PC-PC Communication using FSK Modulator and Demodulator

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Abstract: This paper proposes an innovative experimentation for communication between two computers . The proposed technique uses FSK modulator and demodulator as a modem. A file or data from one PC can be transferred to another PC in serial form by using Hyper Terminal and USB to TTL converter. The purpose of design of this experiment is to study the basic technical concepts of interfacing analog ICs and electronic circuits with PC, use of USB to TTL converter, serial data transmission of PC, use of Hyper Terminal, understanding the concept of Acoustic Coupling, by using the existing set up in the lab.

Keywords: PC,USB, TTL, Hyper Terminal, Acoustic Coupling, FSK.

Introduction

For communication between two PCs we already have LAN connection using Ethernet. In the proposed work an experimental set-up is designed for digital data transfer from one PC to another PC. A electronic circuit from the text book authored by Ramakant A. Gayakwad, [1] is used. This circuit works as a modem.

HyperTerminal (also known as Hyper Term) is a communications and terminal emulation program that comes with the Windows operating system. It can also be used to set up a connection for data transfer between two computers using the serial ports and for serial-port control of external devices or systems such as scientific instruments, robots, or radio communications stations. HyperTerminal can also be used as a troubleshooting tool when setting up and using a modem. We can send commands through HyperTerminal to make sure that your modem is connected properly.

The experimental set–up includes FSK modulator (IC 555) for transmitting the data from one PC and FSK demodulator circuit (IC 565) for receiving the data for another PC. For acoustic coupling speaker and mike are used.

Fig.1 shows the functional block diagram of experimental set-up used for implementation of PC- PC communication using FSK modulator and demodulator.

Upper part of the block diagram is a transmitter section and lower part is a receiver section. The functional explanation for the block diagram is given below,

First open the Hyper terminal on first PC. Then type some message on it using a key board of that PC. This Message will be transmitted serially through USB to TTL converter to FSK Modulator circuit. Output of FSK Modulator is connected to speaker which converts elctrical signal into audio signal. This audio signal is received by a mike placed near to speaker. Output of MIC which is an electrical signal is given as input to FSK demodulator. Finally the ouput of FSK demodulator is connected to another PC by again using USB to TTL converter and received message signal will be automatically displayed on the Hyper Terminal already opened on the second PC.
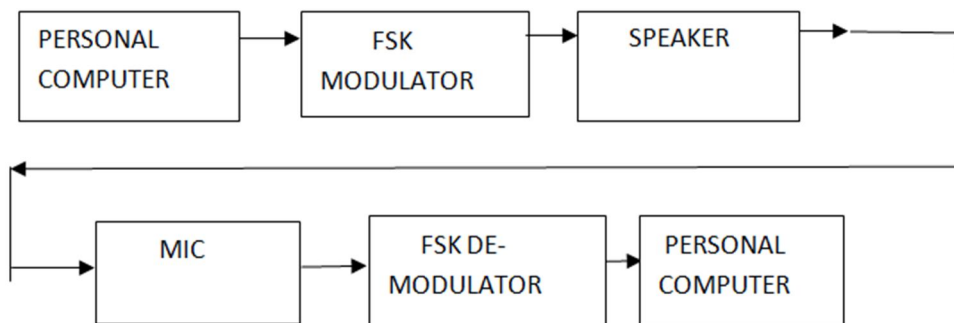

Figure 1. Block diagram of experimental set-up used for implementation of PC- PC communication using FSK Modulator and Demodulator

Proposed System

The proposed system consist of following components and circuits,

- Two PCS
- FSK Modulator using IC 555
- FSK Demodulator using IC 565
- IC 741
- USB to TTL connectors
- Speaker of 5 W and Condensor mike
- Software Hyper Terminal or TeraTerm

Two computers are placed, one at transmitting side and other at receiving side with software Hyper Terminal which is a windows terminal emulation program, installed on it. Combination of FSK Modulator and Demodulator works as a modem. IC 741 is used as an amplifire at the output of modem. USB to TTL converter is used for serial data transfer from computer to/from interfacing circuiti.e. a modem. Speaker is connected at the output of FSK modulator and Mike is connected at the input of FSK demodulator.

