

A Survey on Reconfigurable Smart Sensor Interface for Industrial WSN in IoT Environment

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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

KEYWORDS: FPGA, IEEE1415 protocol, Internet of Things (IoT), sensor data acquisition.

I.INTRODUCTION

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. 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; 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. 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. 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. There is a lot of data acquisition multiple interface equipment's 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. 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

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device. MCU has the advantage of low price and low power consumption. In any case, it plays out an undertaking by method for interfere with, which makes these multi-sensor procurement interfaces not by any means parallel in gathering multi-sensor information. Then again, FPGA has unique hardware logic control, real-time performance, and synchronicity which enable it to accomplish parallel obtaining of multi-sensor information and significantly enhance continuous execution of the framework. FPGA has as of now turns out to be better known than MCU in multi-sensor information acquisition in IoT environment. However, in IoT environment, different industrial WSNs involve a lot of complex and diverse sensors. At the same time, every sensor has its own particular necessities for readout and distinctive clients have their own applications that require diverse sorts of sensors. Sensor data acquisition surface device is the key part of study on industrial WSN application. In order to standardize a wide range of intelligent sensor interfaces in the market and solve the compatibility problem of intelligent sensor, the IEEE Electronic Engineering Association has likewise propelled IEEE1451 brilliant transducer (STIM) interface standard convention suite for the future improvement of sensors. The protocol stipulates a series of specifications from sensor interface definition to the data acquisition.

II.LITERATURE SURVEY

Mihai T. Lazarescu [1] The Internet of Things (IoT) gives a virtual view, through the Internet Protocol, to a huge assortment of genuine items, going from an auto, to a teacup, to a working, to trees in a timberland. Its allure is the ubiquitous generalized access to the status and location of any “thing” we may be interested in. Wireless sensor networks (WSN) are well suited for long-term environmental data acquisition for IoT representation [2] Large-scale electromagnetic transient simulation of power systems in real-time using detailed modelling is computationally very demanding. This study introduces a multi-field programmable gate array (FPGA) hardware design for this purpose. A functional decomposition method is proposed to map FPGA hardware resources to system modelling. Real-time results are compared with offline simulation results, and conclusions are derived on the performance and scalability of this multi-FPGA hardware design. A. Myaing and V. Dinavahi [3] This paper presents a field-programmable gate array (FPGA)-based real-time digital simulator for power electronic apparatus based on a realistic device-level behavioural model. A three-level 12-pulse voltage source converter (VSC)-fed induction machine drive is implemented on the FPGA. The VSC model is computed at a fixed time step of 12.5 ns, allowing a realistic representation of insulated-gate bipolar transistor (IGBT) nonlinear switching characteristics and power losses. Real-time simulation results have been validated using the measured device-level IGBT characteristics. W. Viriyasitavat, L. Xu, and W. Viriyasitavat[4] The emergence of the Internet-of-Things (IoT) allow to the capacity to recognize physical items, as well as to distinguish many sorts of virtual articles, including administrations. Such identification plays a crucial role in service workflow. The success of a service workflow requires the composition of services where requirements must be satisfied. This paper depends on the past dynamic work on Service Workflow Specification dialect (SWSpec), the formally dressed portrayal of necessities, and the consistence checking algorithms based on Constrained Truth Table (CTT) and Exclusive Disjunctive Normal Form (EDNF) ready to keep running in polynomial time.

