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Wireless Sensor Reconfigurable Network Over Iot Using Raspberry Pi

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Abstract:

Wireless Sensor Networks (WSN) has been employed to collect data about physical phenomenon in various applications such as habitat monitoring. 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 environmental systems for data acquisition for IoT representation. A sensor interface device is essential for sensor data collection of industrial wireless sensor networks in IoT environments. Each sensor connected to the device is required to write complicated and cumbersome data collection code. To solve these problems a new method is proposed to design a reconfigurable smart sensor interface for industrial WSN in IoT environment. Thus it can read data in parallel and in real time with high speed on multiple different sensor data. The standard of IEEE1451.2 intelligent sensor interface specification is adopted for this design.

Keywords:
Raspberry Pi, Zigbee, Ethernet, Internet of Things (IoT), Sensor Data Acquisition.

I. INTRODUCTION:

A sensor is a device that detects events or changes in quantities and provides a corresponding output, generally as an electrical or optical signal; for example, a thermocouple converts temperature to an output voltage. But mercury in glass thermometer is also a sensor; it converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. Internet of Things (IOT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IOT is expected to offer advanced connectivity of devices, systems and services that goes beyond machine - to- machine communications (M2M) and covers a variety of protocols, domains, and applications. The inter connection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a Smart Grid.

A. Wireless Sensor Network:

Wireless sensor network (WSN), which integrates sensor technology, wireless communication technology, embedded computing technology and distributed information management technology, has been under rapid development during recent years [4].A wireless sensor network is a collection of nodes organized into an interactive network. Each node consists of processing capability (one or more microcontroller's chips) and contains types of memory, with a Zigbee transceiver module and also, each node have a stable power source and the last part of a node, it is accommodate various sensors and actuators. The nodes communicate wirelessly and often self-organize after being deployed in an ad hoc method. Such systems can revolutionize the way we live and work therefore in this project we want to use WSN technology to control and manage energy in building.

II. DESIGN:

Reconfigurable smart sensor interface device that integrates data collection data processing, and wired or wireless transmission. 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. The overall structure of reconfigurable smart sensor interface consists The central hub collects information from the different frequency channels and controls these channels through the ZigBee module. The central hub sends the state information to a server and then a user can monitor and control the present values using the web based user interface. This facility may create some easiness for the users. The system has been designed for measurement of temperature and LDR parameters. Important functions to the system are the ease of modeling, setup, and use. From the consumer point of view.

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With rapid development of IoT, major manufacturers are dedicated to the research of multisensory acquisition interface equipment [8]. There is 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 is used as the core controller in mainstream data are often restricted in physical properties of sensors (the connect number, sampling rate, and signal types). Now, ARM 11 based Single board computer called raspberry pi. Raspberry pi has the advantage of low price and low power consumption, which makes it relatively easy to implement. It performs a task by way of interrupt, which makes these multisensor acquisition interfaces parallel in collecting multisensor data.

III. INTERNET OF THINGS (IoT):

With the advancements in Internet technologies and WSNs, a new trend is forming in the era of ubiquity [7], [4]. "IoT" is all about physical items talking to each other, where machineto- machine (M2M) communications and person-to-computer communications will be extended to "things" [9], [3]. Key technologies that drive the future of IoT are related to smart sensor technologies including WSN nanotechnology, and miniaturization [8]. Since IoT is associated with a large number of wireless sensor devices, it generates a huge number of data [1]. Sensor data acquisition interface equipment is one of the key parts in IoT applications. Data collection is the essential application of WSN and more importantly it is the foundation of other advanced applications in IoT environment [2]. IoT is a major drive to support service composition with various applications [3]. The architecture of IoT is illustrated as in Fig. 1.

Fig1. Architecture of IoT

It consists of three layers: 1) perception layer; 2) network layer; and 3) application layer [34].

The design of data acquisition interface is mainly applied to the perception layer of IoT [5]. The perception layer of IoT is mainly composed of sensors, Zigbee, M2M terminals, and various data collection terminals [6]. The data acquisition interface is responsible for the integration and collaboration of various environments and collection of sensor data. Examples of such a workflow include a environment monitoring system that adopts sensors to temperature and light [7]. Environment monitoring is one of the IoT application fields, where complexwater quality information, is used to determine the environmental quality at the same time. However, currently, there are few data collection device that are dedicated to quality monitoring on the market. Such devices can ensure high speed of data acquisition for multiple sensors and adapt to complex and various sensor types well. Thus, we design and implement a WSN data acquisition interface that can be used for environmental monitoring.

