DEVELOPMENT OF ARDUINO-ANDROID OSCILLOSCOPE

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ABSTRAK

An oscilloscope is a type of electronic test instrument that allows observation of constantly varying signal voltages. Oscilloscopes which are available nowadays is inconvenient, not user-friendly, not portable, and involves high power consumption. This paper proposed a design and implementation of wireless oscilloscope. The oscilloscope use Android application controlled by Arduino. It offers a low cost, low power, and portable wireless oscilloscope consisting of hardware and software application. The oscilloscope is supported by all smartphones and computers that operates on Android operating system. The hardware contains an integrated circuit to capture the input voltage signals and a Bluetooth module for transmitting the captured signal data to an Android device for displaying the waveform. The software developed in an Arduino perform an application for Android. It will receives the data transferred from the hardware and plots the waveform based on the display settings configured by the user.

Keywords: *Android, Arduino, Bluetooth, Oscilloscope*

1. INTRODUCTION

An oscilloscope known as a cathode-ray oscilloscope (CRO), or modern digital storage oscilloscope (DRO) is a type of electronic test instrument that allows observation of constantly varying signal voltages. It is mainly used for testing the signal, parameter measurement, analyse waveform such as amplitude, time interval and frequency response of the system. Nowadays, world android platform is necessary for many applications and many of the people using the android phones. People are using the mobile, tablets, laptop on a daily basis. 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 (Hatwar & Amol). An android application was developed by a software to receive the output from the Arduino Board and plot the waveform graph in an android device. Arduino Board is used to control the system. Portable oscilloscope is a new trend in the market. It is very much cost, less efficient and low resolutions display (Ganvir & Waghmare). The idea of the Arduino-Android oscilloscope is to design and implement a light weight, compatible and easily accessible oscilloscope which consists of a hardware device and software application (Karim). 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 Arduino 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) (Ganvir & Waghmare).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 Arduino. Android is selected because there are a large number of Android device users and most of these devices satisfy the requirements of the oscilloscope's software application. The hardware device includes a programmable Arduino board to capture the input voltage signals. An embedded Bluetooth module used for transmitting the captured signal information to an Android device and the Android device used for displaying the waveform. The Software application developed for Android receives the data transmitted from the hardware device and plots the waveform according to the display settings configured by the user.
The last paragraph should have the objective of the paper

2. RELATED WORK

The current available Cathode Ray Oscilloscope (CRO) in market is quite expensive and bulk in size. It requires additional power and has small resolution displays. The achievement of a Bluetooth oscilloscope was reported by (Seneviratne & Abhayasinghe). It is also known as Android Bluetooth Oscilloscope which equipped with a Bluetooth enable transmitter circuit which is used to transfer data to the android phone. Then, it will draw the waveforms of signal on its display. The transmitter circuit contain a Microchip's PIC33FJ16GS504 and an LMX9838 Bluetooth 2.0 SPP module. However, the device bandwidth is not specified. Other than that, is not suitable for temperature and resistance measurement. The data rates of 2 Mbps are not realistic with the existing software on module's controller. The disadvantage of the system is that on single board there is no scope for temperature and resistance measurement.
(the paragraph 1 spacing)In the system proposed by (Umare & Padole), an android mobile is used for displaying the waveform and the Bluetooth module used for wireless connectivity. The input signal is generated from the signal generator and it is transferred to the IOIO board. Then, it samples the analogue signal through the built-in analogue to digital (ADC) converter. The converted signal is transferred to the android device and displays the waveform. When the memory is full, the waveform can be stored in the memory card. The system used an Atmel microcontroller for data acquisition. It presents 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. ADC circuit is designed separately and connected into microcontroller. Once the memory is full the microcontroller stops the sampling. (Priya & Nivash) proposed a wireless oscilloscope that displays the waveform in the laptop as a hardware device. The connectivity is done by Zigbee module. The software used is MATLAB. It captures the voltage signals, then transmitting the signal data to the system for displaying the waveform. With the support 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. The configuration used by the hardware device to choose the sample rate and the sample values.

