Design and Implementation of Portable Signal Generator using AVR and Android App

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Abstract: The signal generator which is used in all engineering, mechanical, experimental courses and other fields has high stability and large precision. The main aim of the project is to style a conveyable signal generator for faculty labs and test laboratories to get the fundamental signals like the Sne, Square, Triangle, PWM waveforms, supported wireless technology and bluetooth to speak between microcontroller and android device to line the signal parameters from android mobile. Any Android device can act as a communicable device. The result of this work can execute all the waveforms like sine, square, Triangle, and PWM within 0.1HZ to 1MHZ in accurate manner and which could be then applied to all output devices like motor, light etc,. and therefore the signal will be monitored using digital signal oscillator (DSO) or CRO and Logical analyzer.

1. Introduction

The utility of an audio oscillator, control, depth level, one amongst the earliest functions of a signal generator, was once wont to calibrate Disney's step forward stereo digital tools established in theaters that confirmed Fantasia and consequently the motor speed manipulate supported PWM signal and light-weight depth control (Volodymyrshvaikchenko, 2009) . This ensured audiences had been in a position to experience the sounds and song due to the fact it was once intended, with minimal distortions and laboratory motive of motor speed manipulate method and light-weight intensity manage supported signal generator with reference to the frequency and amplitude (Antoine Frappé, 2009) Simply put, a signal generator may additionally be a supply that outputs a symbol. This sign is a primary sinusoidal wave, a pulse, or a modulation signal Signal generators additionally are regularly known as signal sources or just, sources. a signal generator permits you to output signals with quite a number frequencies, amplitudes, and time durations. Many signal generators even enable you to modulate frequency, amplitude, and section alerts . A signal generator is normally accustomed to grant a secure waveform like sine, square, triangle, pwm etc. (Yang Han , 2015; B. D. Hatwar , 2014; S. Minaei 2012). This steady waveform has many makes use of in telecommunications. One instance is as an oscillator in RF receiver testing (Johannes Stegner 2017). The purer the wave, the much less section noise, and distortion is injected into the RF receiver trying out by way of the oscillator. Thus designers have to work out the true overall performance of the receiver. Another utility the place signal generators are used is in RF strength amplifier testing (J.Vidkjaer, 1986). During this test, the signal generator outputs constant RF electricity throughout a amplification of frequencies to the amplifier. The output of the RF energy amplifier is measured to work out the output flatness.. Signal generators are utilized in cutting-edge high-speed conversation structures like 5G and 802.11ax (G.C. Goodwin 1992; Yan Huo 2019). Powerful software program is used with the signal generator to come returned maintain a reproduction with complicated orthogonal frequency division multiplexing (OFDM) alerts for transceiver testing (.S. Chandrasekhar 2012; JuhaYli-Kaakinen, 2020). For example, when checking out designs, we would like to possess sure bet in your measurements. When signal generator outputs a sine, you desire a sine this is as shut to perfect as possible. A non-ideal sinewave will lift excessive degrees of segment noise, harmonics, and spurs. High segment noise obscures low-level signals. A high-operational signal generator offers you a sinewave it is almost ideal, with low section noise, harmonics, and spurs (Sylvain Pinguet2017). A sign generator additionally approves complicated alerts to be generated from one, built-in instrument barring complicated hardware add-ons. Used alongside with effective software, complicated indicators like Orthogonal Frequency-Division Multiplexing might also properly be generated by using one high-performance signal generator with wifi .A signal generator additionally has the flexibility to output correct strength levels. This functionality is commonly employed in electricity amplifier, filter, and attenuator trying out .
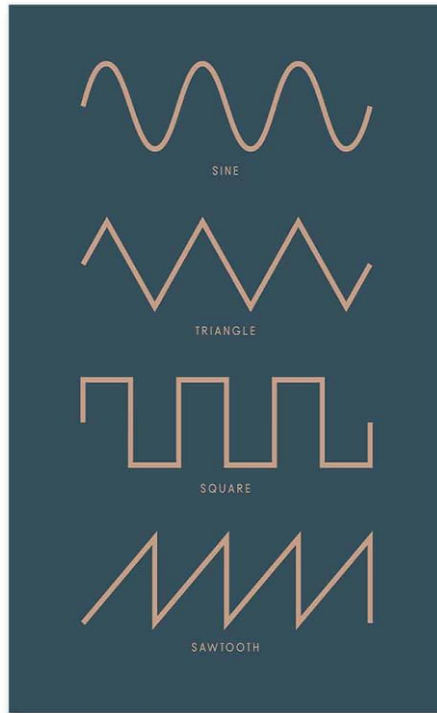
Figure1: Example of an sine, square, triangle waveforms

