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Graphical LCD Oscilloscope using ATmega16 Microcontroller

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Abstract

This paper describes the new way of designing of Graphical LCD (GLCD) Oscilloscope, which shows the improvement over the existing oscilloscope. Our aim is to implement Graphical LCD (GLCD) which is suitable for the measurement of low frequency signals. Here, we are using ATMEGA16 Microcontroller, which consists of 10- bit inbuilt Analog to Digital Converter (ADC). In this project, the designed GLCD has overcome with the problem space occupied, low weight and cost.

Keywords: Graphical LCD (GLCDO), ATmrga16, Proteus Software, AVR studio, Embedded System.

Introduction

Microcontroller becomes popular due to their size and capability. The embedded systems are building around microcontroller and peripheral device[3]. Oscilloscope is commonly used to observe wave shape of an electrical analog signal which is usually voltage, time and frequency. Measurements of peak to peak voltage of waveform, frequency of periodic signal, time is for a signal to rise to full amplitude. Mostly, CRO is used for this purpose but it is very bulky and difficult to carry. The aim of this work is to design a portable oscilloscope.

Working Principle

Graphical LCD works on the basic concept of the sampling theorem. Sampling frequency should be twice to the highest frequency component present in the signal as given in eq. (1).

$$f_s \geq 2f_c \quad (1)$$

Where,
f_s : sampling frequency
f_c : highest frequency control in the signal

For the purpose of sampling, ADC is used which has conversion time of 30 microsecond[5]. This time should be utilized by us to display data on GLCD otherwise time difference between three consecutive samples will increase and decrease the sampling rate of system[8]. As a result the frequency range of whole system will decrease. It is recommended that maximum frequency of an external clock source less than $f_{CLK} = \frac{10}{25}$ and the clock frequency should be between 50 KHz and 200 KHz to get maximum resolution and its conversion time is 13µs - 260µs.

ATmega16 Microcontroller

Graphical LCD JHD12864E is used for displaying the wave shapes or signal. It has the features like high performance, Low power AVR (8-bit) Microcontroller, RISC Architecture[4]. 131Powerful Instruction, 32x8 general purpose working registers.

Display construction – 128 * 64 Dots, Number of data lines – 8 bit parallel.

Graphical LCD

We designed a graphical LCD driver for use with crystal fonts 12864B 128x64 pixel graphical LCD. Fig. 1 shows the block diagram of the ATMEGA16 microcontroller with complete system[3]. The power supply is given to the graphical LCD and 555 timer[2]. Five toggle switches are used for different setting as mentioned.

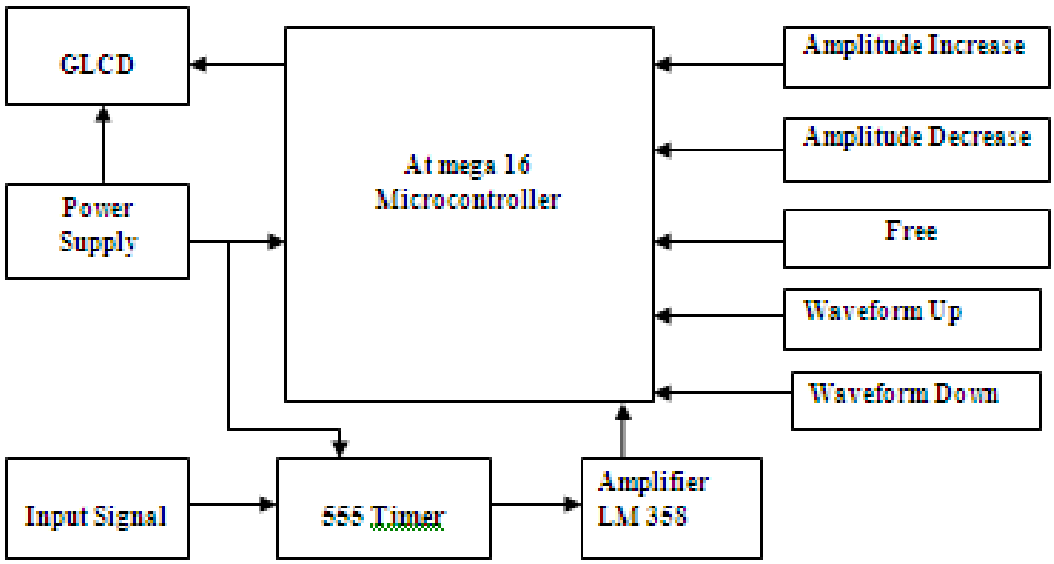

Fig. 1Block Diagram

Description of new system

The oscilloscope probe reads the voltage signal. Fig. 2 shows the flow chart which describes the process of execution og the system.

