

Low Cost Android measuring Embedded Device Using Input Output Board

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Abstract - In today's world android Smartphone plays a important role to users. A Smartphone based handheld oscilloscope has been developed in this work. The oscilloscopes are playing a vital role in electronics laboratory, industries etc. The oscilloscopes cost in the field is very expensive, less power efficient and have small low resolution displays. This paper presents the design and functions of a hardware device using IOIO which captures input analog signal and the signal is interfaced with the Bluetooth module which is for transmitting captured signal information to android device. The input parameter (analog signal) is converted to digital signal (into byte) by using the inbuilt analog to digital converter of the IOIO board. Through an android device, an android application to receive the data transmitted from hardware device is designed and it is plotted as a waveform. An android device used to design a low cost and effective measuring device. A waveform is displayed in an android OS based Smartphone, according to the user configuration. The sampling value and the sampling rate is set by the user, currently analog input pins are sampled 1000 times a second. The android application includes the CRO to analyse the waveform, multi-meter to measure the voltage and current of the device and the logic analyser shows the digital waveform of the system.

Index Terms: Android application, Bluetooth device, IOIO OTG Development board, Multi-meter, Logic analyzer, Smartphone.

I. INTRODUCTION

An oscilloscope called an oscillo-graph, it is a type of electronic test instrument and constantly varying the signal voltage in two dimensional port. It is used to observe the changes in the electrical signal and analyses the waveform such as amplitude, time interval, and frequency response of the system. Portable oscilloscope is a new trend in the market. It is very much cost, less efficient and low resolutions display [1].

The Idea of the android based oscilloscope is to design and implement a light weight, compatible and easily available oscilloscope which consists of a hardware device and software application [2]. The hardware device requires a small circuitry to manage input signal and to provide the signal to Bluetooth device. The Bluetooth device is interfaced with the IOIO board to exchange the data wirelessly with the other Bluetooth devices. In the software application, it contains the android framework provides the Bluetooth functionality through the android Bluetooth Application Program Interface (API) [7]. The developed software application will work in a range of 30 meters between the IOIO board Bluetooth device and Bluetooth of android Smartphone. The Bluetooth contains a dual channel operation with which the user can choose a mode from the application, which in turn sends a signal to the PIC

microcontroller then it changes the sampling frequency accordingly: a higher sampling rate for single channel and half of that for dual channel [8].

II. LITERATURE SURVEY

A. Wireless Oscilloscope

The wireless oscilloscope displays the waveform in the laptop as a hardware device and the connectivity is done by Zigbee module and the software used is the MATLAB in the PC. It captures the voltage signals, transmitting the signal information to the system for visualizing the waveform. With the help of Zigbee module the transmission between the laptop is successfully done by the system. The display configuration given by the hardware device is set by the user and is used by the hardware device to choose the sample rate and the sample values [9].

B. Portable Oscilloscope

The portable oscilloscope is contains a microcontroller for a data rate acquisition and display the waveform in a graphical liquid crystal display(GLCD).the oscilloscope displays a waveform in a real time by reading a finite number of samples and storing them into its internal RAM. Once the memory is full in the microcontroller it stops sampling. It contains a four major units are power supply unit, analog signal conditioning unit, analog to digital converter unit, processing and display unit. So in this portable oscilloscope the memory causes a issues in the system [10].

C. Issues with CRO

CRO is a function to measure the voltage, waveform display, parameter analyses and for testing the signals. It is mainly used for experimental results in educational laboratory and industries application. The disadvantage of the device is very much costly and we cannot able to carry everywhere. The student does not have that much money to buy it. To overcome the issues, CRO can be developed in an android application through Java program. It is more advantage to the user, because it is less cost, easy availability, and eco-friendly [3].

D.HCI Mode

Host Controller interface is the On-board stack is eliminated and the module is placed in a state that executes the Bluetooth module bandwidth. The Bluetooth stack is not properly designed in the Bluetooth module. So compulsory it is interface with the basic PIC controller. The disadvantage of the HCI mode is not efficient with the high-end microcontroller with the complex firmware and

hardware designed module. In the HCI mode it will perform in the less baseband layer protocol [5].

E. Alternative Approach

A more reliable HC-05 is selected because it contains many AT commands and can act as both master and slave process. It can build a connection to other modules for a wireless serial bridge. It gives a throughput 250kbps in a slave mode.

