

A Review on Reconfigurable Smart Sensor Interface

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ABSTRACT: In wireless sensor network (WSN) a sensor interface device is very important. In the Internet of Thing (IoT) environment, each sensor is connected to the device is required to write a complex & long data collection program code. This paper deals with smart sensor interface: a portable STIM block is obtained using a VHDL model of IEEE1451.2. Hence compact solutions allowing low-cost, small, smart, large- scale production is possible. In order to evaluate the performances of proposed model, the comparison between microcontroller & VHDL-based STIM is done.

KEYWORDS: *IoT, STIM, VHDL, IEEE1451.*

I.INTRODUCTION

Now days, IoT (Internet of Things) is a new creation of the Internet. It gives a stage for communication between objects where objects can organize and manage it. Internet of Things (IoT) is the spreading of internet services because it gives daily life things to connect with user and operate wireless from anywhere. IoT means when the objects or things connected with each other using standard protocols and standard architecture so that they can communicate between each other and all these objects/things can be monitored and controlled by anywhere and anytime using internet.

With rapid development of IoT, major manufacturers are dedicated to the research of multi-sensor acquisition interface equipment .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 utilizing as the core controller in mainstream data acquisition interface device. MCU has the advantage of low cost 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. On the other hand, FPGA/CPLD has unique hardware logic control, real-time performance, and synchronicity, which enable it to achieve parallel acquisition of multi-sensor data and greatly improve real-time performance of the system. FPGA/CPLD 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. During that same time, each sensor need its identity or prerequisites to readout and diverse clients bring their provisions that require different sorts for sensors. It prompts the need for composing intricate Also bulky sensor driver code Also information gathering methods to each sensor recently associated with interface device, which acquires A large number tests of the researches. Sensor information procurement surface device is those key and only ponder looking into streamlined WSN requisition. Paper is organized as follows. Section II describes the literature survey of this project. Section III describes the proposed work of this system and complete methodology of project. Finally, Section IV. conclusion.

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II.LITERATURE SURVEY

The Internet of Things (IoT) provides a virtual view, via the Internet Protocol, to a huge variety of real life objects, ranging from a car, to a teacup, to a building, to trees in a forest. Wireless sensor networks (WSN) are well suited for long-term environmental data acquisition for IoT representation [1] 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.[2] which enable it to achieve parallel acquisition of multi sensor data and greatly improve real-time performance of the system [3] FPGA/CPLD 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 a different type of sensors [4]IoT is associated with a large number of wireless sensor devices, it generates a huge number of data [5]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 [6] 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 [7]

III.METHODOLOGY

In information transmission, our design can achieve wired communication through Universal Serial Bus (USB) interface and wireless communication through Zigbee module. Therefore, we 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 device collects analog signal transmitted from colour sensors, light intensity sensors, and other similar sensors through an analog signal interface. It can 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 CPLD, 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.

The core module of this system is CPLD-based reconfigurable smart sensor interface device designed by ourselves It might great meet the necessities specified previously. Here are the primary solutions: Firstly, we recommended that water turbidity sensor, temperature sensor, CO₂sensor, Also light force sensor ought to be used to gather required data; Secondly, Zigbee remote module associated with the gadget may be embraced to sending and getting information

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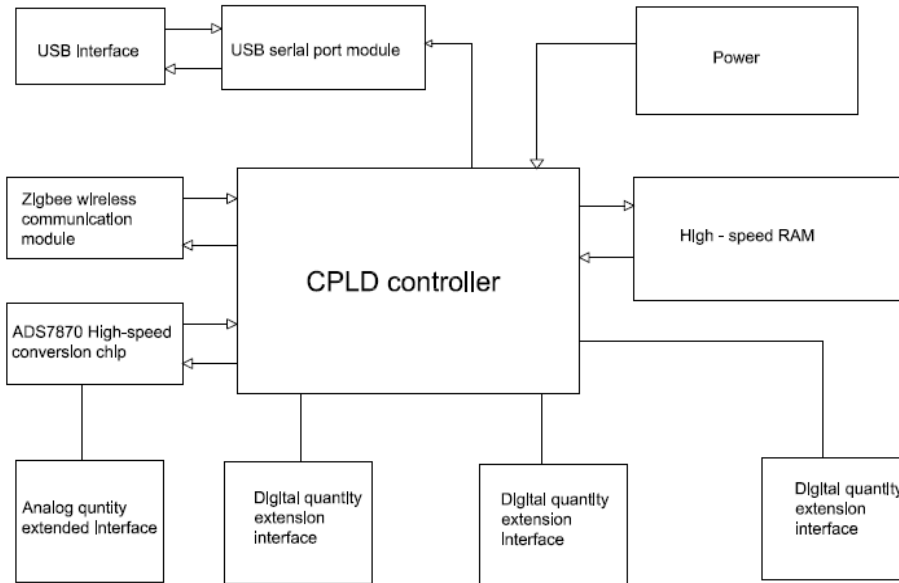


Fig.1 CPLD hardware block diagram.

