Low Cost 4 Channel Logic Analyzer

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ABSTRACT

In this digital era, there are numerous devices which need to be tested and debugged. In this project, we are developing a low cost 4-channel logic analyzer using ARM Cortex M3 based microcontroller STM32F103C8T6. This microcontroller provides high speed data processing at cheap price. The microcontroller is interfaced with a graphical LCD to display the analyzed data, memory storage device such as a SRAM is used to store the received data.4 BNC connectors act as channels which are used to take the input data.

KEYWORDS: Logic analyzer, ARM.

I. INTRODUCTION

In a digital circuit an electronic system that is for capturing and displaying signals is known as logic analyzer. It is also used for debugging purposes of the digital circuit. It converts the captured data into timing diagrams, state machine traces and other forms of information which may heed the debugging for a circuit.

Previously many logic analyzers have been designed but they have flaws such as they are costly, complex to use, some cheap logic analyzers do not have good accuracy. We intend to address the problems that a cheap logic analyzer has.

Our project aims at high speed operation at low cost, providing a simple design rather than a complex design and providing students with the same so that they can debug simple digital circuits. The project is based on ARM M3 Cortex series microcontroller, along with a graphical LCD. The memory storage is addressed by using a SRAM. 4 input channels are provided which are used to acquire the input data.

The graphical LCD is used to display the waveforms from the channels. The project also provides 4-channels with multiple protocols that can be implemented to obtain a waveform which can be further used for different purposes.

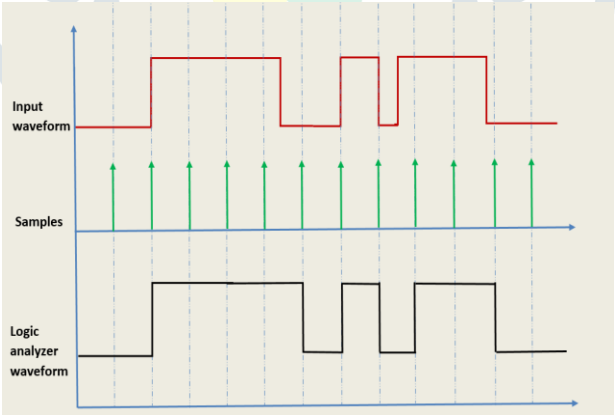

fig. 1: analyzer output

The incoming data from the input channels is sampled and is stored in the SRAM (Static random-access memory). The data stored from the SRAM is accessed by the microcontroller for further operation. The input voltage is captured at fixed sampling time. These samples are stored in the SRAM. The microcontroller accesses this data to generate the output signal. After this the data is displayed on the GLCD.

II. BACKGROUND DETAILS

Logic analyzer is a test instrument which is used to test the electronic circuits, it is used to display the response of the digital system in the form of a digital signal, which can be easily investigate during the debugging process. Depending upon the factor like number of channels, sampling rate, display module, processor used etc., they can be of three types, modular logic analyzer, PC based logic

analyzer, virtual logic analyzer. Modular logic analyzer is also known as professional logic analyzer which can support large number of channels as large as 64 channels, this kind of logic analyzer have an ability to sample the given signal in GHz, it also supports a wide variety of interface options to many external devices for control, storage and printing. But this kind of logic analyzer is too costly, which can't be recommended for institutes or a student.

Another type of logic analyzer is PC Based logic analyzer which uses many inbuilt capabilities of a PC for waveform measurement, waveform storage, data analysis and print options. Such kind of analyzer support 32 number of channels, it is more cost-effective than the professional type but it needs a PC/Laptop for each unit, and it is not a standalone device.

The third one is a Virtual Logic Analyzer and it is a combination of hardware and software. In this system, VHDL (very high-speed integrated circuit hardware description language) is used in programming each functional model. These types of Logic analyzers are specifically used for debugging FPGA based designs.