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 operator on device like mobile or Tab.
2. To design compatible device with high frequency.
3. To develop a system to measure the signals and display it wirelessly on an Android Operating system based Phone.
4. To make the oscilloscope compact and easy.
5. To implement a low – cost and effective Measurable Device The Inputs given will be processed by an embedded system and will be transmitted via a wireless communication protocol (in our case Bluetooth Module). A java based application will develop on the Android OS platform which will accept this incoming data and visualize the same. We will be developing a system which will work two signals at a time.

IV. HANDHELD OSCILLOSCOPE

The proposed block diagram is shown in fig 1 .It consists of IOIO board, Bluetooth dongle and an android device. The input signal is taken from the signal generator and transfers the input to the IOIO board. Through the sampling process it samples the analog signal and provides the signal to the device. The android device receives the signal from the board with the help of Bluetooth module to display the waveform. In the android device developed an android application in Smartphone to display the waveform.

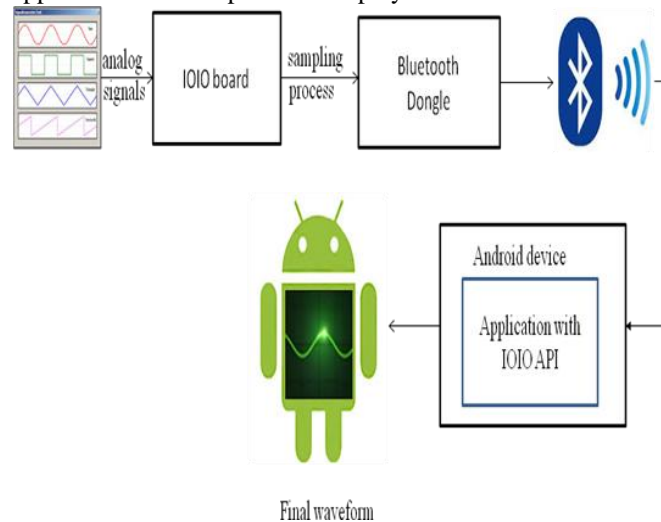


Fig.1 Block Diagram of the handheld Oscilloscope

V.SYSTEM OVERVIEW

A. Hardware Design

1. IOIO Board

The IOIO is a board that provides a host machine the capability of interfacing with external hardware over a variety of commonly used protocols. The original IOIO board has been specifically designed to with the android device. The newer IOIO-OTG (“on the go”) boards work with both Android device and PC’s. The IOIO board can be connected to its host over USB or Bluetooth and provides a high level Java API on the host side for using its I/O functions as if they were an integral part of the client. The limitation of operating frequency range is up to 1 GHz. 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. The IOIO board uses multiple protocols to communicate with a control device. There is the hardware protocol layer, i.e. using the Bluetooth device or a USB connection. Above that, there will be framing for that protocol-over Bluetooth it uses a UART emulated connection. Over USB it can use various android defined protocols. Above that is the IOIO application Protocol which allows an application running on the control device to access the pins and commands of the IOIO

- Number of input channels: 2
- Bandwidth: 2.5 kHz (dual channel mode) and 5kHz (single channel mode)
- Input voltage range: -5 to +5 V with 1:1 probe
- Sampling frequency: 10 kHz (dual channel mode) and 20 kHz (single channel mode)

2. Bluetooth Module

Bluetooth Data Rate Restrictions From research carried out earlier it was found that data rates upon 2 Mbps are not attainable with the existing software stacks designed on the module's PIC controller. Therefore, the approach recommended to fully utilize the bandwidth accessible by Bluetooth, was to use the module in Host. Bluetooth Embedded Controller Interface (HCI) mode, the on-board stack is eliminated and the module is placed in a state that executes the Bluetooth module bandwidth. Therefore, the Bluetooth stack is not properly on the Bluetooth designed module, so it is compulsory to be designed on the interfacing basic PIC processor. So the module is designed for radio broadcasting, executing the lower level MAC operations, while the application stack runs on the basic PIC processor. The advantage of HCI mode is that it permits to achieve maximum throughput and also to execute custom profiles on the Bluetooth module.

3. Android application

Android Smartphone The term “Android” has its origin in the Greek word andr-, meaning “man or male” and the suffix - aides, used to mean “alike or of the species”. This

together means as much as “being human”. Android is a software stack for mobile devices which means a reference to a set of system programs or a set of application programs that form a complete system. This software platform provides a foundation for applications just like a real working platform. The Android device used for testing a Samsung Galaxy Y (GT-S5360) Smartphone with Android version 2.3.5 Gingerbread OS, an 832 MHz processor and RAM of 290 MB. The Smartphone of a 3.0" QVGA 240x320 LCD screen with Bluetooth v3.0 + HS (High Speed). It is one of the low cost Android Smartphone available in the market to-date.

