Portable Oscilloscope using AVR Microcontroller

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Abstract- *In this paper, we have developed a portable oscilloscope. It overcome the problem of space required and make the device handy to use. It also requires less power. We are using AVR microcontroller for designing of a circuit.*

Keywords- Graphical LCD, ATmega32 IC, IC LM358, cost effective, embedded system.

I. INTRODUCTION

An oscilloscope is a device which measures constantly varying signals, it is a graph displaying device. It is also known as cathode ray oscilloscope. It gives a signal in a two way axis form. X-axis represents time which is horizontal axis and vertical Y-axis represents voltage. This graph gives us information about a signal like- frequency, time, voltage, noise. But this classical CRO is not handy to use, also it requires more space. To overcome this problem we can use a digital portable oscilloscope using graphical LCD. The device requires less power and less space.

II. METHODOLOGY

A. BLOCK DIAGRAM

Given block diagram is used to explain the basic functioning of oscilloscope using ATmega32 and GLCD screen. Battery source provides 12 V. This voltage is divided into two different voltage values i.e. 8.2V and 5V. Input signal and 8.2V is given to LM358 IC which is used as a comparator.5V is used to powered up micro-controller ATmega32 and GLCD screen. The switches are interfaced for increasing and decreasing the time. Similarly for beam up and beam down. Switch 1&4 are used for decreasing and increasing the time or frequency. Similarly switch 2&5 are used to move beam up and down. Switch 3 is used to freeze the beam. Output from LM358 is given to micro-controller which is having in built ADC to convert the analog signal to digital signal using sampling and quantization which is then showed in the GLCD screen.

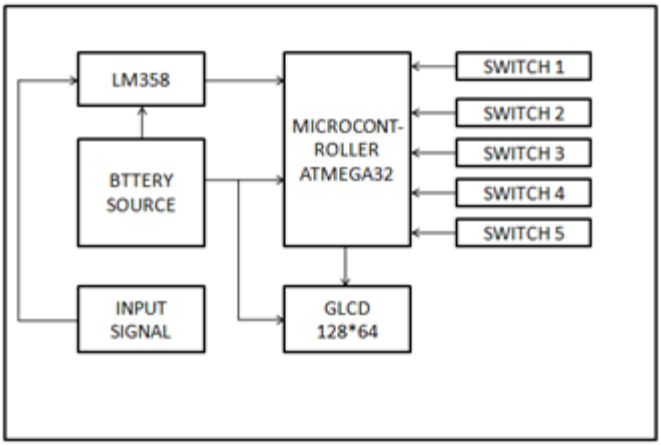


Fig.1: Block Diagram of Portable Oscilloscope

B. ALGORITH

Analog signal is fed to LM358 which work as differential amplifier and compares the differential voltage with the reference voltage i.e. 8.2V.Differential Amplifier uses the negative feedback to improve the output performance of the system. After that analog to digital converter in AVR samples and calculate the middle value of the signal wave form. Samples are calculated from one full period. AVR microcontroller samples the signal continuously and each sample is compared with the previous one. If the current sample value is higher than the previous sample then waveform result as rising waveform and AVR will go to step 4. If the current sample value is lower than the previous value then AVR will go to step 2. Again calculate the value of next sample and compared it with the middle value. If the value of next sample is higher then the middle value then its a rising waveform and AVR will calculate the waveform upto the selected pixels. AVR thus Prints those samples on GLCD. AVR starts again from step 1.

C. FLOW CHART

The system will work as follow: Analog Signal from the device is fed to the LM358 Comparator. LM358 work as a differential amplifier and compares the differential voltage with the reference voltage. 12V DC battery is used as a Source of Energy and 12V is divided into 5V and 8.2V. LM358 is provided with 8.2V of source energy and it work as a reference voltage.LM358 then sample and compare the analog

signal with 8.2V of source energy . After that analog signal is fed to the ADC which is inbuilt in the ATMega32 microcontroller. ADC converts the analog signal to digital signal by sampling and quantization. Then changes has been done as per the requirement of the user with the use of switches. Then signal is displayed on Grapical LCD

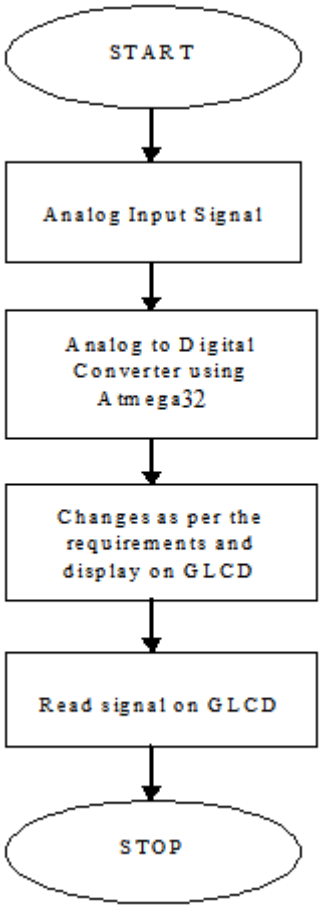


Fig.2: Flow chart of Portable Oscilloscope

III. COMPONENTS REQUIRED

A. Graphical LCD

GLCD is used to display customized characters and symbols but in character lcd we can display only characters and numeric numbers.

