Scientific Journal of Impact Factor(SJIF): 3.134
e-ISSN(O): 2348-4470
p-ISSN(P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 2, Issue 5, May -2015

Health Monitoring System using Microconverter ADuC 812

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Abstract — *For many embedded applications, microcontrollers are used in place of application specific integrated circuit(s), which significantly lowers the cost and increases the flexibility. Microcontrollers are an ideal fit for high-volume, low-price electronics where they may serve as the central or auxiliary control. To design any microcontroller based system; the study and programming of the individual peripherals devices, its interfacing with microcontroller; are some interesting facts which one has to capitalize in growing and maturing an Instrument. This work is aimed to design a "Health Monitoring System using Microconverter ADuC812" which may be useful to test the various control signals of the any microcontroller based instrument (DCE) through communication pins Tx and Rx as per the designated protocol of the DTE. Any request made by the DTE is taken over by the DCE and respond to the DTE accordingly. A communication path can be established between the DTE and the DCE by connecting the Tx pin of the DTE to the Rx pin of the DCE and Rx pin of the DTE to the Tx pin of the DCE.*

Keywords- *DCE, DTE, Rx, Tx , LCD, CPU, RAM, ROM, ADC, DAC.*

I. INTRODUCTION

A microcontroller is often described as a 'computer-on-a-chip'. It is a complete 'computer' that can be built into a device to make the product more intelligent and easier to use. Microcontrollers are programmed to perform a specific control task - for instance, a microwave oven may use a single microcontroller to process information from the keypads, display user information on the seven segment display, and control the output devices (turntable motor, light, bell and magnetron).

Microcontrollers are designed to control specific processes or products. The microcontroller is programmed with a specific software program to complete the desired task. By altering this software program, the same microcontroller can be used to complete different tasks. Therefore the same chip can be used in a range of different products by simply programming it with a different software program. Some of the advantages of using microcontrollers in a product design are:

- Increased reliability and reduced stock inventory (as one microcontroller replaces several parts).
- Simplified product assembly and smaller end products.
- Greater product flexibility and adaptability since features are programmed into the microcontroller and not built into the electronic hardware.
- Rapid product changes or development are possible by changing the program and not the electronic hardware.

Microcontrollers are found in almost all "smart" electronic devices. From microwaves to automotive braking systems, they are around us doing jobs that make our lives more convenient and safer. Microcontrollers are like small computers. Unlike our desktop computer, microcontrollers interact with other machines rather than humans. A microcontroller might be used to measure the temperature of our toast at breakfast and when the temperature reaches a predetermined measure, the toaster could be turned off. A microcontroller could also be used to count the number of customers entering the ball park through a turnstile thereby keeping track of ticket sales. The use for these small versatile devices is diverse. So, we can imagine a microcontroller application that will improve a product or decrease the time required to complete a process.

To design any microcontroller based system; the study and programming of the individual peripherals devices, its interfacing with microcontroller, advantage and controlling several peripherals are some interesting facts which one has to capitalize in growing and maturing an Instrument. This project is aimed to design a "Health Monitoring System using Microconverter" which has its own processor which processes the data according to requirement, and memory both for storing data permanently and storing data while execution by the processor. Practical challenges required for interfacing peripheral devices with micro controller and design issues needed to build Microcontroller based system are well thought-out. Microcontroller based system works on the principle of personal computers but uses micro controller chip as a CPU. The complete system requires necessary peripheral devices like crystal oscillator to give the micro controller clock of required time period, Liquid Crystal Display (LCD) for displaying the result, user selectable inputs for particular task operation, and the microconverter which is a fully integrated data acquisition system incorporating a high performance 8-channel Analog-to-Digital Converter (ADC), two 12-bit Digital-to-Analog Converters (DAC), and a programmable 8-bit (8051-compatible) MCU on a single chip. In addition to this, it has a fixed amount of RAM, ROM, Input/output ports and timer all are embedded together on a single chip. The code is stored in internal program and data memory executed by micro controller to provide required output.

