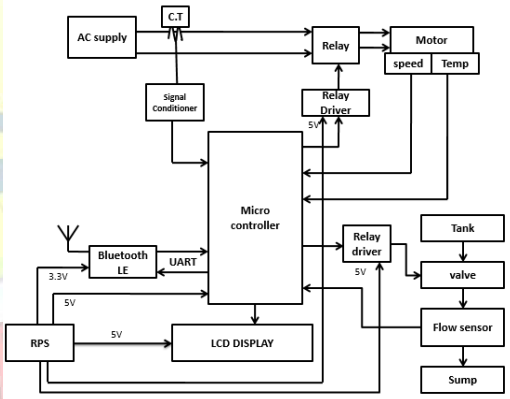


Figure2: Sub control Unit

The schematic of protection and monitoring system is shown in the figure 1 & 2. The workbench was designed to obtain the speed and torque parameters of the single phase induction motor. It has a nominal rotation speed of 1500 RPM. Proximity sensor senses the speed performance of the induction motor which is fixed in front of the shaft. The heat sensor called LM-35 is used to measure the temperature of the motor for each of the rotation. Then the signals from the sensor are transferred to the embedded unit. The PIC16F877A microcontroller controls both the transmitter and receiver section. The read data are sent to the wireless BTLE, which can act as a transmitter and a receiver, transmitter and then to the BTLE receiver through the serial communication using RS 232 port. Thus the speed and torque values were obtained and transmitted to the monitoring unit through BTLE. Those values were getting displayed in LCD as well as sent to the server via WIFI technology. The potential transformer and current transformer is used to find out the voltage and current of the induction motor which can withstand high voltages. If

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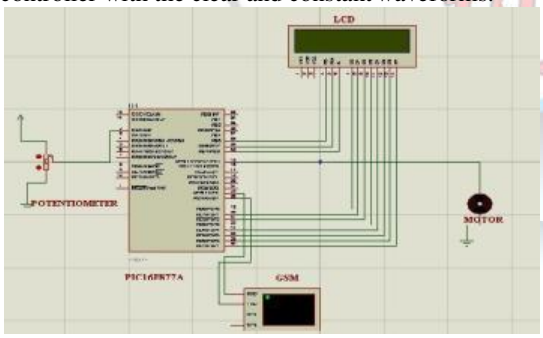
the overload condition occurs, the system makes the relay circuit in open condition. Thus the common switch of relay is in contact with NO (Normally Open) switch which makes the induction motor to turn OFF. Thus the overload condition is prevented by using relay driver circuitry. The input to drive the motor will be given in the keypad. The overload condition will be displayed in the LCD (Liquid Crystal Display) as a message called "motor overload". Thus the input values are maintained within the limit and speed of the motor will be in a controlled manner. Temperature also can be monitored frequently to stop the motor in case of any abnormal condition and will be displayed in the LCD.

The whole monitoring and control operation can be controlled from Internet.

VI. DEVLOPMENT OF SIMULATION BLOCKS

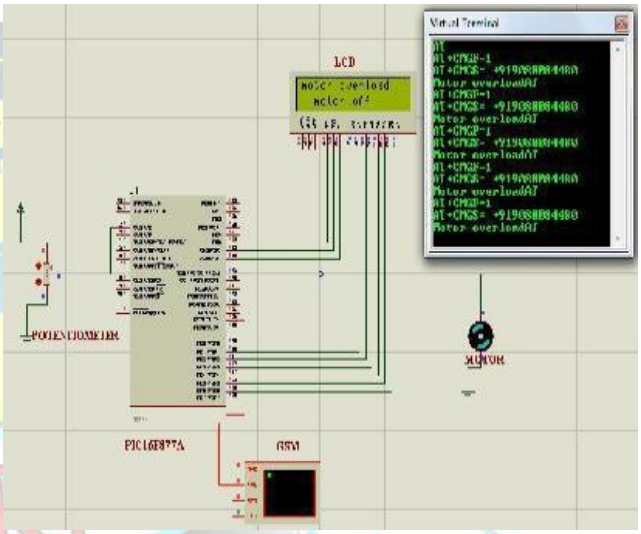
A. Speed monitoring of motor using PROTUES Simulation

