The Design and Implementation of Handheld Multipurpose Scope Using Bluetooth IOIO Board

Ms. Komal B. Umare, Dr. D. V. Padole

***Abstract*— In industrial technology, the digital oscilloscopes have become a kind of intelligent instrument with functions such as waveform displays, parameter measure, analyze, storage, and so on. The oscilloscope is mandatory need for industrial applications for example testing signals etc. But the digital oscilloscopes are very bulky and many times we are not able to carry everywhere. This paper provides the handheld multipurpose scope which provides the functionality of oscilloscope like multimeter, CRO and logic analyzer etc. by using android phone or tab with the functionality of printer. The operating speed of the system is up to 1 GHz by using Bluetooth IOIO board. This device is easy to handle, good range, light weighed with high speed.**

***Index Terms*— IOIO-OTG; Bluetooth IOIO board; Handheld device; Multipurpose scope**

I. INTRODUCTION

Now a day's android platform is necessary for many applications and most of people use the android phones. Electronic technology also permeates very important role in human life. People use mobiles, tabs, laptops on a daily basis. Today, android cell phone and tabs are mostly used by people. Many engineers use high speed digital technologies. It is one of an instrument which is powerful tool. These are useful to designing and testing electronic devices. The oscilloscope is tool for learning different topics for example concept of sampling and quantization. Normally, digital oscilloscope includes element like vertical amplifier, Time base, Trigger circuit [1]. Basically it shows real electronic signals. It more powerful than multimeter. Oscilloscopes are used in fields which are high range, and defense industry. Now a day's science and technology growing up very fastly so the oscilloscopes have made great progress. Now a day's, the oscilloscopes have become a kind of useful instrument with many functions such as waveform displays, parameter measure, analyze, storage, and so on. It is a measurement and testing instrument used to display a certain variable as a function of another. It shows a graph of signals by using two axis. For example: voltage (y-axis) versus time (x-axis).

A repetitive waveform of identical pulses is applied to the input port, the sampling is used to reconstruct the shape of an individual pulse from the input pulse [2].

Manuscript received April, 2015.
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II SURVEY

A. Handheld Oscilloscope THS3000 Series [3]

This digital handheld oscilloscope is different than most other digital oscilloscopes. The all inputs are fully isolated from the main frames and from each other. Moreover the power adapter and USB interface are isolated to assure safe measurements. It determines the risk of involuntary grounding and erratic short circuits. When we use correct probe as input and output then we can able to take safe accurate and exact measurement. Fig. 1 shows the Different type of mixed signal inputs. Here we can handle mix signal by using four inputs channel which may be isolated. For example fig. 1 showing mixed input signal with different voltages. We can add, subtract, or multiply any of signals to investigate instantaneous signals by using this handheld oscilloscope.

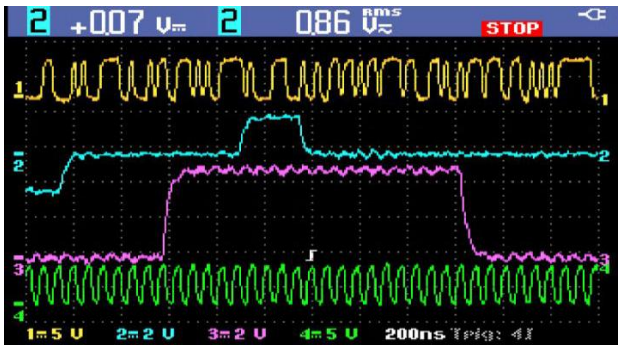


Figure 1. Different type of mixed signal inputs

B. ScopeMeter Oscilloscopes 190 Series II [4]

The channel architecture of ScopeMeter oscilloscope includes all inputs fully insulated from each other and from ground. Inputs may be activated in any combination. This system was used frequency Spectrum using FFT-analysis [4]. The bandwidth limiter of system is user selectable and user can select bandwidth 20 kHz or 20 MHz's. This system is isolated USB host port for direct data storage to a USB memory device and USB device port is easy for PC communication. The 190 Series II include four independent floating isolated inputs, up to 1000 V and 5 GS/s real time sampling (Depending on model and channels used).

