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Design of Secured Cloud Based Condition Monitoring of Wind Turbine Parameters Using IOT

Ambarish K J,[1*] Bharathi S H[1]

Abstract: At present world, renewable source play extremely imperative responsibility in power industry. The condition monitoring of wind turbine is done by using SCADA system (supervisory control and data acquisition). The present SCADA system requires human machine interface (HMI) to monitoring and maintains the system performance. The maintenance is done by using existing SCADA based system, this systems are quite cost effective and provides less reliability in communication. To overcome this problem we are proposing solution by using internet of things (IOTs). The monitoring is done by using wireless sensor network in IOTs atmosphere by receiving information from sensor devices. The major beneficiation of the proposed paper is to providing the stable and fault free solution for automation using industrial internet of things (IIOTs), which can replace the existing SCADA based automation to provide the secured communication and increases the performance of the system.

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INTRODUCTION

At present world due to rapidly increase growth of human population consumption of natural resource also increases. The renewable energy is the major significant source of energy, one of the traditional methods of generating the renewable energy source is wind energy. Most of the industries are providing the effective solution to improve the cost efficiency, flexibility, scalability, interoperability. The condition monitoring of wind turbines (WTs) is done by using SCADA (supervisory control and data acquisition) systems. The IOT cloud automation proposes an integrated solution for SCADA systems to monitoring the WTs. The "smart" industries are developed by this integrated automation [1].

There are thousands of components across the WTs which resulting lot of different failures. Sometimes monitoring of WTs is difficult because of this SCADA systems are using wired methods to maintain the performance of the systems. To provide the better security and reduce the cost effectiveness, increase the performance across the WTs we are overlapping existing system technologies with new technologies. The internet of thing (IOTs) is the one the emerging technology to providing better operation for industries like transportations and manufacturing industries. The major dimensions of IOT are identification of objects, wireless sensor networks and sensors, embedded systems. The IOT play a very important role in energy, healthcare, defence and some application.

The wireless communication is used to monitoring the WTs, IOT consist of embedded entities, network layer, and control functions. To reduce the network overhead and increase the scalability considering the new research topic wireless sensor networks (WSNs). In this article IOT are developed by WSNs. In the earlier decades industries were monitored by SCADA systems, but this paper proposes new artificial intelligent to condition monitoring of the industry without interference of the human.

GOALS AND OBJECTIVES

To deliver an uninterrupted output and to reduce the maintenance cost, optimize critical monitoring system. To provide necessary data related to industry to a maintenance officer located anywhere at any time. To allow easy use of sensors in order to control industrial machineries simultaneously Control devices will take intelligent decision design by using IOTs.

EXISTING SYSTEM

Manual invention required to monitoring. SCADA systems are used to monitoring the industry. These are the time consuming approaches to detect and generate alert message by manually using human interface.

PROPOSED SYSTEM

[1]Reva Institute of Technology and Management, Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Near Border Security Bustop, Bengaluru, Karnataka-560064, India.
E-mail: ambarishkj5646@gmail.com
*Corresponding author

