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A Low Cost Handheld Android Voltage Measuring Embedded Device Using IOIO Board

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ABSTRACT

Oscilloscope plays an important role in industrial application and lab experiment. This paper presents design and implementation of a low cost handheld multipurpose scope with the help of an android application. In the proposed system it consists of hardware and software application. The hardware contains IOIO board and Bluetooth module for wireless connectivity purpose for transferring the input sample analog signal from the board to the Smartphone through the Bluetooth. Software application is developed an application in an android OS device it receives the output sample signal from the hardware circuit and displays a waveform in an android device. A waveform displays in an android device is depends on the users configuration. The sampling value and the sampling rate were set by the user. 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.

1. INTRODUCTION

An Oscilloscope is commonly called as Oscillo-graph; it is a kind of electronic test instrument and varying the voltage signal constantly in two dimensional ports. It is mainly used for testing the signal, parameter measurement, analyse waveform such as amplitude, time interval and frequency response of the system. Cathode Ray Oscilloscope (CRO)is bulky and not portable to use. They are not easily available to students because of high budget involved. CRO's as now a day's replaced with DSO which are comparatively less bulky but again the cost factor is a major drawback. Currently, portable oscilloscope is a new trend in market. It is high cost; less efficiency and small resolution display [1]. In today's world android platform is necessary for many applications and many of the people using the android phones. People are using the mobile, tabs, laptop on a daily basis. Now a days, android cell phone and tabs were mostly used by people. Many engineers and students use an oscilloscope. The idea of the android based oscilloscope to design a less weight, handy and portable availability oscilloscope were consists of a hardware device and software application [2]. An android application was developed by a software to receives the output from the hardware board and plot the waveform graph in an android device. IOIO Board is a hardware board is used to receive external input(I) and produce an external output (O).

It is mainly allow android mobile applications to interact with the external electronic device. IOIO device was invented by ytai ben-Tsvi. The board provides a wired/wireless connection and is controllable from an android application with the help of java Application programme interface (API). Latest IOIO board is developed into IOIO-OTG board, supports both computers and android devices and provides

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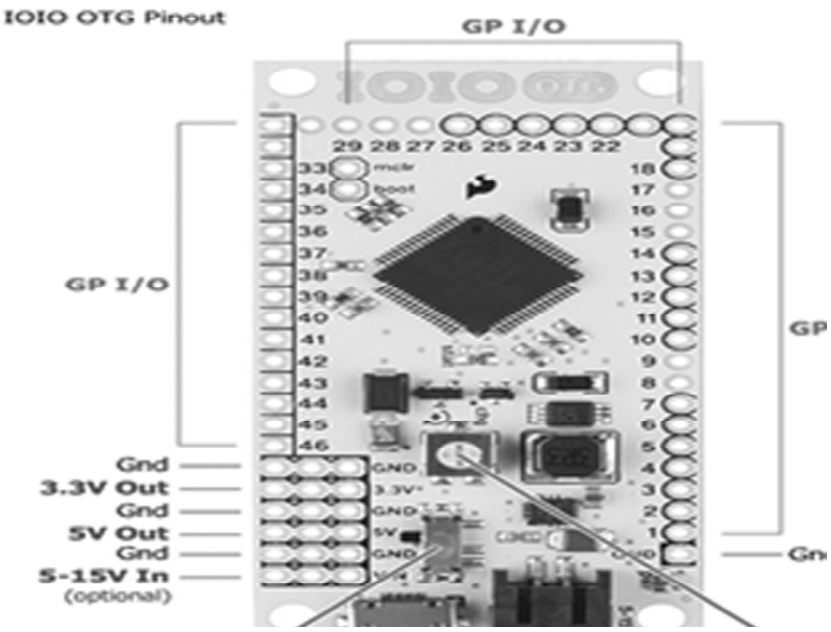

Figure 1: IOIO board

the exact API on both types of devices. First Generation device communicate with PCs over Bluetooth or USB.

