Wireless Video Transmission Using USRP and GNU Radio

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Abstract:
As we know that in the today's world of growing technology the need for communication is very necessary and we can say that the most important means is via Video Communication. G- Streamer which is an open source multimedia framework that will convert the live video into the desired raw format. GMSK modulation scheme which is one of the most effective techniques for the wireless video transmission. Using USRP as a mean of transporting a video file. GRC blocks are used for transmission of the video file from one system to another system just by converting it to the raw format for the real-time video transmission and video source to transmit a source file from the transmitter side. We can access our file which we have transmitted at the receiver side with the minimum loss of the data.

Keywords: *USRP, GNU Radio, GStreamer*

1. Introduction

We are living in the world where technology is changing around every six months. As the technology is growing day by day the needs of peoples are also increasing and with the advancement, the need for communication arises.So the best way to connect with each other in the today's world from the different areas of the various country is video Conference.GNU Radio is used to work on the different modules. The Real-time Video signal will be transferred and receive by the GMSK Modulator and Demodulator.

The equipment that is used for wireless video transmission:

- Webcam
- Two PC with GNU Radio and GStreamer
- One USRP for Transmitter And One for Receiver

Experiment platform

A) Hardware Platform:-

USRP gives the component like transmitter and collector equipment to get our signs broadcasting live. We can utilize a Standard PC equipment to run both the Gstreamer and GNU Radio. PC with a decent component is consummately proficient to pack the video source and run the product radio process in the meantime. Using these segments we can achieve some extremely progressed and some functionalities such as

- Get numerous video streams and other information into one information stream (e.g. MPEG-TS)
- Explore different avenues regarding diverse codecs and compartments
- Try different things with various blends of balance and FEC
- Run reproductions with no RF equipment on the up and up
- Get reporting in real time on 1.2 GHz (WBX, DBSRX, RFX1200), 2.4 GHz (RFX2400) and numerous different frequencies

- Setup two-way video visits

We can use USRP B210 for the transmission of video with the minimal loss of the data with the better quality of the video. Here below is the specification of the USRP B210.

USRP B210

- USB3.0interface
- Analog Devises AD9361RFIC
- Coverage from 70 MHz–6 GHzRF
- Flexible rate 12 bit ADC/DAC
- 2 TX, 2 RX, Half or Full Duplex
- Fully coherent 2x2MIMOcapability
- Up to 56 MHz of real-time bandwidth1x1
- Up to 32 MHz of real-time bandwidth2x2

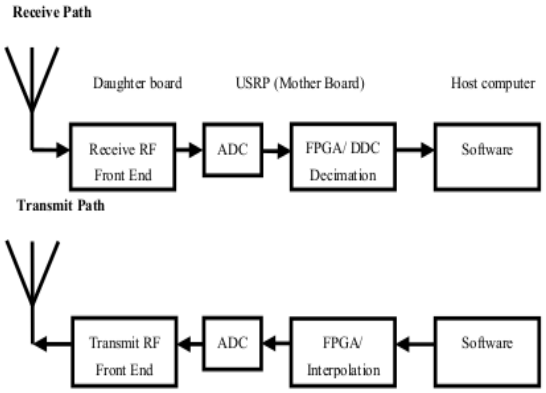
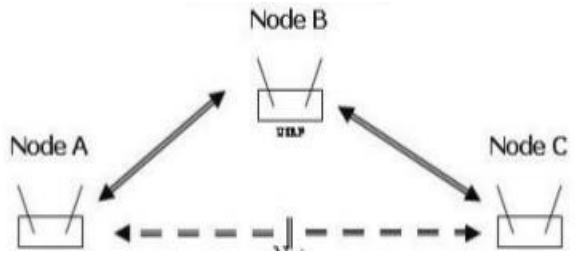


Fig. Basic SDR

To Transmit a real-time video we have to make a pipeline between GStreamer and USRP by using a command mkfifo in the terminal, so by doing this, we can build a pathway for the for the transmission of real-time video. Here below is the

