ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 9, September 2014

Data Management Using Wireless Sensor Networks in Industrial Applications

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ABSTRACT: A sensor interface device is essential for sensor data collection of industrial wireless sensor networks (WSN) in IoT environments. However ,the current connect number, sampling rate ,and signal types of sensors are generally restricted by the device .Meanwhile, in the Internet of Things (IoT) environment, each sensor connected to the device is required to write complicated and cumbersome data collection program code. In this paper, to solve these problems, a new method is proposed to design a reconfigurable smart sensor interface for industrial WSN in IoT environment, in which ATMEGA328 is adopted as the core controller. The standard of IEEE 802.15.4 intelligent sensor interface specification is adopted for this design. It comprehensively stipulates the smart sensor hardware and software design framework and relevant interface protocol to realize the intelligent acquisition for common sensors. A new solution is provided for the traditional sensor data acquisitions. Performance of the proposed system is
Verified and good effects are achieved in practical application of IoT to industrial environment monitoring.

KEYWORDS: ATMEGA microcontroller, IEEE 802.15.4 protocol, Internet of Things(IoT), sensor data acquisition.

I. INTRODUCTION

WIRELESS SENSOR NETWORKS (WSN) have been employed to collect data about physical phenomena in various applications such as habitat monitoring, and ocean monitoring, and surveillance [1]–[3]. As an emerging technology brought about rapid Advances in modern wireless telecommunication, Internet of Things (IoT) has attracted a lot of attention and is expected to bring benefits to numerous application areas including industrial.WSN systems, and healthcare systems manufacturing[4], [5].WSN systems are well-suited for long-term industrial environmental data acquisition for IoT representation [6]. Sensor interface device is essential for detecting various kinds of sensor data of industrial WSN in IoT environments [7]. It enables us to acquire sensor data. Thus, we can better understand the outside environment information. However, in order to meet the requirements of long-term industrial environmental data acquisition in the IoT, the acquisition interface device can collect multiple sensor data at the same time, so that more accurate and diverse data information can be collected from industrial WSN. With rapid development of IoT, major manufacturers are dedicated to the research of multi sensor acquisition interface equipment [8]. There are a lot of data acquisition multiple interface equipments with mature technologies on the market. But these interface devices are very specialized in working style ,so they are not individually adaptable to the changing IoT environment [9]. Meanwhile, these universal data acquisition interfaces are often restricted in physical properties of sensors (the connect number, sampling rate, and signal types). Now ,micro control unit (MCU) is used as the core controller in mainstream data acquisition interface device. MCU has the advantage of low price and low power consumption, which makes it relatively easy to implement. But, it performs a task by way of interrupt, which makes these multi sensor acquisition interfaces not really parallel in collecting multi sensor data.[10], which enable it to achieve parallel acquisition of multi sensor data and greatly improve real-time performance of the system [11].ATMEGA has currently becomes more popular than MCU in multi sensor data acquisition in IoT environment. However, in IoT environment, different industrial WSNs involve a lot of complex and diverse sensors. At the same time, each sensor has its own requirements for readout and different users have their own applications that require different types of sensors [13].Sensor data acquisition surface device is the key part of study on industrial WSN application [17]. In order to standardize a wide range of intelligent sensor interfaces in the market and solve the compatibility problem of intelligent sensor, the IEEE

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Electronic Engineering Association has also launched IEEE 802.15.4 smart transducer and maintained by consultants which specifies the physical layer and media access control for low-rate wireless personal area networks (LR-WPANs) [18].