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III. METHODOLOGY

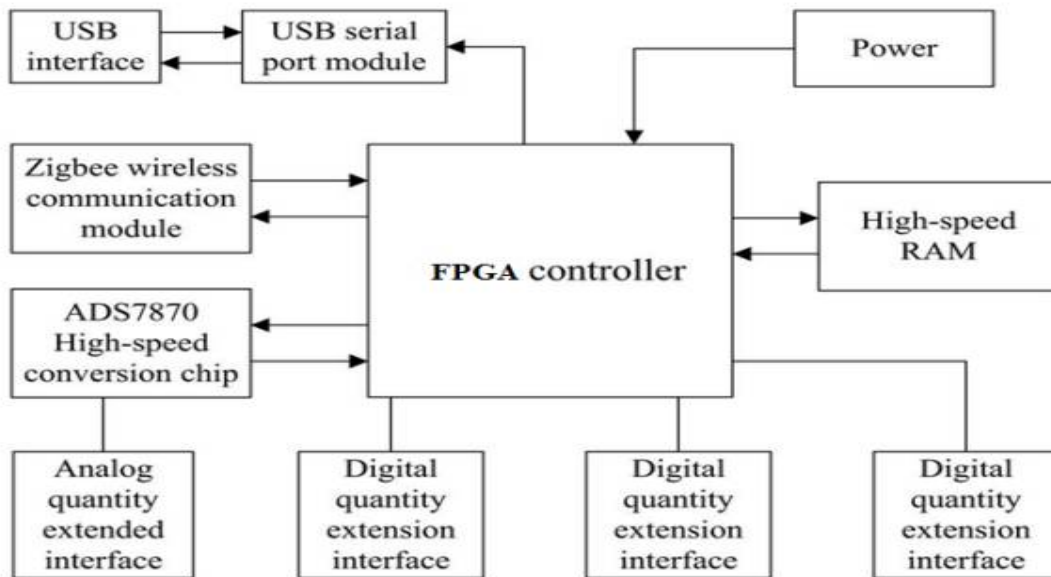


Fig.1:FPGA hardware block diagram.

We design a reconfigurable smart sensor interface device that integrates data collection, 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 in FPGA. 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. FPGA is core controller of the interface device. It is used to control data acquisition, processing, and transmission intelligently, and make some pre-processing work for the collected data . The driver of chips on the interface device is also programmed inside the FPGA. Multiple scalable interfaces are designed on the equipment. It can be extended to 8-channel analog signal interface and 24-channel digital signal interface. 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. Fig. 1 is the application and working diagram of the reconfigurable smart sensor interface device. The designed device collects analog signal transmitted from color 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 FPGA, which makes it possible to collect the 8channel analog signals and 24-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 side by way of USB serial wired communication or Zig-bee wireless communication, so that the user can analyse and process the data.

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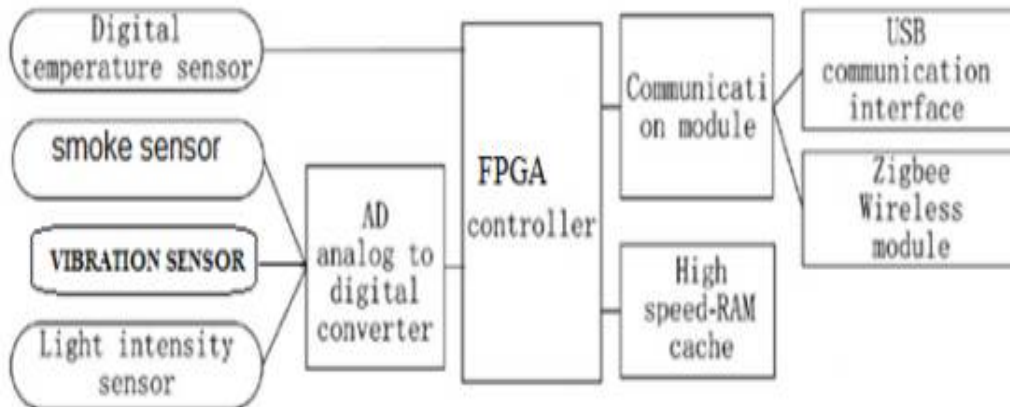


Fig.2: System block diagram.

Fig.2 shows the System block diagram. In this paper we develop a monitoring has higher requirements for equipment and more complex environmental information is needed. MINE SYSTEM information should be collected as much as possible on the kinds and the accuracy. But the MINE SYSTEM equipment used now has many disadvantages, such as bulkiness, complex design, and high cost, etc. It is not suitable for monitoring conducted by small organizations or individual. In terms of MINE SYSTEM monitoring, it mainly involves the following aspects,

- We can monitor CO₂ LEVEL, internal and external MINE temperature, VIBRATION and light intensity INSIDE MINES
- Multiple nodes are distributed in different areas of MINES.
- Low power battery provides power for the system.

In this project we are going to design a system for mine safety, basically we are design a WSN. This can be compensated with the use of a reconfigurable architecture based processing unit (i.e. FPGA) . In this paper, we have used the FPGA based sensor node architecture, featuring the acquisition of data related to fire (i.e. temperature) furthermore, smoke and transmission of data by directing over high information rate remote systems, for example, We will probably distinguish and foresee mines risk immediately and precisely so as to protect the general population working in mines range. The information is transmitted from test hub to base station fulfilling the vitality effective MAC protocol reducing the loss of information.