Each part of the proposed system is explained below,

Interfacing Circuit (MODEM)

Fig. 2 is the circuit diagram for FSK modulator and demodulator. In the circuit shown FSK modulator section consist of IC 555 and FSK demodulator section consist of IC565.

The working of circuit diagram is explained as follows,

Once a message is typed on first PC using a Hyper Terminal then the digital equivalent data of this message is outputed serially from first PC to FSK modulator through USB to TTL connector.

FSK modulator using IC 555 is capable of generating FSK signal with respect to the given input signal. The resistors RA,RB and capacitor C determines the frequency of the FSK modulated signal in the astable mode of operation. The output frequency of the signal was based on the input digital signal given to the base of the transistor. When the given input was high that is of logic 1 the PNP transistor Q1 is off and IC 555 timer works in the normal astable mode of operation. In this mode of operation capacitor C charges through RA and RB to 2/3Vcc and discharges through RB to 1/3Vcc. Thus capacitor C charges and discharges alternately between 2/3Vcc and 1/3 Vcc as long as the input is at logic 1 state [1]. Here the resistors RA, RB and capacitor C were selected in such a way to obtain output frequency of 1070Hz.The output frequency when the input was high is given by the equation,
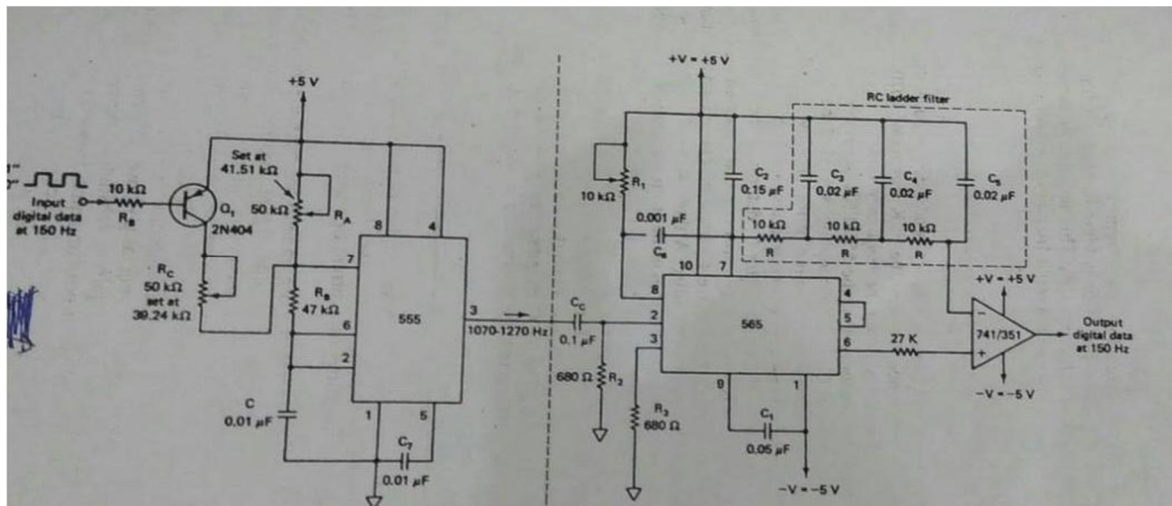
$$f= 1.45/(RA + 2RB)C$$

Figure 2. Circuit diagram of FSK modulator and demodulator

When the input is logic 0, the Q1 transistor is on and it connects the resistance Rc across resistance RA. This action reduces the charging time of the capacitor and increases the output frequency. The RA, RB, RC and C values was selected in such a way to obtain output frequency of 1270 Hz.This was given by the equation

f=1.45/((RA || RC)+ 2RB)C

Thus the resultant output FSK will give frequency of 1070Hz when input is high and frequency of 1270 when input is low.

Thus two different frequencies are generated at the output of FSK modulator depending upon the corresponding input from first PC.

The frequency modulated output from the FSK generator is then given to the speaker which converts electrical signal into audio signal. This audio signal is received by a mike placed near to speaker (not shown in figure). Output of mike which is an electrical signal has given as input to FSK demodulator.

