ISSN: 2319-6505

Available Online at http://journalijcar.org

International Journal of Current Advanced Research
Vol 4, Issue 8, pp 271-274, August 2015

International Journal of Current Advanced Research

ISSN: 2319 - 6475

RESEARCH ARTICLE

DESIGNING MULTISENSOR EMBEDDED SYSTEM USING PSOC

Priyanka D. Patil* and R. D. Patil

Department of Electronics Engineering, Padmabhooshan Vasantraodada Patil Institute of Technology, Budhgaon, Sangli, India

ARTICLE INFO

Article History:

Received 22th, July, 2015
Received in revised form 31th, July, 2015
Accepted 20th, August, 2015
Published online 28th, August, 2015

Key words:

PsoC, Sensor.

ABSTRACT

This research paper presents for embedded sensor design with PSoC controller for measuring the temperature, humidity and light intensity. The PSoC family consists of many Programmable System-on-Chip devices. These devices are design to replace multiple traditional MCU-based system components with one, low cost single chip programmable device. With the help of microcontroller it is difficult to implement multiple sensors on single chip. But PSoC family provides this flexibility and ease of designig.

INTRODUCTION

Modern embedded control systems incorporate a microcontroller as the principal component - a self contained computer-on-a-chip consisting of a central processing unit, RAM memory for data storage, a variety of input/output functions and non-volatile program memory to hold the software written to implement the specific application. The new generation of re-configurable PSoC (Programmable System-on-Chip) controllers, which integrates all the above components, will become the dominant system architecture for the majority of micro-based designs, by employing advanced lithography and FLASH-based programming technology.

The PSoC family consists of many Programmable System-on-Chip Controller devices. These devices are designed to replace multiple traditional MCU-based system components with one, low cost single-chip programmable device. PSoC based data logger measuring temperature and humidity levels. With the help of microcontroller it is difficult to implement multiple sensors on single chip. But PSoC family provides this flexibility and ease of designing. [1]

Related Work

Bo Chang, Xinrong Zhang has designed environmental information monitoring, an indoor temperature and humidity monitoring system based on fuzzy-PID strategy. The system uses CC2430 as the core to develop wireless sensor nodes which follow the ZigBee communication protocol, uses the data collection terminal with high-precision temperature and humidity sensor to collect temperature and humidity data of the environment, uses ZigBee technology to achieve networking of wireless sensors and the automatic aggregation of monitoring data, and uses the fuzzy PID control algorithm to improve the accuracy of test data. The indoor temperature and humidity regulation is achieved based on fuzzy PID control technology. The management function of various sensor nodes and a large number of environmental data is achieved based on embedded database. The monitoring results for temperature and humidity have shown that this system is stable, high reliable in data transmission and easy to use, and can be widely used in various areas of automatic monitoring of environmental parameters [6].

Temperature sensors are one of the fastest growing fields in the sensors market because of the abundance of applications where temperature must be monitored and controlled, including personal computers, mobile phones, automobiles, medical equipments, process industries, nuclear plants, within different sensors and many others. Temperature sensors are also necessary in other sensors, such as flow sensors, pressure sensors IR detectors, humidity sensors etc. [4].

Data loggers are electronic devices capable of recording data from sensors at a certain location over time. The recorded values can be printed using a compact thermal printer or can be saved in files on an USB flash drive using an USB host controller board [3].

Home power consumption makes up the major part of energy consumption. In particular, the power consumption of lamps in a typical home is a factor which can't be ignored. The typical user needs different light intensities in different places. Sometimes the light intensity from outside is sufficient, and thus we don't need to turn on any light. But sometimes the user leaves but forgets to turn off the light. These factors cause energy waste. Therefore some power management of light control in a home is necessary in order to save energy. In some designs one must install specific hardware and software to control the lights, resulting in unacceptable costs. Furthermore this type of system cannot detect either the temperature of the human body or the room light intensity [5].

Scope

PSoC system is the user friendly system; each one operated it very easily. Here system design of any application done in minimum time. On chip analog blocks are present which is programmable, so we reconfigure pin connections, or completely change the block function if necessary.

