Data Transmission Using Laser Light

Amit Agrawal*, Gaurav kumar, Maheshwari narayan singh, Pradeep kumar, Pransu mathur
Galgotias College of Engineering and Technology, Greater Noida, India
amit.stm@gmail.com

Abstract
The paper addresses a microcontroller based communication system using laser light to transmit data. The microcontroller is interfaced with PC for the purpose of giving input parameters such as audio, text and video to transmit with the help of laser medium. In this analysis we found that the data transmission using laser light is superior in many respects to the conventional communication system. Laser light has higher intensity, efficiency, as well as better visibility and performance quality .It provides a much simpler communication system and reducing the complex wiring.

Keywords: microcontroller, laser, photo diode, DTMF, inverting buffer.

I. Introduction

For years, laser light has been merely a system for piping light around corners and into the inaccessible places to allow the hidden to be lighted. But now, laser light has evolved into a system of significantly greater importance and use. Throughout the world, it is now being used to transmit voice, television and data signals as light waves. Its advantages as compared with conventional coaxial cable or twisted wire pairs are manifold. As a result, millions of dollars are being spent to put these light wave communication systems into operation.

Interest in fiber as a medium began in 1966 when C. Kao and G.A. Hock ham at Standard Telecommunications Laboratory predicated that by removing the impurities in the glass, 20 dB/km attenuations would be achievable. One of the most interesting developments in recent years in the field of telecommunication is the use of laser light to carry information over large distances. It has been proved in the past decade that light wave transmission through laser light is superior than transmission through other lights. Typically, laser light has a much lower transmission loss per unit length (0.15-5db/km) and is not susceptible to electromagnetic interference. Economically also, it serves our purpose. The ever increasing cost and the lack of space available in the congested metropolitan cities asks for advent of a less costly system.
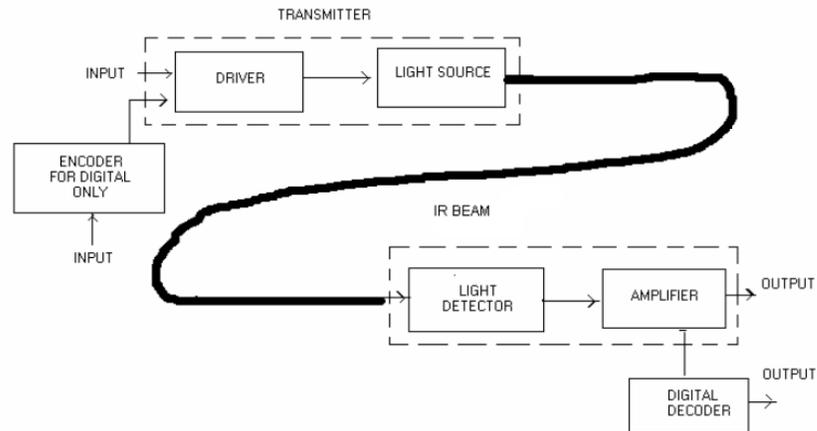
III. Proposed model

Figure1: Data Transmission

IV. Used components

Transmitter: It consists of keypad, microphone, some transistors and an op-amp with attached laser light to transmit the amplified signals.
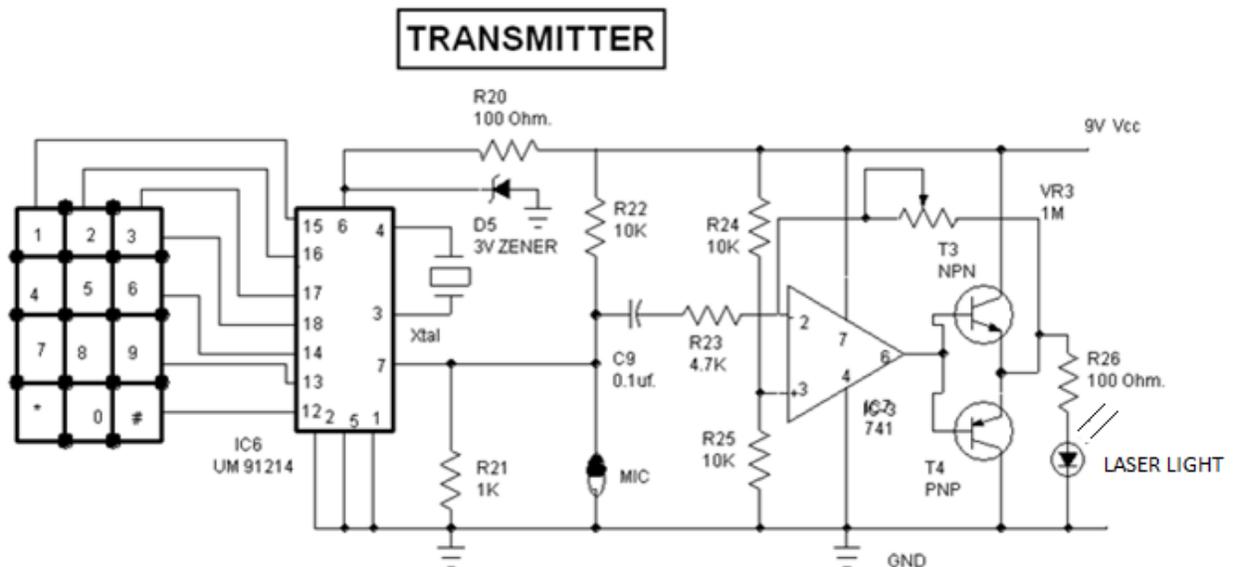

