Implementation of FM Transmitter using Software Defined Radio based on RTL

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***Abstract*- Now wireless communications growing in no time, in their applied techniques and instrumentation. Hardware reduction became a main objective for fewer value and fewer complexness wireless communication devices and systems. one in all the foremost economical solutions for the hardware complexness reduction in wireless communication systems is package outlined Radio (SDR), it's modulation and reception execute through package stored in a Field Programmable Gate Array (FPGA), placed inside an electronic USB device, that modify the radio system to be multi-functional rather than one perform as within the classic radio systems. FM transmission is achieved using a 3 stage FM transmitter with range of (88-108) MHz, up to distance of 50 Km. The translation of signal processed by SDR is carried out by analyzer radio software running on a computer system, which opens up enormous range of potential for Radio Communication.**

1. INTRODUCTION

A radio set is any kind of device that wirelessly transmits or receives signaling in the radio absolute frequency (RF) part of the electromagnetic spectrum to facilitate the transferal of information. In the age of modern technology, radio receivers are present in large scale such as cell phones, computing machine, car door openers, vehicle, and televisions. A SDR is a radio communication system that performs radio signal modulation and demodulation in computer package. SDR are characterized by their flexibleness just by software replacement or modification it is possible to change completely its single-valued functionality. This allows upgrading or improving the operation of the equipment without any computer hardware alteration. It can be easily modified to satisfy the needs of any particular usage. The key difference between a radio that uses software and a software defined radio is that the first one uses software internally to implement a particular function, whereas in a SDR all of its practicality may be modified by suggests that of package modification. This kind of engineering is driven by the convergence of representative, telecasting and information transmissions over mobile devices like cellular phones and smartphones.

2. BACKGROUND

A. SDR (Software Defined Radio)

SDR is a type of radio system in which all parameters regarding radio signals can be adjusted by programs and configuration through a PC software. A SDR typically have an antenna and an Analog to Digital Convertor (ADC) on receiver side. Likewise a Digital to Analog Convertor (DAC) on transmitting side. Rest of the functions are handled by FPGAs on the SDR kit.

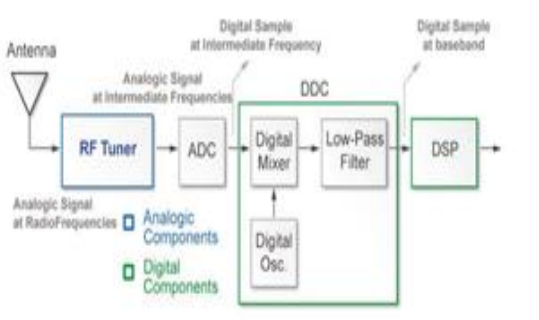

Fig.1 Block diagram of a SDR receiver

Fig. 1 depicts the block diagram of a SDR receiver. At first, the RF tuner converts the analog signal to Next, the IF signal is passed to the ADC converter responsible of adjusting the signal's domain, giving digital samples at its output. The samples are feed to

the subsequent stage's input which is a Digital Down converter (DDC). The DDC is usually a monolithic chip and it stands as the key a part of the SDR system. DDC have 3 main components: (1) a digital mixer, (2) a digital local oscillator, and (3) a Finite Impulse Response (FIR) low-pass filter.

B. CubicSDR

CubicSDR is a Software Defined Radio application supported across multiple computer platform. We can use CubicSDR to explore the RF world around us when paired with a supported hardware receiver. Satellite transmissions, Amateur Radio, Rail, Aeronautical, Shortwave, or any number of possible signals floating through the air can be discovered. Currently common analog demodulation schemes such as AM and FM are supported by this application and will support digital modes with further development. Various digital decoding applications are available that make use of analog outputs to process digital signals by "piping" the data from CubicSDR to another program using software like Sound-flower, Jack Audio or Evocable. All the readily made RTL-SDR "Register Transfer Level "which are inexpensive compared to other SDR kits, are supported by CubicSDR A variety of visualization tools are available in CubicSDR like oscilloscope display, waterfall and FFT displays as well as audio sinks that interface to the PC soundcard

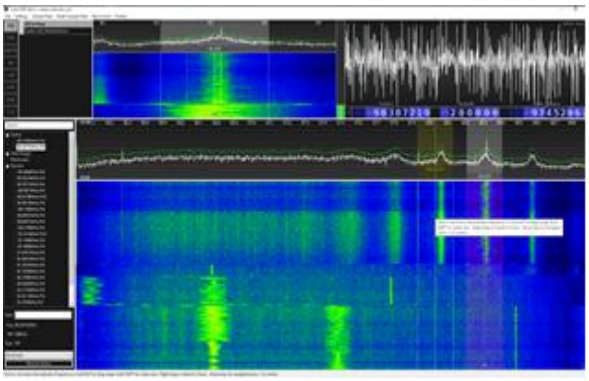

Fig. 2 CubicSDR application running on PC

C. FM Transmitter Kit

For simulating real environment, a powerful 3 stage FM transmitter kit is being used for varying FM radio signals. Such transmitters can provide a range up to few kilometers in open space. Transmission also depends on many factors like type of antenna used, voltage of operation and surrounding conditions that may affect the transmission.

