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Design and Implementation of Zigbee Protocol in Wireless Sensor Networks

M.Tej Kumar, S. Leela Lakshmi

Abstract: ***Recently, there has been a growing demand to incorporate multimedia content delivery over the Wireless Sensor Networks (WSNs). This feature could not only enhance several existing applications in the commercial, industrial, and medical domains, but could also spur an array of new applications. However, the efficient gathering of still images, audio, and video information in WSNs imposes stringent requirements on the throughput and energy consumption. Most wireless communication standards with high or moderate data throughputs do not focus primarily on energy efficiency. The IEEE 802.15.4 WPAN standard provides a widely accepted solution for low-cost and low-power wireless communication, with a potential to cater to many types of application scenarios. To design a wireless interactive data acquisition and control system is a challenging part of any measurement, automation and control system applications. Advancement in technology is very well reflected and supported by changes in measurement and control instrumentation. Data acquisition and control system based on AVR microcontroller (Atmega168) is presented. This makes use of the built in ADC of the microcontroller and thus the resolution is 10 bits i.e. one part in 1024. . The controlling program on an arduino read this input at pre-decided time intervals. The controlling program reads these values and process accordingly. Microcontroller programs are also developed and tested successfully.***

Keywords: - WSNs, Zigbee, Data acquisition, Controlling, 802.15.4

I.INTRODUCTION

Many believe that Wireless Sensor Networks (WSNs) are an indispensable part of the latest wave that will revolutionize the way we do computing today. WSNs will enable our transition from the notion of ‘‘personal computing” to a technology infrastructure that allows us to integrate computing into the environment, a concept coined as ‘‘pervasive and embedded computing”. In this scenario, multimedia data with multiple modalities, such as still image, audio, and video, may be more influential than a large amount of conventional data observed and gathered from the physical environment. Consequently, the scope of its applicability and functionality goes beyond what traditional applications, such as habitat and healthcare monitoring, target tracking and military surveillance, and home automation and control, have to offer. Wireless Interactive Data Acquisition and Control system plays the major role in the rapid development of the fast popularization and control in the field of measurement and control systems. It has been designed with the help of many electrical, electronic and low voltage equipment’s it makes the system more complicated and not reliable.

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It makes the system more reliable and avoids more complication. It is the great demand in consumer applications and many industries. This system replaces various complex cables which are used for data acquisition and it uses ARDUINO and Atmega168 processor for data acquisition and controlling. Data acquisition system is extensively employed in a number of automatic test and measuring equipment’s. They are used to collect the required data from any peripheral input devices, such as meters, sensors and etc. This data acquisition system makes use of a 10 bit fast ADC available in AVR microcontroller Atmega168. The data acquisition system presented makes use of two analogue inputs out of which one can be used for sensing the temperature and the other can be used for sensing the humidity.

II. SYSTEM OVERVIEW

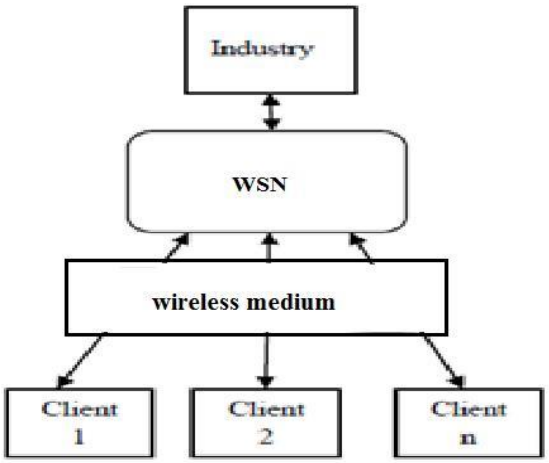

Fig: System overview

Own system using internet. During signal measurements Analog to digital converter is very important, because almost every external source is giving analog signal only. This system has an inbuilt 10-bit ADC with 6 –analogue input channels.

2.1 ARCHITECTURE

IDACS design is the major part in hardware. Atmega168 processor is a Centre core of this system. The general hardware structure of the IDACS is shown in Fig 2. The present data acquisition system makes use of a 10 bit ADC available in AVR microcontroller Atmega168. The ATmega168 has 16K bytes of Flash Program, 512 bytes EEPROM and 1K byte SRAM. This system can measure any kind of electrical and non-electrical signals locally as well as remotely. And it can able to control the devices remotely.

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The measured data can be displayed on flash magic using serial to Ethernet connector through the internet, and at the same time can be controlled.

Figure shows the overview of IDAC system. Every client can access the industry directly without any interaction using internet. IDACS shows Intelligent Data Acquisition and Control System. This system contains single atmega168 processor which is programmed. Atmega168 processor is the heart of this work. It handles two modes at the same time, DAC and internet modes. During DAC mode Processor can measure signals which are coming from various external sources and applications. And it can control the industry machineries by the control instruction sent by client via internet. Client can interact the industry by giving instruction on his

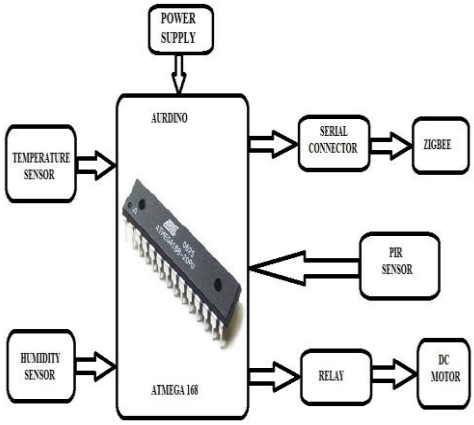


Fig: general structure of IDACS

Atmega168 supports 6 input analogue channels for ADC with 10 bit resolution. The data acquisition system presented makes use of two analogue inputs out of which one can be used for sensing the temperature and the other can be used for sensing the pressure. The system can easily be adopted for additional Analogue inputs. It has 14 digital I/O pins this system makes use of two digital pins one for proximity sensor and other can be used for ac motor controlling.