Using the Bluetooth APIs, an Android application can perform the following:

- Scan for other Bluetooth devices
- Query the local Bluetooth adapter for paired Bluetooth devices
- Establish RFCOMM channels
- Connect to other devices through service discovery
- Transfer data to and from other devices
- Manage multiple connections

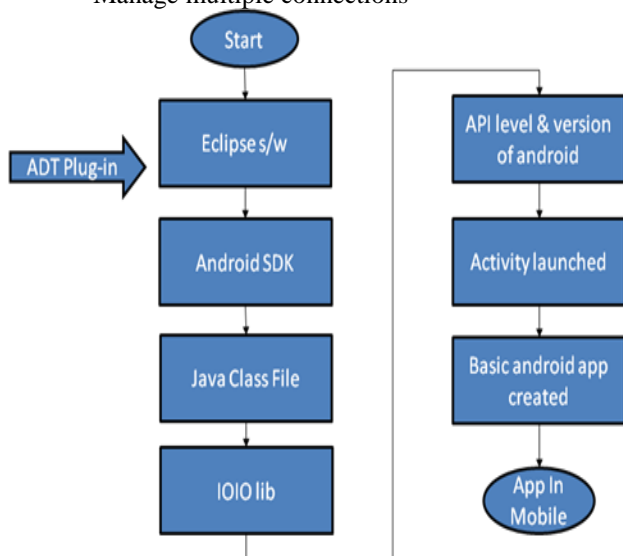


Fig.2: Flowchart to create an android app

B. Software Implementation

Install and configure the software needed to start developing IOIO applications for Android! The aim of this is to regroup all the needed information into a simple and convenient tutorial, to quickly get you develop your first IOIO for android application. Note: This tutorial involves a lot of downloads and installations so make sure you have some time ahead of you.

Step 1: System Requirements

Source: <http://developer.android.com/sdk/requirements.html>

Supported operating systems

- Windows XP (32-bit), Vista (32- or 64-bit), Windows7.

- Mac OS X 10.5.8 or later (x86 only)
- Linux (tested on Ubuntu Linux, Lucid Lynx)
- GNU C Library (glibc) 2.7 or later is required.
- On Ubuntu Linux, version 8.04 or later is required.
- 64-bit distributions must be capable of running 32-bit applications.

For information about how to add support for 32-bit applications, see the Ubuntu Linux installation notes.

Step2: Installing JAVA development kit (JDK)

Get the latest Java SE version on the Java: Java SE download page



Fig.3 Download JDK

Click on the JDK,accept the license agreement and downloaded the right JAVA development kit version for your Operating System

Note: If you are using a 64 bit os,you must downloaded the 64 bit version.



Fig.4 Java Installation

Follow the installation wizard's steps and install all of the components and you don't have to register.

Step 3: Installing Eclipse IDE

Go to the Eclipse Download Page While any of those 3 is recommended to develop Android Applications, just take the Classic version if you're an IOIO beginner.

- Eclipse IDE for Java Developers
- Eclipse Classic
- Eclipse IDE for Java EE Developers

Download Eclipse for your OS. Eclipse Classic is a standalone program; you don't have to install it. Just put the Eclipse folder wherever you want on your computer, and the "Eclipse" executable is the application.

Step 4: Installing the Android SDK

Source: <http://developer.android/sdk/installing>.

Go to the SDK download page and download the installer for your OS.

Run the installer and follow the steps. Troubleshoot: If the installer cannot find your Java SDK and you have the JAVA_HOME variable error, follow these steps.

When the installation finishes, the installer will ask you to run the SDK manager. Don't, we will go through this step later.

Step 5: Run Eclipse IDE

This is the easiest step! Run the "eclipse" application and create a shortcut if you want. Upon first launch, Eclipse will ask you to create a workspace.



Fig.5 Eclipse

Step 6: Install the Android Development Tools (ADT) Plug-in

Source: <http://developer.android.com/sdk/eclipse>.