The simulation model with and without controller for speed monitoring of three phase induction motor are shown in the figures 2 and 3. This model has IGBT (Insulated Gate Bipolar Transistor) which converts the DC (Direct Current) to AC (Alternating Current). The converted AC current is fed to the motor through three legs of the IGBT transistors and three phase V-I measurement block [5]. This V-I measurement block is used to produce the voltage and current of the motor. The resulting speed will be RPS (Rotation Per Second) which is converted into RPM (Rotation Per Minute) through gain block. The particular fault period for the occurrence of fault is given in the three phase fault circuit. This system is designed for both the model with PID (Proportional Integral Derivative) controller and without controller. The obtained speed after the transition time is compared with the set speed value and the error is minimized by PID controller [6]. The speed and torque performances will be better with the model having PID controller with the clear and constant waveforms.



B. Overload protection of a motor using Proteus 7.2

The simulation circuit for overload protection of the motor is designed using Proteus 7.2 software which is shown in the figure 4. The required components are picked form the library block of Proteus design schematic and placed in the model. The pins from PIC16F877A microcontroller are interconnected with the 16x2 LCD display, BTLE module and motor. The voltage produced from the potentiometer is given as the input to PIC16F877A microcontroller. The baud rate set for BTLE module is 9600. Two conditions are verified here. First, what happens to the motor, if the set input voltage is getting exceeded. Second, what happens to the motor, if the set input voltage is not getting exceeded. This input voltages are specified in the program which is written in embedded C language. The tool used here is the MP lab IDE with CCS compiler software to convert the original code into hex file. The converted hex file is dumped into the PIC16F877A microcontroller in the Proteus design suite. Then the simulation is to be compiled and verify the conditions by increasing or decreasing the voltages in the positive and negative terminals of the potentiometer. Thus the operation of the motor is viewed according to the set voltage mentioned in the program. Thus overload of the motor is minimized by displaying the alert messages in LCD and the virtual terminal of the GSM block of the design.



V. CONCLUSION AND FURTHER ENHANCEMENT

CONCLUSION

As the innovation of new technology faces many problems during development stages, this integration of BTLE and IOT based industrial monitoring and control system also have challenges related to standardization, architecture and interfaces with other networks. The integration into the internet will allow for wide access to monitor the sensor data's Such as temperature, speed, current, voltage, etc. this also can be used to control varies industrial parameters.

FURTHER ENHANCEMENT

Currently the BTLE module and the controller are the separate modules. This can leads to increase the size of the system and this will increases the architectural design complexity of the industry. So to have a single compact unit for BTLE and controller unit will be the future enhancement for this paper. Also this should be designed operate using the battery. Once if it is done this design can be used for the domestic purpose.

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REFERENCES

[i]L. Atzori, A. Iera, and G. Morabito, "The internet of things: A survey," Comput. Netw. vol. 54, no. 15, pp. 2787–2805, Oct. 2010.

[ii]L. Foschini, T. Taleb, A. Corradi, and D. Bottazzi, "M2M-based metropolitan platform for IMS-enabled road traffic management in IoT,"IEEE Commun. Mag., vol. 49, no. 11, pp. 50–57, Nov. 2011.

[iii]G. Yovanof and G. Hazapis, "An architectural framework and enabling wireless technologies for digital cities and intelligent urban environments," Wireless Pers. Commun., vol. 49, no. 3, pp. 445–463, May 2009.

[iv]http://searchdatacenter.techtarget.com/definition/sensor-network

[v]http://automationgroup.com.au/wireless-sensors

[vi]http://www.hubbell-automation.com/content/products/specs/specs_files/4300a_wis_dsm_cutsheet.pdf

[vii]http://web.cs.wpi.edu/~rek/IoT/Papers/IoTSurvey2010.pdf

[viii]https://www.mapr.com/blog/14-benefits-and-forces-are-driving-internet-things

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