

NI based Time Dissemination of Timing Information over UHF

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ABSTRACT

The thesis addresses the design and development of NI based transceiver for dissemination of timing information over UHF. In this case, Timing information from the time generator is disseminated over RF by suitable encoding and modulation schemes. On the other hand, receiver will receive the RF signal and then carry out demodulation and decoding in NI platform to fetch out timing information. Then the timing information is displayed on Raspberry Pi based Timing receiver system. The methodology includes design and development of various coding in LabVIEW software such as BFSK modulation and demodulation, Manchester encoding and decoding techniques and other. This coding technique is performed in NI hardware with NI certified LabVIEW software. With the development of LabVIEW software DDS compiler plays a vital role in generating a time varying signal usually a sine wave in digital form and then performing a digital to analog conversion to generate analog waveform. Similarly FIR compiler provides a common interface for users to generate highly parameterizable, area-efficient high-performance FIR filters. Finally the timing information is displayed on the R-Pi based timing receiving system by using Pi board interfaced with the NI hardware.

Keywords: BFSK, DDS Compiler, FIR Compiler, FPGA, LabVIEW, Raspberry-Pi.

1. INTRODUCTION

Now-a-days communication plays a vital role in transmitting and receiving of information through various channels. These channels may include underground or sea level as in Fig. 1. The main problem arises when we find difficulties in

transmitting our desired signal in cables at and under the sea level. Providing cables for the larger distance is quite impossible and is too costly if proposed. Maintenance under the sea level at a greater depth is not possible. So reception of the signal becomes quite difficult as well. Thus it's necessary to set up a low cost receiver system that can easily receive and we can observe our required signal wirelessly.



Fig.1 CDT dissemination over wireless telecommunication link

1.1 Objective

The objective is to get familiarized with the development in the NI environment. The NI platform involves working in the field of NI Flex RIO hardware and LabVIEW software. The NI Flex RIO hardware includes various chassis which performs various functions like embedded controller, Up-converter, Down-converter, various ports for serial and parallel communications, RF pre-amplifier which acts as low noise amplifier and baseband transceiver system. Secondly to get familiarized with the Raspberry Pi related embedded system. Raspberry Pi being a low cost receiver is easier to implement in inaccessible

remote area where communication through cables are not possible. Embedded system which involves NI hardware and LabVIEW software interfaced with the Raspberry Pi board to display the timing information on R Pi display.

1.2 Motivation

The purpose is to serve a good communication facility to the areas where we provide cables to a larger distance are quite impossible and cost effective. Transmission of signal through cables over the sea level for a larger distance is not possible. So we need to implement a type of receiver where we can receive our desired timing information within a stipulated time wirelessly. This installation can be helpful if implemented in inaccessible remote areas.

1.3 Problem Discussion

Now-a-days communication plays a vital role in transmitting and receiving of information through various channels. These channels may also include over the sea level. The main problem arises when we find difficulties in transmitting our desired signal through cables at inaccessible remote areas. And providing cables for the larger distance is quite impossible and is too costly if proposed. Maintenance for the same could rather be not possible. Reception of the signal becomes quite difficult as well. Thus it's necessary to set up a low cost receiver system at those inaccessible remote areas which can easily receive the information and we can observe our required signal wirelessly.

1.4 Problem Solution

The problem can be solved by setting up a low cost receiver at any inaccessible remote places to receive our desired information. The set up can use directional or the Omni-directional antenna for the purpose of reception of timing information. The process involves transmission from baseband to ultra high frequency band to transmit our information. The receiver includes reception from ultra high frequency band to baseband. Thus the receiver will decode the information and we can obtain the CDT on Raspberry Pi. The system performs at NI embedded platform and Raspberry Pi kit.

2. Methodology

The methodology includes incoming of Count Down Time by a Time code generator. The timing information is encoded by Manchester Encoding.

The encoded information is then modulated by BFSK modulation. The signal is then digitally and analogically up-converted at NI platform and is transmitted in UHF band. The receiver receives the signal and the signal is pre-amplified by RF pre-amplifier which acts as a low noise amplifier. The signal is analogically and digitally down-converted by the NI hardware. The decoding of BFSK is carried out followed by Manchester decoding. Finally the timing data is displayed on the Raspberry Pi screen. The flow diagram of the above methodology is shown in Fig. 2.