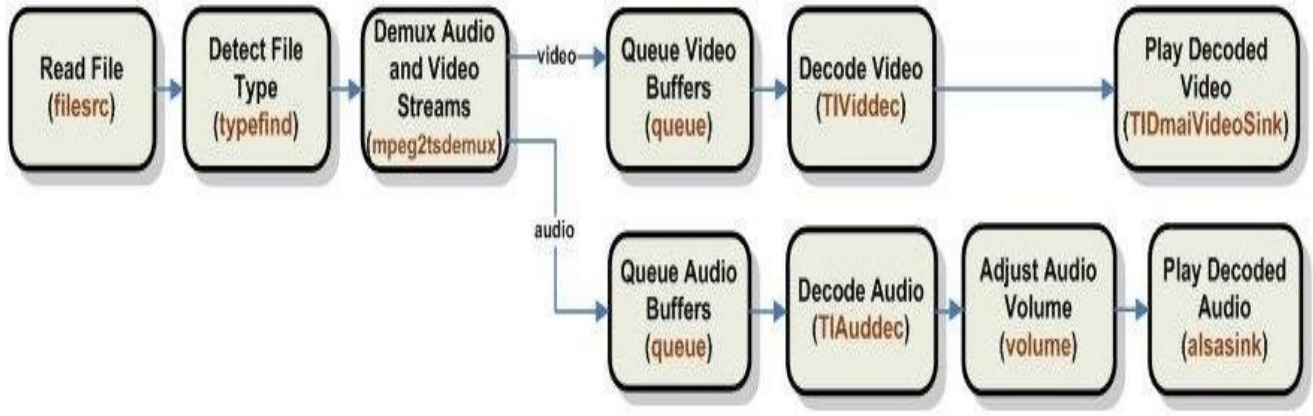


GStreamer is a pipeline-based multimedia framework which links together a wide variety of media processing systems to complete workflows. GStreamer can be used to build a system that can read files in one format and then processes it and exports them in another. GStreamer supports us a wide variety of media controlling components that includes the audio playback, audio and video playback, recording and a live streaming .H264 encoder and H264 decoder is used for the encoding and decoding of the real-time video. Basically, we have to create a pipeline between the GStreamer and USRP for transmission of the real-time video.

B. Software Platform

GNU Radio is open source software which can be written in either python or c++.We can write the flow graph in python language whereas signal processing blocks are written in C++ language. The operating system of GNU Radio is cross-platform. Ubuntu and Fedora are the two main operating systems of the GNU Radio. GNU Radio performs different functions like demodulating, multiplexing, modulation, generation of signal and channel and source coding.

Here We can consider three nodes where Node A and C is Gstreamer And Node B is USRP. So the first pipe will be created between Node A and B so the path for transmission is generated, then the second pipe is created, so by creating the pipe for both the transmitter and receiver we can initiate our real-time video transmission.

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gst-launch filesrc location="video.ts" ! typefind ! mpeg2tsdemux name=demux \
    demux. ! 'video/x-h264' ! queue ! TIViddec ! TIDmaiVideoSink \
    demux. ! 'audio/mpeg'   ! queue ! TIAuddec ! volume volume=5  ! alsasink
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Fig. Basic Understanding of Encoding and Decoding Scheme

III Modulation Scheme

GMSK Modulation:- GMSK modulation scheme which is one of the most effective techniques for the wireless video transmission. Phase frequency shift keying is continuous which can provides us the constant envelope and phase change is changed between the symbols.

The mathematical expressions of the resulting signal is represented by

$S(t) = a1(t) \cos(\pi t/2T) \cos(2\pi fct) - aQ(t) \sin(2\pi fct)$

This equation can be rewritten in a form of phase and frequency modulation.

$S(t) = \cos[2\pi fc(t) + bk(t)\pi t/2T + \Phi k]$

So the signal is modulated in the form of phase and frequency and the phase changes continuously.

IV. Experimental Setup and Plan

We can transmit a video wirelessly in two ways

(1) Transmit a video source (2) Transmit a real- time video source. System model to transmit a video has two parts one is transmitter side implementation and a second part is receiver side implementation of GNU Radio. The signal is transmitted wireless using antennas. Antennas are operated between the frequency range from 0.4 GHz to 4 GHz. Antennas are connected to the USRP device one at the transmitter side and one at a receiver side.

(1)Setup of Video Source Transmission:

