“PC TO PC INFRARED COMMUNICATION”

By:

n AMIT YADAV
n GAURAV MENDIRATTA
n KUNAL PATKI
n MANISH SETHI

VI SEM,
ELECTRONICS AND COMMUNICATION,
UNIVERSITY INSTITUTE OF TECHNOLOGY,
BHOPAL.
CONTENTS

- Introduction
- Data Transmission Techniques
- Component Description
- Working
- Parts List
- Circuit Diagram
- PCB Layout
- Bibliography
INTRODUCTION

The term Communication refers to sending, receiving and processing of information by electronic means. Communication started with Wire Telegraphy in the 1840s, developing with telephony some decades later and radio at the beginning of this century. Communication subsequently became even more widely used and refined through the invention and use of transistors, integrated circuits and other semiconductor devices. Thus a comm. System has three basic components

1. Transmitter
2. Channel
3. Receiver

A transmitter is equipment, which converts a physical message into an electrical message. A receiver on the other hand is equipment, which converts the electrical signal back to the physical signal. The electrical signal from transmitter is conveyed to the receiver through the Channel. Telecommunication engg. is divided into the following two categories depending on the Channel used.
1. Line communication   2. Radio communication

This project basically deals with communication between Computers i.e. transferring data between two computers using infrared beam.

COMMUNICATION USING COMPUTERS:

In modern age communication systems, computers are used broadly. The technology development in the software field has given a boost in the communication to
implement complex and diversely featured communication systems. With the information technology jump the communication and computer industries are merged together and resulting advanced technologies, which comprises services of both computers and communication systems.

The most advanced communication technology is computer networking. Computer network is the interconnection of autonomous computers. Autonomous computers are the computers, which have their own hardware and software and don't depend on any other unit for processing works.

On the basis of area covered, computer networks are distinguished in three categories.

1. Local Area Network [LAN]
2. Metropolitan Area Network [MAN]
3. Wide Area Network [WAN]

LOCAL AREA NETWORKS:

Local area networks are privately owned networks with in a single campus of up to a few kilometers in size. They are widely used to connect personal computers and work attains in company offices and factories to share resources and exchange information. They are the simplest form of networks, which often use a transmission technology consisting of a single cable to which all the machines are attached. Traditional speed of LANs is 10-100 Mbps.

METROPOLITAN AREA NETWORKS:

A metropolitan area network is basically a bigger version of LAN and normally used a similar technology. It might cover a group of nearby corporate offices or a city and
might be either private or public. It can support both data and voice. A MAN just has one or two cables and does not contain switches, which shunt packets.

**WIDE AREA NETWORKS:**

A Wide Area Network spans a large geographical area of a country or Continents. It contains a collection of machines intended for running application programs. The most WAN consist of two distinct components: transmission lines and switching elements. Switching elements are specialized computers used to connect two or more transmission lines. The INTERNET comes under this category. Depending on the transmission media the computer networks are categorized in two ways. They are as follows:

1. Solid transmission lines computer networks.


The computer networks, in which the transmission media used is cables, wires or optical fibers, comes in the category of solid transmission line computer network. The attenuation using solid transmission line is more than that of wireless transmission. The systems become expensive due to large no. of repeaters for large distances. The alternative, wireless communication, is cheaper and more efficient as the media is cost free. The new tech communication systems are adopting this technology due to its very advantages. The bandwidth available is infinite and thus giving room for a lot of channels to frequency multiplexed. Less no. of repeaters are required than that of wire communication thus reducing the maintenance cost. Wireless LANs are easy to install as compared to wired networks. On contrary, they require complex electronics circuitry and antennas. They have the capacity of 1-2 Mbps, which is much slower than wired LAN. The error rates are often much higher.
DATA TRANSMISSION

TECHNIQUES

All communication systems are divided into two categories on basis of method of transmission data bits. They are

1. Parallel Transmission
2. Serial Transmission

PARALLEL TRANSMISSION:

In parallel data transmission each bit of message has its own path and the total message is transmitted at the same time. This means that an n-bit message must be transmitted through n separate conductor paths. Parallel transmission is faster but requires many wires. It is used for short distances and where speed is important, if a system has n parallel transmission lines then it will more than n times faster than that of serial transfer.

