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Logic Analyzer

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Abstract

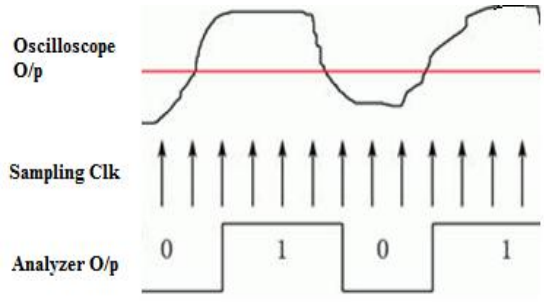
Due to the fast development of electronic devices, the digital circuit designing takes up more and more percentage in total electronic developments thus in the process of debugging and doing validation in a digital system, one of the common task a designer need to do is the acquisition of digital waveforms. The waveforms can be captured by the device Logic Analyzer.
As digital circuit is too fast to be observed by a human being, the basic idea to capture waveforms at higher speed is to implement the design using ARM controller which internally uses RISC Machine unlike simple processors. ARM based embedded systems, providing a low-cost solution to meet the request of flexibility and testability
Logic analyzer is a dedicated application The main objective is to use module as powerful Lab equipment to check and verify the design under test (digital circuit) for design and verification engineers with smaller size and less expensive.

Keywords: Logic analyzer, ARM, RISC

1. Introduction

In order to deliver correct-the-first-time products with complex system requirements and time-to-market pressure design verification is vital in the embedded system design process. A possible choice for verification is to simulate the system being designed.

If a high-level model for the system is used, simulation is fast but may not be accurate enough, with a low-level model too much time may be required to achieve the desired level of confidence in the quality of the evaluation. Since debugging of real systems has to take into account the behaviour of the target system as well as its environment, runtime information is extremely important.



Along with the designing of any digital system it is also necessary to debug and validate the system For debugging the system, different tests are needed to perform on digital waveforms[1]. Logic Analyzer is a tool that allows numerous digital waveforms to be acquired simultaneously. To acquire different digital waveforms a Logic Analyzer is a multi-channel device. The major function of an oscilloscope is to display the analogue characteristics, voltage scope and the spurious interference of a signal.

The logic analyzer is designed for digital circuits because of inherence of a signal, it works on the aspects of voltage level. Each channel inputs one digital signal.

It is the aim that in near future this system will gain the same popularity as a DMM of present time.

When we connect an analyzer to a digital circuit, we are only concerned with the logic state of the signal. It measures and analyzes signals differently than an oscilloscope. It doesn't measure analog details. Instead, it detects logic threshold levels. The advantages of Logic analyzer over oscilloscope are it can monitor multiple channel at a time with good and various triggers .It can be used as a powerful analysis function [3]. For testing a digital circuit using analyzer, only logic state of the signal is considered. The digital systems are faster compared to analog systems so acquiring the data will require higher rate and acquisition of data with high speed is possible with ARM machine as RISC machines are faster.[1]

The acquisition can be clocked internally, or the test system can provide the sample clock. It is designed to trigger a complicated sequence of digital events, and then copy a large amount of digital data from the system under test. The captured data will enable the user to locate failure of the digital system.
The acquisition channel is connected to the System Under Test through test probe. The input voltage is compared against the threshold voltage and decision about the signal's logic state (1or 0) is made.[2] The Logic Analyzer uses the PC as its displaying platform and communicates with the devices through USB ports. It also supports the most popular Windows system and provides convenient User Interface. With its powerful triggering abilities user can easily find out even slightest errors within the system. Logic Analyzer is used to debug and verify digital system operation, used to detect and analyze timing violations and transients on buses and to trace embedded software execution [3]

2. System Architecture

A logic analyzer is an electronic instrument which displays signals of a digital circuit. A logic analyzer may convert the captured data into timing diagrams, protocol decodes, state machine traces, assembly language, or correlate assembly with source-level software. Logic Analyzer is a multi-channel device which helps in displaying the digital waveforms.

With the rapid development of the field of industrial process control and the fast popularization of embedded ARM processor, it has been a trend that ARM processor can substitute the single-chip to realize data acquisition and control. Proposed system is based on embedded ARM processor (LPC2148)

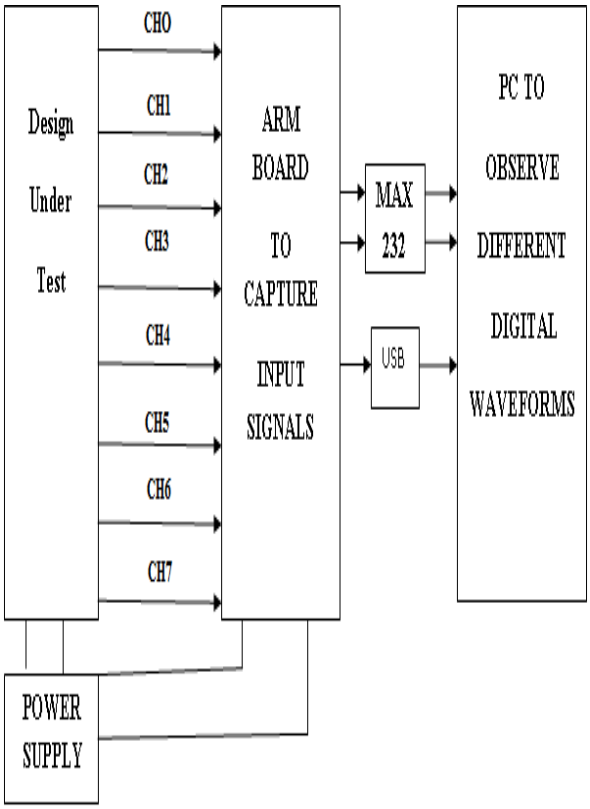
The module includes different parts -The first part includes different testing digital circuit like timer, flip flop, counter Timer can be used to generate a square waveform of particular frequency or variable frequency or it can be different microcontroller signals
As embedded systems are getting more complex, the need for thorough testing becomes increasingly important.

