Design of SDR Transceiver in Industrial Automation

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***Abstract*—Software defined radio is a radio in which the physical layer functions are software defined during which the radio tuned at any frequency in order to implementation of various modulation and demodulation employing a device with powerful hardware and software tools. This offers the advantage of portability, miniaturization, easy software updates. This paper presents the design and execution of reconfigurable SDR based radio transceiver. Both the transmitter and receiver are implemented using Lab VIEW. The audio signal is first recorded using sound capture then it is modulated and demodulated at the receiver side. Finally, we were ready to receive the extract replica of the transmitted audio signal.**

Keywords -Software defined radio, Lab VIEW, QPSK modem, QAM modem.

I.INTRODUCTION

Software defined radio is a technology wherein software modules running on a hardware platform are used to implement radio functions. A software- defined radio is a radio tuned at any frequency in order to implementation of various modulation and demodulation employing a device with powerful hardware and software tools. These hardware components include filters, amplifiers, modulators, and demodulators. These components are defined in software and may be adjusted as required without making any change in hardware.

II.METHODOLOGY

A. SDR architecture

RF section consists of the RF front end which is responsible for transmitting or receiving the RF signal from the antenna and converts the RF signal into IF signal and other way around. Receiver end performs RF power amplification and analog down conversion from RF signal to IF signal and therefore the transmitter end performs RF power amplification and analog up conversion.

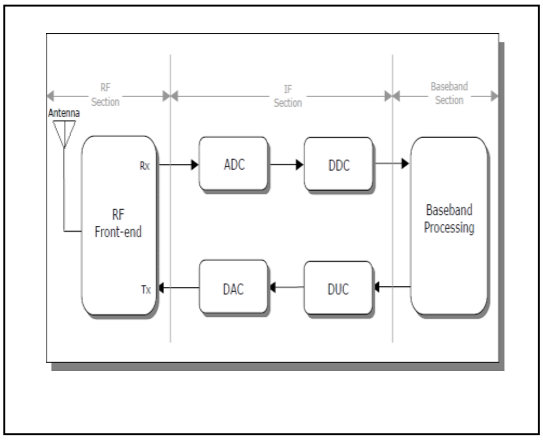

Fig 1 SDR architecture

IF section consists of ADC/DAC and DDC/DUC blocks which interfaces between the analog and digital sections of the radio systems. Baseband section consists of baseband processing which performs functions like connection setup, equalization, frequency hopping, timing recovery and correlation.

B. Lab VIEW

LabVIEW(**Lab**oratory **V**irtual **I**nstrumentation **E**ngineering **W**orkbench) is a visual programming language which was developed by NI as workbench for control of test instrumentation. The graphical language is known as "G". Based on the dataflow programming model, Programs in Lab VIEW are called Virtual Instruments (VI's). Lab VIEW components are often grouped into 3 broad categories: Acquire, Analyze and Present .VI's use Front Panel to interact with users and Block diagrams are the graphical ASCII text file. Each VI consists of three main parts front panel, block diagram and icon/connector.

- Front Panel: It is a interface where the program is controlled and executed.
- Block Diagram: It is diagram where the functions are noted by blocks connected using lines show the connection between them.
- Icon/Connector: The icon is a visual representation of the VI. It has connectors for program inputs and outputs.

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III.DESIGN OF SDR TRANSCEIVER

Digital modulation is employed in communication systems. It provides digital data services, higher data security, better quality communication and more information capacity. Modulation technique used here are QAM and QPSK.

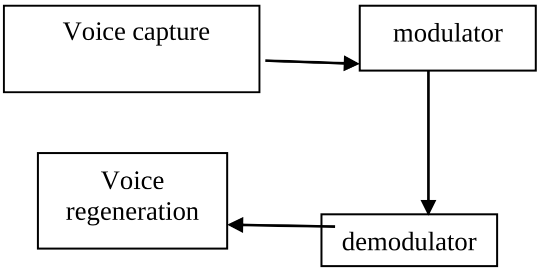

Fig 2 SDR transceiver block diagram

The design steps include designing of VI for voice capturing and reproducing audio signal in Lab VIEW environment. The subsequent step is to design and implement QAM and QPSK modem. Final step is to style the reconfigurable SDR on PC.

It captures sound without the use of IO drivers. The response was analyzed using different types of audio signals.

C. Voice capture

The VI shown above is employed to capture sound in lab VIEW using microphone.