A convenient oscilloscope equipped with a microcontroller for data rate acquisition and display the waveform in a graphical liquid crystal display (GLCD) was presented by (Wagh, et al.). It contains four main units. The power supply unit, analogue signal conditioning unit, analogue to digital converter unit, processing unit and a display unit. The oscilloscope displays a waveform in a real time by reading a finite number of samples and storing them into its internal RAM. If the memory is full in the microcontroller, it stops sampling. Therefore, in this portable oscilloscope the memory causes an issue in the system.

3. SYSTEM OVERVIEW

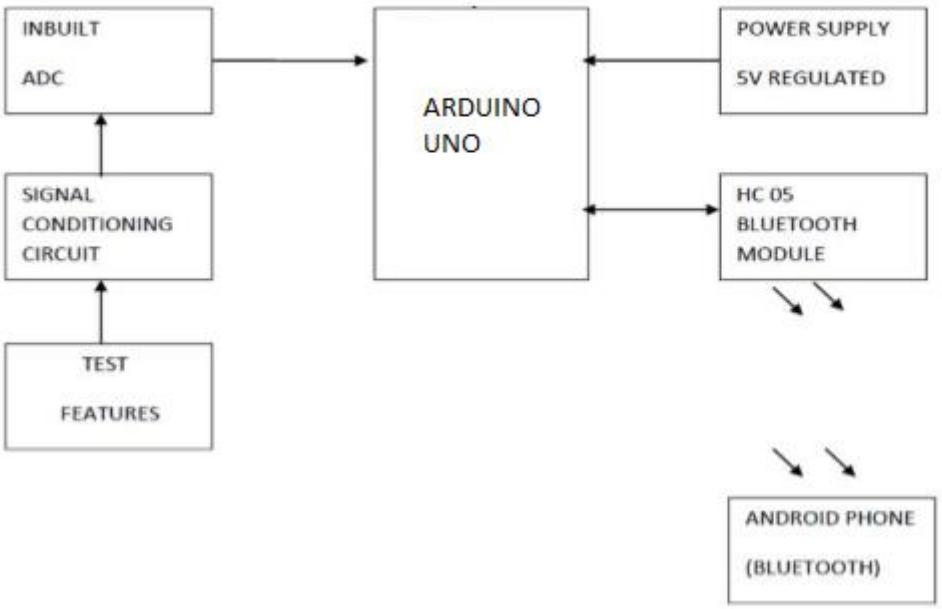

Figure 1: Proposed System Block Diagram

The block diagram of general system is shown in Figure 1. The Arduino UNO is a main part of the system. Arduino UNO is a microcontroller board based on the ATmega328P. It comprises everything needed to support the microcontroller. It also simply connects to a computer with a USB cable or powers it with AC to DC adapter or battery to get started. The input signals like square wave, or triangular wave are transmit to Arduino UNO by using signal conditioning circuit. The frequency range of the measurement system expected by using the sampling speed of the Arduino. The Arduino integrated with an analogue to digital (ADC) converter that can be used to convert the input signal into digital signal. The upgraded digital signal sends to the

Arduino for transmission through Bluetooth module. The external Bluetooth device equipped with the Arduino will receive input signal from and send the signal to the Bluetooth of Android device. Then, the graphical representation will be on the display of Android device.
Figure 2 shows a transmission section of the system. The transmission section is the major component of Arduino. When Arduino receives an analogue signal, the ADC converts the analogue signal to digital and sends it to smart phone via Bluetooth. The receiver section is shown in Figure 3.
In order to establish the connection between a Bluetooth module and android phone, we need to consider android device as a master slave and the Bluetooth module as a slave to pair both devices. After the connection is established, the commands will be sending between both devices. Then, the devices will start functioning and receiving signal for Oscilloscope device. The system consists of hardware device and software applications. Bluetooth module will used to offer connectivity to a device with Bluetooth, and running android operating system for the purpose of displaying the waveforms.

