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ARM 7 Based Portable Oscilloscope Using LabVIEW

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Abstract: The present world measurement and instrumentation has opened up the window for "virtual instrumentation." This paper describes the development of a portable, very low cost oscilloscope using LabVIEW software. The project, initially designed as a graduate thesis, is currently being used for laboratory purposes. The features of this device make it suitable for implementing as an educational re-source for graduate students from Electrical, Electronics, Instrumentation, and Computer Science faculties.

Keywords: ARM processors, Oscilloscope, LabVIEW, GLCD

I. INTRODUCTION

An oscilloscope, previously called an oscillograph, and informally known as a scope, CRO (for cathode-ray oscilloscope), or DSO (for the more modern digital storage oscilloscope), is a type of electronic test instrument that allows observation of constantly varying signal voltages, usually as a two- dimensional graph of one or more electrical potential differences using the vertical or y-axis, plotted as a function of time (horizontal or x-axis). Many signals can be converted to voltages and displayed this way. Signals are often periodic and repeat constantly so that multiple samples of a signal which is actually varying with time are displayed as a steady picture. Many oscilloscopes (storage oscilloscopes) can also capture non-repeating waveforms for a specified time and show a steady display of the captured segment. The need to have a visual perception of signals in order to monitor events in time and value brought about the development of a measuring instrument referred to as oscilloscope. This is a design of portable and low cost oscilloscope. The user can start/stop the display, adjust the time division and adjust the voltage division Portable oscilloscopes currently in the market are very expensive, less power efficient and have small low resolution displays. This paper presents the design and implementation of a low cost, portable, light-weight; low power, dual-channel oscilloscope, consisting of a hardware device and a software application. Virtual instrument to represent a new instrument to change the thinking of traditional instruments , they take full advantage of powerful computer hardware and software resources, the close combination of computer technology and measurement techniques, and integration of electronic measurement, signal processing, computer and network technology new measuring instruments, low cost, easy to use and the advantages of a wide range of applications .In this project we developed a oscilloscope based on general-purpose computer hardware development model developed by National Instruments LabVIEW software development platform to try to develop a multi-function virtual digital oscilloscope.

II. SOFTWARE DETAILS

The proposed system has been implemented using lab view software are used to monitoring and control the applications in evolving according to the software architecture. The server is responsible for data acquisition and data storing memory.
After the display of welcome screen, program will be at pause state until a "start" button is pressed. When program shifts from pause state to start state, a grid along with waveform is displayed on the front panel of oscilloscope. Whenever a new digital value appear at Analog to Digital Converter after real time sampling of input signal, that particular digital value is displayed on Graphical Display as a form of pixels.
Graphical Display is of 128 x 64 pixels; in this project we are using 100 pixels for displaying signal and remaining 28 pixels for displaying digital values of voltage, frequency and time base. This process will continue until device is in switch on mode.

A.SOFTWARE IMPLEMENTATION

LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a graphical programming language that uses icons instead of lines of text to create applications. In contrast to text-based programming languages, where instructions determine the order of program execution, LabVIEW uses dataflow programming, where the flow of data through the nodes on the block diagram determines the execution order of the VIs and functions. VIs, or virtual instruments, are LabVIEW programs that imitate physical instruments.

In LabVIEW, you build a user interface by using a set of tools and objects. The user interface is known as the front panel. You then add code using graphical representations of functions to control the front panel objects. This graphical source code is also known as G code or block diagram code. The block diagram contains this code. In some ways, the block diagram resembles a flowchart.

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III. BLOCK DIAGRAM

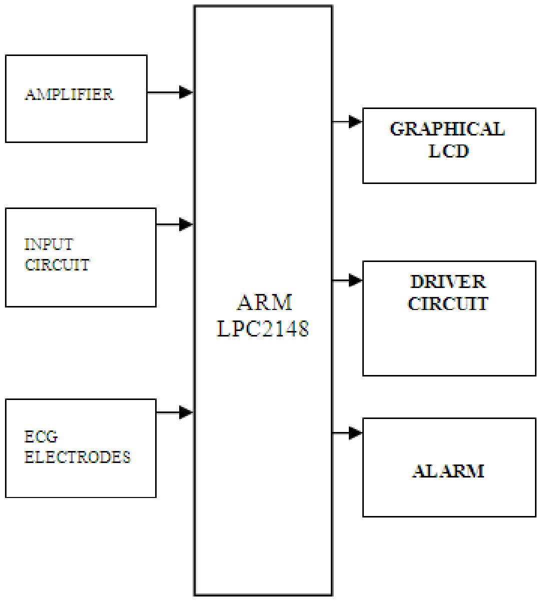

FIG.1.Proposed Block Diagram

Description of proposed method:
ARM7 is one of the widely used micro-controller family in embedded system application. LPC2148 is the widely used IC from ARM-7 family. It is manufactured by Philips and it is pre-loaded with many inbuilt peripherals making it more efficient and a reliable option for the beginners as well as high end application developer.ARM7 has Princeton memory architecture. Vectors, Pointers, Variables, Program segments and the memory blocks for data and stacks have different addresses in the program in Princeton memory architecture.

