Dual Tone Laser Driver

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Abstract— The aim of this paper is to present an approach empowering the user, by making available an open system of solving real world data acquisition problems at very low cost. The microcontroller is interfaced for the purpose of accepting input parameters such as audio and text to transmit with the help of laser medium. The data transmission using laser light is superior to the conventional communication system. It consists of low power amplifier, voltage regulator, relay driver, photodiode, DTMF transmitter and a receiver and a serial data transceiver. The DTMF transmitter and receiver pair is used to transfer the data from the transmitter side to the receiver side. It provides an easy communication system reducing the complexity. This paper though limited to theoretical discussion, aims to create a new communication system with more emphasis on user opinion.

Key words: Microcontroller, Laser, Photodiode, DTMF, Relay Driver

I. INTRODUCTION

Laser light has been merelya system for moving light inside corners and in the unreachable location to allow the hidden surface to get lightened up. But laser light has now evolved into a system of greater importance with its unique structure. The advantages of laser light are much great compared to coaxial cable and twisted wire pairs. For this purpose millions of dollars are utilized to put these light wave communication systems into operation.

The project is based on wireless communication and laser is one of the emerging areas of wireless communication system. The basic idea behind laser transceiver is to empower the user by making available an open system of solving real world data acquisition problems at very low cost. The circuit is used to transmit data like audio signals and text with the help of laser. Laser requires line of sight conditions for transmission. For data (text) communication, keypad is used to give the input parameters. The keypad works on DTMF (Dual tone multiple frequency)principle. For voice communication, microphone is used to give the input signal. Loudspeaker is used for the voice output on the receiver side. Interest in fiber as a medium began in1966 when C. Kao and G.A. Hock hamat Standard Telecommunications 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. 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.

II. BASIC MODEL

A. Basic Voice Communication Block

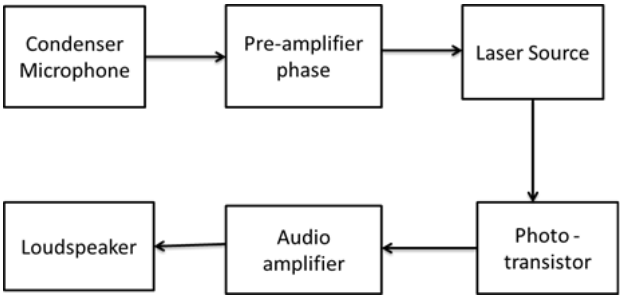

Fig. 1: Block Diagram

B. Basic Data Communication Block

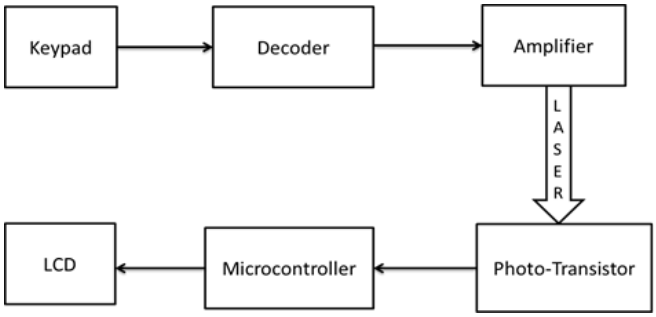

Fig. 2: Block Diagram

III. USED COMPONENTS

A. Transmitter

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

B. Receiver

It is having microcontroller as the secondary 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.