DDS signal generator

It is a basic signal generator. One that may supply upward thrust to sine, square, triangle waves at frequencies of DC up to a greater than a few MHz – let's say 10 MHz or so. The degree wished for rectangular wave is to be 3.3v, and any variety of triangle wave and modulation are needed. One element that was once necessitious alternatively used to be fairly specific frequency manage – (Ex. if I dialed up 1 MHz that's what I wanted, or very shut to it.)
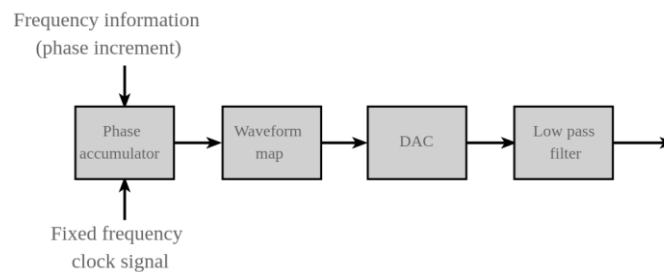

Figure: 2 DDS principle block diagram

Android application

Nowadays for android utility development (**P. Sachin 2014**) we use android studio as a desirable built-in improvement surroundings [IDE]. It has help many software program as Intelli JIDEA, [a Java integrated improvement surroundings] and it additionally beef up the Android OS ,it assimilate the code enhancing and developer equipment it make use of a Gradle primarily based construct device , emulator, code templates and github integration.

2. Proposed

Overall system

The signal generator introduced during this paper is to get sine, square, triangle and pwm waveforms, where the frequency, amplitude a adjustable with bandwidth of 1MHz. As shown in Fig. 3, the signal generators designed within the paper are converted into 5 modules like upper android module, wireless bluetooth module, MCU control module, DDS module and power source module.
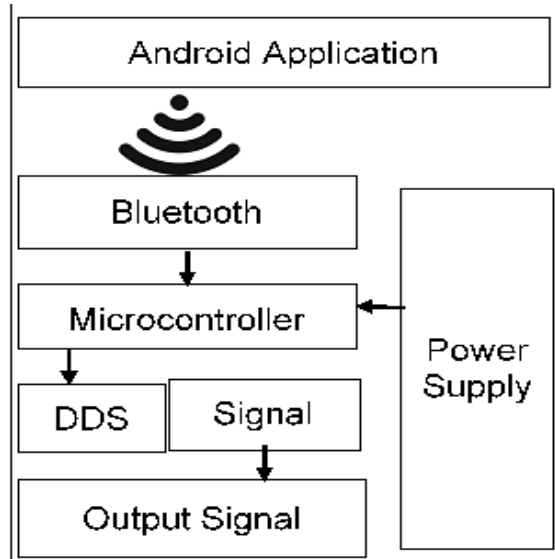
Figure 3:   Overall System block diagram

Android Application Module

In order to readily generate waveform and retailer cost, this paper designs an Android based totally on Application with effective information processing characteristic of Android device, the interface is proven in Fig. 4. Once the Android is related with the signal generator gadget the use of wi-fi technological know-how bluetooth, Connect & Dis-Connect has been finished by means of the button. To choose the signal kind the usage of the pick out button from the listing -> Sin, Square, Triangle. Using the Frequency(+/-) button to configure the frequency of chosen signal. Once all the configuration has been done, use the setConfigurationData button to send the configured information to MCU over bluetooth communication. Also if we desire to alternate the responsibility cycle of the pwm signal use DutyCycle(+/-) button to set the stage and clicking of setConfigurationData button to send the configured information to MCU over bluetooth communication.

