REVIEW ON A RECONFIGURABLE SMART SENSOR INTERFACE USING IEEE 1451FAMILY FOR WSN

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Abstract -- This paper presents a design of the smart module based on the IEEE 1451. A set of common transducer interfaces has been defined in the family of IEEE (Institute of Electrical and Electronics Engineers) 1451 Standards for connecting sensors and actuators to microcontrollers, control and field networks, and instrumentation systems. The standards also defined the Transducer Electronic Data Sheet (TEDS), which allows the self-identification of sensors. The interfaces provide standardized methods to facilitate the “plug and play” of sensors to networks and instrumentation systems.

Keywords—IEEE1451, smart transducer, microcontroller, smart sensors, network capable application processor (NCAP), transducer electronic data sheet (TEDS), wireless sensor.

I. INTRODUCTION

Application development / product development by an industry starts by defining input, process and output definition for the product. Input consists of different parameters sensed by different transducers / sensors in this technological era. For each parameter such as temperature, pressure, humidity, load, different sensors are available. Creating an environment for an application with such diverse parameters to be sensed is a critical job an industry. Thus to solve such a condition wherein each sensor will have different kinds of interfacing circuitry, a system called as “Reconfigurable Smart Sensor Interface using IEEE 1451 family for WSN” is implemented herewith. Reconfiguration is basic feature of IEEE standard. The IEEE electronic engineering association launched IEEE1451 smart transducer (STIM) interface standard protocol suite to solve the compatibility problem of intelligent sensor and to standardize a wide range of smart sensor interface in the market. The protocol define a set of common communication interfaces for connecting transducers to microprocessor-based systems, instruments, and field networks in a network-independent environment. The STIM interface standard, IEEE1451 enables sensors to discover network automatically.

To overcome the drawback of traditional sensor interface device, the work in this synopsis proposes, reconfigurable smart sensor interface using IEEE1451 standard. For this implementation, a controller (LPC2378 or other compatible microcontroller or ARM processor depending on application will be selected) is used to control data acquisition, processing and transmission of data, and make some preprocessing work for the collected data. The work proposes new design method of multi-sensor data acquisition interface that can realize plug and play for various kinds of sensors in WSN. The IEEE1451 interface protocol standard is used for smart sensors automatically discover network.

II. RELEVANCE

Traditional transducers and stand-alone instrumentation result in bulky electronic boxes and in large, long and heavy bundles of cables. Possibilities to add new sensors to traditional systems designs are severely limited.

Transducer are usually selected, tailored or even specially designed and manufactured, and selectively placed in a network according to the system requirements. A transducer node designed
for a system may not be compatible with another system in terms of functionalities and communication requirements or may require tailoring before integrating into another system. It is difficult to maintain and upgrade already existing systems as the newer technology may not be compatible with the older networks. Thus making it costly for the manufacturers to support such diverse market.

III. OBJECTIVES OF IEEE 1451 FAMILY

The IEEE 1451 standard is composed of four parts, 1451.1, 1451.2, 1451.3 and 1451.4. The combination of the four parts define the signal chain from the analog sensor to the digital network. The 1451 family of standards includes –

A) 1451.0-2007 IEEE Standard for a Smart Transducer Interface for Sensors and Actuators – Common Functions, Communication Protocols, and Transducer Electronic Data Sheet (TEDS) Formats

B) 1451.1–1999 IEEE Standard for a Smart Transducer Interface for Sensors and Actuators – Network Capable Application Processor Information Model

C) 1451.2-1997 IEEE Standard for a Smart Transducer Interface for Sensors and Actuators – Transducer to Microprocessor Communication Protocols & TEDS Formats

D) 1451.3-2003 IEEE Standard for a Smart Transducer Interface for Sensors and Actuators – Digital Communication & TEDS Formats for Distributed Multidrop Systems

E) 1451.4-2004 IEEE Standard for a Smart Transducer Interface for Sensors and Actuators – Mixed-Mode Communication Protocols & TEDS Formats

The main objectives of the IEEE 1451 standard are to:

A) Enable plug and play at the transducer level (sensor or actuator) by providing a common communication interface for transducers.

B) Enable and simplify the creation of networked smart transducers.

C) Facilitate the support of multiple networks.

Fig. Conceptual diagram of IEEE 1451

IV. HARDWARE DESIGN

The implementation of IEEE1451 protocol enables the system to collect sensor data intelligently, and makes the whole system become more flexible and extensible. The same smart sensor interface module can be used on multiple control networks, and the selection of a control network for measurement, and control application is totally free of transducer compatibility constraints. Microcontroller is used to control data acquisition, processing and transmission of data, and make some preprocessing work for the collected data.
A) STIM (Smart Transducer Interface Module) - The IEEE 1451.2 standard introduces the concept of the STIM. A STIM can range in complexity from a single sensor or actuator, to many channels (up to 255 channels) of transducers (sensors or actuators). STIM can be used to acquire the data from wireless sensors working on Wi-Fi, Bluetooth, Zigbee and other protocols. A STIM contains the TEDS, logic to implement the transducer interface, the transducer(s) and any signal conversion or signal conditioning. A STIM is controlled by a NCAP module by means of a dedicated digital interface.

B) TEDS (Transducer Electronic Data Sheet) - It stored in a nonvolatile memory attached to a transducer, contains fields that describe the type, attributes, operation, and calibration of the transducer.

C) NCAP (Network Capable Application Processor) – It is responsible for the interface between the external network and the element of the STIM. The NCAP also perform correction of the raw data from the STIM and may include application specific data processing and control functionality.

V. CONCLUDING REMARKS

The smart transducer interface standard provides the enabling technology to ease the connectivity of transducers to microcontroller, control and field networks, as well as data acquisition and instrumentation systems. The transducer vendors and users, system integrators, and network providers can all benefit from the 1451 interface standards for long time. A reconfigurable smart sensor interface module is well suited for the real-time and effective requirements of the high-speed data acquisition system in wired network as well as in WSN.

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