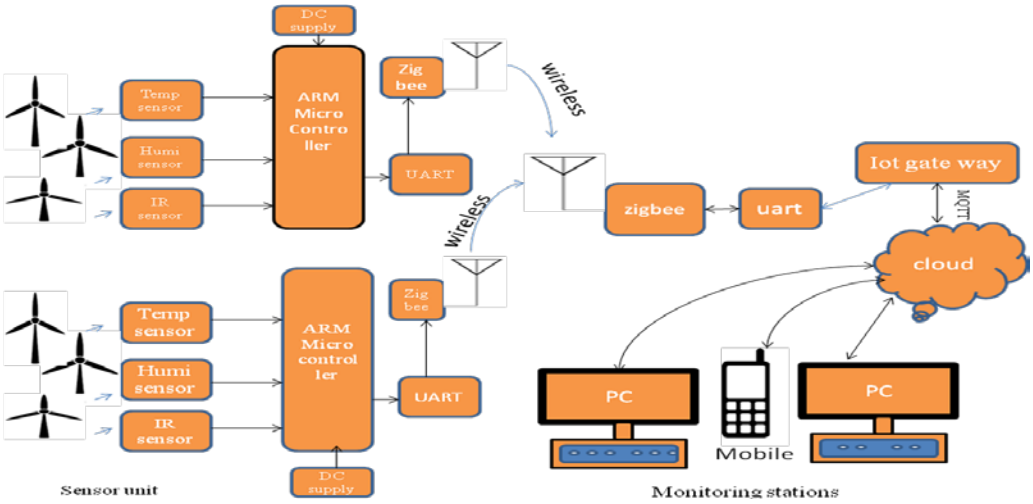

Figure 1: Proposed system

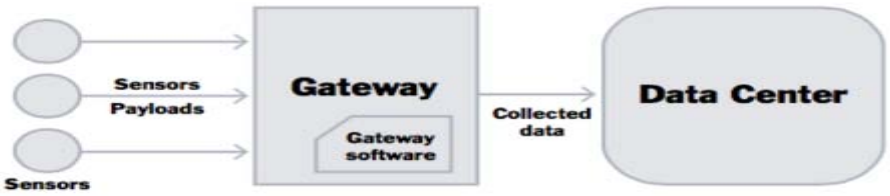

Figure 2: Architecture of Gateway

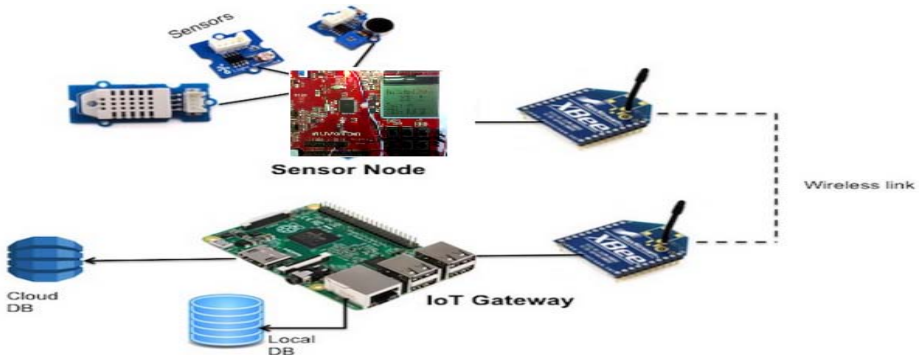

Figure 3: Architectural model of proposed system

The IOT applications are achieved by using raspberry pi which is integrated with raspbian OS or embedded LINUX OS and using the MQTT protocol. The data from the sensor is collected through the WSNs designed for the monitoring the WTs conditions. To provide the communication path between remote station and the monitoring station IBM proposed a IOT Gateways. This IOT Gateways are necessary to provide secured path for communication for monitoring of industry parameters using IOT protocols.

All sensors are connected through ARM microcontroller using for the both wired and wireless technology to monitoring and controlling sequentially by using internet of things. The above system which illustrates that improvement of wireless industry environment measuring light detection, temperature, humidity, fault detection, rotor speeds etc. The core processor used in above system is a Nuvoon'sNUC140VE3N, which is one of the ARM Cortex-M0 core embedded microprocessors for industrial control. The newest ARM processor with 32-bit performance and which can runs up to 50MHz, up to 128K-byte embedded flash, and timers, Watchdog Timer, RTC, USB, ADC,I2c LIN, CAN 16-bit PWM generator and another peripherals. The sensor data is transmitted from the ARM microcontroller to Zigbee using UART communication to the WSNs.