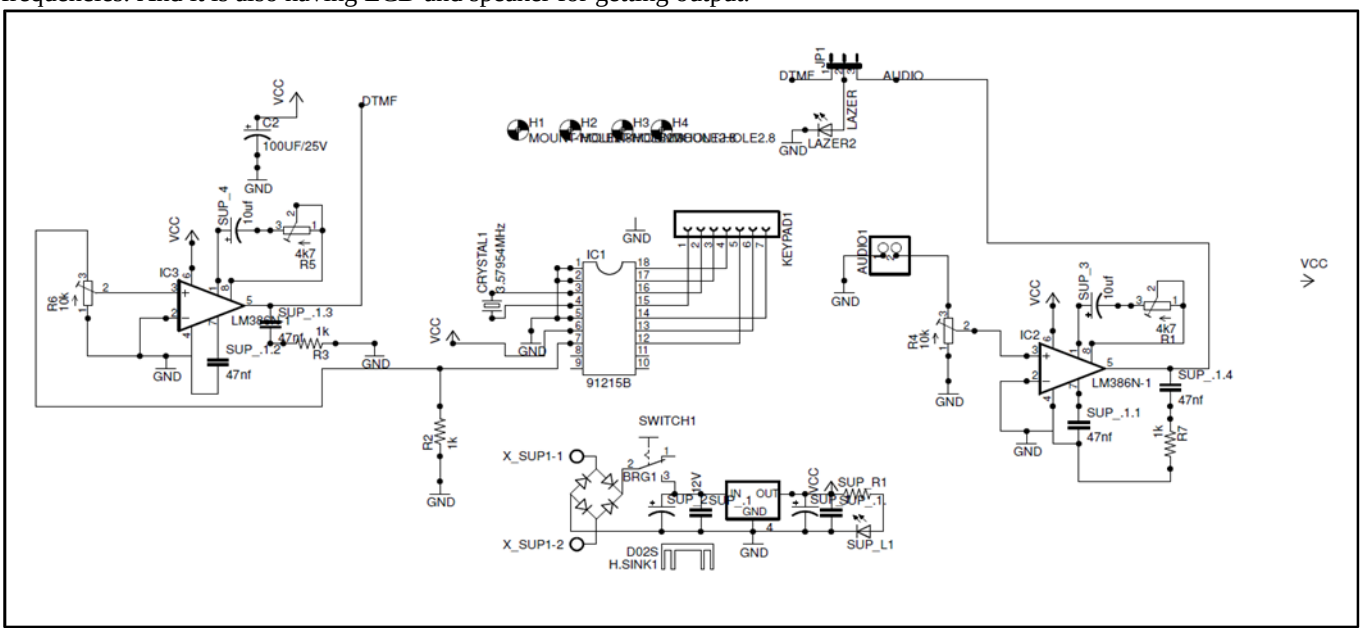

Fig. 3: Circuit Diagram of Transmitter

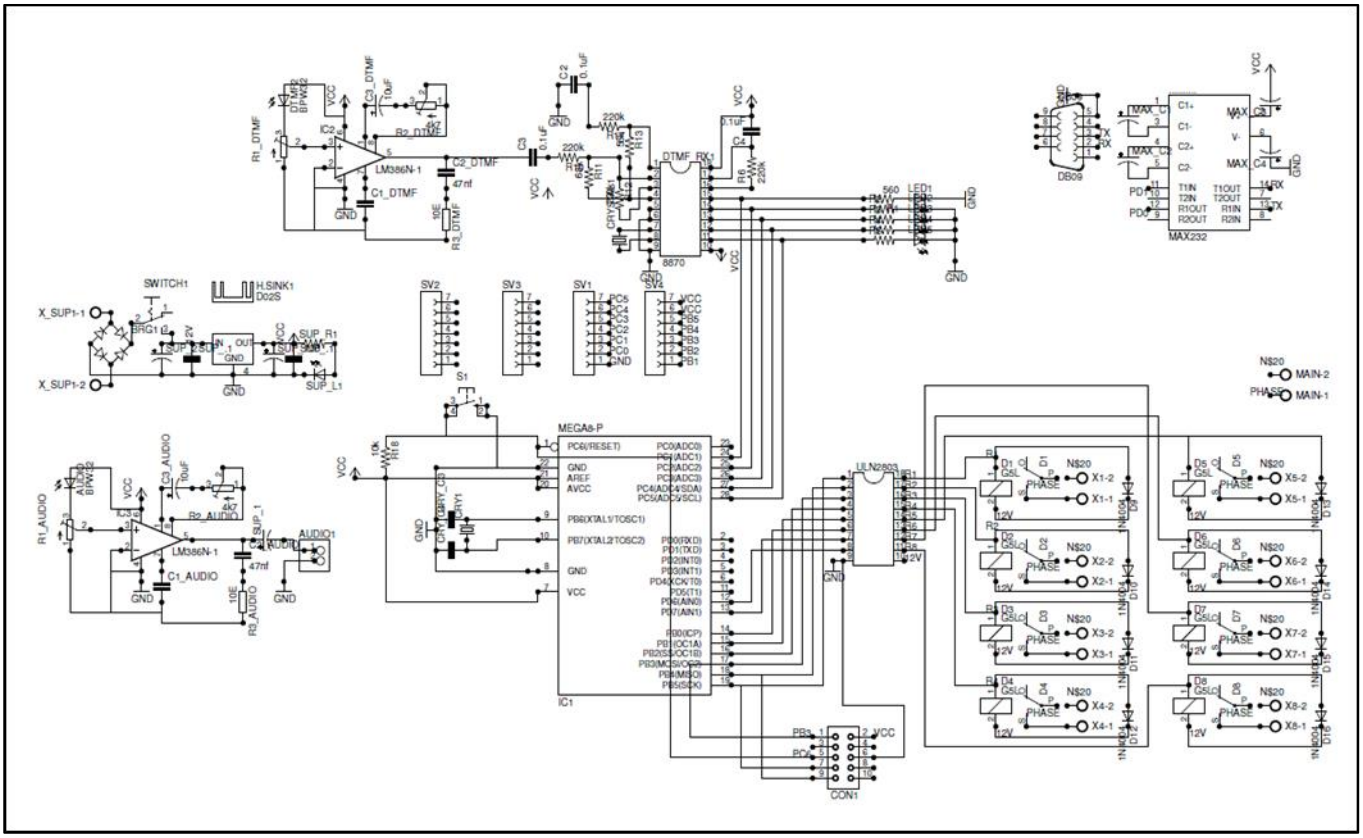

Fig. 4: Circuit Diagram of Receiver

C. Power Supply

Circuit requires regulated voltage and 7805 Regulator IC is most suitable here.

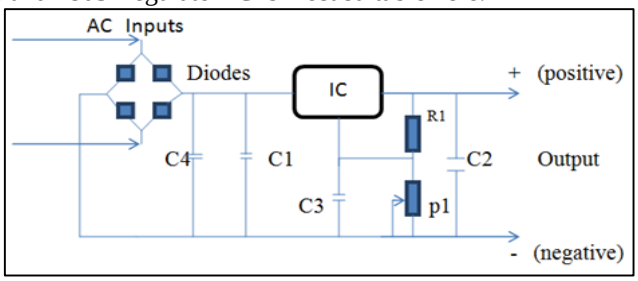

Fig. 5: Circuit Diagram of Power Supply

D. 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. The values can be changed according to our requirement.

E. Photodiode

Used to receive the laser light signal and also convert the received signal into electrical equivalent.

F. DTMF Decoder

It decodes the DTMF signal into BCD numbers.

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.

