INTERNATIONAL JOURNAL FOR TRENDS IN ENGINEERING & TECHNOLOGY
VOLUME 4 ISSUE 2 – APRIL 2015 - ISSN: 2349 - 9303

Smart Sensor Configuration for Security System Automation Using FPGA

M.Dhivya Bharathi[1]
PG Scholar, Sona College of Technology,
VLSI Design,
divyabharathi27@gmail.com

V.Meenakshi[2]
Assistant Professor, Sona College of Technology,
VLSI Design,
meena.vijay27@gmail.com

Abstract--- Automation in industrial control and monitoring systems plays a vital role in maintaining smooth work environment and handling perilous situation that may occur in work area. The available systems mostly use physical cables for signal transfer between the sensors and the control system. These systems have some significant problems such as the cable installation and maintenance costs associated with moving and replacement of cables during machinery maintenance, configuration and re-configuration. While the technological evolution of sensors is reflected in sensors getting smart, small, light weight, and cheapest, another key development is taking place in the sensors industry in the growth of wireless sensor use in industrial applications. The proposed wireless sensor-based controls provide industry attention in order to reduce costs, better power management and ease in maintenance. Wireless sensors have been successfully implemented in many industrial applications because of its performance, monitoring, security development and control the sensor system etc.

Index Terms--- Temperature sensor, Turbidity sensor, light detecting resistors, GSM Wireless Module.

1 INTRODUCTION

Wireless transmission of data in industrial applications using sensors has been used for a long time but recently it has gained more importance, with attention from both market leaders and medium- and small-sized Industries. Successful use of wireless sensors in systems such as FPGA Controller proved that these devices could effectively address the needs of industrial applications nowadays. it is the most critical process, and its application in wireless network and also monitoring the temperature, Gas, Turbidity level, and Light intensity parameters in the system. With the advancement of hardware and software, industrial safety systems have been widely used in many industrial areas. Industrial safety systems can use sensors to gather information about the environment or the condition of machines, after that based on the information from sensors to control and monitor the condition in the environment.
An industrial application provides a scope of growth in wireless sensor network, but this growth cannot be achieved without overcoming some of the key challenges facing the market.

- Multivendor equipment used in system
- Demand can be rectified in industrial-safety-rated using wireless devices
- Lack of adequate open bandwidth
- Because of its network size and hopping challenge
- Constantly evolving g standards

2 INTERNETS OF THINGS IN INDUSTRIES

As an emerging technology, the Internet of Things (IoT) is expected to offer promising solutions to transform the operation and role of many existing industrial systems such as transportation systems and manufacturing systems. For example, when IoT is used for creating intelligent transportation systems, the transportation authority will be able to track each vehicle' in the system, it can be used to monitor the vehicles movement and predict the accident in road traffic. The term IoT was initially proposed to refer to uniquely identifiable inters operable connected objects with radio-frequency identification (RFID) technology. The researchers relate IoT with more technologies such as sensors, actuators, GPS devices, and mobile devices. A number of industrial IoT projects have been conducted in areas such as agriculture, food processing industry, environmental monitoring, security surveillance, and others. Internet of Things (IoT) makes all objects become interconnected and smarter, which has been recognized in the technological revolution. In Internet technologies and Wireless Sensor Networks (WSN), a new trend in the era of ubiquity is being realized. More number of increase in users of Internet and medications on the internet working technologies and to enable the networking of everyday

objects [1]. "Internet of Things (IoT)" is all about physical items talking to each other, machine-to-machine communications and also person-to-computer communications will be extended to "things" [2], [3]. Key technologies that will drive the future IoT will be related to Smart sensor technologies which also including the WSN, Nanotechnology and also Miniaturization.

3 PROPOSED SYSTEM

The proposed system is composed of three main components—a wireless sensor hardware interface, system integration framework (FPGA Controller) and GSM module, which facilitates the defining of interaction between sensors/actuators based on process needs. A variety of industrial sensors (Temperature, Gas, Turbidity, light intensity, etc.), and actuators have been interfaced and successfully tested with the platform.