This paper presents an analyzer, which is cost effective, standalone, and Handheld. This Handheld Logic Analyzer can capture up to 4 channels of digital data, has a maximum input frequency of 1MHz and can display the waveforms on a color graphics LCD. ARM Cortex M3 has been used for the sampling as well as displaying of the signal.

III. SYSTEM ARCHITECTURE

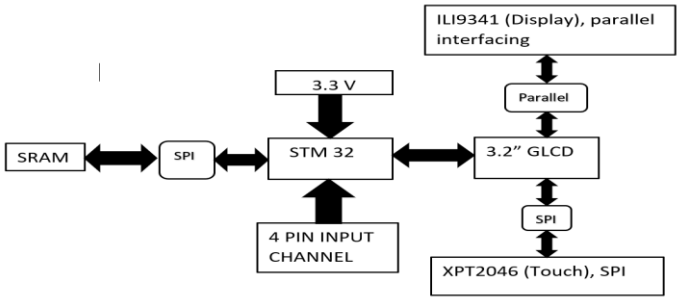

fig. 2: block diagram

Logic analyzer is an instrument which is used to represent digital signals. It converts the captured data into timing diagrams, state machine traces and other forms of information which may heed the debugging for a circuit. Logic analyzer can be used by the user for acquiring the correct logic state of the circuit.

The ARM architecture uses the Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). The advantage of RISC processors over that of a CISC processor is that it gives us high performance, high performance capability, and high clock rate.

The system architecture consists of a main microcontroller which handles the user interface through a Graphical Liquid Crystal Display (GLCD). It also has an external memory
storage device attached to it for storing the sampled data. We are using a SRAM (Static random-access memory).

Further the project also gives additional functionality for the user to either scale (zoom in and zoom out) the signal and to scroll the signal. The user can scroll the signal towards the right or left.

IV. FLOWCHART

The input power received from the wall adapter is converted to 3.3 volts by the help of a power regulator. The power regulator consists of lm317 voltage regulator which provides the voltage to the GLCD, microcontroller, SRAM and the led.

The LED (Light Emitting Diode) is used to indicate whether the circuit is on or off. The microcontroller serves the purpose of sampling the input signals at a high frequency. The sampled data is stored and is further processed. Various operations such scaling (zoom in and out) and scrolling are provided.

The operational flowchart for the same is shown in Fig. 3.

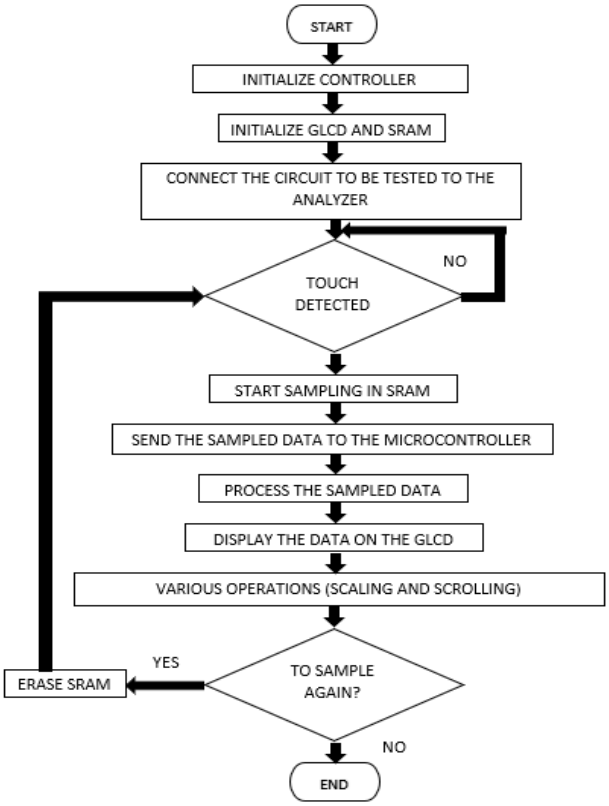

fig .3: operational flowchart

V. REFERENCES

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