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Multi Purpose Measuring Equipment Using Arm Cortex-M3

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ABSTRACT: This paper presents an instrument of multipurpose measuring equipment using ARM Cortex-M3 which is used to perform various functionalities required for lab experiments. Our main aim is to design portable lab equipment called as super scope; it avoids the usage of separate electronic devices which are connected to obtain measurements for lab experiments. This device can perform the operations of voltmeter, ammeter, tachometer, frequency generator, logic analyser, DSO, temperature sensor, light sensor and normal calculator. Students can improve electronic industrial discipline through this equipment which would help in their future, because in industries they want fresher's to be good in handling electronic equipment's.

Keywords: MEMS Accelerometer, Touch Screen and Graphics Library

I. INTRODUCTION

The Electrical and Electronics Measurements (EEM) are basic for undergraduate students. The students should develop their practical skills. The most used instruments in laboratories are very older instruments which are made by basic method rather than advanced technique such as Very Large Scale Integrated Circuits (VLSI) design which has very poor performance and accuracy. Instead of using old instruments we can use laboratory devices with advanced technology will increase the practical skills of the students and also it provides accurate readings then very easily handy one too.

The Texas Instruments has developed the Analog System Lab Kit (ALSK) Pro board [1] to support under and post graduate students to learn how to design analog system. The ALSK Pro board is very useful for EEM laboratory .This laboratory equipment is provided with touch screen which has buttons and menus. Our project is designed by using LPC 1313, a 32-bit microcontroller of ARM Cortex-M3. It is used because of its high performance.

Today in the field of innovative electronics related to the second hierarchical level of an electronic package, the greatest significant part of the whole automated product is the Printed Circuit Board (PCB) [2]. All the students involved in the practical manufacturing of their electronics modules have shown a lot of interest being very keen to see their projects turn into real electronic modules manufacture and tested by themselves [2].

Any electronic devices introducing now a days are made of embedded system and VLSI technique only, so we can inbuilt many devices into single and compact. By using this method, here sensors are used in order to simplify the design to make it as smaller in size.

II. METHODOLOGY

The schematic internal structures of this equipment are shown in fig (2). This show that the inbuilt devices which are used to obtain the measurements. The USB- UART is used for connectivity. Initially when the power is switched on, some of the contents are displayed on the front panel and the remaining contents are displayed on the second and third panel of the touch screen. The users have to click the touch screen panel in order to select the component for measurement. Initially the touch screen first panel consists of digital signal oscilloscope, wave recorder, frequency generator, logic analyser, voltmeter, and ammeter. The second panel consists of ohmmeter, tachometer, audio meter,

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motion monitor, light sensor, temperature sensor. Then the last panel consists of calculator. The user has to click one by one function to obtain the corresponding measurements.

First functionality is a DSO (digital signal oscilloscope). The main function of this DSO is to obtain the digital pulses as shown in fig (1). A graph is plotted with respect to time and amplitude. A square pulse is generated based on the frequency.

Fig.1. Execution of digital signal oscilloscope.