II. ARCHITECTURE

We design a data management for industrial applications, data processing, and wired or wireless transmission together. The device can be widely used in many application areas of the IoT and WSN to collect various kinds of sensor data in real time. We program IP core module of IEEE 802.15.4.corresponding protocol in its zigbee. Therefore, our interface device can automatically discover sensors connected to it, and to collect multiple sets of sensor data intelligently, and parallel with high-speed. ATMEGA328 is core controller of the interface device. It is used to control data acquisition, processing, and transmission intelligently, and make some preprocessing work for the collected data[38]. The driver of chips on the interface device is also programmed inside the ATMEGA. Multiple scalable interfaces are designed on the equipment. It can be extended to 6-channel analog signal interface and 14-channel digital signal interface. This ensures that our device can connect with a number of sensors among the application of industrial IoT or WSN and guarantees the diverse collection of the information. In terms of data transmission, our design can wireless communication through Zigbee module. Therefore ,we can choose different transmission mode of the device in different industrial application environments. is the application and working diagram of the data management. In practice, the designed device collects analog signal transmitted from LPG sensors, light intensity sensors, and other similar sensors through an analog signal interface. It can also collect digital signal transmitted from the digital sensors, such as temperature sensors, digital humidity sensors, and so on, through a digital signal interface. The Analog to Digital Converter (ADC) module and signal interface on the interface device are controlled by the ATMEGA, which makes it possible to collect the 6-channel analog signals and 14-channel digital signals circularly, and sets these collected data into the integrated Static Random Access Memory (SRAM) on the interface device. The collected data can be transmitted to the host computer by the Zigbee wireless communication, so that the user can analyze and process the data.

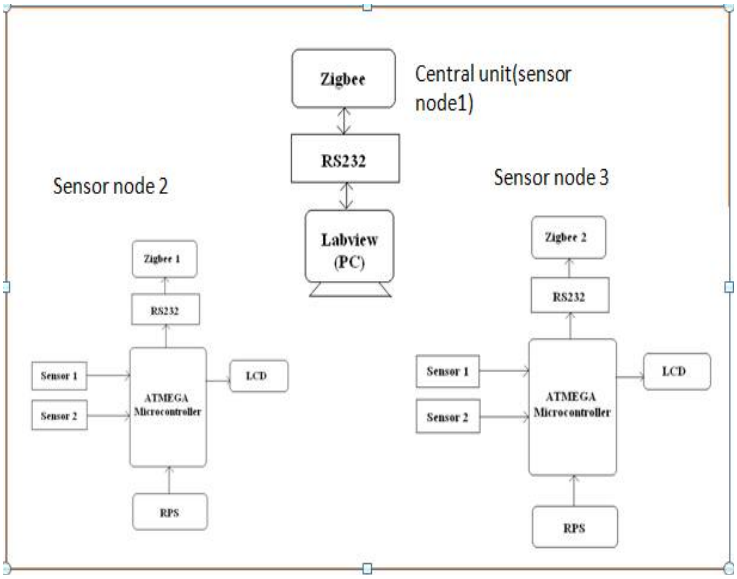

Fig. 1. Block diagram.

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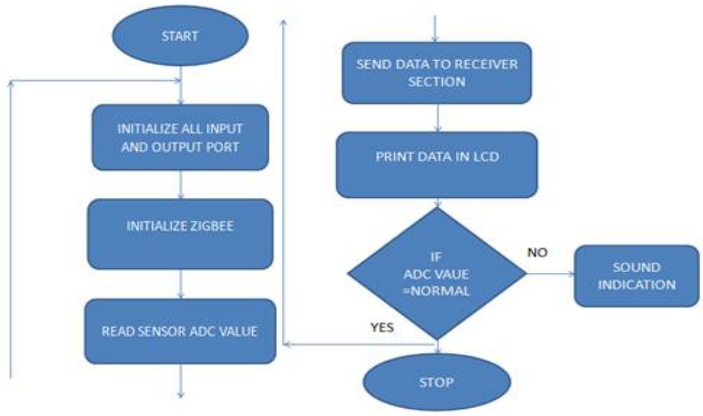

Fig. 2.Flow Chart

IV. IMPLEMENTATION

A. THE INTRODUCTION OF THE HARDWARE ARCHITECTURE:

The overall structure of reconfigurable smart sensor interface consists of ATMEGA328, The Real Time Data Acquisition System structure is designed based on low power consumption micro-controller which is based on ATMEGA328, The monitored data can be transferred to the monitor's using Zigbee transmitter and the data is collected from different sensors like Temperature, Gas, and then input signals in interfaces such as A/D, I2C, RS-232, and PWM . The high-performance Atmega 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts,s erial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes.