Temperature Sensor

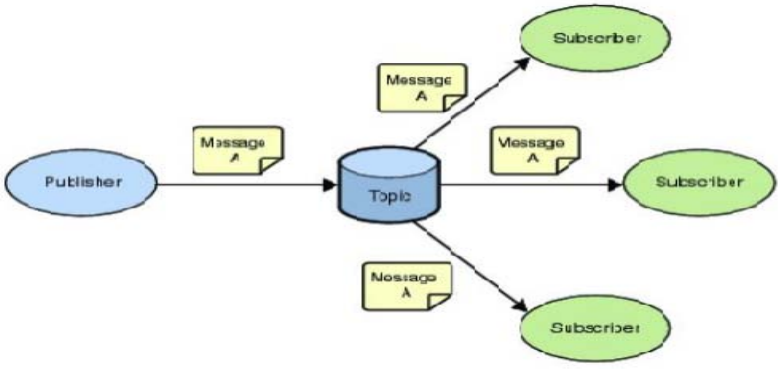

Figure 4: MQTT protocol review

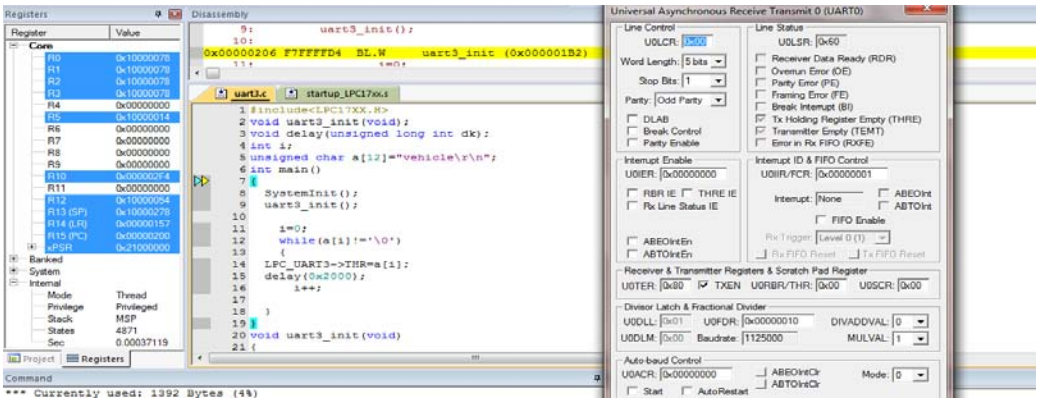

Figure 5: Keil software usage

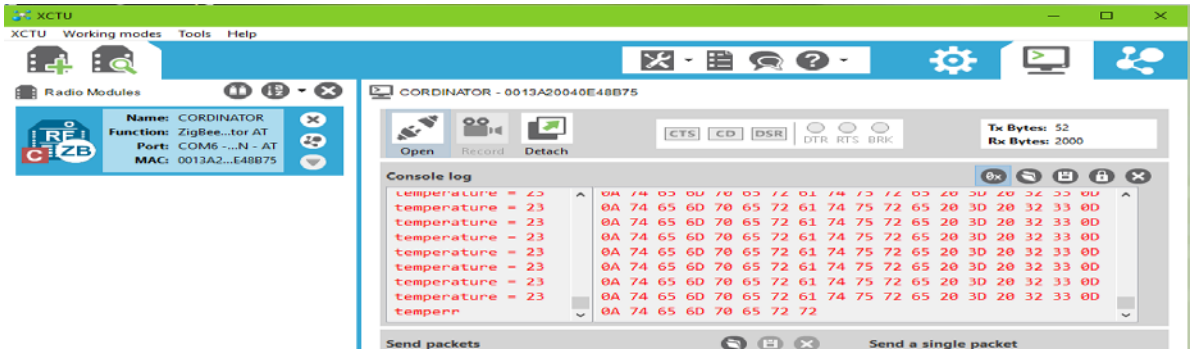

Figure 6: Reading Data from sensor

Temperature sensor is used in various industry applications to maintain the environmental conditions across the industries. In following system LM35 sensor is used to detect temperature across the wind turbines. The temperature is varied according to the environmental conditions across the industries, this variation impact on performance of the system in industries.

Humidity Sensor

Humidity is nothing but the presence of water content in air.In manufacturing industries the amount of water vapor affects human comports and manufacturing processes. The presence of water content in atmosphere also influences physical, chemical, biological process. Therefore humidity across the industries is vital because it may affects the product cost and the health and safety of the personnel's.

IR Obstacle Sensor

IR-obstacle sensor used an obstacle detector which transmits an IR signal to the receiver. In wind turbine this sensor play very impartment role to detects whether the wind fan is working or not, by using the output of this sensor wind fan condition is monitored.