Figure 4: The Android application

Wireless Bluetooth Module

The HC-05 ought to additionally be a genuinely cool module which may want to add two-way (full-duplex) wi-fi performance to your projects. you will be in a position to use this module to discuss between two microcontrollers like Arduino or talk with any system with Bluetooth performance shape of a Phone or Laptop. The module communicates with the assist of USART at 9600 baud subsequently it is easy to interface with any microcontroller that helps USART.
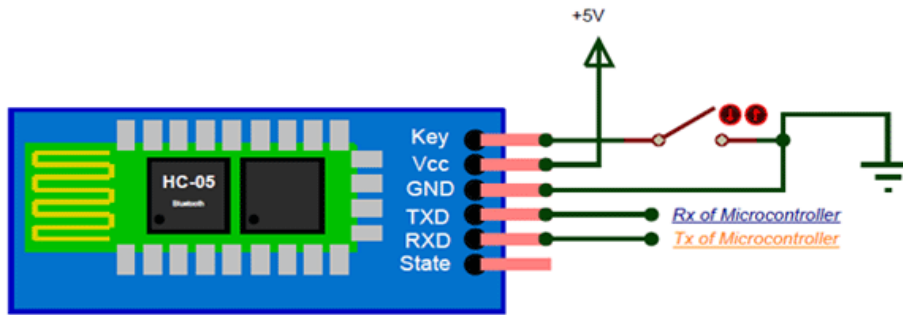
Figure 5: HC-05 the Bluetooth module

Microcontroller Module

The Microchip pico power 8-bit AVR RISC based totally microcontroller that combines greater overall performance with 32KB ISP reminiscence with read-while-write capabilities,1024B EEPROM,2KB SRAM,23 regular cause I/O lines, three adjustable timer/counters with equate modes,32 universal motive registers, serial programmable USART ,internal and exterior pins ,a byte-oriented two wire serial interface ,watchdog timer with many inside oscillator and saving mode of strength with software program selectable. The running voltage of machine will be between 1.8-5.5 volts .By single clock cycle the effective training are carried out, processing speed and balancing electricity consumption .It attains productiveness of upcoming 1MPS per MHZ
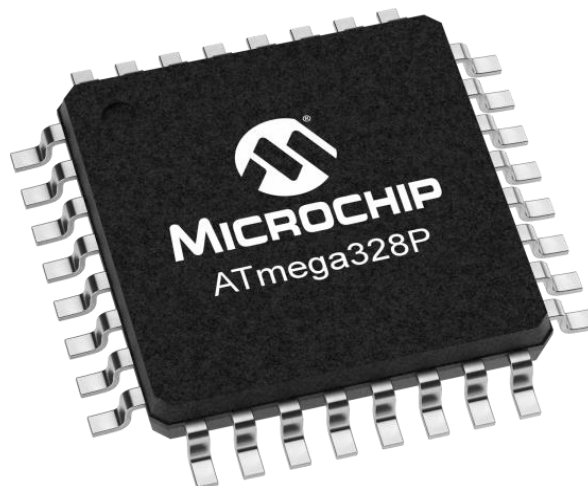

Figure 6 :ATMEGA-328 the microcontroller

DDS Module

CJMCU-9833 AD9833BRMZ is a programmable waveform generator is environment friendly of executing a frequency of 0-12.5MHZ like sine ,triangle ,square wave signal and it is additionally a variety of generator module which is handy to alter the clock of   25MHZ,which has precision of 0.1 HZ and it additionally employed in liquid, fuel waft size ,sensing purposes like sports, correct detection, defect detection .scan clock generator, linear loss, linear decay gear ,medical equipment.
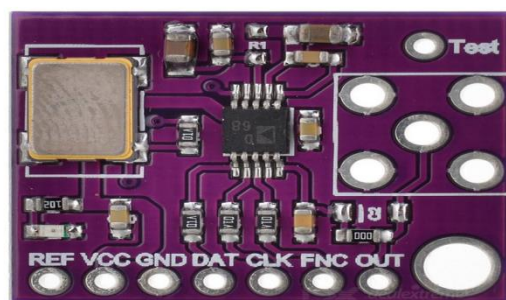

Figure 7: AD9833BRMZ the DDS module

Power Module

The gadget can function on an exterior grant of 6 to 20 volts. If furnished with much less than 7V, however, the 5V pin might also provide much less than 5 volts and the board may also be unstable. If the use of greater than 12V, the voltage regulator can also overheat and harm the board. The advocated vary is 7 to 12 volts