FSK demodulator using PLL 565 circuit helps us to generate FSK signal at ease with minimal components. In PLL 565 the frequency shift is usually accomplished by driving a Voltage Controlled Oscillator with the received binary data signal. Thus the output of this demodulator circuit correspond to the input logic 0 or 1 signals. The working of this PLL takes in such a way that it locks the input signal frequency and tracks it between the two possible frequencies with a DC shift at the output of this PLL IC.The resistor R1 and C1 determine the free-running frequency of the internal VCO of the PLL IC. The VCO comparator output was fed into the phase comparator input to perform the locking operation of signal frequencies. A three stage RC filter was used in the circuit for removing the total sum frequency component from the output signal of the IC. The R1 was selected in such a way to adjust the VCO frequency to equalize the voltages obtained at pin 6 and pin 7.The digitized output will obtain high voltage level if the input frequency is low that is output will be high (14 V) when the input frequency is 1070 HZ. The output will be driven to low state (-5V) if the input frequency was 1,270 HZ. At the end IC 741 is connected to amplify the output signal.

The resulting demodulator output is then given as input to USB port of second PC using USB to TTL connector and received message signal will be automatically displayed on the Hyper Terminal, already opened on the second PC.

USB to TTL Connector

The USB TTL Serial connectors are a range of USB to serial converter which provide connectivity between USB and serial interfaces. Two such connectors are used in the proposed system for serial communication. First connection is between USB port of first PC and input terminal of FSK modulator. Second connection is between output of FSK demodulator and USB port of second PC.

Speaker & Mike arrangement

A speaker of 5W and condenser mike is used in the system for acoustic coupling. Output of FSK Modulator is connected to speaker of 5 W which converts electrical signal into audio signal. This audio signal is received by a condenser mike placed near to speaker. Output of mike which is an electrical signal is given as input to FSK demodulator. Therefore signal transmission between FSK modulator and demodulator takes place in audio form. We can directly connect output of FSK modulator to input of FSK demodulator as shown in fig. 2.

Software Hyper Terminal or TeraTerm

HyperTerminal is a communications program that is included free with Windows 95 and later.It's handy for sending data to serial displays. One can access it by clicking Accessories in Program option on your PC.

Afterwards, a series of dialog boxes will appear. Enter the following settings, select serial communication port as COM1, also for COM1 Properties the Port Settings will be, set baud rate equal to 9600, data bits equal to 8, parity none and stop bits 1.

Now the complete working principle of the proposed system is as follows,

First open the Hyper terminal on first PC. Then type some message on it using a key board of that PC. This Message will be transmitted serially through USB to TTL converter to FSK Modulator circuit. Output of FSK Modulator is connected to speaker of 5 W which converts elctrical signal into audio signal. This audio signal is received by a condensor mike placed near to speaker. Output of MIC which is an electrical signal is given as input to FSK demodulator. Finally the ouput of FSK demodulator is connected to another PC by again using USB to TTL converter and received message signal will be automatically displayed on the Hyper Terminal already opened on the second PC.

Performance Evaluation

The hardware implementation and testing is carried out through three steps
- Breadboard Implementation of FSK modulator and demodulator
- Testing of the breadboard circuit using function generator and CRO
- PCB implementation of the tested circuit

Fig. 3 shows the FSK modulator and demodulator circuit implemented on breadboard. To test the working of this circuit, a function generator is used to apply input to FSK modulator and cathode ray oscilloscope is used to observe the output . For e.g. if a square wave of one frequency from function generator is applied to FSK modulator then same square wave should be recovered back at the output of FSK demodulator to which CRO is connected as shown in Fig. 4.