System Architecture

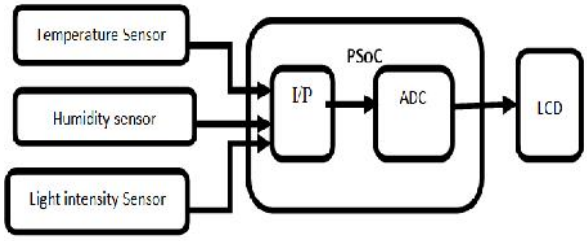

Figure 1 System architecture

- The system architecture as shown in Figure 1. consist of a PSoC chip to interface directly with sensors from one side and to exchange sensors data with the signal converter.
- The important feature of PSoC is the capability to change the configuration of analog circuitry for the ease of configuration by changing some software parameters. [7]
- This is especially important because of the nature of the sensor interfacing problem.
- Due to the diverse sensor types, signal conditioning circuits are a limiting factor of sensors interoperability.
- PSoC solves such problem by allowing the signal conditioning to be executed inside the chip.
- The operation of the PSoC can be changed by software means.
- In addition to all the standard elements of 8-bit microcontrollers, PSoC chips feature digital and analog programmable blocks such as Analog multiplexer, ADC and DAC, Analog Comparators, Switched capacitors block, Op-Amp circuits.[8]

Types of Sensor

For measuring temperature, humidity and light intensity we can use different sensors like bipolar junction transistor, LM35, photocell, LDR etc.

Temperature Sensor

Temperature is the most-measured process variable in industrial automation. Most commonly, a temperature sensor is used to convert temperature value to an electrical value. Temperature Sensors are the key to read temperatures correctly and to control temperature in industrials applications.

Humidity Sensor

Humidity sensor is used to detect the quantity of humidity from the environment. Humidity is measured into percentage and different types of Humidity Sensors are used to measure humidity. With interfacing with microcontrollers it becomes a standalone system to measure the percentage in the environment. Relative humidity/temperature and relative humidity sensors are configured with integrated circuitry to provide on-chip signal conditioning. Absorption-based humidity sensors provide both temperature and %RH (Relative Humidity) outputs. In this system for humidity sensing SYH-2R sensor is used.**[8** On-chip signal processing ensures linear voltage output versus %RH. Sensor laser trimming offers +5 %RH accuracy and achieves 2 %RH accuracy with calibration. Packages are chemically resistant and operate in ranges of -40 °C to 85 °C [-40 °F to 185 °F] to accommodate harsh environments.

They are following types:

- Relative Humidity Sensor
- Digital Humidity Sensor
- Soil Humidity Sensor
- Humidity and Temperature Sensor
- Humidity Sensor Switch
- Humidity Sensor probe

Light intensity Sensor

- A Light intensity Sensor generates an output signal indicating the intensity of light by measuring the radiant energy.
- 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.

Hardware Description

LM35

In this system for temperature sensing LM35 is used. Voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C Low cost is assured by trimming and calibration at the wafer level.[2]

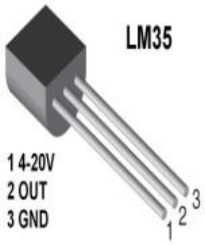

Figure 2

SYH-2R

In this system for humidity sensing SYH-2R sensor is used. These resistive type humidity sensors pick up changes in the resistance value of the sensor element in response to the change in the humidity. Thick film conductor of precious metals is printed and calcinated in the shape of the comb to form an electrode. Then a polymeric film is applied on the

electrode; the film acts as a humidity sensing film due to the existence of movable ions. Change in impedance occurs due to the change in the number of movable ions.

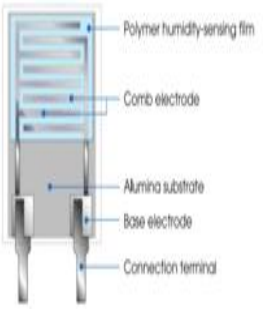

Figure 3 SYH-2R

LDR

- In this system for light intensity is sensed by LDR.
- Light Dependent Resistor (LDR) is made from a piece ofexposed semiconductor material such as cadmium sulphide that changes its electrical resistance from several thousand Ohms in the dark to only a few hundred Ohms when light falls upon it by creating hole-electron pairs in the material.