Algorithm:

The system will execute as follows:

- It starts from analog input signal which is taken from device.
- Then initialize graphical LCD.
- After that analog signal is converted into digital signal through ADC which is inbuilt in the ATmega16 microcontroller.
- Then changes has been done as per the user requirements.
- Finally display on graphical LCD

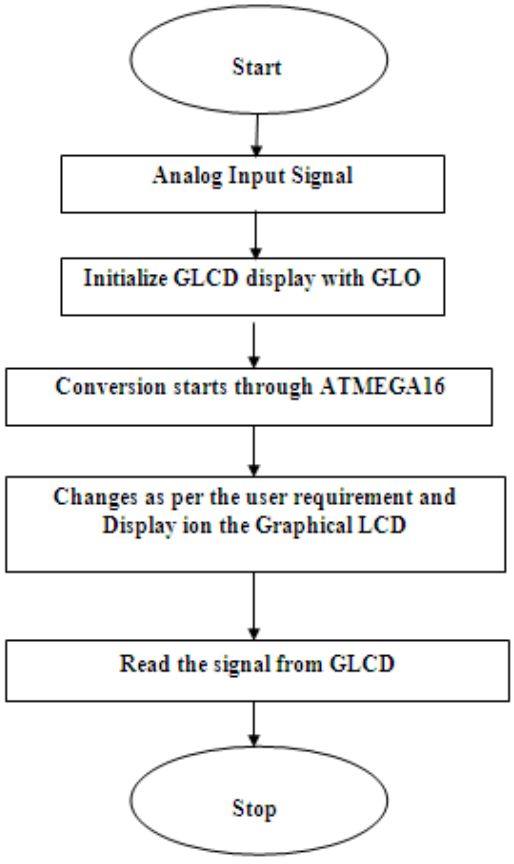

Fig. 2 Flow Chart

Description of Circuit diagram

Atmega16 is low-power, high performance, advanced RISC architecture with 8kbytes of in-system self programmable flash and erasable EEPROM memory[1]. Flash program memory and 5kbytes EEPROM, and 1 kbyte internal SRAM. The power

supply 5 v is given to Atmega16 microcontroller, graphical LCD and 555 timer[7]. Then conversion is done with 10 bit inbuilt ACD. According to the user requirement, we can adjust the toggle switch. The graphics LCDs are preferred over the character LCDs for is 128 X 64 so there are only 64 dots in each column. ADC has 10 bit resolution. We need only 8-bit to plot data those applications where both character and graphical representation are required. To interface this LCD with microcontroller, two registers (Input and Output register) are provided in the LCD. Fig. 3 shows the block diagram of the new system. These registers are selected by the combination of RS and RW signals. The resolution of GLCD are on these dots. So, that ADC generates a 10-bit result when is presented in the ADC data register, ADCH and ADCL. The resolution of GLCD is 128 X 64, therefore only 64 dots in each column are available.