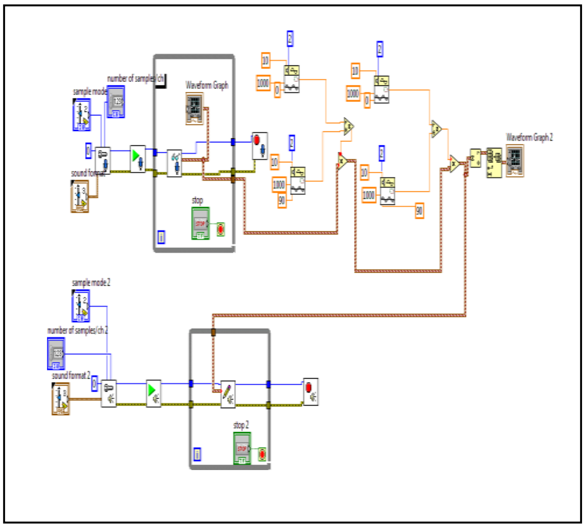

Fig 3 voice capture

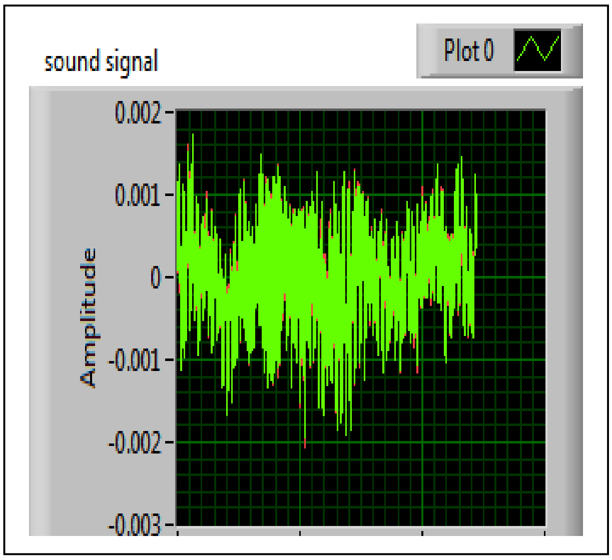

Fig 4 sound input

IV.VOICE REGENERATION

Voice regeneration produces the original sound information. The sound can be heard using speaker. .Again, this VI eliminates the utilization of IO drivers

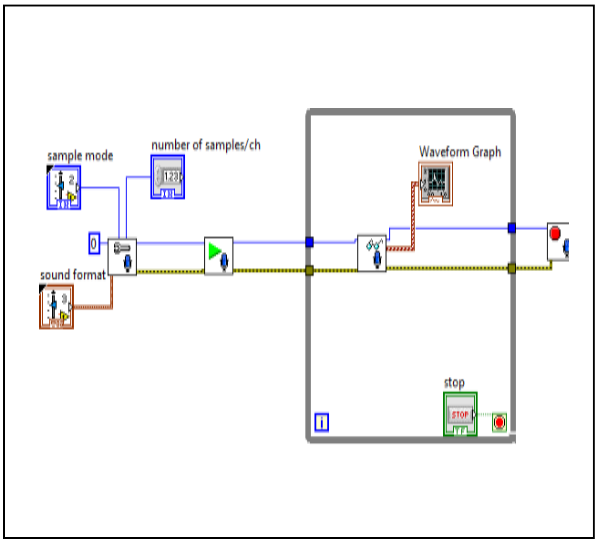

Fig 5 voice regeneration

A. QAM modem VI

Modulation technique that exploits the amplitude and phase of the carrier is understood as QAM. The VI is employed to modulate the carrier signal using captured audio signal. The received modulated signal is demodulated using QAM demodulator

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QAM demodulator is employed to extract the original sound information. The demodulated signal is obtained by multiplying the complex carrier signal consisting of sine and cosine signal and therefore the real part of the modulated signal. At the receiver side, the receiver multiplies the received signal separately with the sine and cosine signal.

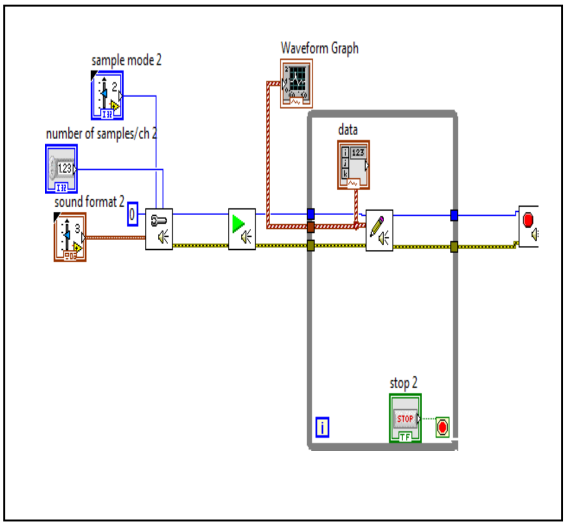

Fig 6 QAM modem block diagram

B. *QPSK modem VI*

The VI is to modulate the audio signal using QPSK modulator. The original sound information is extracted by using QPSK demodulator. After designing QAM modem and QPSK modem separately in Lab VIEW the subsequent step is to design reconfigurable SDR which consists of case structure which works in two cases. In true case, QAM is employed and in false condition QPSK works