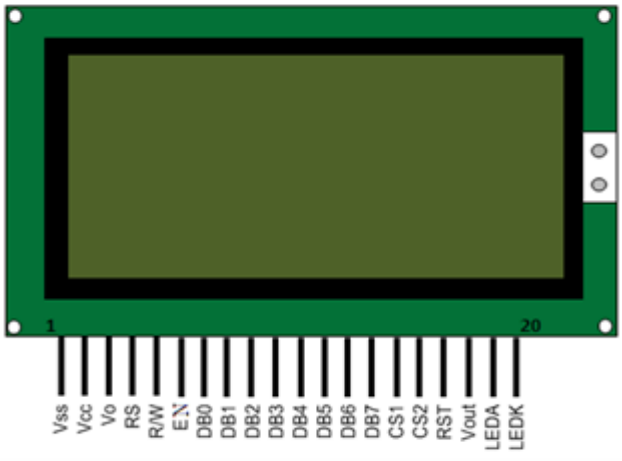


Fig.3: Graphical LCD with 20 pins

GLCD 128*64 is having 128 columns and 64 rows and 128*64 means 1024 pixels. GLCD has max. of 20 pins. Data port is of 8 bits and it works on +5V. GLCD is used where we want character and graphical representation to display. RS, RW and Enable are the control pins of the GLCD Each half has 8 pages and it is controlled by a separate controller. In each page we have 8 rows and 64 columns. For selecting the halves we have two pins named as chip select. Graphical LCD is mainly used in many applications like mobile phones, video games , lifts as a display. GLCD is divided into two equal halves.

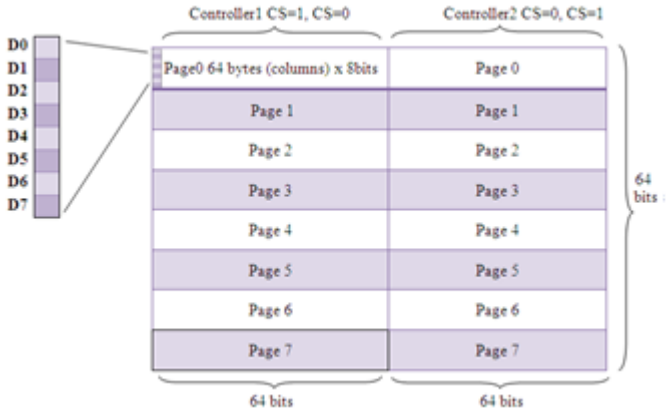


Fig.4 Page format of GLCD

Above figure shows the division of two halves. Each half consist of 8 pages and each half is selected by using the chip select pin 15 and 16 of GLCD [8]. If high is given to pin 15 and low is given to pin 16 then first half is selected and vice versa.

B. ATMEGA32

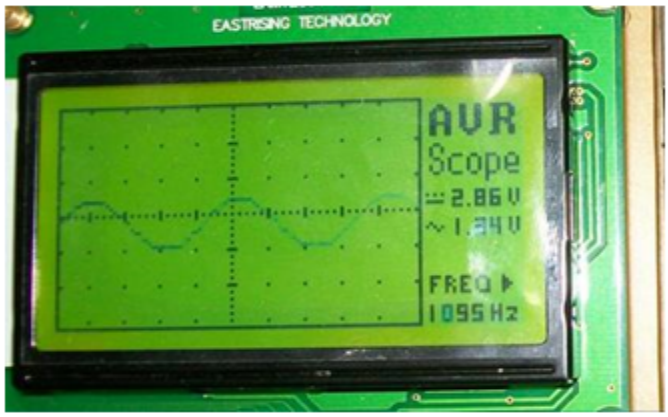
The ATMEGA32 is a low-power, high-performance advance RISC 8-bit microcontroller with 32K bytes of in-system programmable Flash memory. The on-chip Flash

allows the program memory to be reprogrammed in system or by a conventional nonvolatile memory pro-grammer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel ATMEGA32 is a powerful microcontroller, which provides a highly flexible and cost-effective solution to many, embedded control applications. The ATMEGA32 provides the following standard features: 32K bytes of Flash, 1024 byte of EEPROM & 2KB INTERNAL S RAM ,32 I/O lines, Watchdog timer, two data pointers, two 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator,8-channel 10 bit ADC and clock circuitry. In addition, the ATMEGA32 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning.

C. LM358

The LM358 series are operational amplifiers which can operate with only a single power supply voltage, have true-differential inputs, and remain in the linear mode with an input common-mode voltage of 0 VDC. These amplifiers operate over a wide range of power supply voltage with little change in performance characteristics. The amplifier's differential inputs consist of a non-inverting input (+IN) and an inverting input (–IN). The amplifer amplifies only the difference in voltage between the two inpus, which is called the differential input voltage.

IV. WORKING MODEL



V. ADVANTAGES & DIS-ADVANTAGES

Advantages

(i) It consumes less power
(ii) It is portable and handy to use.
(iii) Easy to install

Disadvantages

(i) Because of small bandwidth we cant expect the signal above bandwidth
(ii) All though systems shares same VDD so there will be some noise

VI. CONCLUSION

Thus, this system is capable of displaying different waveforms such as sine wave, triangular wave, square wave by using ATmega32 and graphical LCD. It has removed the problem of moving the ideal oscilloscope from one place to another because of its size and it is affordable too. Due to small size it is easy to handle and operate, therefore this system can be used in research purposes and development. Therefore, this system can be used as portable.

Parameter	Specification
Bandwidth	10 Hz- 5Khz
Resolution	100*60

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