Comparative Study of Temperature Sensors by using Programmable System on Chip (PSoC) to Monitoring Green House

V.T.Kulkarni[1], M.J.Chaudhary[2], Mayur Kumavat[1], Dr.S.N.Helambe[1],
Aurangabad, Maharashtra, India.
[1.Deogiri College, PhD and research center BAMU, Aurangabad. 2. Shivchhatrapati College, Aurangabad,]
anant.vrush@gmail.com , snhelambe@deogiricollege.org

***Abstract*-**Programmable system-on-chip (PSoC), which provides a microprocessor, microcontroller and programmable analog and digital secondary functions in a particular chip, is very suitable for mixed-signal electronic organism intend. PSoC facilitates rapid prototyping and fast development as well as optimized PCB layouts. It also enables system-level design decisions in firmware and digital and analog hardware. This paper presents the understanding of new technology PSoC, and Comparative study of temperature sensors interfacing to PSoC. Comparative study of temperature sensors for monitoring a green house temperature and interfacing used sensors with PSoC has been presented in this paper.

***Index Terms*-** PSOC, Green House, Temperature Sensors (PT100 and LM35). SONOS-Silicon-Oxide-Nitride-Oxide-Silicon.

*****

I. INTRODUCTION

A PSoC integrated circuit is composed of a core, configurable analog and digital blocks, and programmable routing and interconnects. The configurable blocks in a PSoC are the biggest difference from other microcontrollers**.** PSoC has three separate memory spaces: paged SRAM for data, Flash memory for instructions and fixed data, and I/O Registers for controlling and accessing the configurable logic blocks and functions. The device is created using SONOS technology. PSoC mixed-signal arrays' flexible routing allows designers to route signals to and from I/O pins more freely than with many competing microcontrollers. Global buses allow for signal multiplexing and for performing logic operations.

PSoC system is the user friendly system; each one operated it very easily. Here system can be 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.

A. PSOC Module-

The PSoC family consists of many Mixed- Signal Array with 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-1 module is used for this project and the chip is CY8C2764324PVXI by cypress semiconductors. This chip belongs to CY8C27X43 family. The PSoC-1architecture is comprised of four main areas: PSoC Core, Digital System, Analog System, and System Resources. Configurable global busing allows all the device resources to be combined into a complete custom system. The PSoC CY8C27x43 family can have up to five IO ports that connect to the global digital and analog interconnects, providing access to 8 digital blocks and 12 analog blocks.

B.

Working of system architecture –

- Temperature is sensed by PT100.
- Temperature is sensed by LM 35.
- Measured values are displayed on LCD.

C. Software Description

PSOC Designer - This is the first generation software IDE to design and debug and program the PSoC-1 devices. It introduced unique features including a library of pre-characterized analog and digital peripherals in a drag-and-drop design environment which could then be customized to specific design needs by leveraging the dynamically generated API libraries of code. PSoC provides complete high performance temperature sensing and control solutions for RTDs,T thermocouples,Thermistors, temperature diodes, IC temperature sensors, other analog output temperature sensors and digital output temperature sensors. PSoC includes current and voltage sensor drive, DAC and PWM outputs for control, LCD drive, key pad or touch screen interface, power management and USB or RS-232 communication.

D. PSOC-1 Designer Design Flow –

- Determine system requirements.
- Choose user modules.
- Place user modules.
- Set global and user module parameters.
- Generate the application.
- Review generated code.

II. EXPERIMENTAL WORK

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. Data loggers are electronic devices capable of recording data from sensors at a certain location over time. The recorded values of the green house temperature can be displayed on LCD. 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.

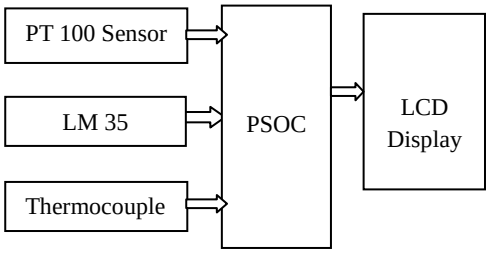


Fig.1 The proposed system architecture

In Figure consists 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 easy of configuration by changing some software parameters.

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.

Features:

- 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.