III. ARDUINO

An Arduino is a tiny computer that you can program to process inputs and outputs going to and from the chip. The Arduino is what is known as a Physical or Embedded Computing platform, which means that it is an interactive system that through the use of hardware and software can interact with its environment. The Arduino can be used to develop stand-alone interactive objects or it can be connected to a computer to retrieve or send data to the Arduino and then act on that data (e.g. send sensor data out to the internet).The Arduino board is made of an Atmel AVR Microprocessor, a crystal or oscillator (basically a crude clock that sends time pulses to the microcontroller to enable it to operate at the correct speed) and a 5-volt linear regulator. Depending on what type of Arduino you have, you may also have a USB connector to enable it to be connected to a PC or Mac to upload or retrieve data. The board exposes the microcontroller's I/O (Input/output) pins to enable you to connect those pins to other circuits or to sensors, etc.

IV. ATMEGA168

The Atmel ATmega168 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega168 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle.

The Atmel ATmega168 features a 10-bit successive approximation ADC. The ADC is connected to an 8-channel Analog Multiplexer which allows eight single-ended voltage inputs constructed from the pins of Port C. The single-ended voltage inputs refer to 0V (GND). The ADC contains a Sample and Hold circuit which ensures that the input voltage to the ADC is held at a constant level during conversion. The data acquisition system presented makes use of two analogue inputs out of which one can be used for sensing the temperature and the other can be used for sensing the pressure. The system can easily be adopted for additional Analogue inputs.

V. UART COMMUNICATION:

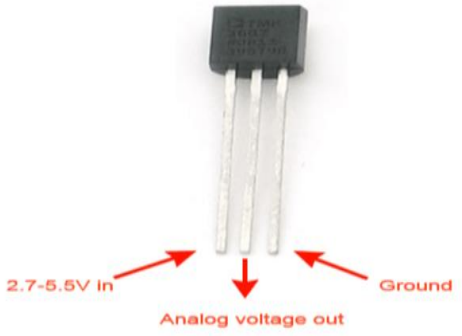
RS-232 (Recommended standard-232) is a standard interface approved by the Electronic Industries Association (EIA) for connecting serial devices. In other words, RS-232 is a long established standard that describes the physical interface and protocol for relatively low-speed serial data communication between computers and related devices. RS-232 is the interface that your computer uses to talk to and exchange data with your modem and other serial devices. The serial ports on most computers use a subset of the RS-232C standard.

VI. LM35 TEMPERATURE SENSOR

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in oC).

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.

How it look like



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6.1 HUMIDITY SENSOR

Based on a unique capacitive cell, these relative humidity sensors are designed for high volume, cost sensitive applications such as office automation, automotive cabin air control, home appliances, and industrial process control systems. They are also useful in all applications where humidity compensation is needed.

FEATURES

- Full interchangeability with no calibration required in standard conditions
- Instantaneous desaturation after long periods in saturation phase
- Compatible with automatized assembly processes, including wave soldering, reflow and water immersion (1)
- High reliability and long term stability

6.2 PIR SENSOR

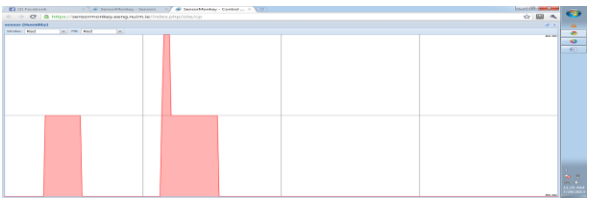
A passive infrared sensor (PIR sensor) is an electronic sensor that ensures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. A PIR-based motion detector is used to sense movement of people, animals, or other
objects. They are commonly used in burglar alarms automatically activated lighting systems.
They are commonly called simply "PIR," or sometimes "PID," for 'passive infrared detector'.

VII. ZIGBEE TECHNOLOGY

ZigBee is the only standards-based wireless technology designed to address the unique needs of low-cost, low-power wireless sensor and control networks in just about any market. Since ZigBee can be used almost anywhere, is easy to implement and needs little power to operate, the opportunity for growth into new markets, as well as innovation in existing markets, is limitless.

VIII. RESULTS & DISCUSSIONS

We have tested the complete wireless data acquisition system. And successfully got the results as shown below:



IX. CONCLUSION AND FUTURE SCOPE

Over the years, the IEEE 802.15.4 standard has made a reputation as a prominent technology, with the potential to cater to many types of application scenarios. Moreover, advancements in image technology encourages combining image data with conventional sensing data to leverage existing Wireless Sensor Networking applications. However, multimedia communication over resource-constrained networked sensors imposes a new set of challenges, where higher data throughput with lower latency is demanded without compromising energy efficiency.
With the rapid development of the field of industrial process control and the wide range of applications of network intelligence, digital distributed control System, it is necessary to make a higher demand of the data accuracy and reliability of the control system. Wireless interactive data acquisition and control system based on an AVR microcontroller Atmega168 from Atmel Corporation is designed developed and tested.
This system can be widely applied to electric power, petroleum, chemical, metallurgy, steel, transportation, Electronic & Electrical industries, Automobiles and so on. The system is flexible in design so that it can be adapted to a wide variety of experiments requiring continuous monitoring of several signals under program control. This system can also be implemented by different sensors.

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