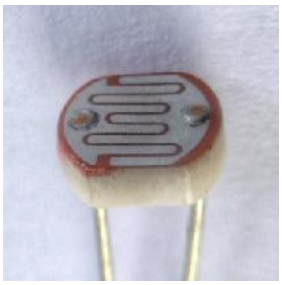

Figure 4 LDR

Characteristics of LDR

LDR's are light dependent devices whose resistance decreases when light falls on them and increases in the dark. When a light dependent resistor is kept in dark, its resistance is very high. This resistance is called as dark resistance. And if the device is allowed to absorb light its resistance will decrease drastically. If a constant voltage is applied to it and intensity of light is increased the current starts increasing. Figure 5 below shows resistance vs. illumination curve for a particular LDR**.**

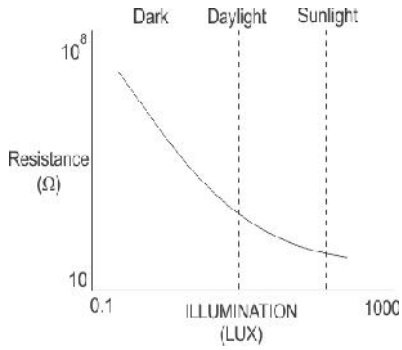

Figure 5 curve for a particular **LDR**

the system, using LDR one application is made to control power consumption.

PsoC module

PsoC 4 module is used for this project and the chip is CY8C4245AXI by Cypress Semiconductors. This chip belongs to 4200 family. PsoC 4 is a scalable and reconfigurable platform architecture for a family of mixed-signal programmable embedded system controllers with an ARM Cortex-M0 CPU. It combines programmable and reconfigurable analog and digital blocks with flexible automatic routing. The PSoC 4200 product family, based on this platform, is a combination of a microcontroller with digital programmable logic, high-performance analog-to-digital conversion, opamps with Comparator mode, and standard communication and timing peripherals. The PSoC 4200 products will be fully upward compatible with members of the PSoC 4 platform for new applications and design needs. The programmable analog and digital sub-systems allow flexibility and in-field tuning of the design. Provides up to 32 kB of flash with Read Accelerator up to 4 kB of SRAM. 32-bit MCU subsystem, programmable digital, programmable analog low power operation, capacitive sensing, segment LCD drive, serial communication, timing and pulse width modulation, upto 36 programmable GPIOs, PsoC creator design environment are some of the special features. Below figure6 shows PSoC development board.

Figure 6 PSoC4 development board

Working of System Architecture

- Temperature and light intensity is sensed through respective sensor.
- Measured values are displayed on LCD.
- After some time interval, data will be stored in EEPROM.
- In the mean time values are displayed on LCD.
- Using these measured values we control the operation of systems.
- Figure7 Shows hardware setup.

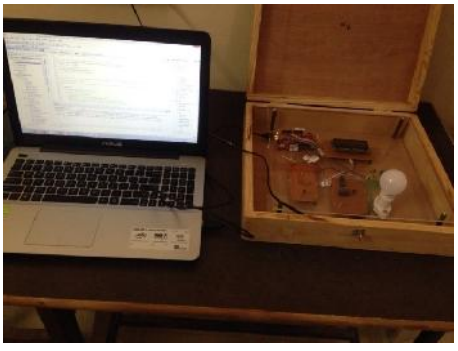

Figure 7 Hardware setup

Software Description

PSoC Creator

PSoC Creator is a free Windows-based Integrated Design

Environment (IDE). It enables concurrent hardware and firmware design of PSoC 3, PSoC 4, and PSoC 5LP based systems. Create designs using classic, familiar schematic capture supported by over 100 pre-verified, production-ready PSoC Components; we can see the list of component datasheets. Figure 8 shows the system design with PSoC creator.