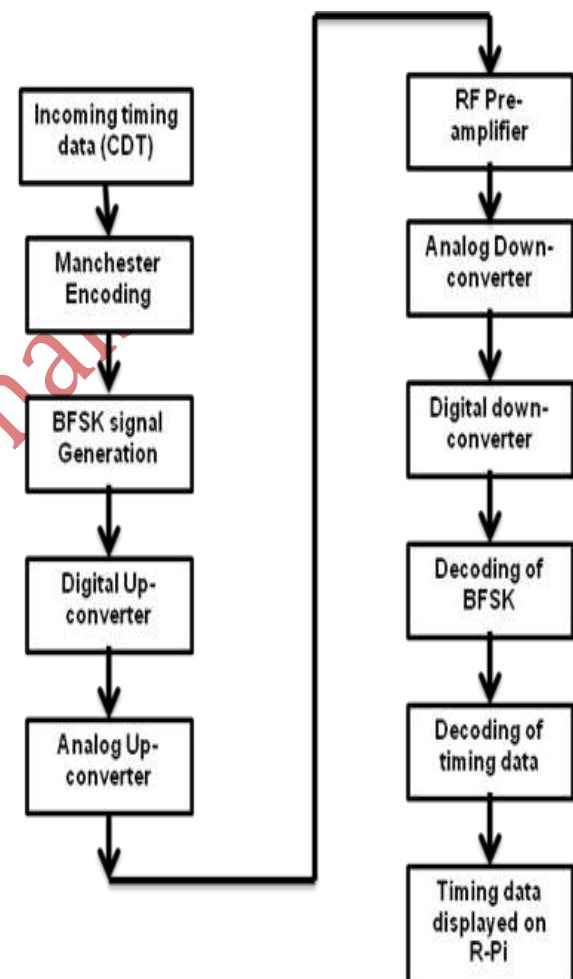


Fig. 2 Methodology for Time Dissemination System

3. LabVIEW Programming

3.1 BFSK Modulation

4. The BFSK data is performed after the Manchester encoding inside the same single cycled timed loop running at 5MHz clock frequency. After encoding process the BFSK signal is generated by using

DDS compiler for generating higher frequency and lower frequency using two controls of fixed point at `pinc_in` (phase increment in). The higher and lower frequency is selected accordingly by using a selector option. Thus the generated BFSK signal is transferred to the Host by using a case structured loop by providing Target to Host FIFO as in Fig. 3 and the output is shown in Fig. 4.

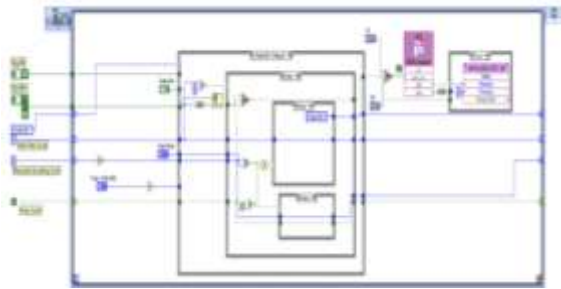


Fig. 3 BFSK Modulation

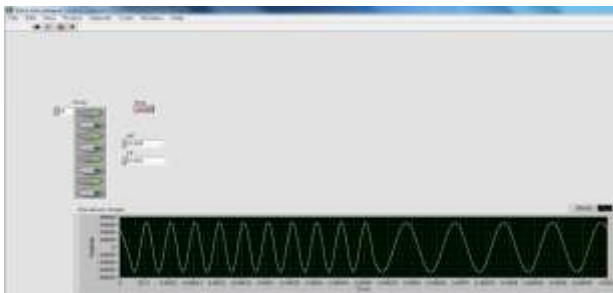


Fig. 4 Generation of BFSK signal by LabVIEW software

4.1 BFSK Demodulation

In practical approach BFSK signal is received by the target scoped FIFO and the required signal is filtered out by using FIR compiler. The demodulation is carried out taking a single cycle timed loop of 5MHz clock frequency and using a case structure for filtering out the desired signal of higher and lower frequency. The FIR compiler was configured accordingly in order to filter out higher and lower frequency. The programming is shown as in Fig. 5

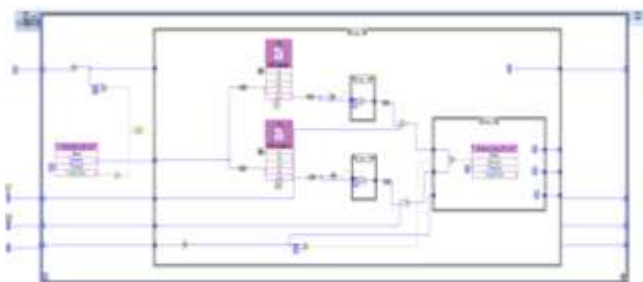


Fig. 5 BFSK Demodulation

4.2 Manchester Encoding

The BFSK demodulated signal is received by the target scoped FIFO. In similar way the Manchester decoding was carried out by a single cycle timed loop of 5 MHz clock frequency. The loop was provided with appropriate constants for generating required number of bits and loop rates. The loop was also provided with an increment and a comparator for increasing the bit by number of 1 and comparing the sample to 1250 respectively. The program is shown in Fig. 6.