ZigBee Wireless Module

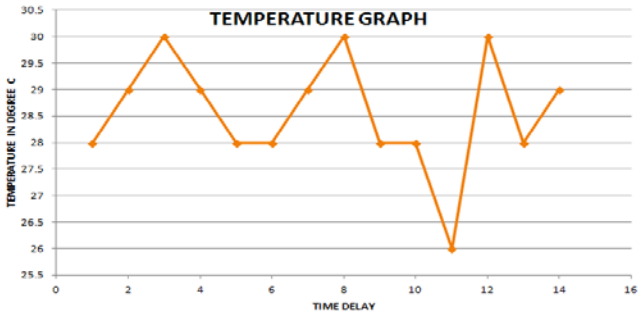

Figure 7: Temperature Response

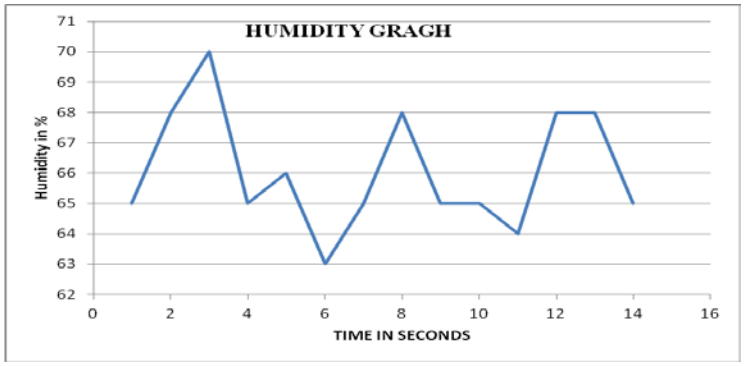

Figure 8: Humidity Responce

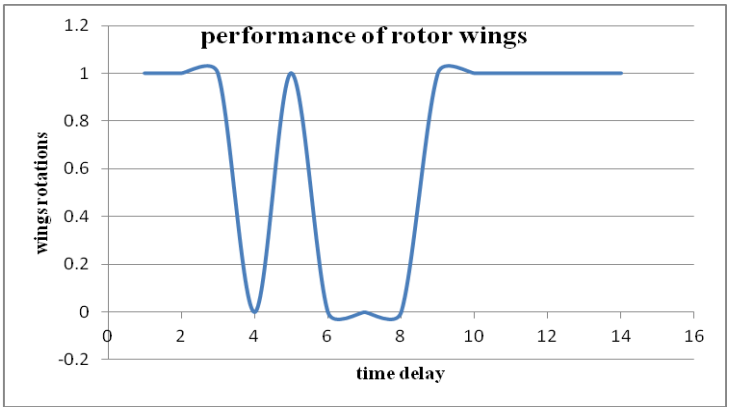

Figure 9: Rotor Performance

Wireless modules are used to achieve the some IOT application across the industries like wind mills, gas ant iol, solar grids. Wireless sensor network communication be developed by using ZigBee protocol. Zigbee is one of high-level communication protocol which can create the personal area network across the industries with low power consumption limits transmition distance. The data can be transferred through serial port between the controllers which are limited to 10-100 meters. To offer extensive range of transmition in excess of extended distance ZigBee protocol uses the mesh network. The main applications of an ZigBee are in the field of wireless sensor network based industries to provide the better network across industries. Major applications are in electrical meters, traffic management systems and other consumer and industries.

IOT Gateway Devices

Gateway is the key component of every IOT solution. In this proposed system raspberry pi is used as IOT gateway device, python script is used to display the data from the sensor node and xbee module connect to raspberry pi for communicating through MQTT and cloud. Industrial IOT automation achieved by using sensor nodes, low-power networks and IOT gateways used for industrial scenarios. These gateways are used collect the data from the sensor nodes interconnected with the microcontroller through a