For example in computers, parallel data transfer scheme is used for fast processing. The deciding feature of speed of any microprocessor is no. of data lines in it and the clock frequency. The data lines are actually parallel conductor's paths, which makes the parallel communication channel in computer architecture.

SERIAL TRANSMISSION:

In serial data transmission each bit in message is sent in sequence one at a time. This method requires use of one pair of conductors or one conductor and a common
Serial transmission is slower but is less expensive since it requires only one pair of conductors. For example, all Public Telephone Networks are used for serial transmission of data as the transmission path length is very from few meters to many kilometers. All computer networks use serial transmission technique as it requires less out system space and is cheap. Although this makes the speed slower but the advantages out weights the disadvantages. In account of load offered by any network, serial transmission is capable of handling the load with bearable failures and sufficient efficiency. Many complex techniques are developed and used to use full capabilities of the single channel. These techniques are called media access techniques and multiple access techniques. The media access techniques are software called protocols, which directs the terminals connected to the network about the channel access. Multiple access techniques are techniques in which a common scale is shared by many terminals.

**TRANSMITTER:**

The operation of the transmission portion of the interface is as follows. The CPU uses the status register and checks the flag to see if the transmitter register is empty. If it is empty, the CPU transfers a character to the transmitter register and the interface clears the flag to mark the register full. The first bit in the transmitter shift register ids set to 0 to generate a start bit. The character is transferred in parallel from the transmitter register to the shift register and the appropriate no. Of stop bits are appended in to the shift register. The transmitter register is then marked empty, the character can now be transmitted one bit at a time by shifting the data in the shift register at the specified bond rate. The CPU can transfer another character to the transmitter register after checking the flag in the status register. The interface is said to be double buffered because a new character can be loaded as soon as the previous one stalls transmission.
RECIEVER:

The operation of the receiver portion of the interface is similar. The receive data input is in the 1 state when the line is idle. The receiver control monitors the received data line for a 0 signal to detect the occurrence of the start bit. Once a start bit has been detected the incoming bits of the characters are shifted in to the shift register at the prescribed bond rate. After receiving the data bits the interface checks for the parity and stop bits. The character without the start and stop bit is then transfer in parallel from the shift register to the receiver register. The flag in the status register is set to indicate that the receiver register is full. The CPU reads the status register and checks the flag and if set it reads the data from the receiver register.

The interface checks for any possible errors during transmission and sets appropriate bits in the status register. The CPU can read the status register at any time to check if any errors have occurred. The three possible errors that the interface checks during transmission are parity error, framing error and overrun error. Parity error occurs if the no. Of 1s in the received data is not the correct parity. A framing error occurred if the right no. Of stop bits is not detected at the end of the received character. An overrun error occurs if the CPU does not read the character from the receiver register before the next one becomes available in the shift register. Overrun error results in loss of characters in the received data stream.

PROTOCOLS:

The communication lines, modems, and other equipment used in the transmission of the information between two or more station is called data link. The orderly transfer of
information in a data link is accomplished by means of a protocol. A Protocol may be a hardware or software. Protocol regulates and controls the flow of data in communication between two systems.

On the basis of work, the computer networks are divided into layers and each layer does a specific work. Tills work is regulated and controlled by the protocol. Obviously, each layer has a separate set of protocols. For example a data link control protocol is set of rules that are followed by interconnecting computers and terminals to ensure orderly transfer of information. The purpose of data link protocol is to establish and terminate a connection between two stations, to identify the sender and receiver to ensure that all message are passed correctly without error, and to handle all control functions involved in sequence of data transfers.