HARDWARE COMPONENTS:

Sensors

1. Gas Sensor (mQ2)

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a methane gas sensor that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element.

2. Vibration Sensor

Vibration Sensor is a one of the most regularly utilized module for vibration or tilt location over a specific limit. This module comprising of vibration sensor SW-420 switch and comparator LM393.

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3. Lm 35

The LM35 series Are precision integrated-circuit Temperature devices with an output Voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^\circ\text{C}$ at room Temperature and $\pm 3/4^\circ\text{C}$ over a full -55°C to 150°C temperature range

4. LDR

An LDR or light dependent resistor is also known as photo resistor, photocell, and photoconductor. It is a one type of resistor whose resistance varies depending on the amount of light falling on its surface. When the light falls on the resistor, then the resistance changes. These resistors are often used in many circuits where it is required to sense the presence of light. These resistors have a variety of functions and resistance. For instance, when the LDR is in darkness, then it can be used to turn ON a light or to turn OFF a light when it is in the light.

IMPLEMENTATION

VHDL Design

Very-High-Speed Integrated Circuit Hardware Description Language (VHDL) design of the system includes two parts. One part to uses the VHDL language as the basic tool and write related features of the reconfigurable smart sensor interface device by referring to the standard of IEEE1451.2 agreement. It reflects the difference between reconfigurable smart sensor interface device and general data acquisition card, which has a great effect in intelligently collecting sensor data.

IEEE1451.2

Fig.3 The STIM HDL model can be both (a) standalone or (b) included into a C. Sensor S and actuator A has been attached to STIM. An analysis of the IEEE 1451.2 standard shows how the STIM collects data from sensors, applies calibration laws and holds sensor specifications. It has a modular structure; in fact, each channel has the same underlying architecture. Communication block is conceptually simple and the TII, used to dialog with Network Capable Application Processor (NCAP), is basically a synchronous serial interface with handshake lines (DOUT, data out; DIN, data in; DCLK, data clock), The STIM is a

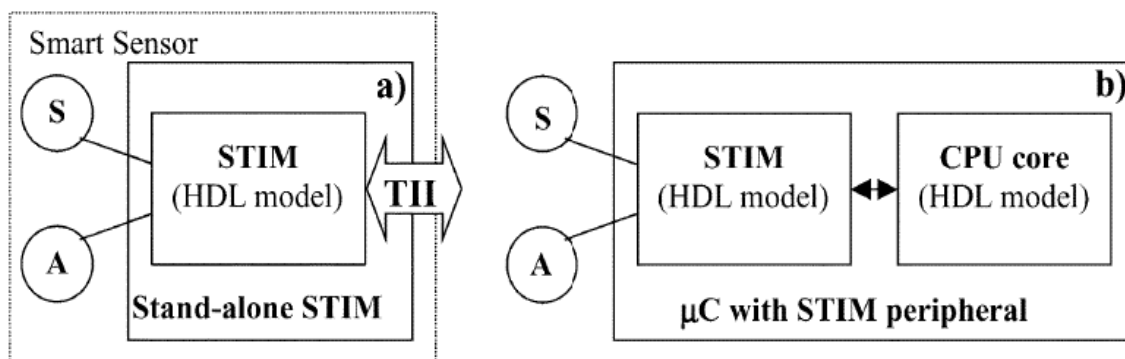


Fig.3: The STIM HDL model can be both (a) standalone or (b) included into a C. Sensor S and actuator A have been attached to STIM

Slave-type device, i.e., it remains in a “quiescent” state until an external stimulus is applied by its master, the NCAP. NCAP can access to STIM data (read or write) asserting the NIOE line signal on TII or can trigger a channel operation (e.g., sensor sampling) asserting the NTRIG. STIM responds driving the acknowledgment (NACK) line.

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IV. CONCLUSION

This paper depicts a reconfigurable smart sensor interface for industrial WSN in IoT environment. The system can collect sensor data intelligently. It was designed based on IEEE1451 protocol by combining with CPLD and the application of wireless communication. It is very suitable for real-time and successful necessities of the high-speed data acquisition system in IoT environment. The application of CPLD greatly simplifies the design of peripheral circuit, and makes the whole system more flexible 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 interface device is described in this paper. At long last, by taking real-time monitoring of water environment in IoT environment as an example, we verified that the system achieved good effects in practical application.

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