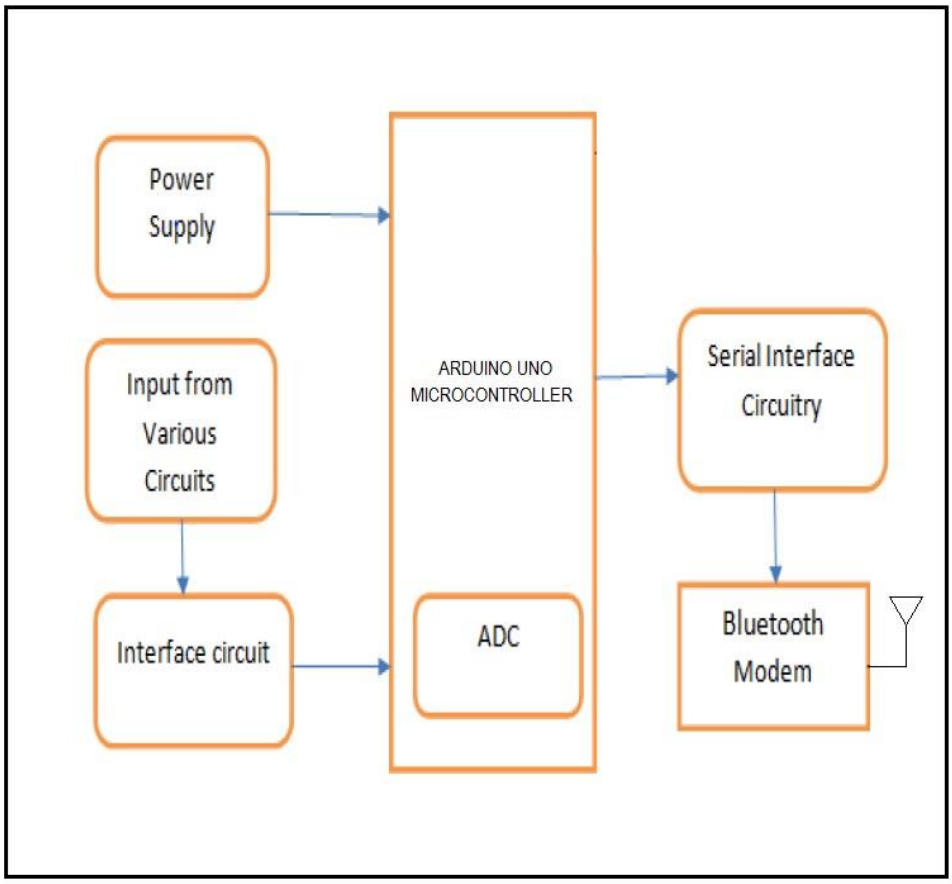

Figure 2: Transmitter Section

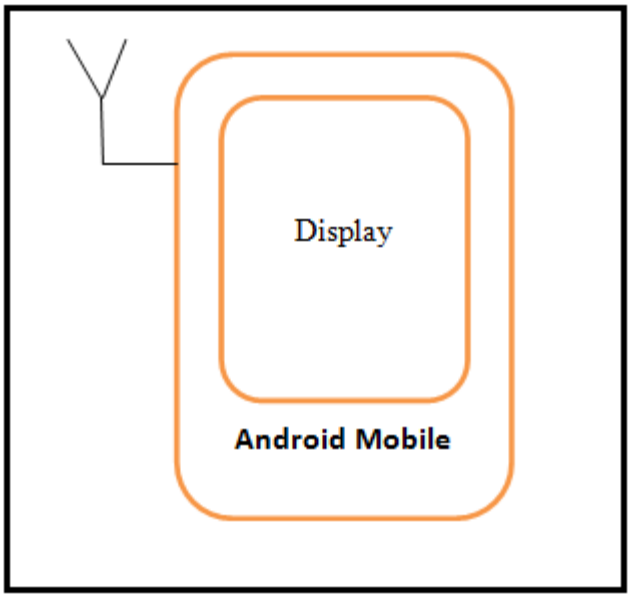

Figure 3: Receiver Section

4. SYSTEM DESCRIPTION

4.1 Arduino UNO

The Arduino UNO is a microcontroller board based on the ATmega32. It has 14 digital input and output pins. The pins of which 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller. Furthermore, it is simply connect to a computer with a USB cable or power it with an AC to DC adapter or battery to get started. The UNO differs from all previous boards in that it does not use the FTDI USB to serial driver chip. As an alternative, it features the Atmega16U2 programmed as a USB to serial converter.