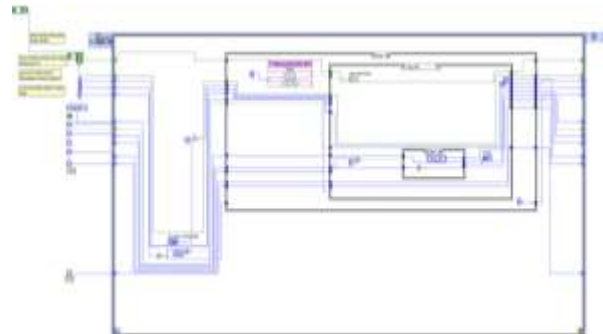


Fig. 6 Manchester Encoding

4.3 Configuring with Raspberry Pi

The Raspberry Pi was installed accordingly with necessary equipments. The display was connected to the Raspberry Pi board. The R-Pi runs on Linux based environment. The configuration was carried out by providing login id as pi and password as raspberry as shown in Fig. 7.

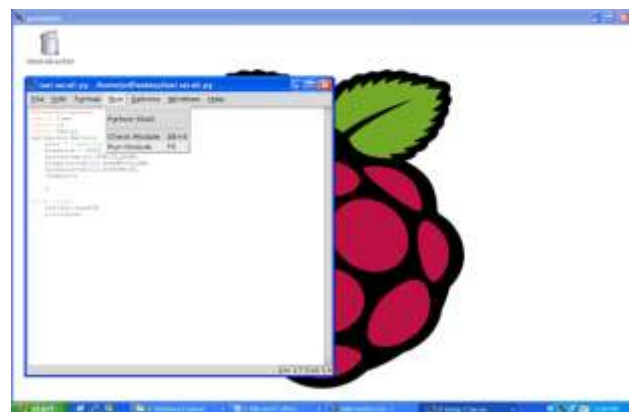


Fig. 7 Configuring of R-Pi

4.4 Experimental Results

By various encoding, modulation and digital analog conversions the transmitter transmits up-converted BFSK of 25 MHz in UHF band and it receives the same in the down-converted form of 15 MHz. after the process. According to the Fig.8. The transmitted

BFSK signal is mentioned in blue and the received BFSK signal is shown in pink.

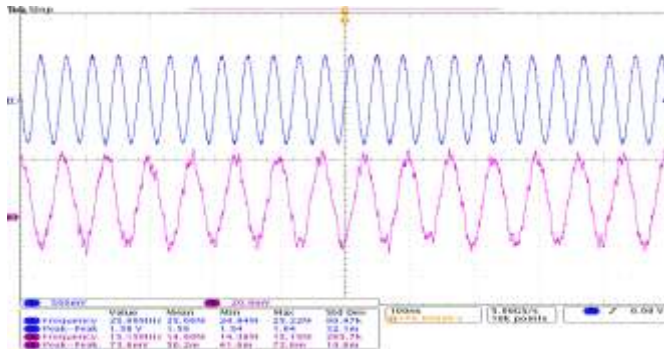


Fig. 8 BFSK signal generation at Transmitter (blue) and received BFSK signal at receiver (pink)

Fig. 9 indicates the front panel view of the Count Down Time by the LabVIEW software where the up-converter gain is increased by 15. Each value of the timing frame is mentioned by 4 bits of the Boolean LEDs as shown below.



Fig. 9 Front panel view of CDT display

Fig. 10 indicates the CDT display on the Raspberry Pi after the process of demodulation and decoding. The display is displayed on a screen after the demodulation, decoding and down conversion by the NI hardware. This information of timing data is broadcasted to receiver stations.

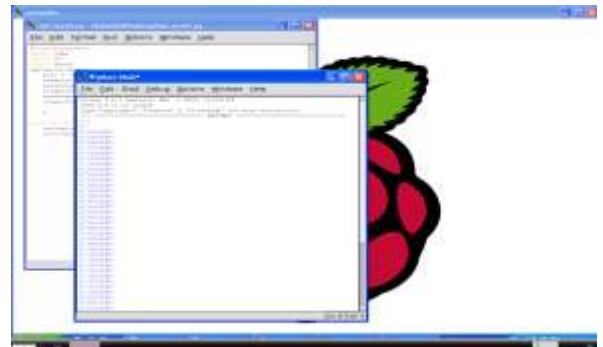


Fig. 10 CDT display Raspberry Pi

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