Advances in surface-mount packaging and multiple-layer PCB fabrication have resulted in smaller boards and more compact layout, making traditional test methods, e.g., external test probes and "bed-of-nails" test fixtures, harder to implement. As a result, acquiring signals on boards, can be beneficial to hardware testing and software development, It also include the probe to be connected from testing circuit to ARM board
The second part includes actual ARM board to capture real time signals of digital circuits The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on 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). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core.
Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory.

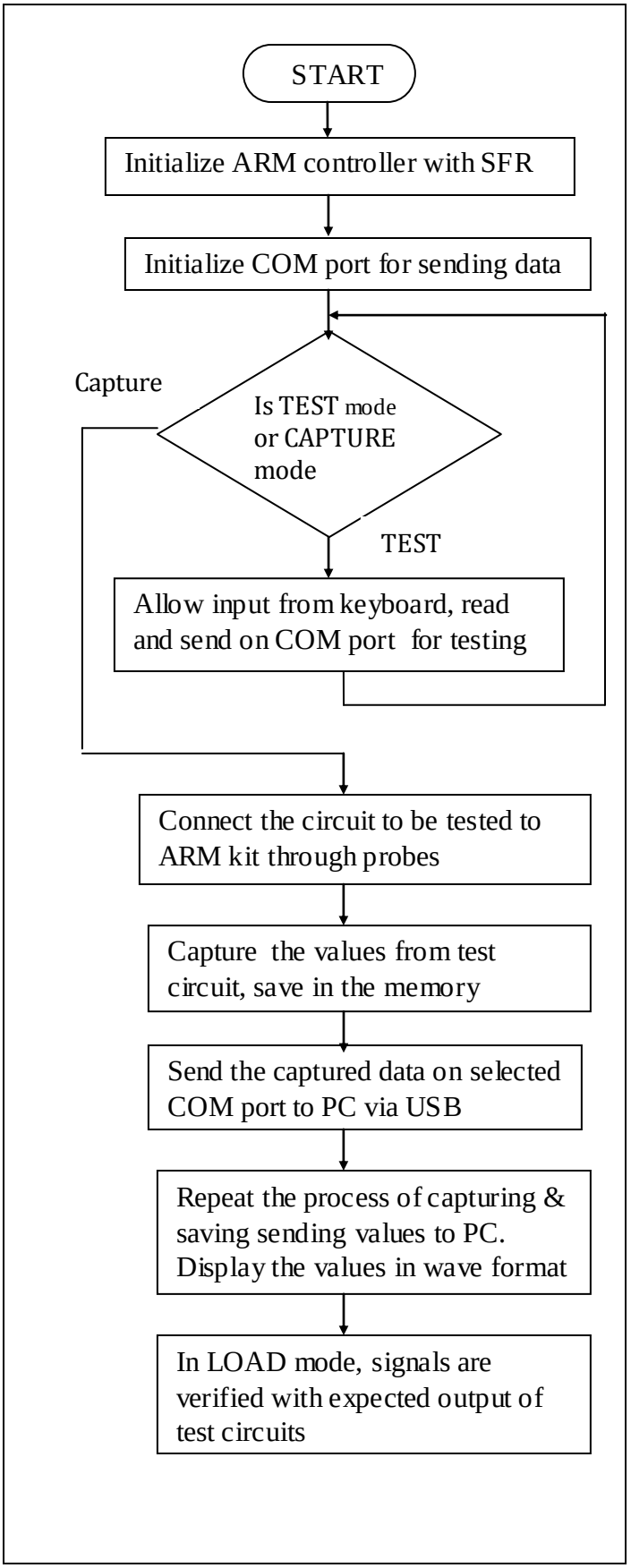
The advantage of using RISC processor is that the processor use smaller die sizes and requires shorter time to develop. The processors gives higher performance than CISC. It uses high clock rate with single cycle The ARM board is connected to PC through USB connector
The further part includes displaying the captured waveforms on the PC with the help of GUI control signals. The waveforms can be saved on the PC and retrieved back to analyze or to debug the different timing signals

The GUI (Graphical User Interface) includes different control buttons to connect different serial ports, hardware testing, debugging i.e capturing as data logging and analyzing i.e loading timing signals which are saved in data logging window

3 .Block Diagram



4.Flow Chart



5.Applications

Laboratory Purpose

Oscillator measurement: Observe the waveforms to find out if there are burrs or interferes or if change in frequency

Timing measurements Measure the timing of signals to find out conflicts or timing problems

Assistance on analysis It provides additional analysis to bus signals or protocol to simplify the development cycle.

Bug finder; Logic analyzer can be used for error tracing or finding error bugs.

Multichannel Measuring: It has 8 channels it can handle this kind of measurement easily.

Bus Frequency measurement

Trigger ability

Error Captures

6. Conclusion

The successful completion of the nodule can be used as low cost powerful lab equipment to debug and verify different digital systems with like timers, counters ,microcontroller circuits

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