II. APPROACH AND IMPLEMENTATION

Products using microprocessors generally fall into two categories. The first is high performance microprocessors where system performance is critical. These microprocessors contain no RAM, no ROM and no I/O ports on the chip itself. That's why they are commonly known as General Purpose Microprocessors. For general purpose microprocessors, it is necessary to add RAM, ROM I/O ports and timers externally to make them functional. The addition of external RAM, ROM and I/O ports make these systems bulkier and much more expensive although they have the advantage of versatility to decide the amount of RAM, ROM and I/O ports required to fit the task at hand. This is not the case with the second category of microprocessors, commonly known as a microcontroller. A microcontroller has a CPU (microprocessor) in addition to a fixed amount of RAM, ROM, I/O ports and timer all are embedded together on a single chip. Therefore there is no need to add any external memory, I/O or timer to it.

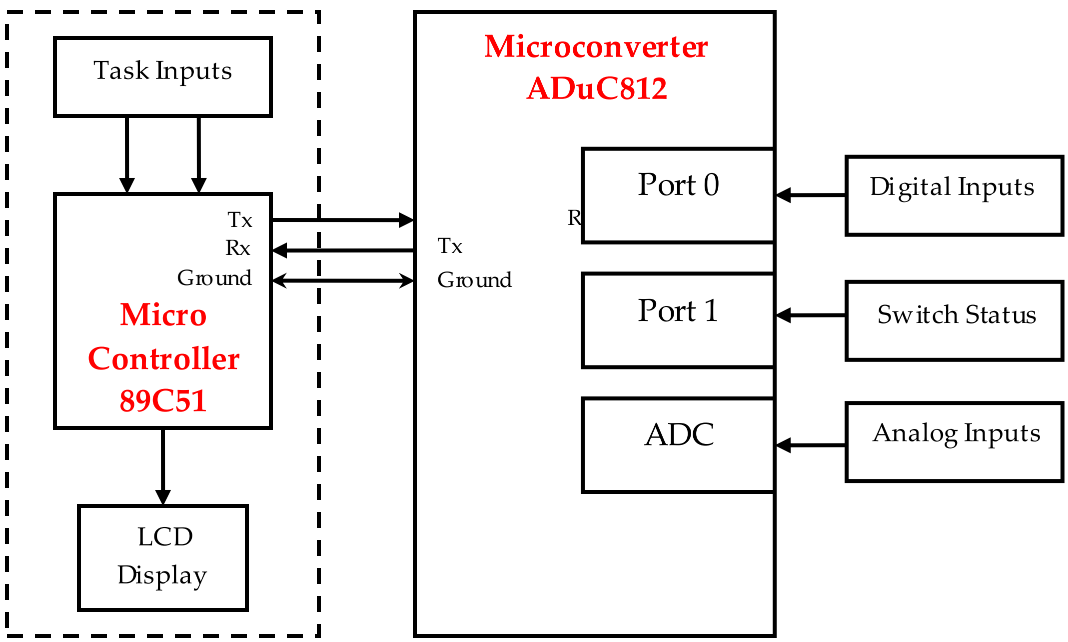

Fig. – 1 Block Diagram of the Proposed Scheme

The built in memory and I/O ports makes them ideal for the applications where cost and space are critical. The ADuC812 is the latest generation of the microcontroller family. The ADuC812 is a fully integrated 12-bit data acquisition system incorporating a high performance self-calibrating 8-channel ADC, two 12-bit DACs, and a programmable 8-bit (8051-compatible) MCU on a single chip. The Programmable 8051-compatible core is supported by 8K bytes Flash/EE program memory, 640 bytes Flash/EE data memory, and 256 bytes data SRAM on-chip. Additional MCU support functions include Watchdog Timer, Power Supply Monitor, and ADC DMA functions. The part is specified for 3V and 5V operation over the industrial temperature range (-40°C to +85°C) and is available in a 52-lead, Plastic Quad Flat Package and 56-lead, Lead Frame Chip Scale Package. Two integrated 12-bit DACs provide rail-to-rail buffered analog outputs and can be individually configured for 0-to-V_{DD} or 0-to-V_{REF} output voltage range. The reference source for the ADC and DACs can come from an external voltage reference or from the on-chip 2.5V band gap reference. All analog peripherals are fully configurable through the on-chip MCU via a simple SFR interface. 89C51 belongs to the family of MCS-51. It has the compatibility with the various tools to assemble the program and to download the corresponding 'Hex' files for the microcontroller based development system. The tools used for this microcontroller based development system.