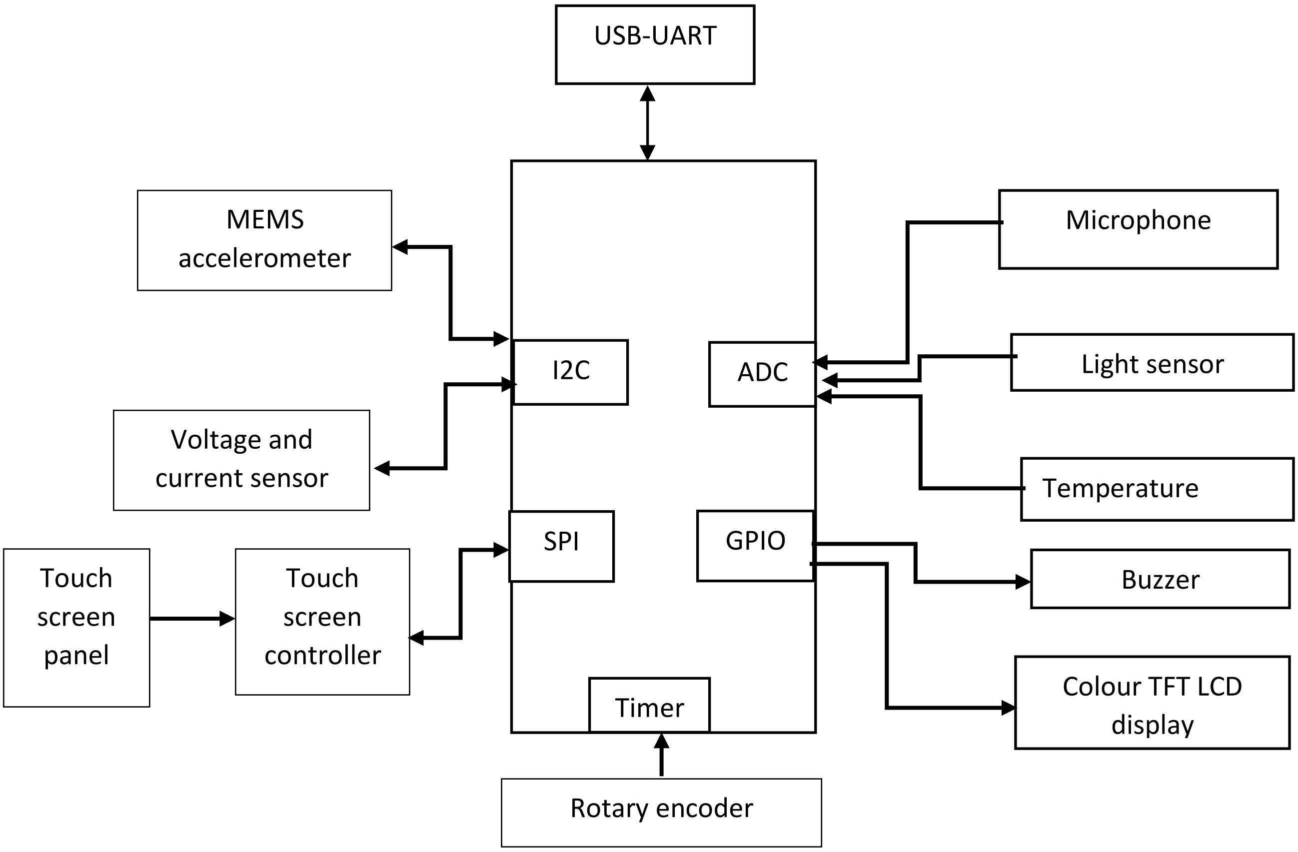

Fig.2. Schematic internal structure of this equipment

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The next functionality is frequency generator. The users have to click the backward arrow in order to come back to the first panel and then click the frequency generator. He/she provides the corresponding frequency and duty cycle. The frequency and duty cycle range varies from 50 to 50000 Hz. The appropriate waveforms are generated to the corresponding frequency and duty cycle.

Then the next functionality is logic analyser. The user have to provide an ASCII value as an input and it produce the corresponding logical waveform as an output with appropriate binary bits as shown in fig(3).

The next functionality is wave recorder. This functionality is used to store the waveform which is produced by frequency generator. The waveform stored at each and every time period.

The next functionality is voltmeter. The VIN pin is connected at 0v or 3v or 5v in order to measure the corresponding voltage readings.

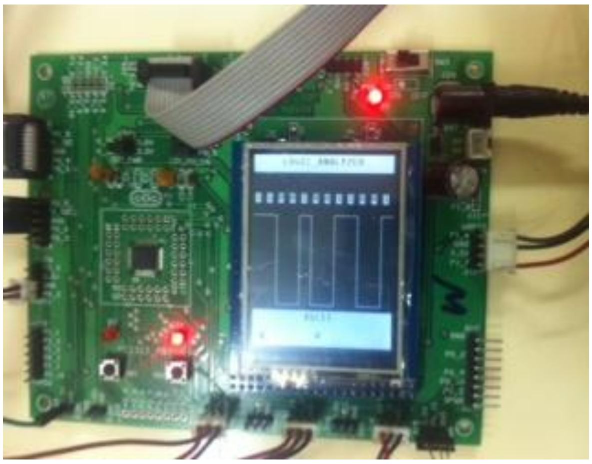

Fig.3. Execution of logic analyser

The next functionality is ammeter. For ammeter observations, the Vin pin is connected to battery of 9v and the jumper is connected at resistor to find the amount of current flowing through it. Then the jumper replaces at the next resistor and measures the readings. The measurement has to follow for different resistors.

The next functionality is ohmmeter. Now the VIN pin is connected at the resistor to find its value. Usually resistor is identified with colour code. But here by using ohmmeter we find the resistor values.

The next functionality is tachometer. The speed of any motor can be measured. Here we are using a 180 rpm motor and the corresponding speed of rotation can be displayed as a graph measured with respect to rpm. The next functionality is motion analyser. The variation in x, y and z direction is indicated by means of graphical waveform as shown in fig (4)

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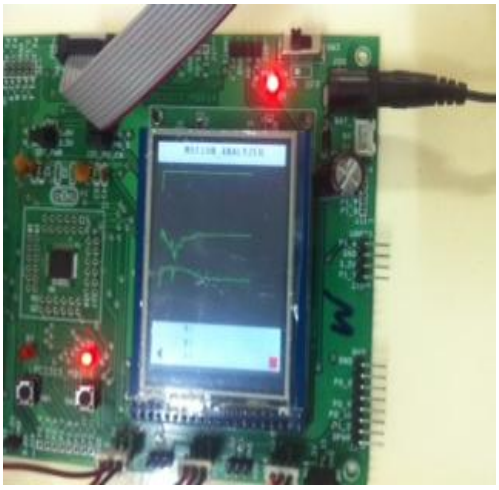

Fig.4. Execution of motion analyser.

The next functionality is audiometer. A microphone is connected to the module. It detects and measures the audible frequency range of about 20 Hz to 20000Hz.

The next functionality is Light meter. Light meter is used to measure the brightness range and it clearly indicates the nature of brightness by varying the colour and its brightness range in the display.

The next functionality is Temperature probe. The rate of heat produced is measured and it is also indicated in the display. The variation in the colour represents the amount of heat it withstands.

The last functionality is Calculator. The arithmetic operations are performed in this module itself. A touch screen panel consists of 4x4 matrix which has numbers of about 0 to 9 and an operators like '+', '-' , '*', '/'. The result is displayed in the touch screen panel.

II. PERFORMANCE ANALYSIS

The basic necessary components for an electronic engineer are inbuilt in a single equipment in order to reduce the space and improve the accuracy for the observations. In our project we achieved greater accuracy. We design these projects as compact and user-friendly. It consumes low power and produces accurate observations for simultaneous readings.

III. CONCLUSION

In real time, engineers use the basic components in a separate manner. We avoid this disadvantage by including all the basic components in a single device which is user-friendly and compact. It deal's with all necessary basic components in which a DSO, frequency generator, logic analyser are built in a single device.

IV. FUTURE ENHANCEMENT

In future the components like VSWR meter, voltage to current convertor, current to voltage convertor are also been integrated. Hence engineering students have more interest in practical sessions rather than theoretical concept.

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