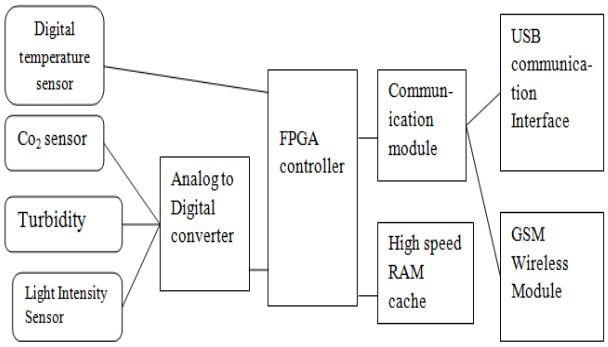

Fig 1 Block diagram for the Proposed System

3.1 Temperature Sensor

This sensor is used to detect Temperature or heat. temperature sensor vary from simple ON/OFF thermostatic devices and also used to control a domestic hot water heating system ,which is highly sensitive semiconductor types that can control complex process in the control furnace plants. These sensors use a solid-state technique to determine the temperature. In this fact temperature increases, the voltage across a diode also increases in known rate. This is actually the voltage drop between the base and emitter - the Vbe - of a transistor. It is easy to generate an analog signal that is directly proportional to temperature in this system. it have some improvements in the technique but, essentially is to measure temperature . Because these sensors have no moving parts and they are not precise which are never wear out also don't have to need calibration of work under many environmental conditions, and its consistent between sensors and readings of device . Moreover they are very inexpensive and quite easy to use for our environmental condition.

- Industry standard compatibility.
- Feature-rich, integrated nonvolatile memory

3.2 CO_2 Sensor

Fixed Smoke sensors are used in mall, factories and shops etc. According to the mechanism of operations, Gas sensors may be a Semiconductor device, the Catalytic, an Oxidation and also an Infrared sensor types. The Gas sensor has a cap on top and a base element and also has a sensing element. In this sensing element have a sensing material which have a heater to heat up the sensing material. When the Tin Oxide is heated to high temperature, it adsorbs oxygen on its surface also with a negative charge. When the donor electrons from the Tin oxide crystals, it can passes into the adsorbed oxygen and leaving the positive charge in a space charge layer. This can creates a surface potential in the circuit which prevents more electron flow. Inside the sensor, the current can flows through the boundary of Tin oxide crystals. In the boundary of the crystals, adsorbed oxygen forms a barrier region to prevent the free moving of electrons. This potential barrier provides the electrical resistance to the sensor.

3.3 Turbidity Sensor

Turbidity Sensor to measure the turbidity of freshwater or seawater samples and determine water quality. Turbidity is the term used to describe the reduction in water clarity or "cloudiness" as perceived by the human eye caused by the scattering of light due to particulate matter suspended in solution. The greater turbidity, the more cloudy is the water. Increases in turbidity reduce the transmission of light .Turbidity Sensor, which along with a micro controller unit which takes care of turbidity measurements. Crafted with plastic material and some metal-alloy traces can be used, turbidity sensor uses light to convey information in water. Once the turbidity is more than the safety level should preprogrammed at FPGA controller, the controller decodes beep alarms through the headset speaker connected with controller. The turbidity sensor in this implementation has been used for water quality testing and management, river monitoring, stream measurement, reservoir water quality testing, groundwater testing, water and wastewater treatment, and effluent and industrial control.

3.4 Light Intensity Sensor

A light sensor is a device for measuring the intensity of light. One of the most common and least expensive detectors which can be used in building a light sensor that is a photo resistor. Photo resistors, also called as light detecting resistors (LDR) are made with cadmium sulfide (CdS) cells that are sensitive to visible and also near with infrared light sensor. The resistance of material CdS cell varies inversely with the amount of light incident and the brightness if light causes a low resistance between the two leads of the cell while low light results in a higher resistance. There are many applications for light sensors, such as flame detector, and security systems, also a lighting control, and robotics, etc. In these applications, the sensor produces an analog output, which can be interfacing this type of sensor used in microcontroller will require a conventional analog-to-digital converter in this circuit.