MODEMS:

Computers communicate using digital signals, while for telephone lines the signal should be in analogue form. Modems make it possible for computers to communicate over telephone lines. (The term modem is an abbreviation for modulator-demodulator.) At the sending side, a modem modulates digital signals into analogue signals. These analogue signals are demodulated back into digital signals, by another modem at the receiving end. The speed of a modem is measured in baud rate.
COMPONENT DESCRIPTION

The project “PC to PC Infrared Communication” is a communication-based project with an interfacing circuit facilitating to convert the electrical signals in to infrared radiation with modulating unit. Detailed description of the interfacing unit is presented below based on the interfacing, circuit diagram shown in Figure 2.

The interfacing unit consists of following main parts:

1. 9 pin 'D' connector.
2. Voltage level converter [IC MAX232]
3. Modulator and transmitter [555 timer in Astable Mode]
4. Receiver [Infrared RXR Module]

Details of various parts are as follows

9-PIN ‘D’ CONNECTOR:

The 9 pin ‘D’ connector is used to connect the serial port of the computer (COM 1 port) to the interfacing unit. The pin description of the connector is as shown below.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Dir</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CD</td>
<td>IN</td>
<td>Camel-Detect</td>
</tr>
<tr>
<td>2</td>
<td>RXD</td>
<td>IN</td>
<td>Receive Data</td>
</tr>
<tr>
<td>3</td>
<td>TXD</td>
<td>OUT</td>
<td>Transmit Data</td>
</tr>
<tr>
<td>4</td>
<td>DTR</td>
<td>OUT</td>
<td>Data Terminal Ready</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>------</td>
<td>System Ground</td>
</tr>
<tr>
<td>6</td>
<td>DSR</td>
<td>IN</td>
<td>Data Set Ready</td>
</tr>
<tr>
<td>7</td>
<td>RTS</td>
<td>OUT</td>
<td>Request to Send</td>
</tr>
<tr>
<td>8</td>
<td>CTS</td>
<td>IN</td>
<td>Clear to Send</td>
</tr>
<tr>
<td>9</td>
<td>RI</td>
<td>IN</td>
<td>Ring indicator</td>
</tr>
</tbody>
</table>
Infrared Communication

Connector

25 pin DB25

9 pin DB9

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data Carrier Detect</td>
<td>6</td>
<td>Data Set Ready</td>
</tr>
<tr>
<td>2</td>
<td>Received Data</td>
<td>7</td>
<td>Request to Send</td>
</tr>
<tr>
<td>3</td>
<td>Transmitted Data</td>
<td>8</td>
<td>Clear to Send</td>
</tr>
<tr>
<td>4</td>
<td>Data Terminal Ready</td>
<td>9</td>
<td>Ring Indicator</td>
</tr>
<tr>
<td>5</td>
<td>Signal Ground</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
VOLTAGE LEVEL CONVERTER: (MAX 232A)

For converting the voltage level of serial O/P of computer (TTL/CMOS levels) of 9 V to interfacing circuit compatible levels 0/5 V we have used the IC MAX232 which is a bi-directional voltage converter. The internal description is shown in Figure 3

A MAX232 is a lever converter driver chip basically called a charge pump. The chip requires four capacitors to help it build up 10 volts, so that it can communicate with a PC serial port on the outbound side. On the other side of the chip, you must have a micro-processor or some sort of serial input usually from some kind of logic circuit. The chip is typically powered by a 5vdc regulated supply.
It is a standard serial interface for PC RS232C, and requires negative logic, i.e., logic '1' is -3V to -12V and logic '0' is +3V to +12V. To convert a TTL logic, say, TxD and RxD pins of the uC chips, you need a converter chip. A MAX232 chip has long been used in many micro-controller projects. It is NOT a stand alone device. Normally it mounts in a 14-pin dip socket or is soldered straight to a circuit board. It provides 2-channel RS232C port levels and requires external 10uF capacitors. A DS275 chip, however, has no need external capacitors and is smaller. The table for conversion levels is shown below.