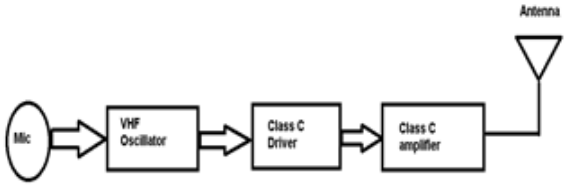

Fig.3 Block Diagram of 3 Stage FM transmitter

Among the three stages two BC547 transistor is used in first two stage and a RF transistor is used at output stage. This kit have 3 trimmer capacitor that are used for changing transmitting frequency and output power range. Mic is used to transmit audio over FM channel. For transmission telescopic dipole antenna is used.

3. IMPLEMENTATION

Although commercial FM radio stations are broadcast all over the world the received signal at any particular location is poor. FM system removes noise easily compared to AM systems. As the commercial standards for all the radio stations wideband FM is used which is commonly called as "FM Radio". A FM signal can have unlimited no. of sidebands with a frequency deviation of 75 MHz These sidebands are located at every positive and negative multiple of the information signal located around the carrier.

For the purpose of our project, the FM receiver setup consists of:

- An RTL-SDR dongle
- A Computer with audio card.
- SDR supported application package

Computer processor acts as real time processor for real time digital signal processing using SDR. The real time data from SDR can be accessed using CubicSDR. CubicSDR provides real-time visualization of data via various forms of display of spectrum like FFT, Waterfall. SDR dongle provides a good signal reception with a tunable frequency range of 25MHz – 1.7GHz which is much larger than FM frequency range

The demonstration setup consists of 2 sides. (1)Receiver side PC installed with CubicSDR software and RTL-SDR dongle connected to it via USB interface. (2) Transmitter side, a 3-stage FM transmitter with variable frequency.

Fig.4 FM transmitter

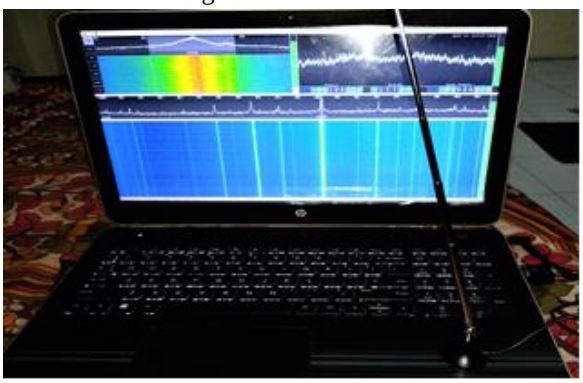

Fig 5. Receiver setup with PC and SDR dongle

4. RESULTS AND DISCUSSION

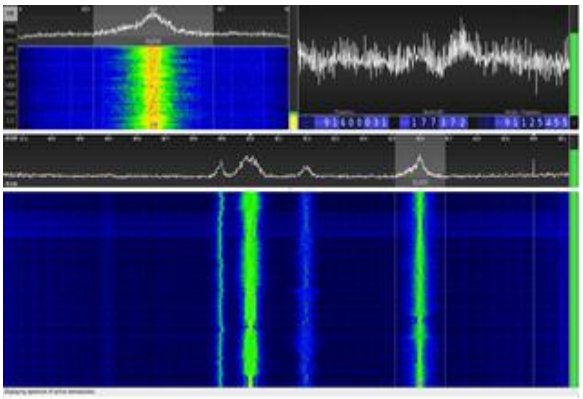

Fig 6. Output as displayed by application

We can see from given output that, after tuning frequency to required range we obtained two spectrum at 91.6MHz and 91MHz respectively. One of the frequency is standard commercial FM radio frequency, while other one is signal transmitted by our FM transmitter. Audio from both sources can be heard clearly via speakers of the PC. Upon further tuning of FM transmitter, signal can be obtained at various other frequencies throughout FM transmission range of 88MHz to 108 MHz with very less deviation.

5. CONCLUSION

Software Defined Radio have potential to bring a revolution and inspire ideas in field of wireless communication. With the help of profound software packages and hi-tech hardware for SDR, the there is no extent to which SDR cannot be implemented and access Radio Spectrums thoroughly. RTL-SDR with its low cost and high performance parameters, it is a suitable hardware of implementation of Software Defined Radio. With RTL-SDR, there is no need to write and execute any codes. It is just plug and play implementation, which is quite easy compared to other SDR techniques. SDR provides functionality like spectrum analysis, interference detection and noise bands characterization. With its limitless application and continuous growth in technological advancement SDR have paved its way through the likes of radio enthusiasts and amateur radio operators to implement and develop further.

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