2. PRESENT SCENARIO AND EXISISTING SYSTEM

In the present system, an android mobile is used for visualize the waveform and the Bluetooth module for wireless connectivity. The input signal is taken from the signal generator and it is given to the IOIO board, it samples the analog signal through the inbuilt ADC converter. The converted signal is given to the android device and visualizes the waveform. Once the memory is full the waveform can be stored in the memory card.

In an existing system it used an Atmel microcontroller for data acquisition and it displays a waveform in a graphical liquid crystal display (GLCD) screen. The Oscilloscope displays a waveform in a real-time system by reading a finite number of samples and stored into its internal RAM. Once the memory is full the microcontroller stops the sampling.ADC circuit is designed separately and connected into microcontroller. The data acquisition between the present and exisisting system takes time [10].

3. LITERATURE REVIEW

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].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].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].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].

4. PROPOSED SYSTEM

The proposed block diagram is shown in fig 2 It consists of IOIO board, Bluetooth dongle and an android device. The input analog signal is taken from the signal generator and transfers the input to the IOIO board. In the IOIO board it samples the signal and the conversion of analog into digital is done by ADC operation. 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.

5. HARDWARE DESCRIPTION

5.1. IOIO Board OTG

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

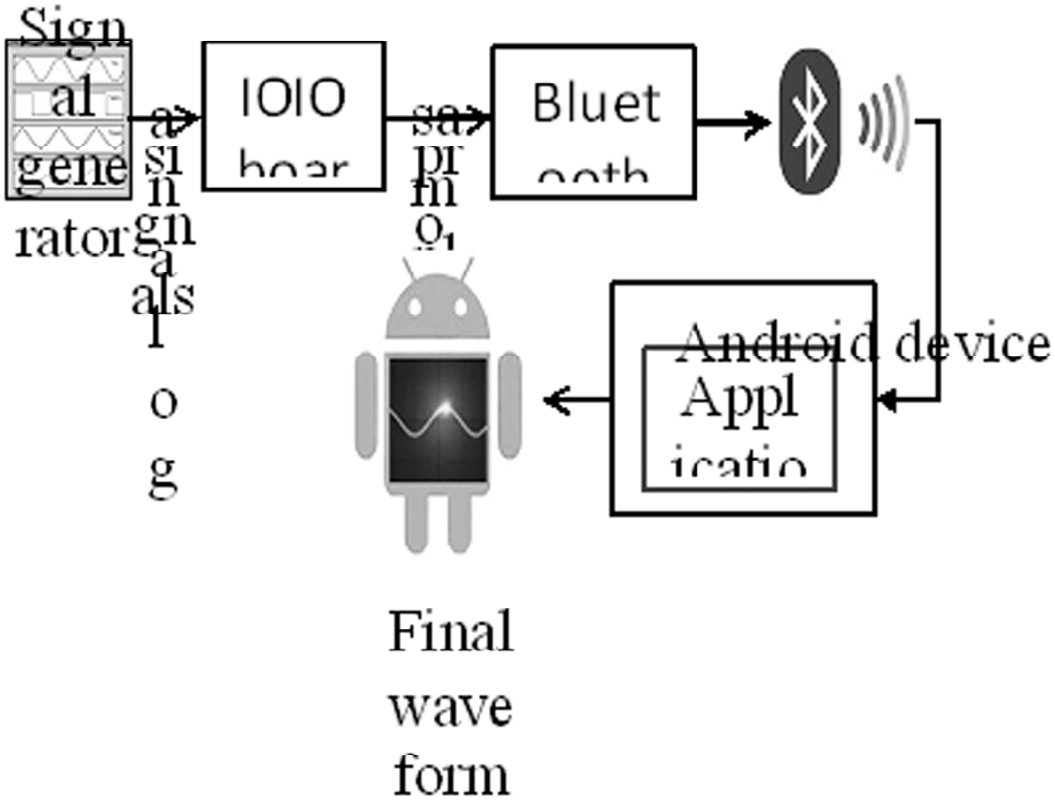

Figure 2: Block diagram of handheld Oscilloscope

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)

5.2. 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.