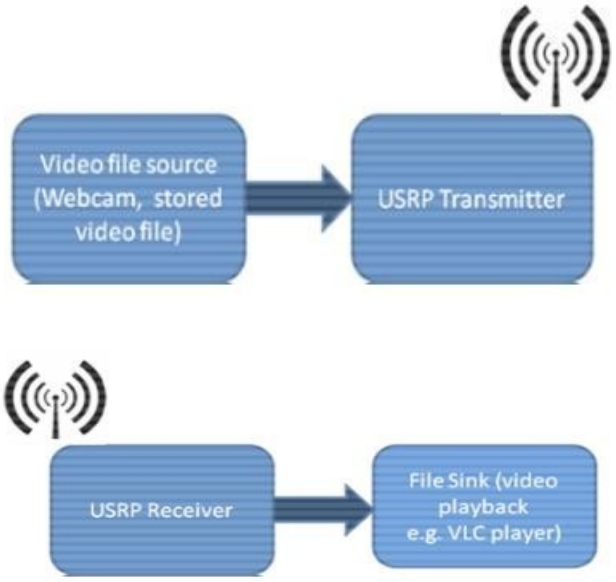

Fig. Sourc Transmission

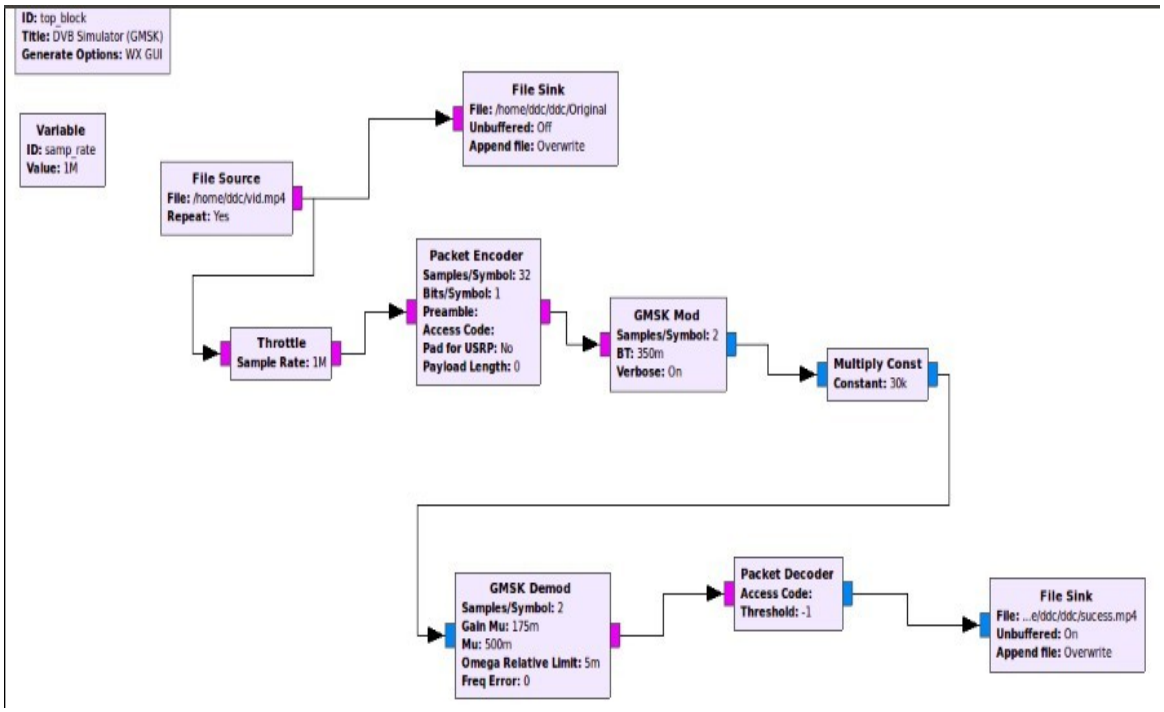

Fig. Simulator Setup

Basically here we can use a source file. Then we can playback the video to ensure that we receive the same video that we have transmitted. This setup can be use without use of USRP.

Now The USRPs shall be introduced and loop back is removed. The transmitter and receiver block is made and now we can transmit a video source using USRP. The experimental setup of the transmitter side is shown below