Software requirement:

1. Arduino IDE
2. AVR studio
3. Terminal software

3.Results and Discussion

The basic format has been developed right here as prototype and proven in Figure 3. In LCD it has been displayed as android primarily based signal generator .The idea of this technological know-how in the subject of electronics can make our conversation extra environment friendly and quicker with larger efficiency. This is a methodology for exactly producing quite a number traditional waveforms the usage of ATMEGA328P. It is comparatively cheap system and very handy to handle. This characteristic generator will be used as an nice potential of technology. Compared with the generic signal generator, the device format has the blessings of small size, excessive precision, flexible and handy to use, etc, and it is very environment friendly to set the signal amplitude, waveform, phase, frequency. We can show the messages with much less errors and upkeep.
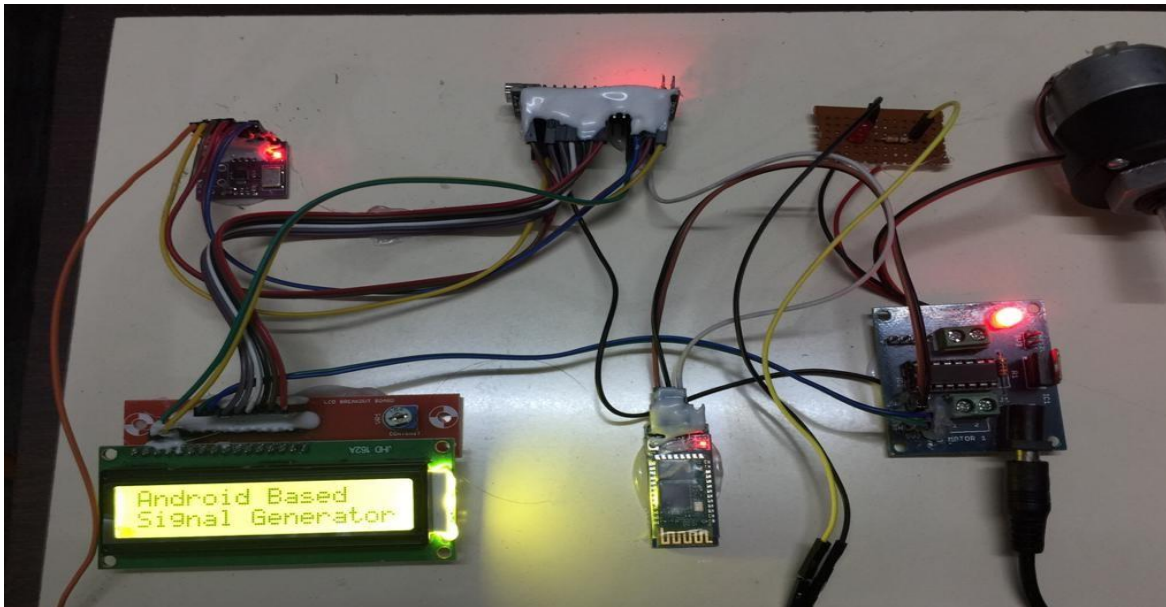