C. Bluetooth Embedded Oscilloscope [5]

This oscilloscope is a one type of embedded device which will take incoming input signals and it transmit that input signal to an device like android smart phone or tab via Bluetooth which operate on android operating software. Since the device is use Bluetooth it can make use of the smartphone's display and processing power. The block

ISSN: 2278 – 1323

diagram of system is shown in fig. 2 which consists of Bluetooth embedded device and Android phone. The fig.3 shows the sinusoidal signal at bandwidth of dual channel mode and voltage of 5 volt. The Sampling frequencies of system are 10 kHz for dual channel mode and it take 20 kHz for single channel mode. The Bandwidths of this device is 2.5 kHz for dual channel mode and 5 kHz for single channel mode. The operating input voltage range is from -16.5 V to +16.5 V with 1:1 probe.

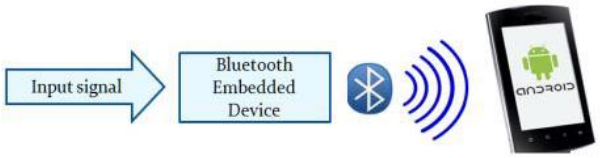


Figure 2. Block diagram of system

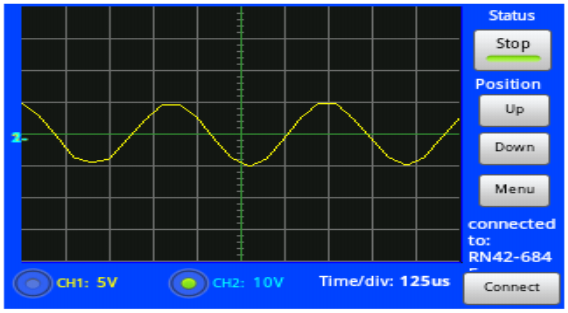


Figure 3. Sinusoidal signal at 2.24 kHz

D. IOIO-OTG Board [6][7]

The IOIO-OTG board is a board generally designed to work with android platform (i,e. support for Android OS version 1.5 and greater). This board is generally use for dada acquisition for android device [6]. The IOIO-OTG board provides strong connectivity to an android phone/tab via a cable (USB cable), Bluetooth, other wired or wireless connection. We can interface IOIO-OTG board with android phone via remote control [7]. But in this project USB cable can be used for connection between them. The limitation of operating frequency range is up to 1 GHz. Figure. 4 shows the IOIO board with its I/O pins input voltage and ground pin. Also, using the IOIO-OTG android mobile or tab can directly communicate without extra modification in hardware or their software.

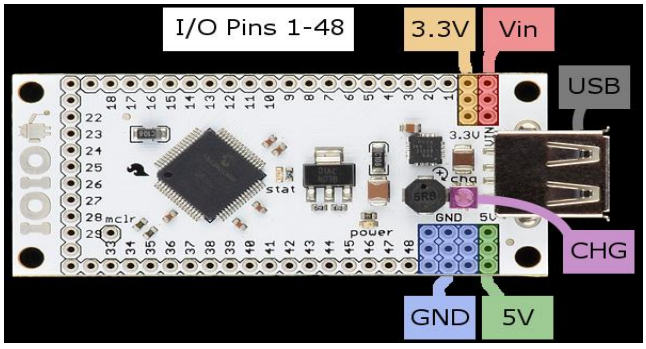


Figure 4. IOIO-OTG board

The IOIO board is consists of ARM processor. The IOIO board can interact with peripheral devices like same as MCU. The IOIO device can use with digital input/output, pulse width modulation, I2C, Analog input and USB port. Open Accessory will provide improved performance and throughput. The IOIO Board provides a I/O pins for transmitting outputs and inputs on the board, as directed by a specialized Android application. The IOIO-OTG board and Bluetooth IOIO board device both are same by internal operation. In Bluetooth IOIO board, Board connects with Bluetooth instead of any cable or wire. It provides wireless connection between android mobile and IOIO board. The applications code of both boards exactly the same. This actually makes IOIO one of the affordable, easy and most powerful Bluetooth-enabled prototyping platforms.