- Start Eclipse, then select Help > Install New Software....
- In the "Work With:" area, click Add, in the top-right corner.
- In the Add Repository dialog that appears, enter "ADT Plug-in"

Step 7: Install Android Packages

In eclipse, Window>Android SDK Manager. Then install the IOIO library and API versions

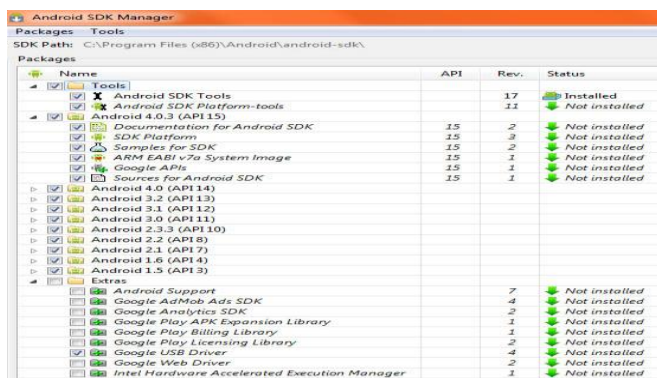


Fig.6 Android SDK Manager to select the version of API

Step 8: Create an Android Emulator

- Source: <http://developer.android/resources/hello-world.html>.
- In Eclipse, select Window > AVD Manager.
- Select Virtual Devices in the left panel.

- Click New....
- The Create New AVD dialog appears.
- Type the name of the AVD, such as "my_avd".
- Choose a target. The target is the platform
- Click Create AVD.

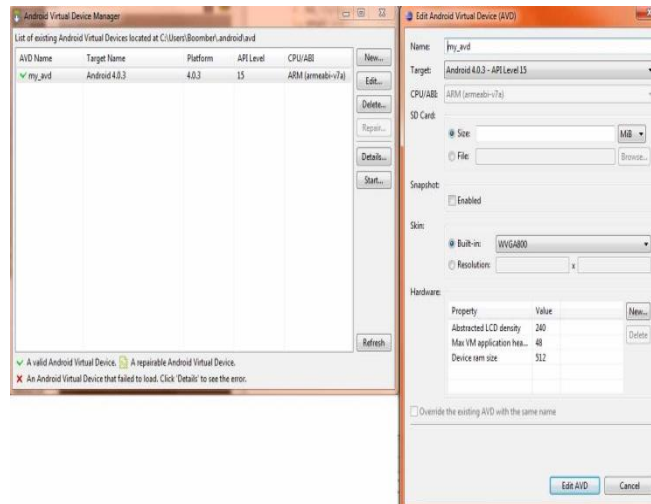


Fig.7 Android Virtual device to select the target and API level

Step 9: Compile Your First IOIO Project! Import the IOIO

libraries

In eclipse, file>Import and select the projects into workspace.

Click next

In "select root Directory" browse and unzipped IOIOLib.

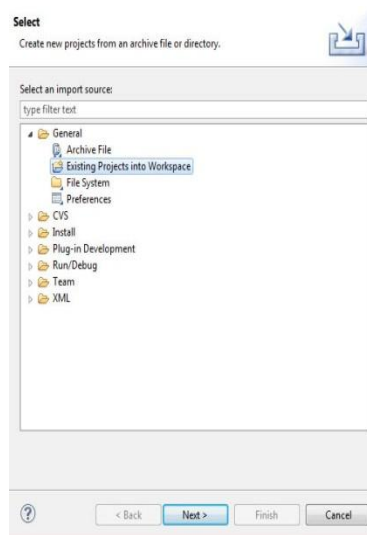


Fig.8 IOIO project

VI. RESULTS

The operation of the device was tested by providing test signals from the signal generator and to interface the IOIO board with the Bluetooth module and created an android application. Figure 9 and 10 shows a screen shot of the application displaying the LED On when the IOIO is Interface with the Bluetooth device and LED off when it is unpaired condition. Figure 11 shows the measuring voltage of potentiometer.



Fig.9 LED off when it is Unpaired



Fig.10 LED On when it is interfaced with Bluetooth device

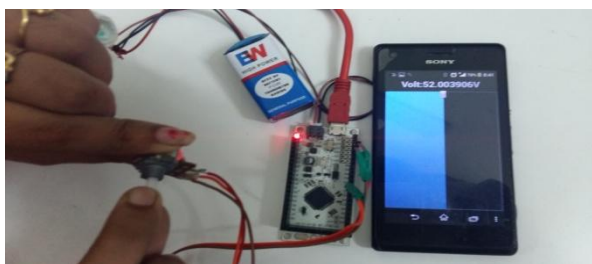


Fig.11 measuring the voltage of potentiometer

VII. CONCLUSION AND FUTURE WORK

With the help of android application, a Smartphone based oscilloscope is designed using an IOIO board. From this a low cost portable oscilloscope is developed. Using this android application we could measure the voltage, testing signals, waveform analyses and parameter display. In the range of 30 meters we get the waveform in the Smartphone.

Future development of this work deals with android application with multipurpose oscilloscope. By using this IOIO board it's possible to monitor up to 9 different analog and digital processes. Using android device we can get the digital waveform (e.g. logic analyzer).

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