4.2 HC-05 Bluetooth Module

The HC-05 is a class 2 Bluetooth module designed for wireless serial communication. It is pre-configured as a slave Bluetooth device. Once it is paired to a master Bluetooth device such as smart phones, personal computer, and tablet, its operation becomes transparent to the user. There is no specific user code needed to the Bluetooth module in the user microcontroller program. The HC-05 supports in two work modes; command and data mode. The work mode of the HC-05 can be changed by push button on the board. The HC-05 is in command mode if the push button is activated. Any changes made to system parameters will be retained even after power is off. The HC-05 can be reconfigured by the user to work as a master Bluetooth device using a set of AT commands. Once it is configured as master, it can automatically pair with a HC-05 in its default slave configuration. The HC-05 will work with DC supply voltage of 3.6V to 6V. The HC-05 needs to be programmed to transmit at 115,200 baud.

4.3 Android Application

Most of the smart mobile devices that are manufactured in the market are Android OS based. Mobile application programming is done SerialScope App Software. As the Android device detected Bluetooth from HC-05 module, the connection begin between HC-05 and the Android device. After successful pairing, the Android application receive data via Bluetooth. The

application plots a graph based on received data as on y-axis and time on x-axis. It makes easy to view data. The Figure 4 shows the SerialScope for signal display an measuring.

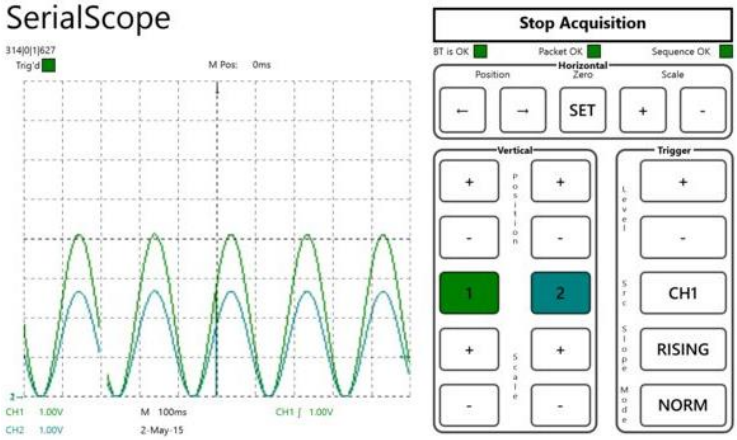

Figure 4: SerialScope App

5. MODES OF OPERATION

The device provides one mode of operation, namely single channel mode where only channel 1 is operational, with the full bandwidth available for channel 1. Likewise for channel 2, full bandwidth also available. The sampling frequency in single channel mode is 5 kHz .The user can select a mode from the application. It is in turn sends a message to the Arduino to notify the selected mode, so it can change the sampling frequency. It helps to make effective use of the available bandwidth when only one channel is required. By default, the hardware is in single channel mode, so both input channels are not sampled simultaneously. After sampling and conversion, Channel 1 and Channel 2 samples are converted to a byte and are directly written to the Arduino's UART buffer for transmission via Bluetooth. Finally the depending on sampling frequency the waveforms are displayed on Android device.

6. CONCLUSION

This paper presents the basic idea of low cost, portable, low complexity Arduino Android oscilloscope. The hardware device includes integrated circuit to capture the input voltage signals and a HC-05 Bluetooth module for transmitting the captured signal to an Android device for displaying the waveform. The software application developed for Android receives the data transferred from the hardware device and plots the waveform according to the display settings which is set by the user.

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