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IMPLEMENTATION OF SMART SENSOR INTERFACE FOR INDUSTRIAL MONITERING IN IOT

[1]S.Prasanth, [2]Mr.V.R.Balaji

[1]PG Student, Department of ECE,
Sri Krishna College of Engineering and Technology, Coimbatore

[2]Assistant Professor, Department of ECE,
Sri Krishna College of Engineering and Technology, Coimbatore

Abstract- WIRELESS SENSOR NETWORKS (WSN) has been employed to collect data about physical phenomenon in various applications such as habitat monitoring, and ocean monitoring, and surveillance. 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 environmental 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 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: IoT, virtual instrumentation, sensor interface, ADC

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 a 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 interconnection 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.Applications

The ability to network embedded devices with limited CPU, memory and power resources means that IOT finds applications in nearly every field. Such systems could be in charge of collecting information in settings ranging from natural ecosystems to buildings and factories, thereby finding applications in fields of environmental sensing and urban planning.

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- Environmental Monitoring: Environmental monitoring applications of the IOT typically utilize sensors to assist in environmental protection by monitoring air or water quality, atmospheric or soil conditions and can even include areas like monitoring the movements of wildlife and their habitats.
- Infrastructure management: Monitoring and controlling operations of urban and rural infrastructures like bridges, railway tracks, on- and offshore- wind farms is a key application of the IOT. IOT devices can also be used to control critical infrastructure is likely to improve incident management and emergency response coordination, and quality of service, up-times and reduce costs of operation in all infrastructure related areas.
- Industrial applications: Network control and management of manufacturing equipment, asset and situation management, or manufacturing process control bring the IOT within the realm on industrial applications and smart manufacturing as well. The IOT intelligent systems enable rapid manufacturing of new products. 1.3.4 Medical and Healthcare systems

B. Virtual Instrumentation

Virtual Instrumentation is the use of customizable software and modular measurement hardware to create user-defined measurement systems, called virtual instruments. 'Traditional' or 'natural' instrumentation systems are made up of pre-defined hardware components, such as digital multimeters and oscilloscopes that are completely specific to their stimulus, analysis, or measurement function. Because of their hard-coded function, these systems are more limited in their versatility then Virtual Instrumentation systems. The primary difference between 'natural' instrumentation and virtual instrumentation is the software component of the virtual instrument. The software enables complex and enables complex and expensive equipment to be replaced by simpler and less expensive hardware e.g. analog to digital converter can act as a hardware complement of a virtual oscilloscope, a potentiostat enables frequency response acquisition and analysis in electrochemical impedance spectroscopy with virtual instrumentation.

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 of CPLD chip (XC2C256 chip), crystals and puerperal circuit, communication circuit for turning USG to serial port (PL2303HXC chips and peripheral circuits), power supply of 1.8 and 3.3V (LM1117 chip, voltage regulator and filter circuit), LED indicator light, an analog extended interface, and three digital extended interfaces. Every extended interface among them can connect eight independent sensors, namely the reconfigurable smart sensor interface device can access eight analog signals and 24 digital signals.

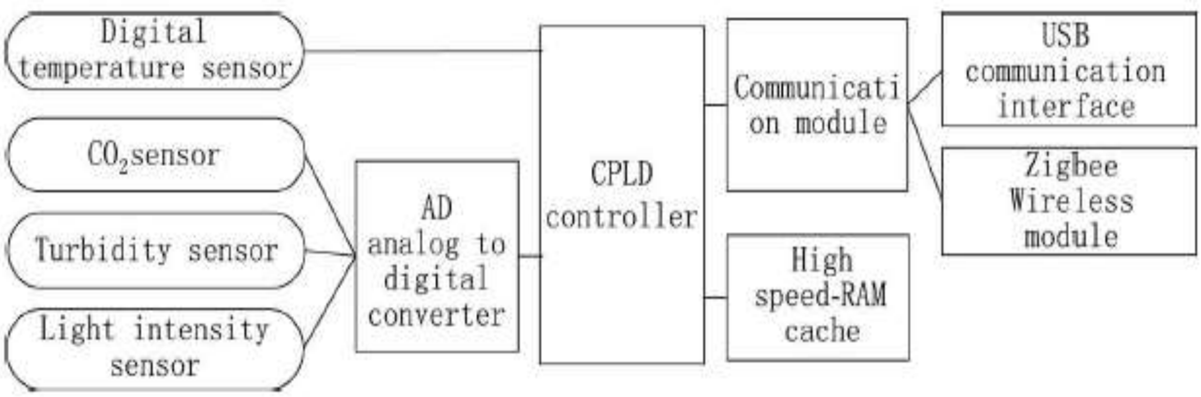

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Fig 1 System's block function design

A.Temperature sensor

Temperature sensors are vital to a variety of everyday products. For example, household ovens, refrigerators and thermostats all rely on temperature maintenance and control in order to function properly. Temperature control also has applications in chemical engineering. Examples of this include maintaining the temperature of a chemical reactor at the ideal set-point, monitoring the temperature of a possible runaway reaction to ensure the safety of employees and maintaining the temperature of streams released to the environment to minimize harmful environmental impact.