The entire hardware system of the monitor is divided into three parts: the slave unit 1, slave unit 2 and the central (monitoring) unit ,an analog extended interface, and three digital extended interfaces. Every extended interface among them can connect eight independent sensors, namely, the smart sensor interface device can access six analog signals and 14 digital signals. The hardware system can also send and receive data besides the basic sensor data acquisition. It can send data to the control center via Zigbee wireless module. Zigbee wireless communication module can be connected with the board through the mini-USB interface or the extensible GPIO interface on the device. It can be used as wireless data transceiver node when the main controller receives trial or executive instructions [39]. After the data control center finished further processing for the received data, it needs to feed back related actions to sensor interface device. Data communication function can also control the running status of corresponding peripheral device.

B.ZIGBEE PROTOCOL:

Wireless communication module consists of 2.4GHz IEEE 802.15.4 based MRF24J40 RF Transceiver Zigbee unit which is used to establish the wireless connectivity of the system. In terms of data transmission, our design can achieve wired communication through Universal Serial Bus (USB) interface and wireless communication through Zigbee module. Therefore, we can choose different transmission mode of the device in different industrial application environments. the design of wireless parameter progress helps in an industry to monitor the parameter in real time with the use of zigbee, is an easy installation platform, cost effective method for the low bit rate transmission, so with the help of the ready zigbee platform by using the PSoC Designer we interface the module with the pc and we monitor the parameters in the system.

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C) MODULE DESIGN OF THE SENSOR INDEPENDENT INTERFACETII:

Sensor independent interface TII is the communication part of the smart transmitter STIM and network capable application processor (NCAP) [42].It interconnects with NCAP through the synchronous serial interface. TII usually includes data output (DOUT) and data input (DIN), which are used to shake hands for data and communication, DCLK is used to make data synchro- nization, and other signal lines such as special function signals are used as alternative choices.using six sensors. Light,temperature,lpg are the analog sensors.IR, proximity,soil moisture are the digital sensors.

The LM35 series are precision integrated-circuittemperature sensors, whose output voltage is linearl yproportional Celsius (Centigrade) temperature. The LM35thus has an advantage over linear temperature sensorscalibrated in ° Kelvin, as the user is not required to subtract alarge constant voltage from its output to obtain convenient Centigrade scaling.lpg sensors are used for the monitaring the pressure. They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, natural gas , town gas, avoid the noise of alcohol and cooking fumes and cigarette smoke. IR sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red(IR) spectrum. A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. LCDs require all most no power to operate.Many LCD calculators can operate from the power of a solar cell, others can operate for years from small button cell batteries LCDs are optically passive displays.

RS232 communication protocol is adopted in design to sup- port the TII interface. The feature of RS232 is completely in accordance with the TII. Function of the interface owns good versatility and usability. As slave device in the system, STIM remains in the standby state, until awaking notification is received from the master device. The notification message is sent from the main equipment, NCAP, or network equipment con- nected to NCAP. NCAP can communicate with STIM through TII's NIOE line and activate the specific channel of sensors through TII's NTRIG line. STIM makes response information through NACK line. This system sends or receives the corre- sponding control or feedback signals through DIN cable and DOUT cable, so as to finish communication between STIM and the upper application software

V. CONCLUSION

This paper describes data management using wirless sensor networks for industrial applications. The system can collect sensor data intelligently. It was designed based on IEEE 802.15.4 protocol by combining with ATMEGA and the application of wireless communication. It is very suitable for real-time and effective requirements of the high-speed data acquisition system in IoT environment. The application of ATMEGA greatly simplifies the design of peripheral circuit, and makes the whole system more fl exible and extensible. Application of IEEE1451 protocol enables the system to collect sensor data intelligently. Different types of sensors can be used as long as they are connected to the system. Main design method of the reconfigurable smart sensor interfacedeviceisdescribedinthispaper.Finally,bytakingreal- time monitoring of water environment in IoT environment as an example, we verified that the system achieved good effects in practical application. Nevertheless, many interesting directions are remaining for further researches. For example, the IEEE 802.15.4 protocol can be perfected and the function of spreadsheet should be expanded. It will have a broad space for development in the area of WSN in IoT environment.

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