The STMI is modular structure. An analysis of the IEEE1451.2 gives how the STIM collects data from sensor, holds sensor application and applies calibration laws. The communication part of Network Capable Application Processor (NCAP) [14] and the smart transmitter STIM is the sensor independent interface TII. Fig 1 is the TII function diagram, TII is easy in concept. Because of the interface with handshake lines DOUT (Data Out), DIN (Data In), DCLK (Data Clock) NCAP is basically a synchronous serial interface, as shown in Fig. 1. As slave device system, STIM remains in the standby state, until awaking notification is received from master device. The STMI can read or write data through NIOE line on TII or can activate specific sensor through NIOE line signal on TII. Though NACK line STIM makes response information. Events can also be signalled to NCAP by means of an interrupt (NINT).

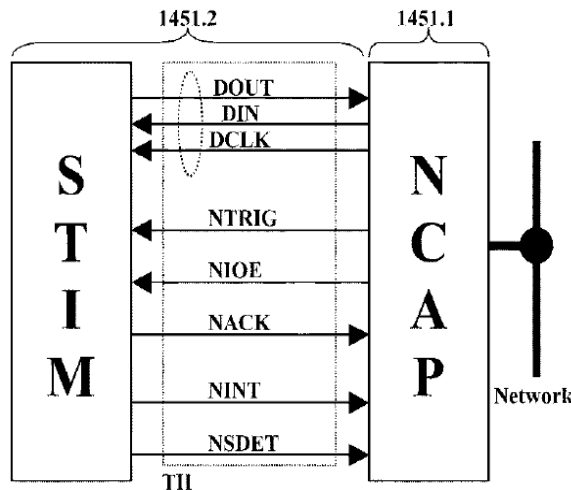


Fig.2 General model of a IEEE1451 smart sensor. Diagram shows TII details data lines and handshake signals.

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The conceptual block diagram of proposed VHDL STIM is shown in Fig.3 The functions of intelligent transducer is mainly controlled by three fundamental state machine modules, which are Main or Master State Machine, Data Transport State Machine, Channel Trigger State Machine and in addition, memory controller with high speed RAM data cache is also involved. The Master State Machine controls effect on Data Transport State Machine and Channel Trigger State Machine and also is responsible for all the primary operations of the STIM. The Data Transport State Machine is responsible for data communication between the upper levels. Through the TII Data Transport State machine can transmit bit, byte and frame data.

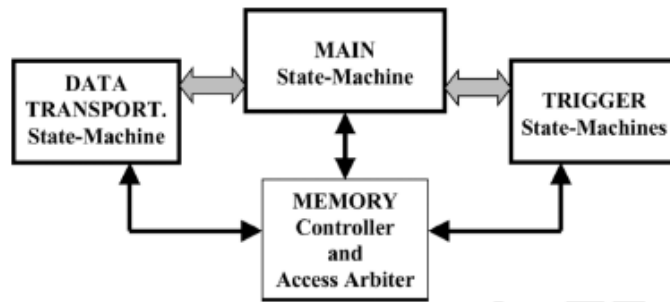
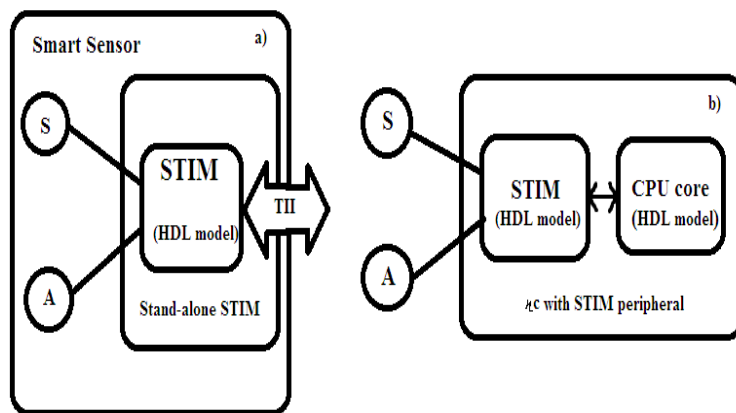


Fig.3 Block diagram of the proposed STIM.