III. DEVELOPMENT METHODOLOGY

To fully evaluate the performance of the instrument by communicating the current status of various analog and digital modules and control panel switch status, a communication path has to be established between the DTE and the DCE. The microcontroller will work as Data Terminal equipment (DTE) and the microconverter will work as a Data Communication Equipment (DCE). The microconverter is preferred because it helps in reducing the required additional hardware (such as ADC and DAC) for simulating the various Good/Bad conditions of analog and digital power modules and control panel switch status of the instrument. The inputs given to the microcontroller (DTE) are user selectable and work as a command to the microconverter (DCE) for that particular task. The microconverter decodes that particular inputs and fed the status of that particular inputs to the microcontroller which displays the status whether it is of a digital signal, analog signal or the switch status of the control panel on the LCD display interfaced with the microcontroller.

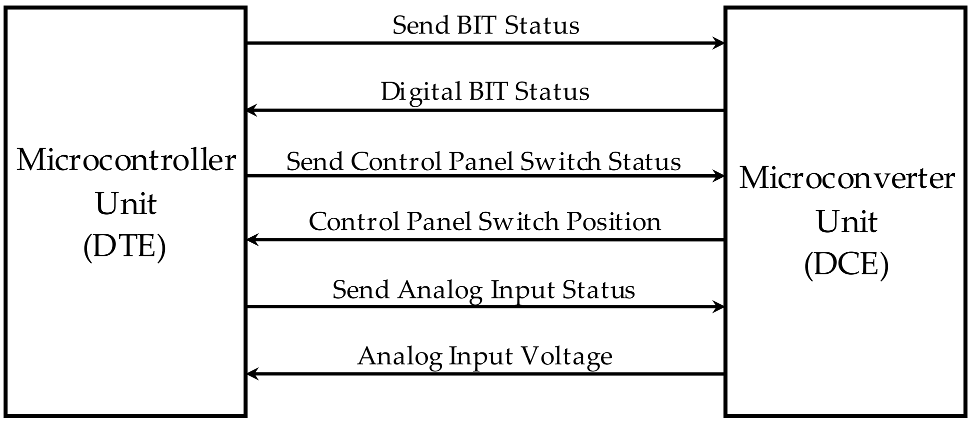

Fig.2 – Serial Communication between DTE and DCE

Fig.3 – Communication set-up for the Health Monitoring System

Communication Protocol

The various control signals of the instrument is communicated to the DTE through communication pins Tx and Rx of the microcontroller. The following communication protocol is used to exchange the information. The information from DTE to the DCE is sent as an instruction of 1 Byte (8 Bits). Each byte has an identification code. The last two bits in the Instruction code are decoded as a command from the DTE.

Communication Software

To start the communication between the DTE and the DCE, two programs has been written in language C; one for the microcontroller unit (DTE), File name: DTE.C; and one for the microconverter unit (DCE), File name: DCE.C. The Keil Micro Vision software takes an C language source file and saved with '.C' extension and creates two files, an output list file (.LST) and a machine language object file in standard Intel Hex format (.HEX). The list file output (.LST) displays the results of the complier operation. The complier will display the text "COMPILATION COMPLETE, 0 WARNING(S), 0 ERROR(S)" indicating that it has successfully compiled the file and has created the hex and list files along with the input source file. If the compiler indicates any errors, we can view the output editor to examine the errors. The Intel DTE Hex file (DTE.HEX) is used to program the Microcontroller AT89C51 using the Universal Device Programmer and Tester (UDPT) and DCE Hex file (DCE.HEX) is used to program the Microconverter ADuC812 using the Windows Serial Downloader (WSD).

IV. RESULTS

Digital Bit Status:

1. Digital BIT Status: 11111111- GOOD
2. Digital BIT Status: 10101010 – 1's-GOOD 0's – BAD
3. Digital BIT Status: 11110000 - 1's-GOOD 0's – BAD

Control Panel Switch Status:

1. Control Panel Switch Status: 11010101 – 1's – UP 0's – DOWN
2. Control Panel Switch Status: 01101101 - 1's – UP 0's – DOWN
3. Control Panel Switch Status: 00111010 - 1's – UP 0's – DOWN

V. CONCLUSION

By simulating various conditions, this health monitoring system will exactly pinpoint the location of fault. Apart from this, the control panel can also be tested fully. The hardware requirement of the end target has also been met by using the Microconverter ADuC812 which is a fully integrated data acquisition system incorporating a high performance 8-channel Analog-to-Digital Converter (ADC), two 12-bit Digital-to-Analog Converters (DAC), and a programmable 8-bit (8051-compatible) MCU on a single chip.

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