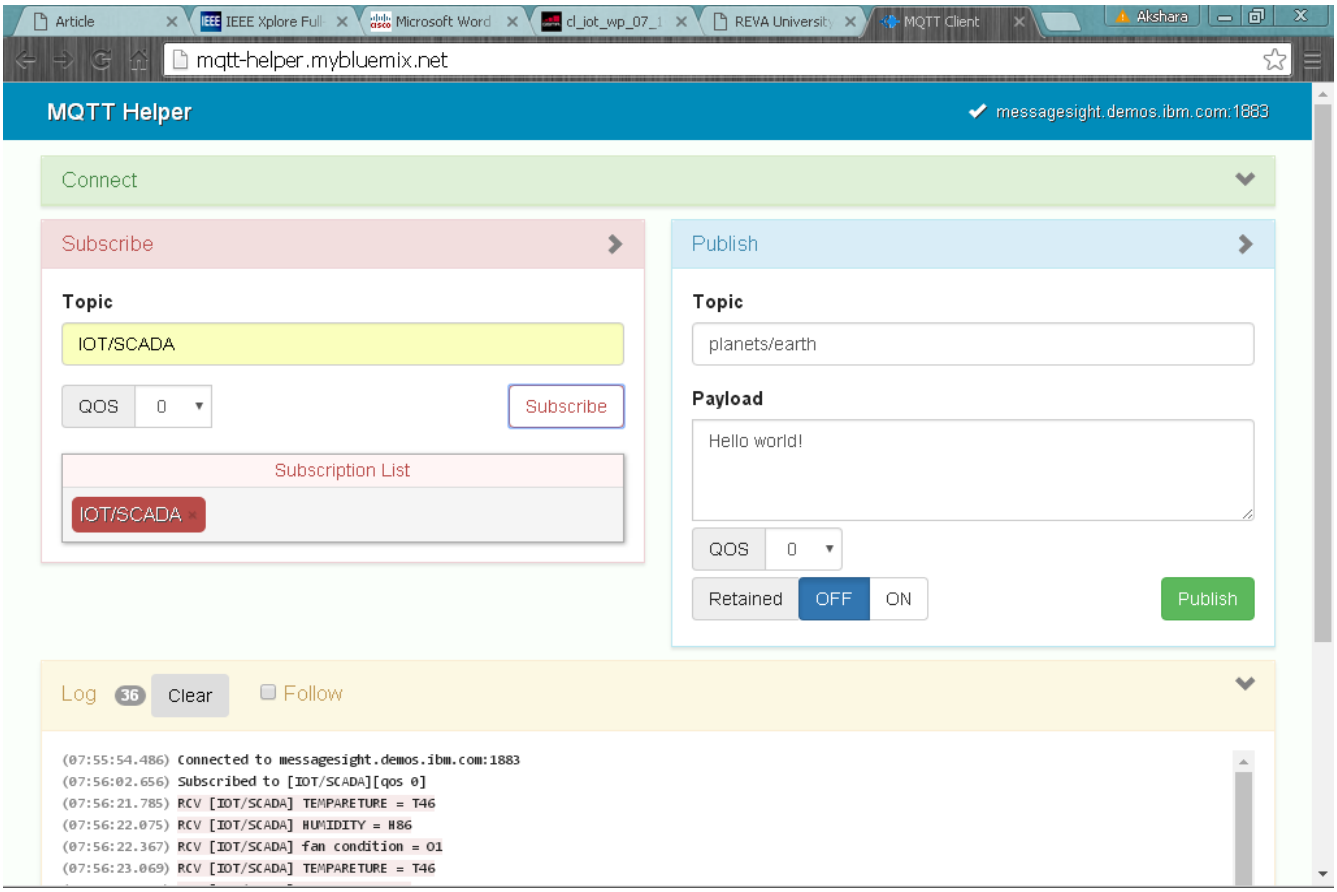

Figure 10: Output of proposed system

radio module. The simple gateway architecture is shown in Figure 2.

The gateway supports the multiple communication protocols which accept the data from the sensor nodes. To access the Sensor node directly the connections are established between internet and cloud using gateway devices. Some of the protocols which are used to bound the sensor node and cloud are MQTT, CoAP, STOMP and even sms.

Protocols Review

The IOT protocols were introduced to provide the secured communication between the cloud and the IOT gateways. In this article MQTT (Message Queue Telemetry Transport) protocol is used for M2M communication. MQTT has a client/server model, where the sensor is act as client model and TCP/IP act as broker. The broker receives messages from client by using subscriber and publishes the message using address called "topic". The main goal of these protocols is to collect the data from sensor node and transport that to an cloud to control and monitor the industry parameters. The following figure explaining us how the messages are published / subscribed from the gateway devices.

SOFTWARE TOOL USED

Embedded C Programming

Embedded C programming is extended language of C programming. To address the common issues in C language embedded c language was developed.

Keil uvision4 IDE

The Keil µVision4 IDE tool is a -based programming advancement stage depends on window that consolidates current a powerful and editorial with a task administrator and make facility tool. It joins each one of the instruments anticipated that would make introduced applications including C/C++compiler, large scale constructing agent linker/locator, and a HEX record generator. µVision4 offers different elements and focal points help the engineer to make inserted applications quickly and successfully. The Keil gadgets are definitely not hard to use, and are guaranteed to offer you some help with accomplishing your arrangement destinations in a favorable way. Figure demonstrates the recreation of accelerometer where it interfaced and those data to the uart.

OUTCOMES OF THE PROPOSED SYSTEM

ZigBee

ZigBee is a protocol used to provide the communication network between sensor nodes and microcontroller. In this

article XBee series2 modules are used to provide wireless sensor network. By using XCTU software this XBee modules are tested. The following figure shows that the temperature across the wind turbines. This sensor values is collected by using microcontroller.

The following graphs shows the temperature, humidity and performance of the rotor wings

The following figure showing that the cloud based monitoring of the wind turbines by using IOT. The MQTT protocols are used to provide communication between the IOT gateway devices and the cloud to monitoring the WTs by using wireless stems

CONCLUSION

The article explains an excellent wireless monitoring for wind turbine systems. The cost of monitoring system gets reduced by using the wireless network and low cost controller and low power consumption equipments. The basic concept of a internet of things and its basic platforms of operation, both hardware and software platforms are summarized and also replace the existing SCADA based automation by industrial internet of things. Wireless sensor network is used to send the data between the monitoring station and the remote working station using IOT protocols (MQTT).

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