4 HARDWARE IMPLEMENTATION

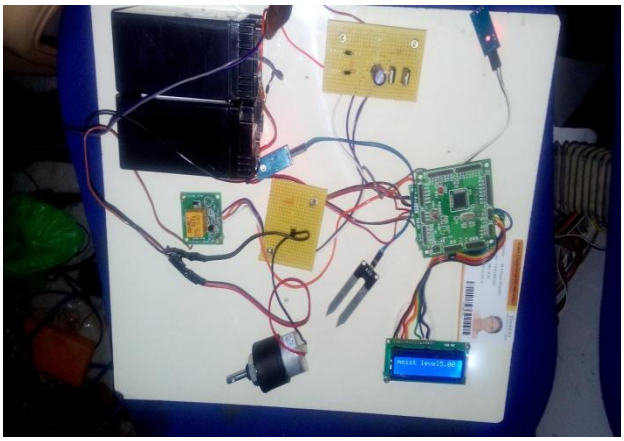

Fig 2 Embedded kits for Security System

The hardware units here is made of temperature sensor LM35, gas sensor MQ2, Light Intensity Sensor(LDR),ADC module, FPGA, GSM modem, Alarm indication.

4.1 ADC Module

FPGA are digital in nature. It can only differentiate between HIGH or LOW level in the input pins. For example, if input is more than 2.5v then it is assumed as 1 and if the input is below than 2.5 then it is assumed as 0 in this case of 5v in the systems). Any analog values cannot be directly measured from the sensor network. To solve this problem ADC unit is used. ADC stands for analog to digital converter. It will convert an analog value to a digital (number) so that this digital value can be processed by a FPGA. All the sensor outputs are given to the ADC converter which converts analog value into digital values (i.e. 0's and 1's). Most important specification of ADCs is the resolution. The ADCs helps to accurately measure the analog input signals in the circuit. Other specification also includes in the sampling rate that means ADC can take reads fast in the circuit.

4.2 FPGA

The FPGA used to implement this system is a Spartan III from Xilinx; this device gives the node a big freedom to adapt to new applications, and makes the system versatile in its processing capabilities. The main feature of FPGAs is concurrency. This allows the processing layer to manage complex digital sensors in a fast way and the FPGA processes the most complex signals. The FPGA needs three different power voltages, specifically 3.3, 2.5 and 1.2 V.

4.3 GSM Modem

GSM was designed with a moderate level of security in network services. The system was designed with authentication of the subscriber using a pre-shared key and also challenge-response of network service. Communications between the subscriber and the base station can be encrypted. In our proposed system the message will be passed to the employees. Once the temperature, smoke, turbidity and light intensity level is more than the safety level as preprogrammed in FPGA controller. The main characteristics of GSM network is simple in design and easy to implement, which requires low power of consumption and low cost in Interface of circuits and reduce redundancy of devices. It also allows the network to work with a great number of active devices.

4.4 Alarm Indication

When an alarm warning is triggered, the main controller sends a message to a list of recipients who are the employees of the industry. The body of the message contains information about the incident which is going to happen inside the industry. Once the temperature is more than the safety level as preprogrammed at FPGA controller, and this controller can decodes the beep alarms sound start rings through the headset speaker connected with controller. Again, once the measured smoke value is more than the safety level as preprogrammed at FPGA controller, it

decodes in different type of beep alarm used in network and gas concentration also causes the safety level in the system. Microcontroller can decodes siren alarms and the same for light intensity level. In all such cases, this will send an alarm through an urgent message and alarm sound to the ground control terminal through GSM.