IV. IMPLEMENTATION:

The overall structure of reconfigurable smart sensor interface Consists as below A. Raspberry Pi The Raspberry Pi is a credit-card sized computer that plugs into your TV and a keyboard. It is a capable little computer which can be used in electronics projects, and for many of the things that your desktop PC does, like spreadsheets, word-processing and games. It also plays high-definition video. We want to see it being used by kids all over the world to learn how computers work, how to manipulate the electronic world around them, and how to program. The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

Fig2. Raspberry Pi Board (ARM11).

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B. Zigbee :

Zigbee is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries and the mesh networking provides high reliability and larger range. Zigbee has been developed to meet the growing demand for capable wireless networking between numerous low power devices. Zigbee is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices.

C. Temperature Sensor (lm35):

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range.

D. LDR:

LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1,000,000 ohms, but when they are illuminated with light, the resistance drops dramatically. Thus in this project, LDR plays an important role in switching on the lights based on the intensity of light i.e., if the intensity of light is more (during daytime) the lights will be in off condition. And if the intensity of light is less (during nights), the lights will be switched on.

E. Ethernet:

Ethernet is a shared-media LAN, which means that all stations on the segment use a part of the total bandwidth. Depending on the type of Ethernet implemented, this total bandwidth is a 10 Mbps (Ethernet), 100 Mbps (Fast Ethernet), or 1000 Mbps (Gigabit Ethernet). In a shared Ethernet environment all hosts are connected to the same bus and compete with each other for the bandwidth. In such an environment packets meant for one machine are received by all the other machines.

V. EXPERIMENTAL RESULTS:

The following figure shows the kit arrangement of Master module. Initially RaspberryPi board is powered by using adapter. HDMI to VGA connector is connected to the monitor to boot up the Raspberian OS and start the application using Qt UI. Master unit reconfigures to Sensor Unit 2 when ever button is pressed on html page and corresponding operation information sent to Zigbee module and to the controller to perform the action otherwise Master unit configures to Sensor nit 1 and displays current status of sensors connected to the module.

Fig: Arrangement of Master Module

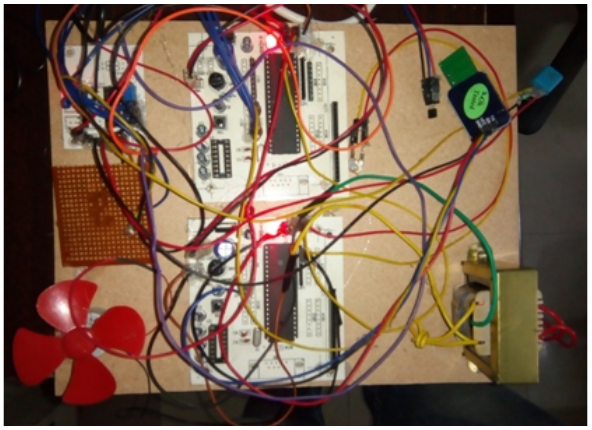

Fig: Kit Arrangement of Sensor Units

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LM35 and LDR are connected to the Sensor Unit 1 and Fan and Light devices are connected to Sensor Unit 2 for testing purpose, any device could be connected as per the application.

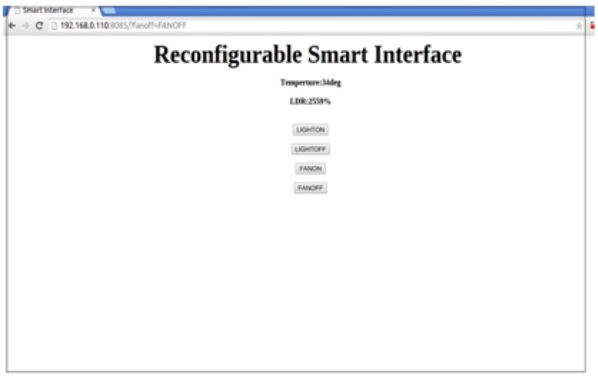

Fig: Data view over web page

Above figure shows the buttons to be pressed to operate the corresponding devices and displays the sensors live data. This page is configured to port 8085.

VI. CONCLUSION:

This paper describes a reconfigurable smart sensor interface for industrial WSN in IoT environment. The system can collect sensor data intelligently. It was designed based on IEEE1451 Ethernet protocol by combining with ARM 11 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 designed using ARM 11 greatly simplifies the design of peripheral circuit, and makes the whole system more flexible and extensible.

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