An RTOS is an Operating System for response time controlled and event controlled processes. The processes have predictable latencies. An RTOS is an OS for the systems having the real timing constraints and deadlines on the tasks, ISRs. After choosing the frequencies and ADC sampling, signal enters the ARM7 core.ARM7 core communicate with PC using RS232 convert circuit.

IV. HARDWARE DETAILS

A. LPC2148
ARM LPC2148 is used as a controlling device and graphical display for displaying signals. Probes will be there for testing circuit. The probes will be similar to as used in bigger oscilloscopes. By using ARM it will be an easier task to sense a particular signal and control it. As ARM consists of in-build ADC, there is no need to externally interface it. So the sensed signals from probe are directly send to the microprocessor, where it is converted to its digital value.
ARM processor will sit ideal until a new data or digital value is sensed at probes. Then it will pass the data to being displayed on GLCD. At some point of time tuning and altering of waveform is also required, for its proper demonstration. Switches are provided for adjusting voltages, frequency and its time base. The values of voltage and frequency are chosen such that the waveform is displayed in an appropriate manner.

Triggering is also an important factor because if its value is not properly set then waveforms will not be shown. This will be a design of auto triggering. In this type of designs user does not have to take care of horizontal and vertical triggering.

B.GRAPHICAL LCD
Graphical Liquid Crystal Displays add versatility to any project. I designed a graphical LCD driver for use with the Crystal fonts 12864B 128 x 64 pixel graphical LCD for student use. Characteristics JHD12864AB Series Display content: 128 x 64 dots Driving mode: 1/64D Available type:stn(yellow-green,grey,b/w) Backlight color(Emerald Green).

FEATURES OF GLCD:
Operation Voltage Range: 4.5V to 5.5V. Support 8-bit, 4-bit and serial bus MPU interface. 64 x 16-bit display RAM (DDRAM) Supports 16 words x 4 lines (Max) LCD display range 16 words x 2 lines. 64 x 256-bit Graphic Display RAM (GDRAM).

2M-bits Character Generation ROM (CGROM): Support 8192 Chinese words (16x16 dot matrix) .16K-bit half-width Character Generation ROM (HCGROM): Supports 126 characters (16x8 dot matrix) . 32-common x 64-segment (2 lines of character) LCD driver's l Automatic power on reset (POR).

External reset pin (XRESET). With the extension segment drivers, the display area can up to 16x2 lines. Contrast is already adjusted for 5V when shipped out. Once contrast is set to an optimum, internal temperature Compensation circuit provides best contrast all over the whole temperature range of -20..+70°C. An external contrast adjustment is normally not necessary, but can be done via external potentiometer.

BACKLIGHT
Graphic displays featured with a low-power LED-backlight. Brightness can be switched off and adjusted infinitely. Driving the LED backlight requires a current source or an external series resistor for current limiting. Forward voltage is between 2.2..2.6V (amber), 3.9..3.6V (white),3.7..4.1V (green). Maximum supply current is 90mA@+25°C. Operating with 5V.

BLACK&WHITE, BLUE, AMBER, GREEN
The blue-white display is best for indoor use with and without ambient light. Reading the display requires a minimum of backlight with about 15mA. Black and white version and green version are especially designed for outdoor applications.

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These displays do provide best contrast for all ambient illuminations, even with direct sunlight. No need to say that display can be read in darkness when LED backlight is switched on. This is same for the amber backlighted version EA DIP128J-6N5LA.The greatest advantage here is the long life backlight.

FIG.2.GLCD

C.DRIVER CIRCUIT

In electronics, a driver is an electrical circuit or other electronic component used to control another circuit or other component, such as a high-power transistor. The term is used, for example, for a specialized computer chip that controls the high-power transistors in AC-to-DC voltage converters. An amplifier can also be considered the driver for loudspeakers, or a constant voltage circuit that keeps an attached component operating within a broad range of input voltages. The following circuit will allow you to drive a 12V relay using logic voltage (an input of 4V or greater will trip the relay). The circuit has its own 12V power supply making it self contained but the power supply portion can be left out if an external supply will be used. The circuit shows an output from the power supply that can be used to power other devices but it should be noted that the supply is unregulated and not particularly powerful with the parts stated. The 12V DC output is suitable for powering a few LEDs or low voltage lights but should not be used to power other electronic boards or motors.