B. Light intensity sensor

A Light sensor generates an output signal indicating the intensity of light by measuring the radiant energy that exists in a very narrow range of frequencies basically called "light" and which ranges in frequency from "infra-red" to "visible " up to "ultraviolet" light spectrum. The light sensor is a passive devices that convert this " light energy" whether visible or in the infra-red parts of the spectrum into an electrical signal output. Light sensors are more commonly known as "Photoelectric Devices" or "PhotoSensors".

C. Humidity sensor

Humidity is the presence of water in air. The amount of water vapor in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapor also influences various physical, chemical and biological process. Humidity measurement in industries is critical because it may affect the business cost of the product and the health and safety of the personnel. Hence, humidity sensing is very important, especially in the control systems for industrial processes and human comfort.

D. CO2 sensor

Carbon di oxide (chemical formula CO_2) is a naturally occurring chemical compound composed of 2 oxygen atoms each covalently double bonded to a single carbon atom. It is a gas at standard temperature and pressure and exists in Earth's atmosphere. A carbon di oxide sensor or CO_2 sensor is an instrument for the measurement of carbon di oxide gas. The most common principles for CO_2 sensors are infrared gas sensors (NDIR) and chemical gas sensors. Measuring carbon di oxide is important in monitoring indoor air quality, the function of the lungs in the form of a capnograph device, and many industrial processes.

E.ADC

The analog-to-digital conversion involves quantization of the input, so it necessarily introduces a small amount of error. Instead of doing a single conversion, an ADC often performs the conversions ("samples" the input) periodically. The result is a sequence of digital values that have been converted from a continues-time and continuous-amplitude analog signal to a discrete-time and discrete-amplitude digital signal. Typically the digital output will be a two's complement binary number that is proportional to the input, but there are other possibilities. An encoder, for example, might output a Gray code.

F. CPLD

A complex programmable logic device (CPLD) is a programmable logic device with complexity between that of PALs and FPGAs, and architectural features of both. The main building block of the CPLD is a macro cell, which contains logic implementing disjunctive normal form expressions and more specialized logic operations.

Some of the CPLD features are in common with PALs:

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- Non-volatile configuration memory. Unlike many FPGAs, an external configuration ROM isn't required, and the CPLD can function immediately on system start-up.
- For many legacy CPLD devices, routing constrains most logic blocks to have and output signals connected to external pins, reducing opportunities for internal state storage and deeply layered logic. This is usually not a factor for larger CPLDs and newer CPLD product families.

The most noticeable difference between a large CPLD and a small FPGA is the presence of on- chip non-volatile memory in the CPLD.

G. Communication module

The oddly named Communications Modules form the central time switch of the exchange. 5Ess runs on a Time-Space-Time (TST) topology in which the Time-slot-Interchangers (TSI) in the switching Modules (SM) assign each phone call to a time slot for routing through the CM. CMs perform time-divided switching and are provided in pairs; each module (cabinet) belonging to Office Network and Timing Complex (ONTC) 0 or 1, roughly corresponding to the switch planes of other designs. Each SM has four optical fiber links, two connecting to a CM belonging to ONTC 0 and two to ONTC 1. Each optical link consists of two multimode optical fibers with ST connectors to plug into transceivers plugged into backphone writing at each end. CMs receive time-multiplexed signals on the receive fiber and send them to the appropriate destination SM on the send fiber.

H. USB communication module

USB communications device class (or USB CDC) is a composite Universal Serial Bus device class. The class may include more than one interface, such as a custom control interface, data interface, audio or mass storage related interfaces.