MAX232 CONVERSION LEVELS

<table>
<thead>
<tr>
<th>TTL / CMOS VOLTAGE LEVEL</th>
<th>RS232 COMPATIBLE VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5 V</td>
<td>-9 V</td>
</tr>
<tr>
<td>0 V</td>
<td>+9 V</td>
</tr>
</tbody>
</table>

The MAX232 have two internal charge-pumps that convert +5V to +/-10V (unloaded) for RS-232 driver operation. The first converter uses capacitor C1 to double the +5V input to +10V on C3 at the V+ output. The second converter uses capacitor C2 U invert +10V to -10V on C4 at the V- output.
Internal circuitry of IC MAX 232
MODULATOR AND TRANSMITTER (555 timer):

The modulator used in the circuit is an astable multivibrator using 555 TIMER. The duty cycle is set to 25% and it generates square waves of 38 kHz, which modulates the signal to be transmitted. The NE555 silicon monolithic timing circuit is a highly stable controller capable of producing accurate time delays, or oscillation. In the time delays, mode of operation, one external resistor and capacitor precisely control the time. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output structure can source or sink up to 200 mA. The block diagram and pin diagram of 555 TIMER is shown in figure.

Figure: The 555 internal circuit
The 555 circuit is consisted by two comparators, one ohmic ladder one flip-flop and a discharging transistor, as it is shown in figure.

![Image of 555 circuit](image)

**Figure:** The 555 modes of operation a) monostable b) astable (multivibrator).

If the circuit is connected as an astable multivibrator (figure b), the comparator 2 of figure sets the flip-flop, when the voltage on the capacitor $Ct$ falls below $1/3Vcc$, while the comparator 1 resets the flip-flop when the voltage on the capacitor becomes bigger than $2/3Vcc$. In this case the discharging transistor is turned on, which discharge the time capacitor $Ct$ via $Rb$.

This allows the use of the 555 as an oscillator (figure b) The time at the high (or charging) period is given by the equation:

$$Th=0.7(Ra+Rb)Ct$$
While the time for the low period is given by the equation:

\[ T_l = 0.7 R_b * C_t \]

The obvious observation from the above equations is that the duty cycle of the oscillator is always bigger than 50%. Or in other words the charging time is always bigger that the discharging period, since \( Ra + R_b > R_b \) taken in account that \( Ra > 0 \). Yet if \( Ra >> R_b \) then a 50% duty cycle can be approximated.

**RECEIVER (IR RXR MODULE):**

To receiver the infrared signals we have used IR RXR Module, which senses the infrared signals and generates corresponding voltages. The description is as follows.

**Description**

The TSOP17xx - Series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame; the epoxy package is designed as IR filter. The demodulated output signal can directly be decoded by a microprocessor. The main benefit is the reliable function even in disturbed ambient and the protection against uncontrolled output pulses.

The module used has active low output with following pin description.

<table>
<thead>
<tr>
<th>PIN</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ground</td>
</tr>
<tr>
<td>2.</td>
<td>Supply (-5 V)</td>
</tr>
<tr>
<td>3.</td>
<td>Output (Active Low)</td>
</tr>
</tbody>
</table>
IR – RXR MODULE (TSOP-1738)

Block Diagram
WORKING

Working of RS-232:

The RS232 signals are represented by voltage levels with respect to a system common (power / logic ground). The "idle" state (MARK) has the signal level negative with respect to common, and the "active" state (SPACE) has the signal level positive with respect to common. RS232 has numerous handshaking lines (primarily used with modems), and also specifies a communications protocol.

The RS-232 interface presupposes a common ground between the DTE and DCE. This is a reasonable assumption when a short cable connects the DTE to the DCE, but with longer lines and connections between devices that may be on different electrical busses with different grounds, this may not be true.