After testing of circuit on breadboard two separate PCBs are designed for FSK modulator and demodulator
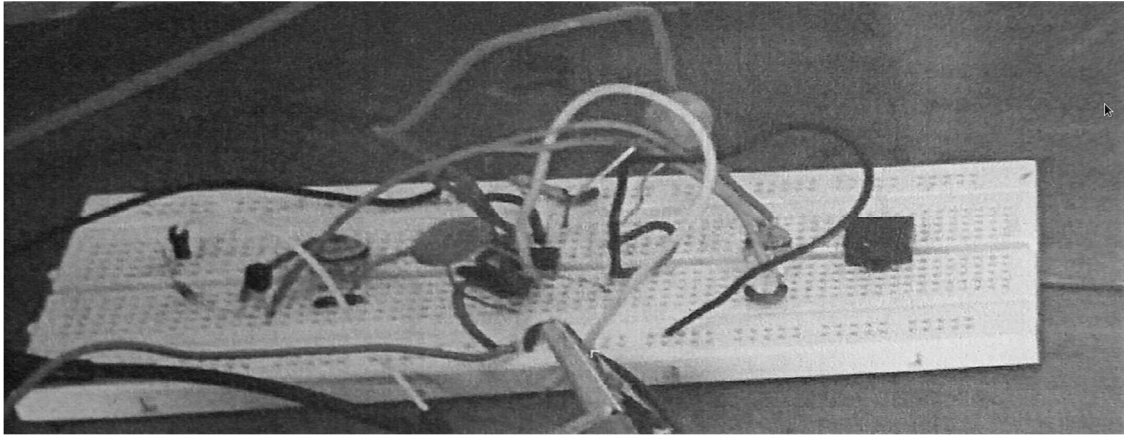
Figure 3. Breadboard Implementation

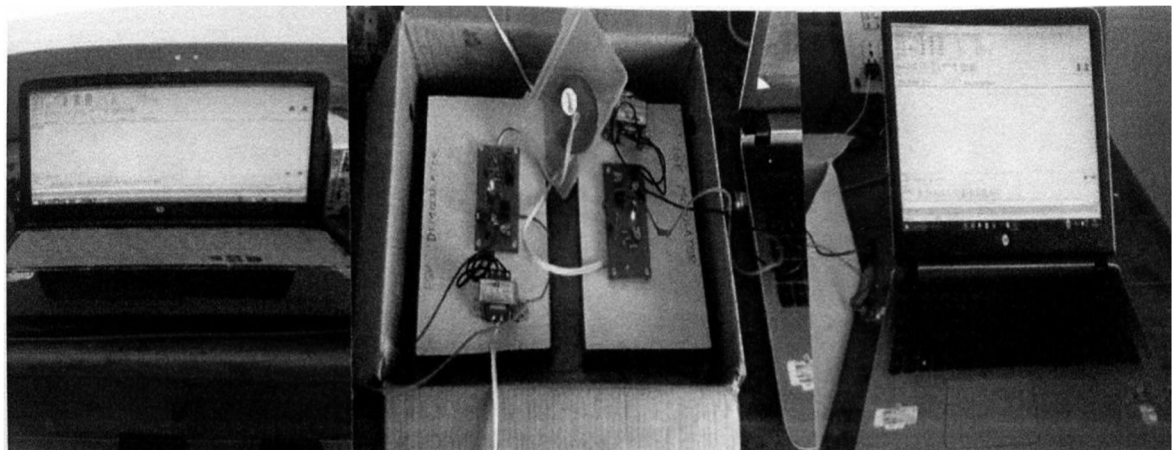Figure 4. Testing set- up using function generator and CRO

Figure 5. Final Experimental set-up

After making hardware connections as explained in the above section one can directly observe the performance by typing a any random message on Hyper Terminal of first PC and at the same instant you can see the same message automatically gets displayed on the Hyper Terminal of second PC as shown in Fig. 5. No time lag is there. Digital data transmission from one PC to another PC takes place directly without any interference. If we increase the distance between speaker and mike

then certainly signal will get affected. For the purpose of sudy of basic technical concepts of interfacing analog ICs and electronic circuits with PCs this experiment has been designed using the existing components in the lab.

Conclusion

In this way communication between two PCS in terms of serial data transfer can be established by using existing set up in the lab. The message displayed on the second PC is exactly same as the message typed on first PC without any error. One can say that data transfer is 100% without any distortion.

 As a future scope the proposed work can be extended by inclusion of   Intercom Telephone connection instead of speaker and mike for acaustic coupling. So by using the Intercom Telephone connection within one institute one can experiment for data transfer between two PCs placed at different rooms.

Acknowledgment

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