Microsoft windows versions prior to Windows Vista do not work with the networking parts of the USB CDC, instead using Microsoft's own derivative named Microsoft RNDIS, a serialized version of the Microsoft NDIS (Network Driver Interface Specification). With a vendor-supplied INF file, Windows Vista works with USB CDC and USB WMDC devices. This class can be used for industrial equipment such as CNC machinery to allow upgrading from older RS-232 serial controllers and robotics, since they can keep software compatibility. The device attaches to an RS-232 communications line and the operating system on the USB side makes the USB device appear as a traditional RS-232 port. Chip manufacturer such as prolific Technology, FTDI,Microchip and Atmel provide facilities for easily developing USB RS-232 devices.

I.ZigBee wireless module

ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power consumption limits transmission distances, ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. Zigbee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) Zigbee has a defined rate of 250kbit/s, best suited for intermittent data transmissions from a sensor or input device. Application s include wireless light switches, electrical meters with in home displays, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or WiFi.

III. RESULTS AND DISCUSSIONS

A. ADC

An analog-to-digital converter (ADC, A/D. or A to D) is a device that converts a continuous physical quantity (usually voltage) to a digital number that represents that quantity's amplitude. The input to the ADC is a voltage. ADC is designed for voltages from 1 to 10v, from -5 to

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+5v, etc., but they almost always take a voltage input. In any event, the input is an analog voltage signal for most cases. The output of the A/D converter is a binary signal, and the binary signal encoders the analog input voltage. So, the output is some sort of digital number.

- The input can range from 0 to 100 v.
- When the input voltage goes above 50v, the output is a binary one (1).
- When the input voltage is below 50v, the output is a binary zero (0).

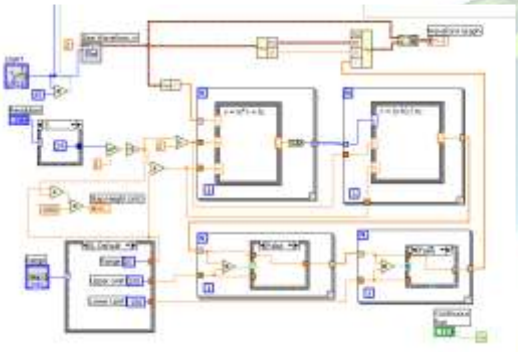

Fig 2: Implementation of ADC

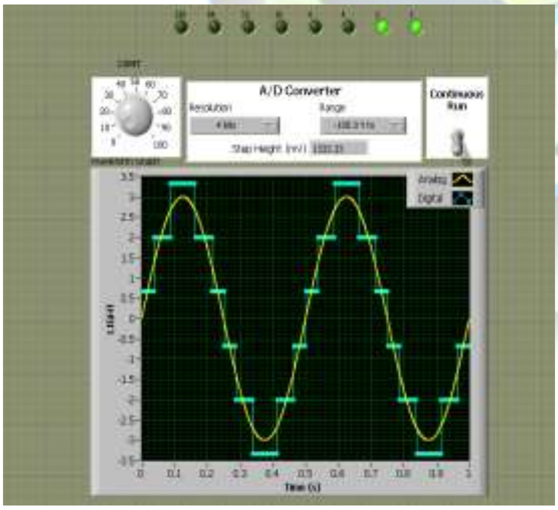

Fig 3:Front panel of ADC

Temperature sensor	45
Humidity sensor	50
Light intensity sensor	9
CO2sensor	35000
Ph sensor	7

Table 1: Threshold limit

B. Binary Conversion

Given analog value is converted to equivalent binary numbers. Analog value is divide by 2 and compare the remainder with constant value 1. The output of this value is given to the led indicator. In this project we have converted for 8 bits.