Referring to Fig. 4(a), the VHDL STIM model describes only the block that has been called “Standalone STIM.” According to IEEE1451.2, no hypothesis is done about how transducers and signal conditioning work. The proposed software model represents a transducer as a “digital number” contained in a register. How this number reflects detected physical amount (e.g., its change figure, nonlinearity, and so on) is not concerning the present work. The STIM model, as described here, is not supposed to introduce degradation of metrological characteristics of transducers since it does not apply any kind of mathematical transformation on transducer values. In order to demonstrate the feasibility of the proposed VHDL model, a complete prototype has been built. In addition, two programming based STIM models, acknowledged on a microcontroller, have additionally been considered to make an examination: a business execution proposed by Microchip in the AN214 application note [11] and an enhanced rendition we understood



1.

Fig.4 The STIM HDL model can be both (a) standalone or (b) included into a μ C. Sensor S and actuator A have been attached to STIM.

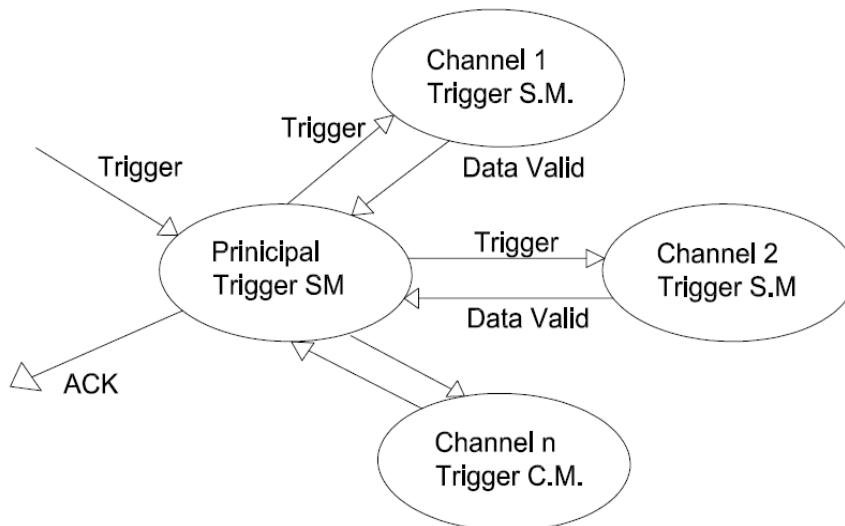


Fig.5 Data reading channel state machine.

The channel trigger state machine is responsible for reading data from the sensors in different channel. Every STIM channel has its corresponding controller of independent channel trigger state machine. These independent channel trigger state machines hidden in the sensor channel' trigger state machine. Fig. 8 shows each channel data reading state machine. These independent channel trigger machines can be started through the corresponding trigger signal. Otherwise, they will be dormant. Each independent sensor channel' trigger state machines possess the same structure, and its implementation process can be executed in parallel. It ensures minimum delay, real-time performance and reliability of data collection in the process of multiple sensor data collection. The differences of different channel types are just reflected in the independent channel types, and the last transmitted data are previously stored in the cache

VHDL configuration

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. The other part, is programming the interface driver based on VHDL hardware description language. It mainly covers [13] programming of each hardware chip driver and sensor driver on the device. The proposed VHDL STIM requires about 850 microcells (55%) and 512 bytes (2%) of RAM, including counters and logic for frequency measurements of Channel 1, as described above. Electronic datasheets (TEDS) are maintained in a RAM bank that is initialized after each reset; initial values can be stored either in an internal EEPROM area or in an external serial EEPROM. In the second case, a serial interface (Serial Peripheral Interface SPI or Inter Integrated Circuits bus IC can be included in the project adding a suitable IP block.

IEEE 1451

IEEE 1451.4 defines a physical connection (Mixed-Mode Interface, or MMI) that is alternately used for TEDS data and analog signals, on either 2, 3 or 4 wires. This adapts the Standard for use with a wide variety of sensors and actuators. Contained in the standard is a definition for a transducer electronic data sheet (TEDS), which allows the use of very small memories, through the use of templates. The small physical size of the memory device allows TEDS to be

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included in tiny, lightweight sensors. However, the low bit-count available in physically small memory devices dictates that only essential data is stored in an array

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 protocol by combining with CPLD 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 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.

IV. 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 protocol by combining with CPLD 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 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.

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