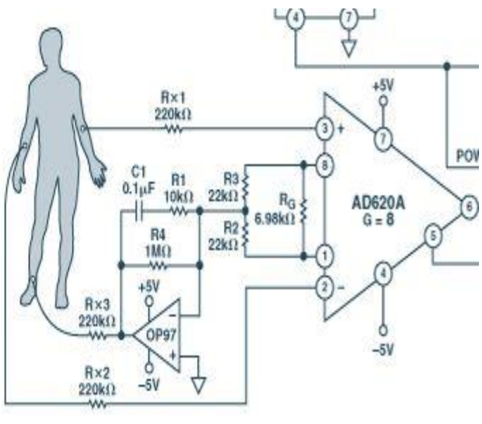

FIG.3.Medical ECG Monitors Using The AD620 Instrumentation Amplifier

One of features of the AD620 instrumentation amplifier is low current noise, this benefit allows its use in the Electrocardiography (ECG) monitors. A medical ECG Monitor Circuit is shown in the following picture. The AD620 is a low cost, high accuracy instrumentation amplifier that requires only one external resistor to set gains of 1 to 10,000. Furthermore, the AD620 features 8-lead SOIC and DIP packaging that is smaller than discrete designs and offers lower power (only 1.3 mA max supply current), making it a good fit for battery powered, portable (or remote) applications. The AD620, with its high accuracy of 40 ppm maximum nonlinearity, low offset voltage of 50 µV max, and offset drift of 0.6 µV/°C max, is ideal for use in precision data acquisition systems, such as weigh scales and transducer interfaces. Furthermore, the low noise, low input bias current, and low power of the AD620 make it well suited for medical applications such as ECG and non-invasive blood pressure monitors. The low input bias current of 1.0 nA max is made possible with the use of Superϐeta processing in the input stage. The AD620 works well as a preamplifier due to its low input voltage noise of 9 nV/√Hz at 1 kHz, 0.28 µV p-p in the 0.1 Hz to 10 Hz band, and 0.1 pA/√Hz input current noise. Also, the AD620 is well suited for multiplexed applications with its settling time of 15 µs to 0.01%, and its cost is low enough to enable designs with one in-amp per channel The picture tells the use of AD620 in ECG monitors where high source resistances of 1 MOhm or higher are not uncommon. It can improve the dynamic range for better performance when low bias current and low current noise coupled with the low voltage noise of the AD620.Capacitor C1 maintains the stability of right leg drive loop. An isolation addition to this circuit may protect the patient from possible danger.

D.BUZZER:

An alarm gives an audible or visual warning about a problem or condition.

A buzzer or beeper is a signalling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise). Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC-connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8-ohm speaker. Nowadays, it is more popular to use a ceramic-based piezoelectric sounder like a Son alert which makes a high-pitched tone. Usually these

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were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.

V. ADVANTAGES

- It is easy to operate.
- Simple and reliable design.
- Low cost.
- It is easy to operate

VI. CONCLUSIONS

The portable oscilloscope is low cost and avoid of the complexity use in the development of conventional scopes. It produces comparative results. It is a choice for all non-critical work that goes on every day in the laboratory and in out-of-lab measurements due to its portability. Initially the ARM-Oscilloscope was tested feeding the signals from function generator. Provided facility for having different sampling rate and variable voltage divisions. The kind of input waveform, like sine wave, triangular wave, square wave or any other function can be continuously changed and tested in this oscilloscope.

VII. FUTURE SCOPE

In this project, we can also generate a waveform by giving amplitude and frequency values. We can also select the type of waveform like,

- Sine wave
- Cosine wave
- Rectangular wave
- Triangular wave
- Saw tooth wave

Filter which is used to filter out the noise signal from the input signal. There are so many types of filters available which is of two forms either in analog form or digital form. We can use any type of filter for filtering the unwanted signal from the source. The current project in future, portable oscilloscopes can be designed with dual channel options. In this model many additional features like delay, magnifier, and intensity can be added to make device more serviceable. The range of operating frequency can also be increased. By adding these more features it can fully substitute the available bulky oscilloscopes at very low cost.

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BIOGRAPHY

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