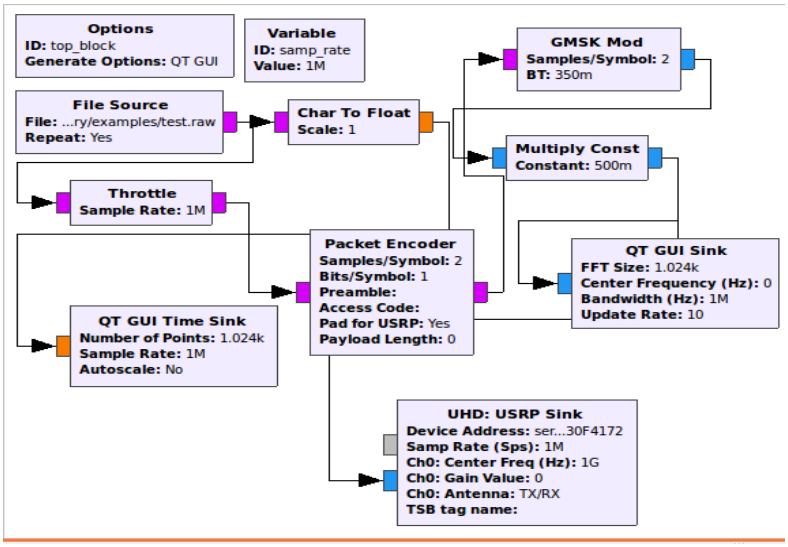

Fig. Transmitter Side Block

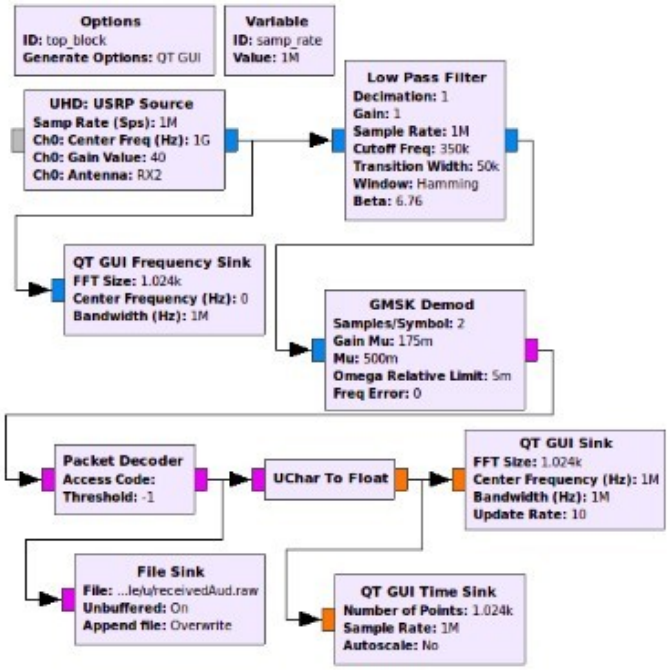

Fig. Receiver Side Block

The BT=350m, Samples per symbol rate =2 sink and USRP used 1.2345 GHz channel frequency for video transmission.

(2)Setup of real-time Videotransmission:-

Transmission

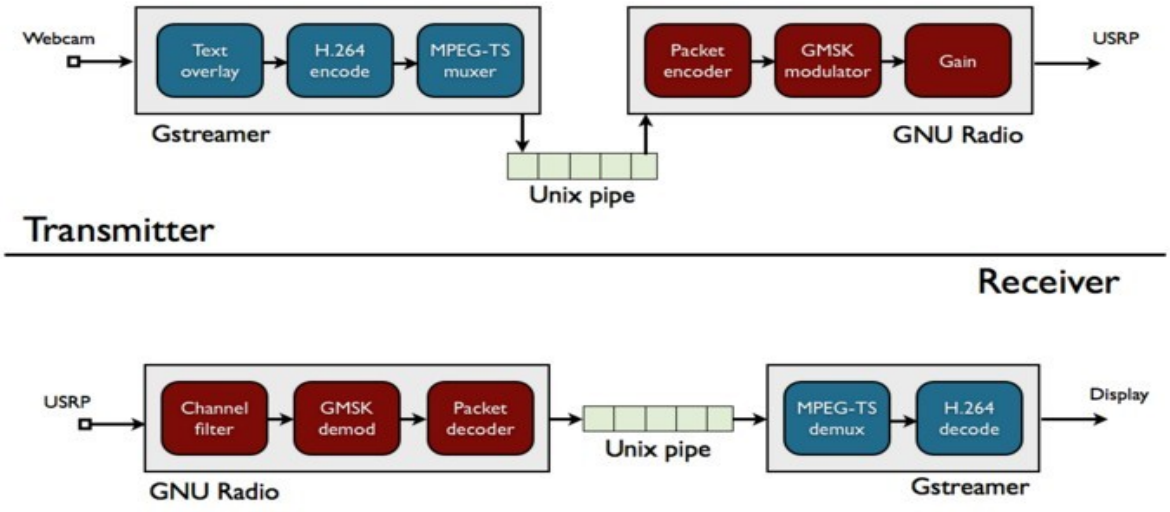

Fig.Real-TimeVideo

Conclusion

There is different way of transmission of real-time video:-

- G-Stream system which is an open-source programming that procedures and encodes the video motion from the camera.
- UDP attachments tuning in to the camera port toward one side and another UDP attachment sending to the camera port at the flipside.

Parameter	Transmitter	Receiver
Frequency	0.5-4 GHz	0.5-4 GHz
Video Rate	1000 kbps	1000 kbps
Modulation	GMSK	GMSK

Here in this paper, the main focus is on the transmission of video source using a GMSK modulation scheme. The open source software GNU radio is very powerful platform for the implementation of real-time video transmission. The encoding and decoding of the real-time video can be done significantly with the minimal loss of data by using the H.264 encoder and H.264 decoder. In conclusion, SDR system provides flexibility to development of video transmission using GNU Radio software and USRP hardware.

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