PSoC4 creator Design Flow

- Determine system requirements
- Choose User Modules
- Place User Modules
- Set global and User Module parameters
- Define the pin-out for the device
- Generate the application
- Review generated code
- Demonstrate working configuration

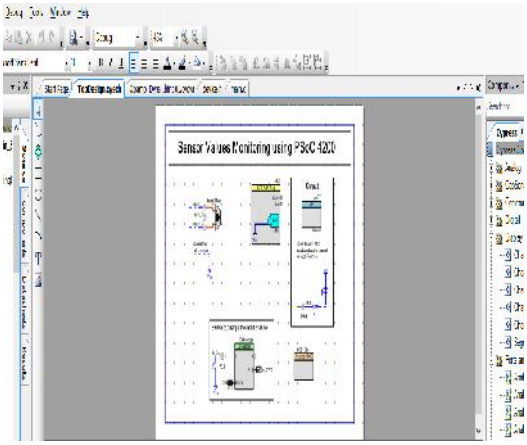

Figure 8 Final design with PSoC Creator

Experimental Results

A PSoC implementation of multisensor system is given here, which presents a new methodology to approach sensor solutions.

The system is more reliable because use of multisensors. Experimental results show sensing functions about the temperature, humidity and light intensity by using resistive changes of the sensor. And values of room temperature, humidity and light intensity are displayed on LCD as shown in figure 9.

Figure 9 Experimental Results

CONCLUSION

Using PSoC we can sense temperature, humidity and light intensity simultaneously and displayed values on LCD. We can use this system to control the power consumption. The PSoC implementation of dual sensor system presents a new methodology to approach sensor solutions using silicon based transducer. The implementation takes the advantage of dynamically configuration changing for measuring different physical parameters. It's simplicity and effectiveness makes it suitable for fast prototyping and low cost solutions.[1]

References

1. Bo Chang, Xinrong Zhang.: " Design of Indoor Temperature and Humidity Monitoring System Based on CC2430 and Fuzzy-PID" Faculty of Computer Engineering Huaiyin Institute of Technology Huai'an, Jiangsu, China mmm33534@sohu.com; Faculty of Electronic and Electrical Engineering Huaiyin Institute of Technology Huai'an, Jiangsu, China nn33@163.com; Publication Year: 2011
2. C. Semiconductor, "Programmable System-on-Chip" http://www.cypress.com/psoc/.
3. Florin Udrea, Sumita Santra, Julian W. Gardner "Cmos Temperature Sensors-Concepts, State-Of-The- Art And Prospects" Engineering Department, University of Cambridge, 9 JJ Thomson Avenue, Cambridge CB3 0FA, UK School of Engineering, University of Warwick, Coventry CV4 7AL, UK; Publication Year: 2008
4. Adly,H. F. Ragai, A. El-Hennawy and K. A. Shehata "Over-The-Air Programming of PSoC Sensor Interface in Wireless Sensor Networks"# Electronics Engineering Department, Faculty of Engineering, Ain Shams University ,Egypt 1,College of Engineering, French University, Egypt College of Engineering, Arab Academy for Science and Technology, Egypt.
5. Marius Muresan, Gabriel Chindris.:"PSoC Dual Sensor for Pressure and Temperature Using Bipolar Junction Effects"Applied Electronics Department, Technical University of Cluj-Napoca, Cluj-Napoca, Romaniamarius.muresan@ael.utcluj.rolm35.pdf
6. Silviu Folea, George Mois, Mihai Hulea, Liviu Miclea, Vio Biscu.: "Data Logger for Humidity and Temperature Measurement Based on a Programmable SoC" Faculty of Automation and Computer Science, Technical University of Cluj-Napoca, Cluj- Napoca, Romania ;Publication Year: 2014
7. www.samyoungsnc.com
8. Ying-Wen Bai and Yi-Te Ku "Automatic Room Light Intensity Detection and ControlUsing a Microprocessor and Light Sensors" Publication Year: 2008

****