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Designing a PC Based Oscilloscope Using Arduino

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Abstract: **The main aim of this project is to develop the PC Based Oscilloscope with the Arduino interfaced with PC or Laptop. In this project we use an Arduino board (Duemilanove) which is used to capture multiple input values and pass them via USB serial port to a PC or Laptop that takes the values, decode it and display them on the screen. In many applications we observe that the certain voltage waveform in a circuit plays a crucial role in understanding the operation of circuit. Several measurement instruments are used like voltmeter, ammeter or the oscilloscope. An oscilloscope (sometimes called scope) is a voltage sensing instrument which is used for displaying, analyzing electrical signals and to visualize certain voltage waveforms. An oscilloscope has a screen to display a signal trace that is offset in the X and Y axis by measurements taken from two different inputs. Now a days PC based measurements have become more affordable and easy to use, thus opening the door for "virtual instrumentation". This paper describes about developing a PC based oscilloscope. IN this project we use aArduino which is an open-source electronics prototyping platform based on flexible easy to use hardware and software and this environment makes it easy to write code and upload it to the I/O board.**

Keywords: **PC Based Oscilloscope, PC or Laptop.**

I. INTRODUCTION

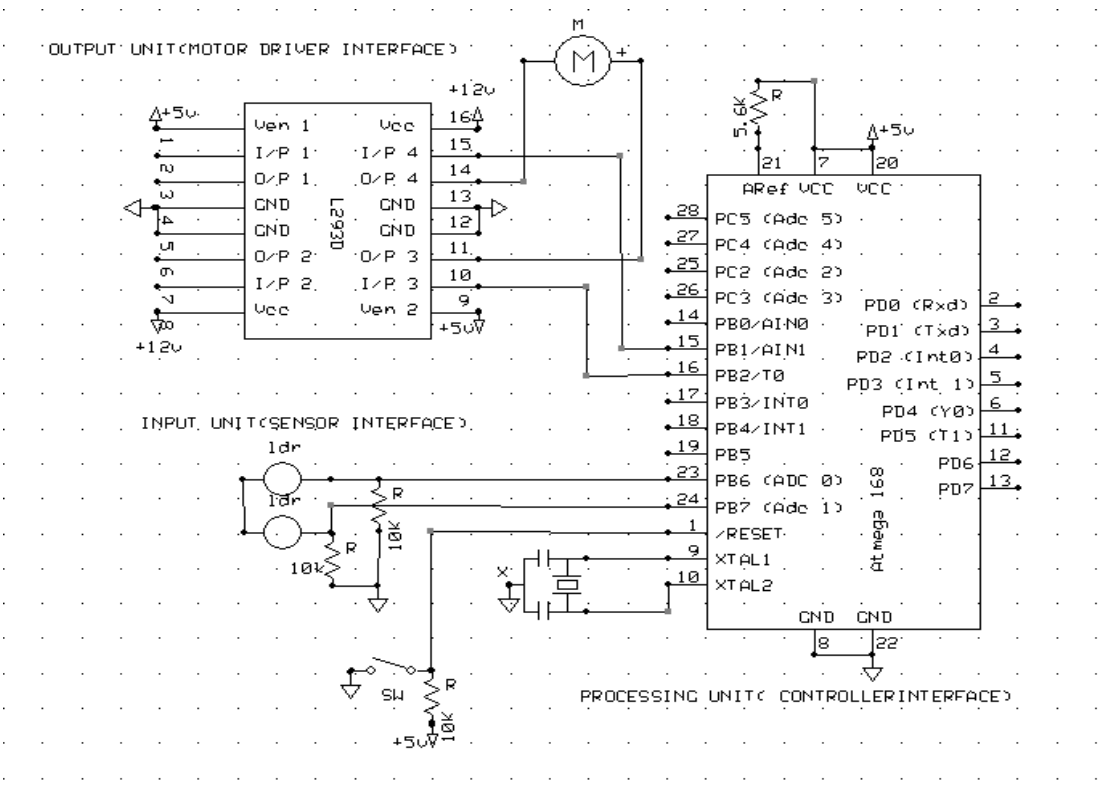
In earlier days signals were analyzed using electromagnetic oscilloscope graph which later was replaced by cathode ray oscilloscope for getting higher bandwidth. Digital storage oscilloscope has now been introduced in the market and is widely used because they have high input impedance which allows us to analyze both the digital and analog signals. Our project is a simple prototype of an oscilloscope. We are using inbuilt ADC convertor of microcontroller to convert the analog signal to digital signal in order to send a data to PC. Two channels of ADC are used to send the data hence it is a two channel oscilloscope. In PC or Laptop the software running is made using processing.