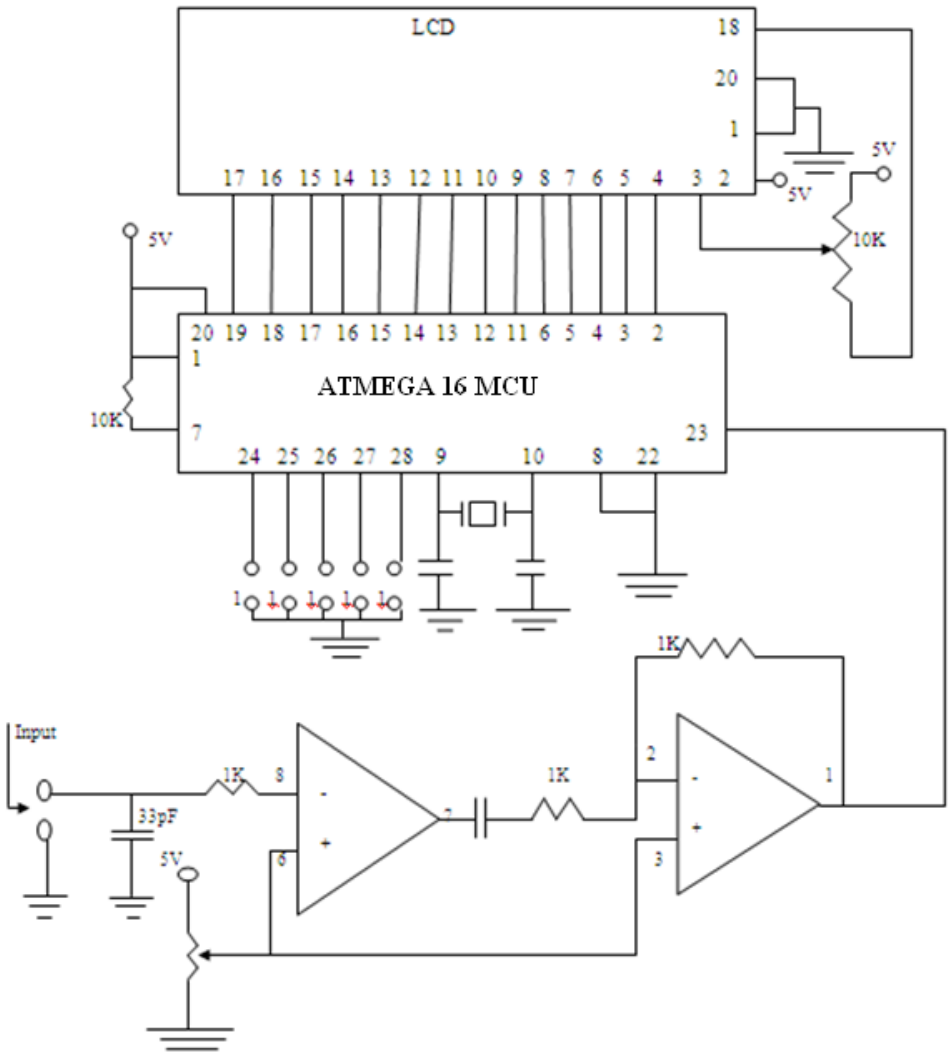

Fig. 3 Circuit Diagram

To plot data on these dots we need only 6-bits, but as laid above that ADC has 10 bits, but as laid above that ADC has 10 bits resolution[5]. To, represents data of 10-bits, we need 1024 dots, but we have only 64 dots in column, we have to convert 10-bit digital value of ADC into 6-bits. This can be done by the ways:

i) Leave first four bits ie. from MSB of 6-bit data, but this will decrease the range and maintain the resolution.
ii) Leave first four bits ie. from LSB of 6-bit data, but this will decrease the range and maintain the resolution.

Programming Details

The program for G. L. O. is written in C language.

Result and Discussion

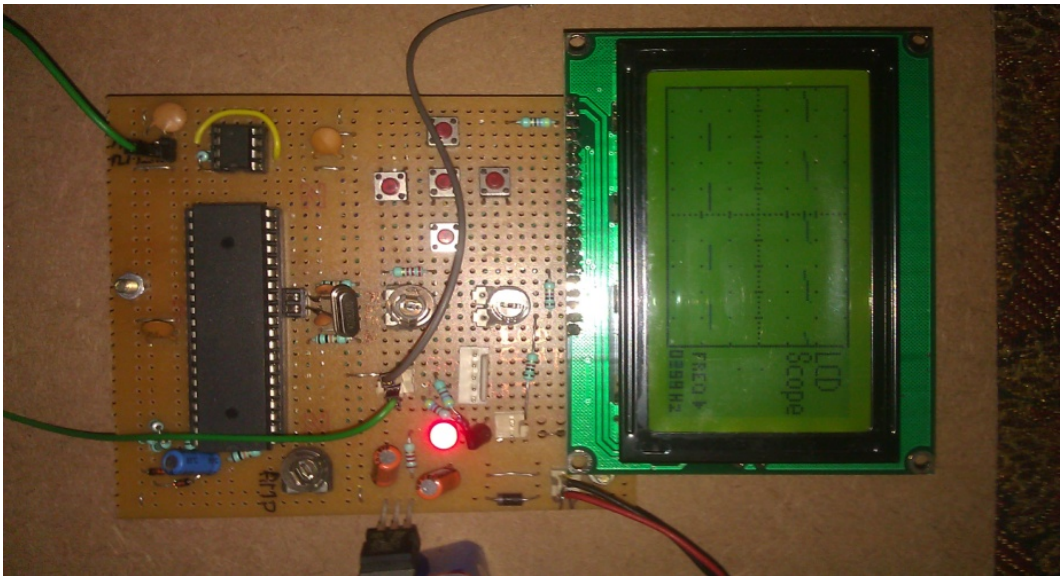

Fig. 4. Result

Input signal is applied using the functional generator. Fig. 4 shows the result square wavee shape on GLCD for 200 Hz input frequency. To avoid aliasing effect for practical purpose we can use anti aliasing filter.

Conclusion

This embedded system can be used to analyze low frequency signal and amplitude voltage. It helps student use to develop new system which is compact in size and cost is also very low as compared to available portable oscilloscope.

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