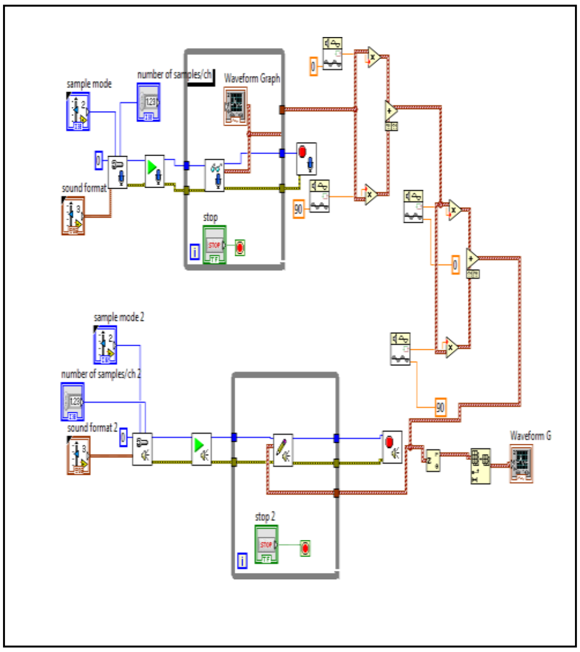

Fig 7 QPSK modem block diagram

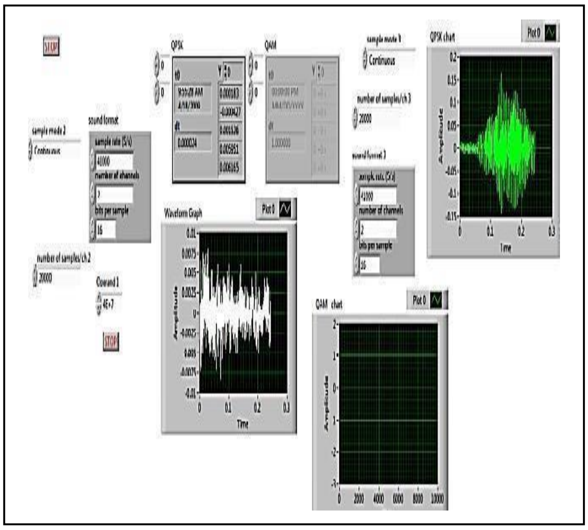

Fig 8 Front panel of SDR transceiver for QPSK modem

The choice of the condition depends on the frequency range. If the frequency range is between 5Mhz to 42Mhz QPSK works otherwise QAM will work. Other modulation also be implemented using different frequency ranges.

Fig8 shows the front panel of QPSK MODEM when the signal frequency is chosen in between 5 to 42 MHZ. Similarly when the frequency value exceeds 42 MHZ. QAM MODEM output is executed which is shown in Fig9.

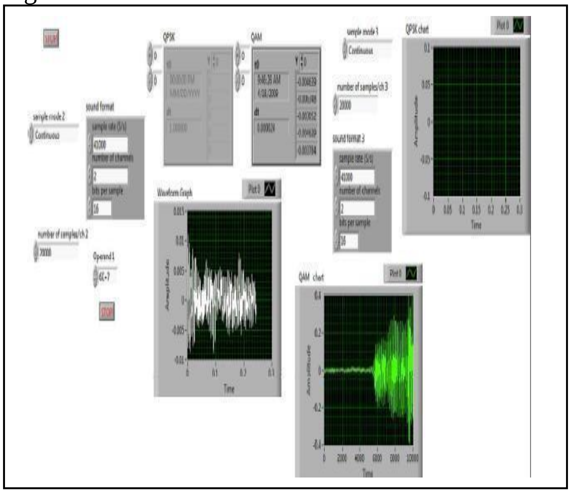

Fig 9 Front panel of SDR transceiver for QAM modem

CONCLUSION

This paper presents the planning and execution of the SDR using Lab VIEW. The audio signal was modulated by different modulation techniques under various frequency ranges. The modulated signal was demodulated to urge the extract replica of the transmitted signal.

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