This project can be explained with the following block diagram.

To demonstrate the project we will be required a signal generator hence here we have made a simple square wave generator using triple five timers for demonstration only also a preset is there to change a voltage at any channel. These two signals can be connected with any channel.

II. EMBEDDED SYSTEM

Embedded systems are components integrating software and hardware jointly and specifically designed to provide given functionalities. A combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a dedicated function. An embedded system is a special purpose computer system designed to perform one or a few dedicated functions often with real-time computing constraints. Embedded systems are designed to do some specific task rather than be a general purpose computer for multiple task.



An embedded system is not always a separate block –very often it is physically built-in to the device it is controlling. The software written for embedded systems is often called firmware and is stored in read only memory or flash convector chips rather than a disk drive. It often runs with limited computer hardware resources small or no keyboard, screen and little memory.

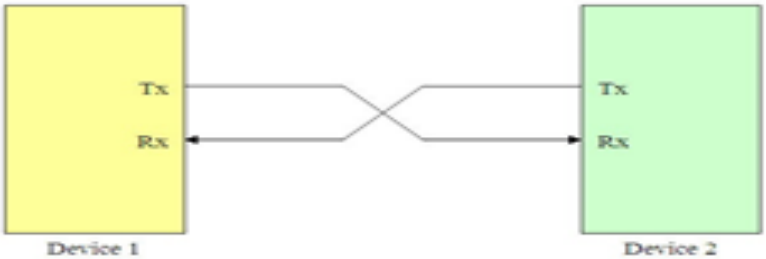
III. HARDWARE COMPONENTS

A. ATMEGA168:

There are number of popular families of microcontroller which are used in different applications as per their capability and feasibility to perform the desired task. Most common of these are 8051 AVR and PIC microcontrollers. Here we use Atmel ATMEGA168 which is a low power CMOS 8 bit microcontroller based on the AVR enhanced risk architecture by executing powerful instructions in a single clock cycle the ATMEGA168 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. The Atmel ATMEGA168 provides the following features: 16K bytes of In-System programmable flash with read-while-write capabilities, 512 bytes EEPROM, 1K bytes SRAM, 23 general purpose I/O lines, 32 general purpose registers, a serial programmable USART, a byte oriented 2-wire serial interface, an SPI serial port , a 6 channel 10 bit ADC, a programmable watchdog timer with internal oscillator.

B. UART:

UART is a popular method of serial asynchronous communication. Typically, the UART is connected between a processor and a peripheral. To the processor, the UART appears as an 8 bit read-write parallel port that performs serial to parallel conversions for the processors and vice versa for the peripheral.



This 16550 UART core emulates the functionality of National Semiconductors PC 16550D UART with FIFOs. It is capable of communicating with any other 16550-compliant UART. The universal asynchronous receiver/transmitter (UART) takes bytes of data and transmits the individual bits in a sequential fashion. At the destination; a second UART re-assembles the bits into complete bytes. Each UART contains a shift register, which is the fundamental method of conversion between serial and parallel forms. Serial transmission of digital information (bits) through a single wire or other medium is less costly than parallel transmission through multiple wires.

C. Software Used:

Here we used an Arduino software(IDE) version 1.6.0 which is a latest Arduino software is easily available in the arduino website and it is of free of cost. With the help of this software we can easily upload the program to the programmer with the help of a inbuilt bootloader.In this project for hardware interfacing we used a compiler named "Processing". Processing is a programming language, development environment and online community.

IV. CONCLUSION

A low cost, portable, plug- in- type PC oscilloscope is based on the communication features of the PC parallel port has been developed. Hereby we conclude that Arduino can be used as Oscilloscope for displaying waveforms Arduino Oscilloscope also has the ability to perform various operation on the applied inputs such as addition, subtraction etc. This makes analysis simpler and overcomes the drawbacks of the conventional CRO's. We built hardware interface circuit to make the functioning of a oscilloscope much easier with few affordable electronics components so as for the conversion and processing of the analog signal into the digital form. We used Arduino software (IDE) which is easily available on the Arduino website and it is free of cost. The software has been developed to manage the acquisition, to represent the signals and post processing of the signal. The only drawback is it cannot take negative inputs or voltage above 5 volts. We can also use the potential divider circuit so as to protect the Arduino from over voltages or from getting damaged.

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