Figure2: Circuit Diagram of Transmitter

Receiver: It is having microcontroller AT89c52 as the main part and there is a DTMF Decoder to convert light signal into corresponding frequencies. And it is also having LCD and speaker for getting output.
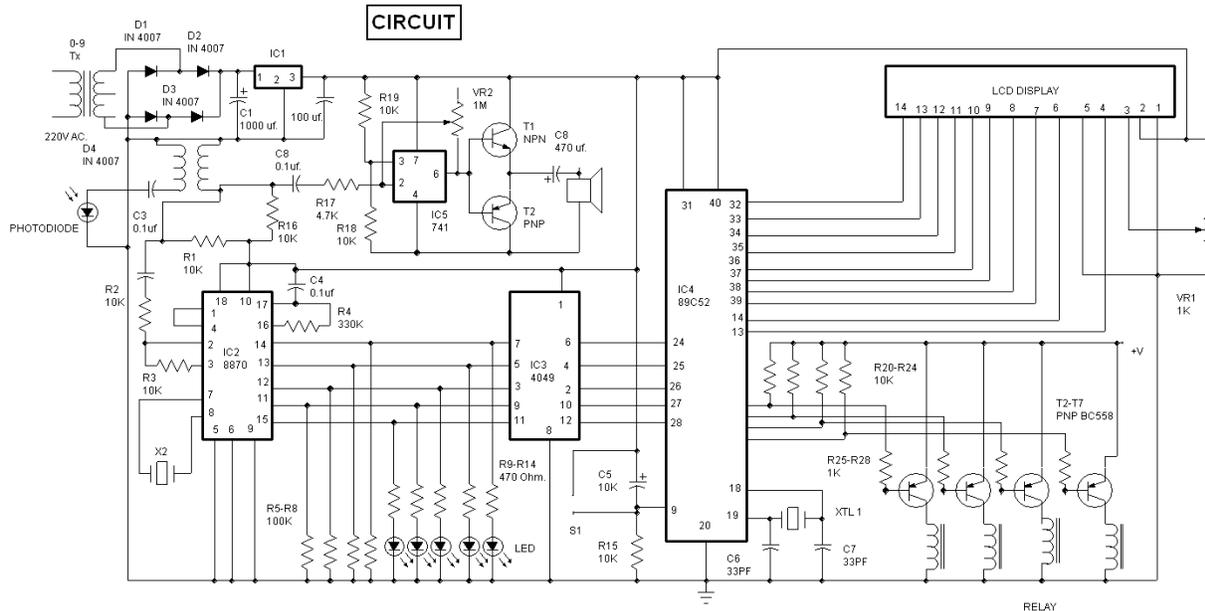

Figure3: Circuit diagram of receiver

Power Supply: It favors regulated voltage and 7805 Regulator IC is most suitable here.
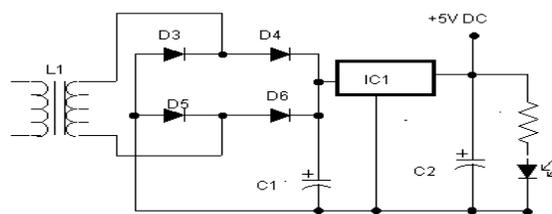

Figure4: Circuit diagram of power supply

Resistor: Fixed and variable resistor both are used here. Fixed resistors are generally 1k, 10k and 470ohm value and variable resistors are of 1Mohm value.

Photodiode: It is used to receive the laser light signal and also convert the received signal into electrical equivalent.

DTMF Decoder: It decodes the DTMF signal into BCD numbers.

Microcontroller chip: It is thee processing unit of whole prototype.

LCD and Speaker: it is used to get the desired output.

Inverting Buffer: When used in the input section, it acts as a isolator between the controller and the rest of the circuits. When used in the output, it increases the current drive capability.

DTMF: when you press a button in the telephone set keypad, a connection is made that generates a resultant signal of two tones at the same time. These two tones are taken from a row frequency and a column frequency. The resultant frequency signal is called "Dual Tone Multiple Frequency". These tones are identical and unique. A DTMF signal is the algebraic sum of two different audio frequencies, and can be expressed as follows:

$$f(t) = A_0 sin(2*\Pi*f_a*t) + B_0 sin(2*\Pi*f_b*t)$$

V. Operation of circuit

The receiver end comprises input, decoder, speaker, photodiode and display sections. The input section consists of a DTMF decoder, 89c52 microcontroller. For the decoder section, the underlying concept is DTMF signal reception and decoding the signal to BCD format through DTMF decoder 8870. The display section consists of a microcontroller and the LCD. The
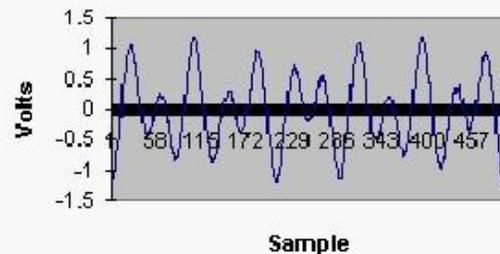

Figure5: Corresponding frequencies

Microcontroller processes the decoded signal and outputs it for display on the LCD in the form of text message.