5 RESULT AND DISCUSSIONS

Simulation (shown in fig. 3) is done using Xilinx 13.2i. During the simulation sensor inputs are manually forced to the value for various real time situations in the industry. The simulation result shows more accurate decision are taken depending upon the environment and given input conditions. The data to the GSM transmitter is also generated during the simulation process.

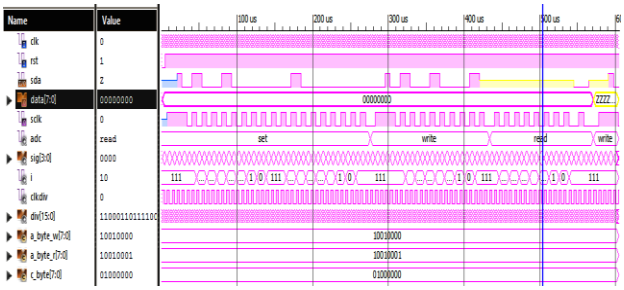

Fig 3 Simulation Result of Smart Sensor System

6 CONCLUSION

In the proposed system the implementation is made by integrating FPGA, wireless sensor network and GSM network. In the industry the control of machinery plays a key role for a profitable and optimum production. Wireless Control using GSM ensures uninterrupted connectivity and Superior Control. The GSM Modem comes with a serial interface through which the modem can be controlled using AT command interface. It can detect the surrounding nodes (sensors) and communicate with each other nodes. The simulation has been done and the implementation is made using FPGA Kit. The proposed system is more safety because of systematic approach is implemented for monitoring and control.

REFERENCES

[1] Qingping Chi, Hairong Yan, Chuan Zhang, Zhibo Pang, and Li Da Xu, Senior Member "A Reconigurable Smart Sensor Interface for Industrial WSN in IoT Environment" IEEE transactions on industrial informatics, vol. 10, no. 2, may 2014.

[2] S. D. T. Kelly, N. Suryadevara, and S. C. Mukhopadhyay, "Towards the Implementation of IoT forenvironmental condition monitoring in homes," IEEE Sensors J., vol. 13, no. 10, pp. 3846–3853, Oct. 2013.

[3] L. Xu, "Introduction: Systems science in industrial sectors," Syst. Res. Behav. Sci., vol. 30, no. 3, pp. 211–213, 2013.

[4] Mihai T. Lazarescu 'Design of a WSN Platform for Long-Term Environmental Monitoring for IOT Applications". IEEE journal on emerging and selected topics in circuits and systems, vol. 3, no. 1, march 2013.

[5] R. Dafali, J. Diguet, and J. Creput, "Self-adaptive network-on-chip interface," IEEE Embedded Syst. Lett., vol. 5, no. 4, pp. 73–76,Dec. 2013.

[6] Z. Pang et al., "An RTOS-based architecture for industrial wireless sensor network stacks with multi-processor support," in Proc. Ind. Technol. (ICIT), 2013, pp. 1216–1221.

[7] S. Li, L. Xu, X. Wang, and J. Wang, "Integration of hybrid wireless networks in cloud services oriented enterprise

[8] L. Xu, "Information architecture for supply chain quality management," Int.J. Prod. Res., vol. 49, no. 1, pp. 183–198, 2011.

[9] Pedro Cheong, Student Member, IEEE, Ka-Fai Chang, Member, IEEE, Ying-Hoi Lai, Sut-Kam Ho, Iam-Keong Sou, and Kam-Weng Tam, Senior Member. "A ZigBee-Based Wireless Sensor Network Node for Ultraviolet Detection of Flame". IEEE transactions on industrial electronics, vol. 58, no. 11, november 2011.

[10] Fabiano Salvadori, Member, IEEE, Maurício de Campos, Student Member, Marco Aurélio Spohn, and Alexandre Cunha Oliveira Monitoring in Industrial Systems Using Wireless Sensor Network With Dynamic Power Management IEEE transactions on instrumentation and measurement, vol. 58, no 9, september 2009.