III. SENSORS

Following sensors are used to interface –

- PT100
- LM 35
- Thermocouple

The interfacing of individual sensor and their response are as follows-

A. *Response of PT-100:*

This Sensor is used for precise temperature monitoring applications, where errors in measurement have to be excluded. The linear relationship of the resistor to temperature, simplifies its use in many electronic applications. The precision of the Pt100 allows its universal use for temperature monitoring, control, and switching in windings, bearings, machines, motors, transformers and many other industrial applications.

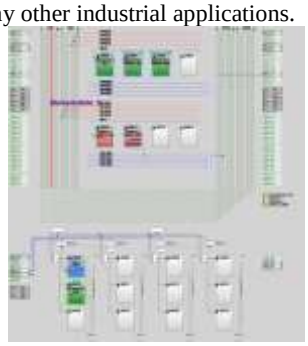
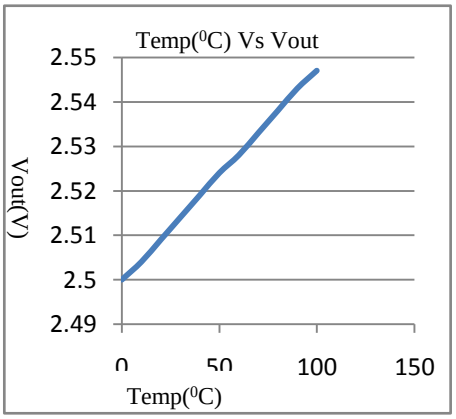


Fig.2 PT-100 interfacing design with PSOC Designer

Temp (^{0}C)	Vout (V)
0	2.5
10	2.504
20	2.509
30	2.514
40	2.519
50	2.524
60	2.528
70	2.533
80	2.538
90	2.543
100	2.547



Graph1

B. *Response of LM 35:-*

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in ^{o}C). It has an advantage over linear temperature sensors. It does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. Its low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

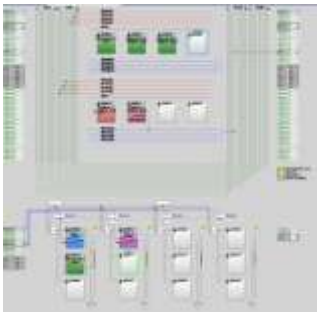
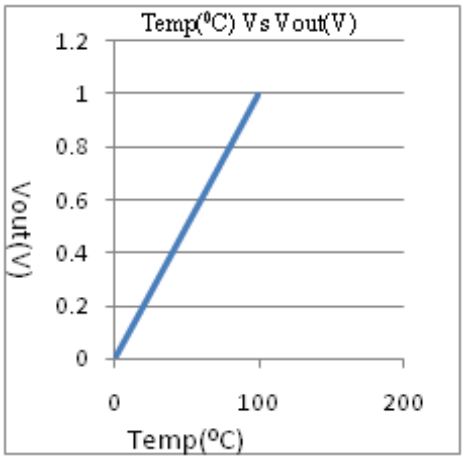


Fig.3 : LM 35 interfacing design with PSOC Designer

Temp(^{0}C)	Vtherm (V)
0	0
10	0.1
20	0.2
30	0.3
40	0.4
50	0.5
60	0.6
70	0.7
80	0.8
90	0.9
100	1



Graph2

C. *Response of Thermocouple:*

A thermocouple is a junction formed from two dissimilar metals. One at a reference temperature (like 0 ^{o}C) and the other junction at the temperature to be measured. A temperature difference will cause a voltage to be developed that is temperature dependent. Thermocouples are widely used for temperature measurement because they are inexpensive, rugged and reliable, and they can be used over a wide temperature range. But its wide range is not useful for green house temperature measurement.