Once the connection is established between the two receivers and transmitter, whatever key is typed at the transmitting end, the corresponding DTMF tone is heard in the earpiece of the receiver. The earpiece is connected to a microphone and the microphone picks up the DTMF tone. Its output is fed to the DTMF decoder. The DTMF decoder would give the corresponding BCD value of the tone. As shown in the circuit, LED5 acts as visual indicator when the valid signal is received

by the system. The tone output is fed to an inverter buffer. The output of the inverter buffer is fed to port 2 of the microcontroller. The microcontroller connected to the LCD through port 0 and read port 2. After processing the data, it sends the output data through port 0 to the LCD and the message is displayed in the LCD. No separate driver is used for the LCD, it is driven directly by the microcontroller. The microcontroller requires regulated 5V DC supply. Reset pin 9 of the controller is connected to 5V through reset switch S1. You can press reset switch two-three times for proper display of characters on the LCD.

VI. Message decoding algorithm and soft computing

According to our algorithm, the cursor will initially point to the first location in the LCD when power in the circuit is switched on. Just press a key from the phone at the transmitter end. The symbol corresponding to the button pressed will be shown on the LCD at the receiver end. For instance, if you press'2' on the phone, characters 'abc2' will be displayed. Now to display character 'a' press button '1' on the phone. (The old display of 'abc2'will be cleared automatically, except character 'a'.) For 'b' press button 2, for 'c' press button 3 and for character '2' press button 4. (Pressing button 5 will not have any effect on the display, which is shown by '__' dash line in Table III).

Example: To send message 'efy3' we have to follow below steps;

Step 1: Press button 3 followed by button 2 to display 'e'

Step 2: Press button 3 twice to display 'f'

Step 3: Press button 9 followed by button 3 to display 'y'

Step 4: Press button 3 followed by button 4 to display '3'.

The mas.asm program is written in Assembly language and compiled using keil cross-compiler. The compiler generates msg.lst and msg.hex files. The hexadecimal code is used and burned into the microcontroller chip. Programming can be done using any AT89C51 compatible programmer board and software. We have used the Top View programmer from frontline to burn the chip. For displaying each character or characters, the code has been written as per the algorithm explained above, which is pretty self-explanatory. Microcontroller processes according to code and then displays the result on the LCD.

A part of code for this algorithm in C language is mention below.

```
import processing.serial.*;
int p=0;
boolean flag=false;
int y, s=0, t=0;
Serial rxPort;
void setup() {
            size(200, 300);
            background(170, 255, 255);
            rxPort=new        Serial(this,
"COM3", 300);
```

```
            rxPort.clear();
        }
 void draw() {
            byte b[] = new byte[0];
            int sum=0;
            while        (rxPort.available
()>0||t<9) {

     y=rxPort.read()-48;

     if (y==1)       {
                t++;
            }
     else if (y==0) {
     // print(t);
                t=0;
            }
        }
            println("xuctolvho");
            while        (rxPort.available
()>0||t==9) {
     y=rxPort.read()-48;
     if (y==1) {
            flag=true;
                break;
            }
            else if (y==0) {

            int k=0, c=128;
            sum=0;
            while (k<8) {
                y=rxPort.read()-48;
                if (y==0||y==1) {
     sum=sum+(y*c);
                c=c/2;
                ++k;
            }

                }

            // print((char)sum);
     // println(sum);
            byte kk=(byte)sum;
            print(kk +" ");
```

```
            b=append(b, kk);
        }
    }
     if (t==9) {
                t=0;
            }
            saveBytes("data.rar", b);
            println("x");
        }
```

VII. Result and discussion

High transmission security, quick link setup, high bit rate and low bit error rate are main advantages using laser light over RF communication and fiber optics. Also we can send text files by speed of 9600 bits per second. Metropolitan area network is using this model widely now. We can go to Automatic Alignment System in future using this meathod.

VIII. Conclusion

Laser transceiver, the device for wireless transfer of data has been developed. Laser beam technology has increased the distance of RS-232 interface from approx. 10 m up to 500 m, so monitoring equipment can be placed at a significant distance and without wiring to computer. Data channel is resistant to electromagnetic and radio noise and it does not interfere with other equipment. This technology requires no FCC licensing. This low cost device is capable of 115.2 kbps speed and distance of 500 m and is ideal for applications where round the clock monitoring is necessary.

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