III. Research Design

The multipurpose handheld scope device has been implemented. Following are the research objective of multipurpose handheld scope system,

1. To develop multipurpose handheld device based on device like mobile or Tab.
2. To design light weighted device with high frequency.

IV. Proposed Architecture

The proposed architecture shown in fig. 5 and can be explained as follow, It basically consist of Android phone and Bluetooth IOIO board. The device is connected with the hardware interface i,e. IOIO board device which will provide input signal to the android device.

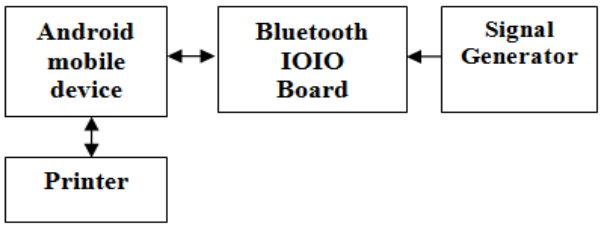


Figure 5. System Architecture

When we want to use this multipurpose handheld oscilloscope then first we have to take input signal from IOIO board. After that we can operate oscilloscope on our mobile phone or tab. The facilities which provided by this handheld oscilloscope are multimeter for measurement of current and voltages in both AC and DC mode, logic analyser which has advanced triggering capabilities, CRO for showing signal waveform. Whenever we want to save waveform we can stored it in SD card. And additional facility that is printer also connected to mobile for printing data.

ISSN: 2278 – 1323

V. OPERATION

The some pins of IOIO device are used for multimeter, CRO and logic analyzer. The methodology of the research design is given below,

1. ADCs are internally connected to the IOIO board.

2. IOIO board reads the value from the ADC (from their digital pins) and creates a frame in the form following format

$	A0	A1	D0	D1	D2	D3	D4	D5	D6	D7	#

Figure 3. Frame format created by Bluetooth IOIO board

Fig. 3 shows the frame format created by Bluetooth IOIO board from digital pin of ADC. Here "$" is first bit of frame which shows the starting bit. After that A0 and A1 is used for multimeter and CRO respectively. The 8 channel logic analyzer using bits from bit 3 to bit 10 that is from D0….D7. And the last bit that is '#' shows the stop bit of frame.

3. After that IOIO waits for the android device to send a byte of frame.

4. On receiving the byte, the IOIO sends the data back to the android device. The android phone will give the random value of voltage (From ADC). There is one formula for calculation of desired voltage. It is given as below,

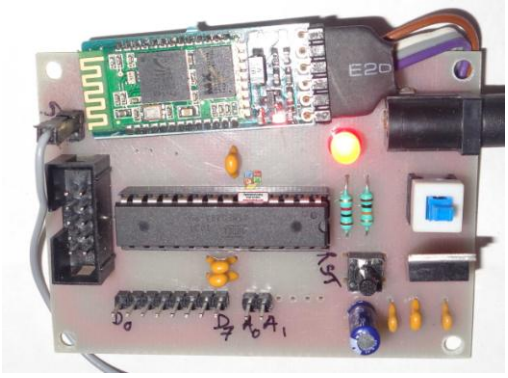
Voltage = (5* Random value)/256

5. The Android code decodes this data which is in the form of above frame format (shown in Figure 3) and then plots it on screen. And finally it show required waveform on android device screen.

VI. RESULT

Proposed system consist of both hardware and software implementation. Hardware parts consist of Bluetooth IOIO Board. Software part consists of basic application of handheld oscilloscope which will give the functionality of oscilloscope like multimeter, CRO and logic analyser. The detail of how the handheld multipurpose scope is conducted is shown below considering various snapshots.