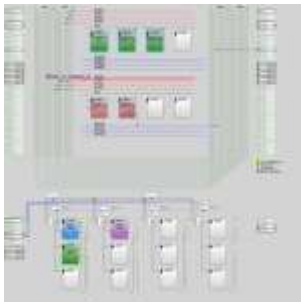
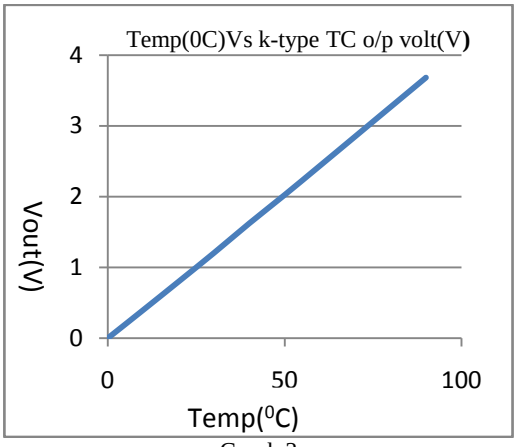


Fig.4:Thermocouple interfacing design with PSOC Designer



Graph 3

IV. COMPARISON OF TEMPERATURE SENSORS

Criteria	PT100	LM 35	Thermocouple
Temperature range	-50°C to +230°C	−55°C to +150°C	-267^{0}C to +2316^{0}C
Accuracy	Best	Best	Good
Linearity	Best	Best	Good
Sensitivity	Best	Best	Worst
Circuitry	Simplex	Simplex	Complex
Power consumption	Low	Low	Low-high

V. CONCLUSIONS

- A PSOC implementation of multisensory system is given in this paper.
- PSOC provides a new methodology to approach sensor solutions.
- The implementation takes the advantage of dynamically configuration changing for measuring physical parameters.
- It's simplicity and effectiveness makes it suitable for fast prototyping and low cost solutions
- In PSOC on chip analogue and digital blocks are present which are programmable. So we can reconfigure pin connections, or completely change the block functions if necessary. So that system can be upgraded in minimum time.
- The experimental results of all used sensors are displayed as per their own characteristic.
- With LM35, temperature of green house can be measured more accurately than with a thermocouple. It also possesses low self heating and does not cause more than 0.1^{0}C temperature rise in still air.

REFERENCES

[1] Green House Monitoring and Automation using GSM , B.VidyaSagar, International Journal of Scientific and Research Publications, Volume 2, Issue 5, May 2012 1 ISSN 2250-3153.

[2] Wireless Monitoring of the Green House System Using Embedded Controllers Miss. Vrushali R. Deore , Prof. V.M. Umale , International Journal of Scientific & Engineering Research, Volume 3, Issue 2, February-2012 1 ISSN 2229-5518.

[3] Greenhouse automation system using Psoc 3, *sengunthar gayatri r*. Journal of information, knowledge and research in electronics and Communication engineering.

[4] Greenhouse Management Using Embedded, System and Zigbee Technology, S.Thenmozhi1 , M.M.Dhivya2 , R.Sudharsan3 , K.Nirmalakumari4 , International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, *(An ISO 3297: 2007 Certified Organization)*,Vol. 3, Issue 2, February 2014.

[5] Analyzing and Predicting the Green House Parameters of Crops, International Journal of Computer Applications (0975 – 8887) Volume 97– No.3, July 2014.

[6] Review of Greenhouse Management Using Embedded System, Narendra Kumbhkar, Ravi Pandit, International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2014): 5.611.

[7] Application of wireless sensor networks for greenhouse parameter control in precision agriculture, D.D.Chaudhary1, S.P.Nayse2, L.M.Waghmare3, International Journal of Wireless & Mobile Networks (IJWMN) Vol. 3, No. 1, February 2011.

[8] Remote Temperature Monitoring Using LM35 sensor and Intimate Android user via C2DM Service, Poonam1, Prof. (Dr.) Yusuf Mulge2, International Journal of Computer Science and Mobile Computing A Monthly Journal of Computer Science and Information Technology ISSN 2320–088X IJCSMC, Vol. 2, Issue. 6, June 2013, pg.32 – 36.

[9] Hardware Implementation of Dew Point Measurement,T. O. Aluko*P*1 *P*, H. O. Boyo*P* 2*P*, T. P. Adebayo*P*3*P*, O. F. Odubanjo*P*4, IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 9, September 2016, ISSN (Online) 2348 – 7968 | Impact Factor (2015) - 4.332.

[10] Multipoint Temperature Data Logger and Display on PC through Zigbee using PSoC., Md. Moyeed Abrar1, Rajendra R. Patil2, International Journal of Advanced Research in Computer and Communication Engineering, Vol. 2, Issue 9, September 2013.