5.3. 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

6. SOFTWARE DESCRIPTION

To develop an android application java code is used. The below fig. 3 is explaining the coding flowchart of the required output. Mainly in java, libraries are used for the header file. First, add the required libraries in

the eclipse software and plug-in the android software development kit. IOIO activity files which is used for developing a program in the window. We add the requirements of the user are added in the activity Xml file. In java we access the different layout that is specialized feature in an android application. Java is also works like other program in a step by step process of the device. In Java it's add like a library packages and works in that manner. The software application is used for get the graph that is given by the hardware device. After getting the input from the IOIO board it plots the waveform in the android device. All the process was happened in the sensor gravity graph package. After done the programming part send the execution file to the Smartphone. Then install the application in the android device then through Bluetooth device we can see the waveform in our android device.

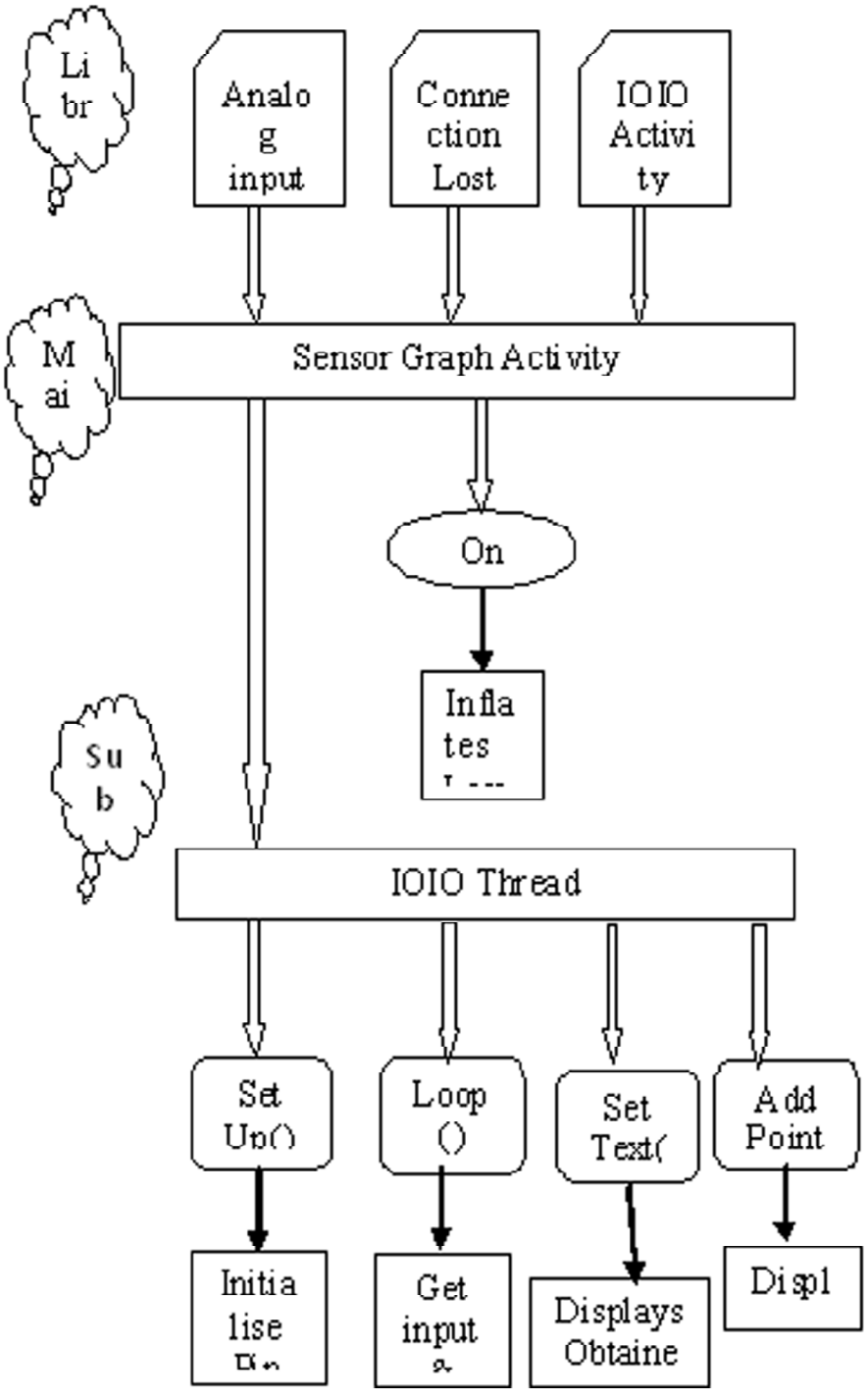

Figure 3: Coding Flowchart for waveform plot in the android device

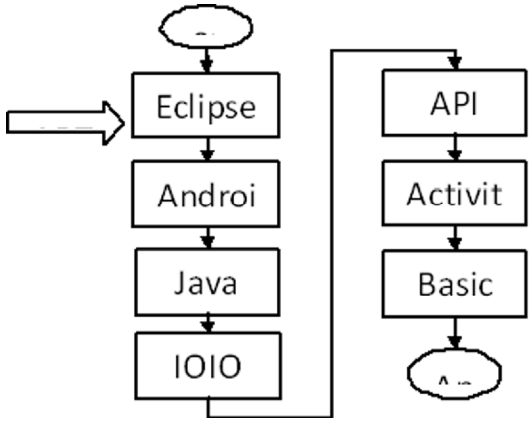

Figure 4: Flowchart to create an android app

The above flowchart is the way to create an android app. First, install the eclipse software and plug-in the android development tools then add the android software development kit and program in the java class file. Using IOIO board we have to add the ioio library file in the program. Select the api level of the android device and build the coding part according to the user configuration. Activity is launched in the program finally we can see the application and waveform in the android device.

7. HARDWARE SETUP

Input circuit consists of step-down transformer, voltage regulator, capacitors and diodes. The transformer supplies secondary peak voltage up to35v can be used but the voltage increases size of the transformer and