RS232 data is bi-polar.... +3 TO +12 volts indicates an "ON or 0-state (SPACE) condition" while a –3 to -12 volts indicates an "OFF" 1-state (MARK) condition.... Modern computer equipment ignores the negative level and accepts a zero voltage level as the "OFF" state. In fact, the "ON" state may be achieved with lesser positive potential. This means circuits powered by 5V DC are capable of driving RS232 circuits directly, however, the overall range that the RS232 signal may be transmitted/received may be dramatically reduced.

The output signal level usually swings between +12V and -12V. The "dead area" between +3V and -3V is designed to absorb line noise. In the various RS-232-like definitions this dead area may vary

An RS-232 port can supply only limited power to another device. The number of output lines, the type of interface driver IC, and the state of the output lines are important considerations.

The types of driver ICs used in serial ports can be divided into three general categories:
• Drivers which require plus (+) and minus (-) voltage power supplies such as the 1488 series of interface integrated circuits. (Most desktop and tower PCs use this type of driver.)

• Low power drivers which require one +5 volt power supply. This type of driver has an internal charge pump for voltage conversion. (Many industrial microprocessor controls use this type of driver.)

• Low voltage (3.3 v) and low power drivers which meet the EIA-562 Standard. (Used on notebooks and laptops.)

Data is transmitted and received on pins 2 and 3 respectively. Data Set Ready (DSR) is an indication from the Data Set (i.e., the modem or DSU/CSU) that it is on. Similarly, DTR indicates to the Data Set that the DTE is on. Data Carrier Detect (DCD) indicates that a good carrier is being received from the remote modem.

Pins 4 RTS (Request To Send - from the transmitting computer) and 5 CTS (Clear To Send - from the Data set) are used to control. In most Asynchronous situations, RTS and CTS are constantly on throughout the communication session. However where the DTE is connected to a multipoint line, RTS is used to turn carrier on the modem on and off. On a multipoint line, it's imperative that only one station is transmitting at a time (because they share the return phone pair). When a station wants to transmit, it raises RTS. The modem turns on carrier, typically waits a few milliseconds for carrier to stabilize, and then raises CTS. The DTE transmits when it sees CTS up. When the station has finished its transmission, it drops RTS and the modem drops CTS and carrier together.

Clock signals (pins 15, 17, & 24) are only used for synchronous communications. The modem or DSU extracts the clock from the data stream and provides a steady clock signal to the DTE. Note that the transmit and receive clock signals do not have to be the same, or even at the same baud rate.

Note: Transmit and receive leads (2 or 3) can be reversed depending on the use of the equipment - DCE Data Communications Equipment or a DTE Data Terminal Equipment.
HARDWARE SECTION

This section comprises of all hardware parts as dealt in circuit description. All other parts are as follows.

a. Transmitter:

Data singles transmitted through pin 3 of 9 pin 'D' connector of RS 232 COM I port are sent to pin 8 of MAX 232 and it converts these EIA (Electronics Industry Association) RS232 compatible levels of 9 volts to 0/5 TTL levels as given in table 1. The output pin of MAX 232 TC (pin no. 9) drives the BC547 npn transistor and powers the base of transistor. Now, depending on the input at pin 8 of IC MAX232, the transistor goes in active region or in cutoff. Let us take this one by one.

1. With input at pin 8 is +9V:-

   The output at pin 9 of MAX232 will be 0 V and thus the transistor T1 will be in cutoff. This supply voltage (+5 V) will thus appear on collector of transistor T1 and the 555 TIMER will reset as collector is connected to pin 4 of 555 TIMER (reset pin). This output thus goes to logic I at pin 3 of 555 timer and IR LEDs will glow.

2. With input at pin 8 is -9 V:-

   The output in this case on pin 9 of MAX232 will be +5 volts thus driving the transistor T1 in active region. The voltage at pin 4 of 555 TIMER will goes to zero and output at pin 3 of 555 timer goes low thus the LEDs will not glow. The electrical pulses send by the COM port are now converted in to corresponding modulated pulses of IR light.