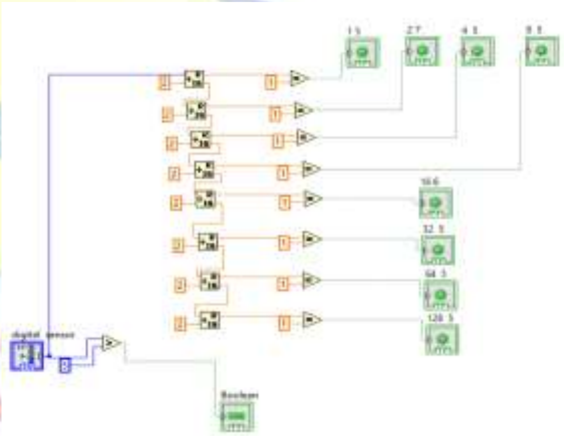

Fig 4: Logic diagram for binary conversion

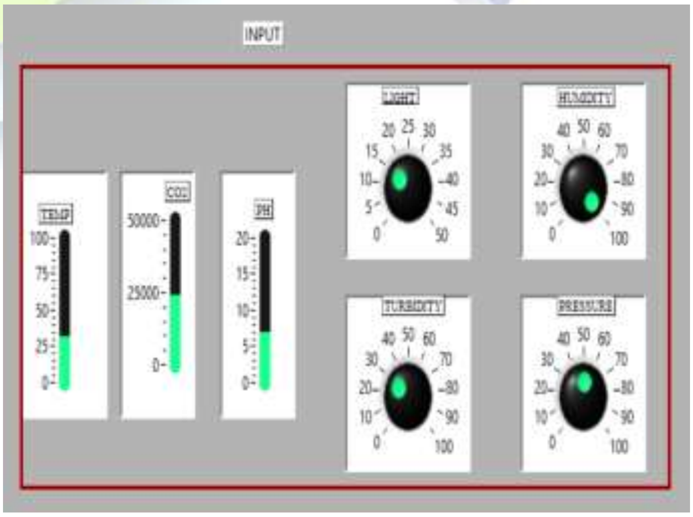

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Fig 5: input

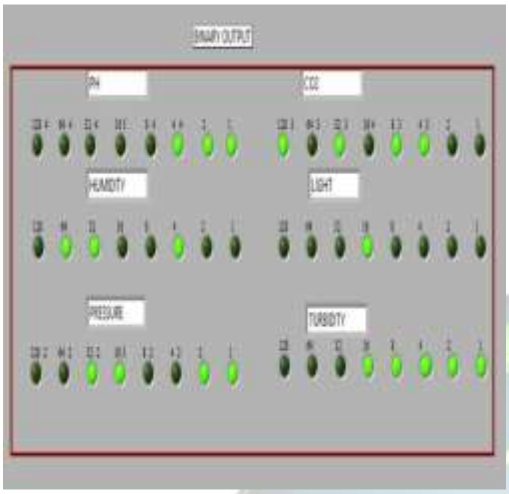

Fig 6: Equivalent binary output

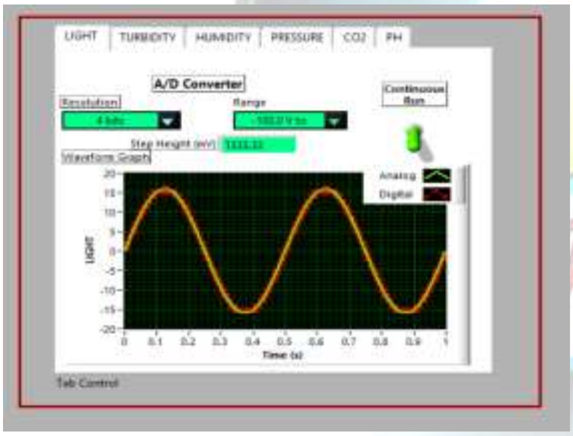

Fig 7: Output waveform

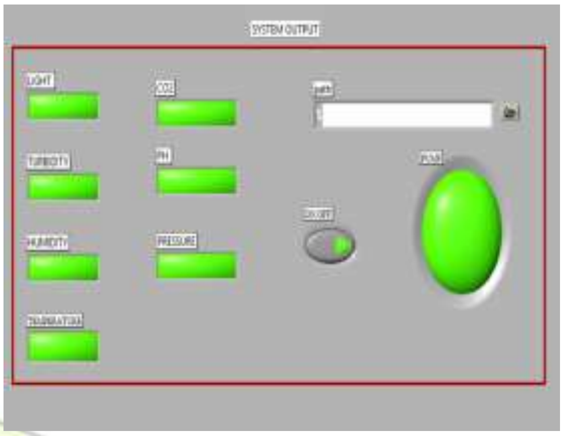

Fig 8: Output of the system when all sensors meet threshold

IV CONCLUSION AND FUTURE WORK

This describes a reconfigurable smart sensor interface for industrial WSN in IOT environment. The system can collect sensor data intelligently. It was designed in LabVIEW. Various analog and digital sensors are implemented in LabVIEW. Various sensors like digital temperature sensor, turbidity sensor, ph sensor, CO2 sensor, light sensor, humidity are implemented in LabVIEW and graphs are plotted for each sensor. Digital value of each sensor is obtained. Each sensor has certain threshold limit. If any one of the sensor does not satisfy threshold limit an alarm sound is played indicating which sensor is not satisfying the limit. Web publishing tool is used to control inputs over web page. But hosting is done within the internal server. We have to use arduino board completely implementing these sensor values over internet.

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