Figure 3:Proposed Android based signal generator

Here the data has been set through android device and sent to the controller via wireless Bluetooth adapter and displayed in LCD is shown in Figure 4 Output waveform in logic analyser is shown in Figure 5
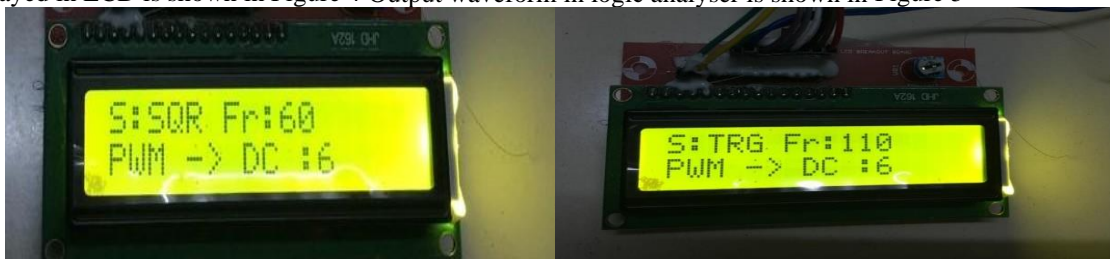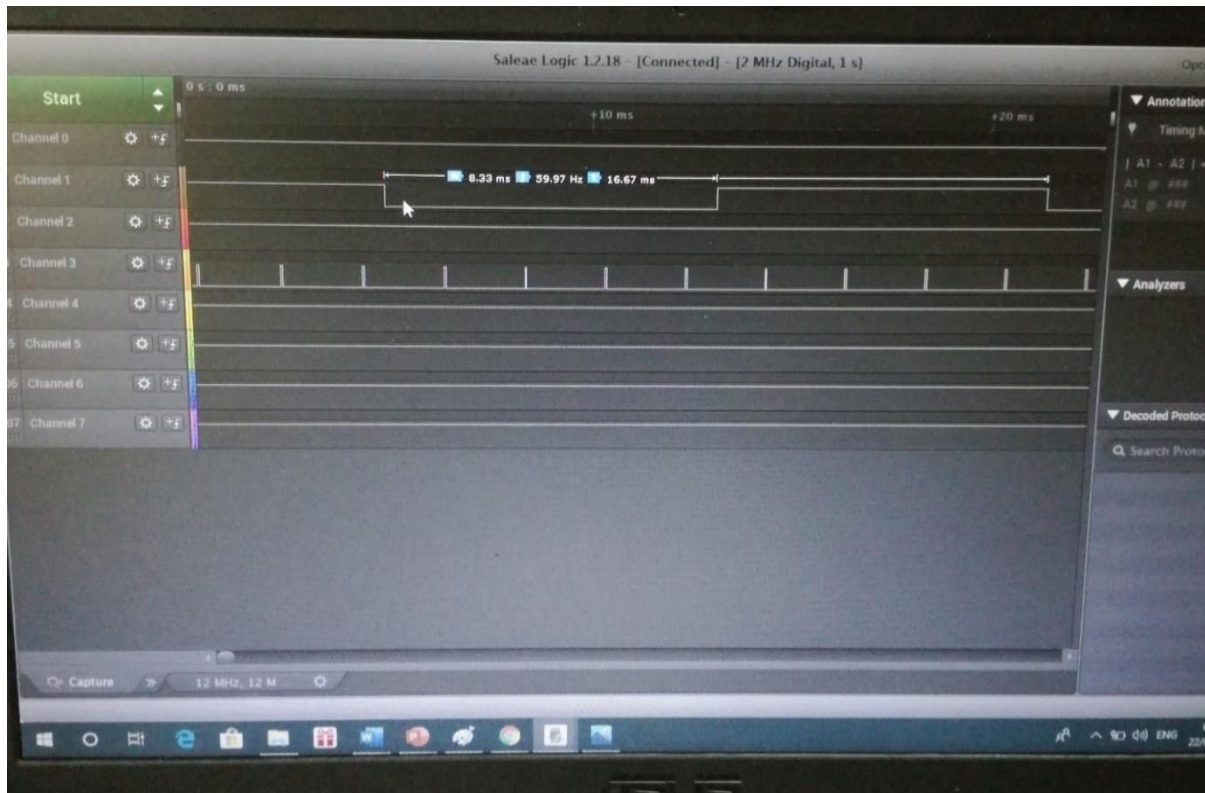
Figure 4: Output of LCD display

Figure 5 : Output waveform in logic analyzer

4. Conclusion

The signal generator primarily based on DDS technology brought in this paper has a vast utility prospect. The equipment we recommend the user type Lab concept, the experimental team of workers can behavior a collection of experiments at every time and anywhere, which can successfully enhance the realistic capability of experimental staff. According to the device diagram scheme brought in this paper, the signal generator based totally on DDS technological know-how developed can output bipolar signals whose frequency, amplitude and DC offset voltage are adjustable. Then, we will take sine signal as an instance and take a look at the frequency and amplitude of the output waveform. The signal generator based totally on DDS technological know-how added in this paper can be utilized in many fields which need low frequency signals with excessive precision and excessive stability, such as digital course experiment, mechanical engineering, conversation take a look at and so on. Compared with the typical signal generator, the system format has the benefits of small size, excessive precision, bendy and handy to use, etc, and it is very environment friendly to set the signal amplitude, waveform, phase, frequency. What's more,

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