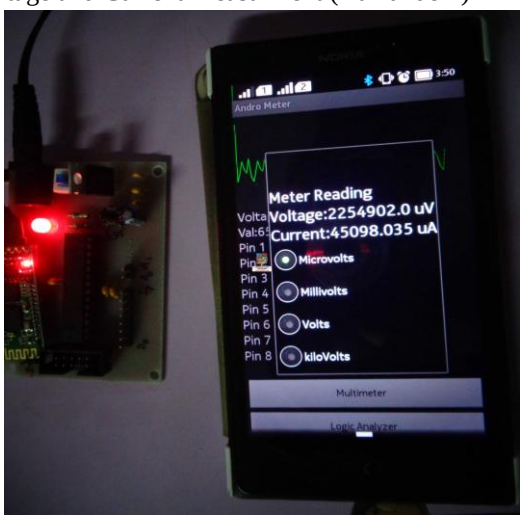
Snapshot 1: Hardware (Bluetooth IOIO Device)



Snapshot 2: Scanning device

Snapshot 3: Multimeter

(a)Voltage and Current Measurment (At Random)



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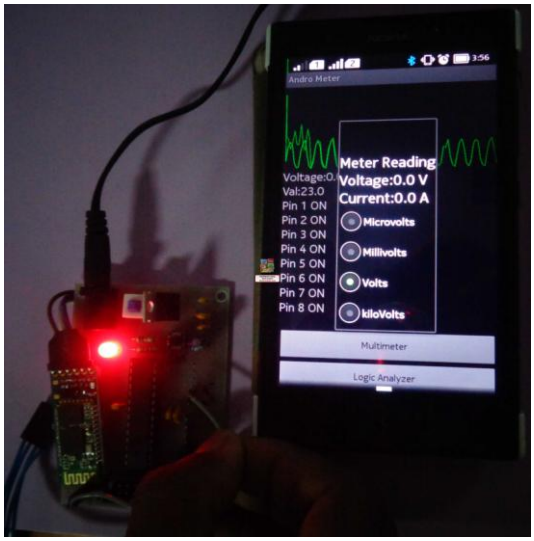
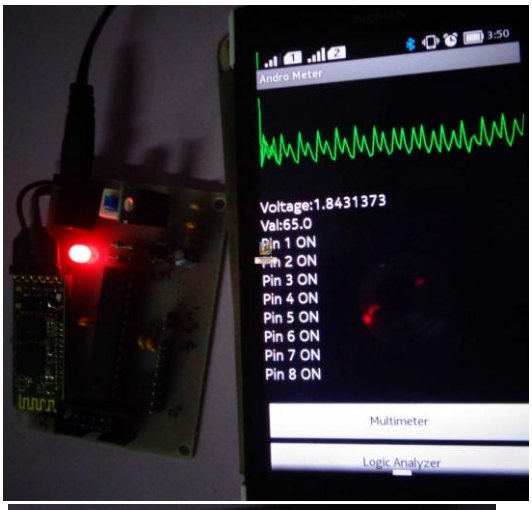
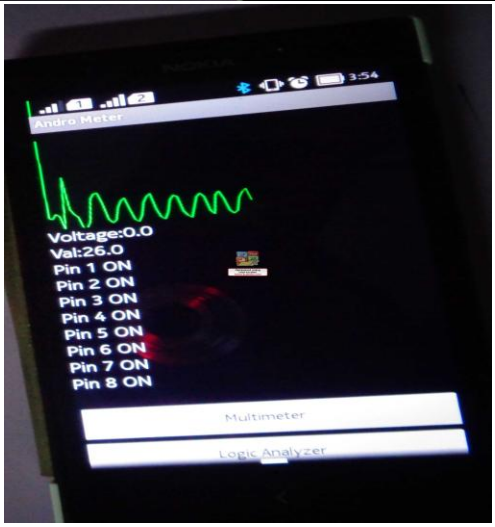
(b)Voltage and Current Measurment (At Ground)



Snapshot 4: Waveform of CRO





Snapshot 5: Waveform of Logic Analyzer

VII. CONCLUSION

Here the voltage and current measurement has been taken correctly in multimeter. The screen of android phone is shown the waveform of incoming input signal. It has been taken input up to 5 Volt. The logic analyzer has given logic of each pin and it shown waveform of all 8 pins simultaneously. The operating speed of Bluetooth IOIO board is 1GHz and its range of operation is 30m. The system handheld multipurpose scope with android device is shown output successfully.

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ISSN: 2278 – 1323