   The astable multivibrator is set to generate square wave of 38 kHz as the IR module used in the circuit is tuned to 38 kHz. The range of 38 kHz is widely used in practical purposes as most Television remote controls operates on this frequency thus providing extra tool for testing.

b. Receiver:

A visible LED I at pin 7 of Max 232 IC indicates that the signals are being received. Pin is also connected to pin 2 (receiving pin) of 9-pin (or pin 3 of 25 pin) ‘D’ connector used for the serial port in the PC so that the data may be read. The optical signals received by the IR Module...
are in fact converted to the electrical pulses and both PCs 'think" that there is a null modem cable connected between them. in some PCs the serial port is terminated it to a 9 pin 'D' connector and in some others in to a 25 pin 'D' connector.

The module used works in active low and thus when receives TR radiation gives output low. With low logic at base of transistor T2 the emitter of it will be at low voltage level voltage and then the received low voltage signal is converted in to +9 voltage level by IC232.

When there is no IR radiation on the module .it gives high output. With high logic at base of transistor T2 the emitter of it will be at high voltage level and then the received high voltage signal is converted in to -9 voltage level by IC232.

Various voltages are discussed in the troubleshooting section.

SOFTWARE SECTION

We have used “TELIX FOR WINDOWS” as our software. We have also experimented it with other softwares made in C++ and Visual Basic. But TELIX has many advanced operations so we preferred it.

<table>
<thead>
<tr>
<th>Baud Rate</th>
<th>Parity</th>
<th>Bits / Character</th>
<th>Stop Bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td>None</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>2400</td>
<td>None</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>4800</td>
<td>None</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>
## PARTS LIST

### Semiconductors:
- **IC1**: MAX232A +5V powered multichannel RS232 driver / receiver.
- **IC2**: NE 555 Timer
- **IC3**: IR – RXR Module; Telefunken TSOP-1738
- **T1**: BC 547 NPN Transistor.
- **T2**: BC 548 NPN Transistor.
- **D1**: 1N 4148 Diode.
- **LED1-3**: Red LEDs.
- **IRLED 1,2**: Infrared Light Emitting Diode

### Resistors (All 0.25 Watts +/- 5% Carbon):
- **R1, R2**: 47 ohm
- **R3, R4**: 4.7 kilo ohm
- **R5, R9**: 1.0 kilo ohm
- **R6**: 1.2 kilo ohm
- **R7**: 10 ohm
- **R8**: 330 ohm
- **R10**: 2.2 kilo ohm
- **R11**: 10 kilo ohm
- **VR1**: 4.7 kilo ohm preset

### Capacitors:
- **C1-C5**: 1 micro farads, 25 V Electrolytic
- **C6**: 470 micro farads, 25 V Electrolytic
- **C7,C8**: 0.01 micro farads, Ceramic disk.
CIRCUIT DIAGRAM FOR PC TO PC COMMUNICATION

USING 38KHz MODULATED PULSES
Single - Sided PCB layout for the circuit.
BIBLIOGRAPHY

- K.R BOTKAR, INTEGRATED CIRCUITS, NINTH EDITION.
- RAMAKANT A. GAYAKWAD, OP-AMPS AND LINEAQR INTEGRATED CIRCUITS, THIRD EDITION.
- R.P SINGH AND S.D SAPRE, COMMUNICATION SYSTEMS ANALOG AND DIGITAL, FIRST EDITION.
- ELECTRONICS FOR YOU, MAGAZINE, NOV 2000 ISSUE.
- ELECTOR ELECTRONICS, MARCH-APRIL 2000 ISSUE.
- COMMUNICATION SYSTEMS BY SIMON HAYKENS, SECOND EDITION.
- PRINCIPLES OF COMMUNICATION SYSTEMS BY HERBERT TAUB AND DONALD L. SCHILLING, SECOND EDITION.
- http://www.electronicsforu.com
- http://www.ee.ed.ac.uk/~kap/555