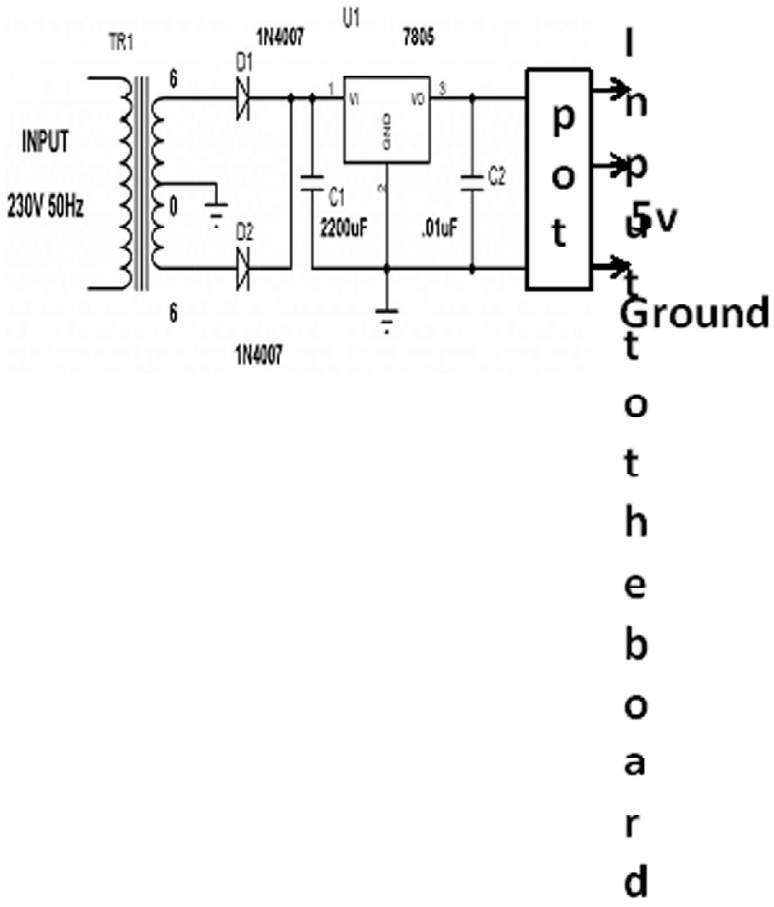

Figure 5: Input Circuit for the power supply

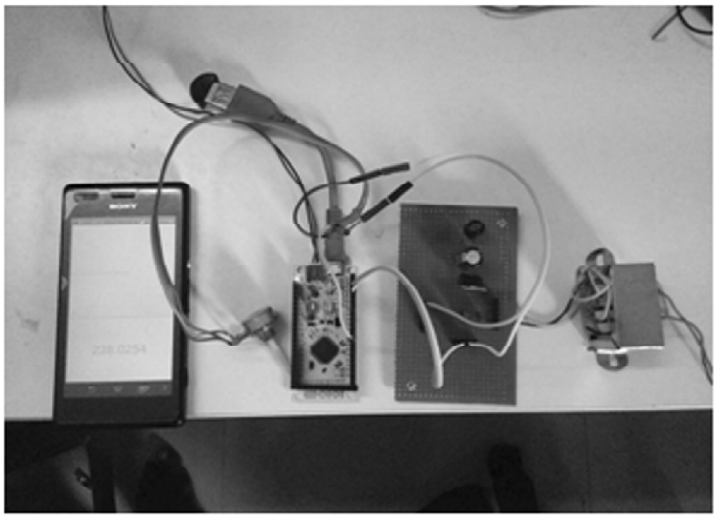

Figure 6: Hardware circuit measuring voltage and Waveform

power dissipation across the regulator increases. The diode is capable of withstanding a higher reverse voltage of 1000v whereas IN4001 is 50v. Capaciors for filtering the voltage, input side of regulators to avoid ripple and the output side to avoid the transient changes in the voltage due to change in the load.

8. RESULT AND DISCUSSION

In this section, results of the module are described.

Using the android application in Smartphone we can measure the voltage and waveform analyses in our device.

In the above fig. 7 measured a voltage 75.75 and we get the waveform. Finally we get a low cost portable android device was done. Instead of oscilloscope we can measure the voltage and analyse the waveform in our own module. From that we can get accurate result with low cost device.

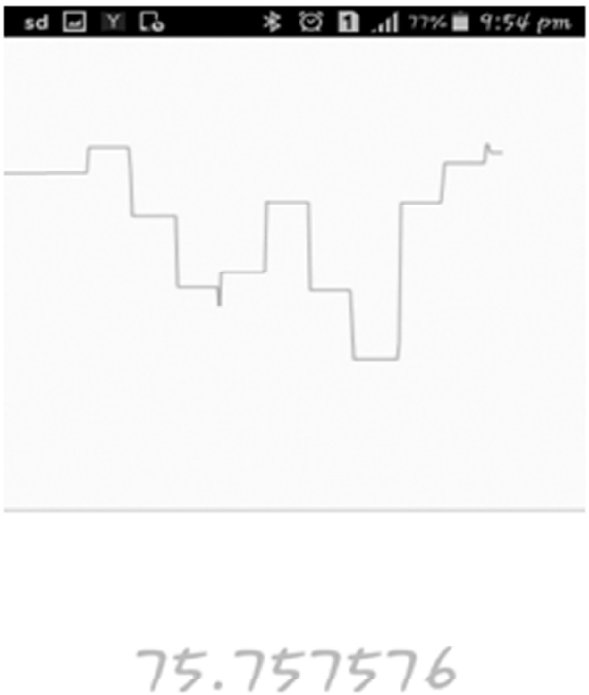

Figure 7: Output screenshot of voltage and waveform

9. CONCLUSION

With the help of android application, a handheld 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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