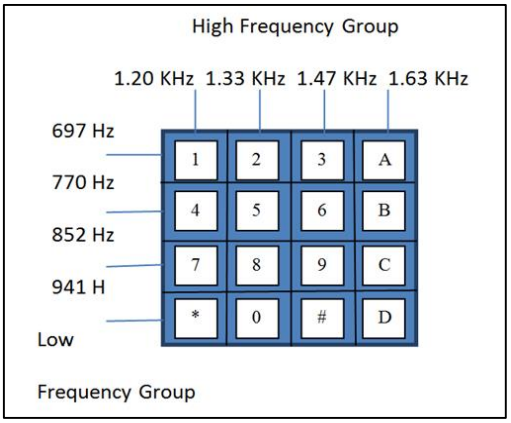

Fig. 6: Corresponding Frequencies

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:

$$f(t) = A0\sin(2*\Pi*fa*t) + B0\sin(2*\Pi*fb*t)$$

G. LCD and Speaker

They are used to get the desired output.

H. Laser Source

Laser is required to transmit the data and audio to the receiver side.

IV. OPERATION OF CIRCUIT

A. Transmitter

It consists of LASER, Lm 386 audio amplifier, DTMF encoder UM91215B, regulated power supply using 7805 and audio – data selection switch. LASER used is a 5V DC.

Laser is driven using the modulated signal by the audio amplifier. LM 386 is a high gain audio amplifier, which amplifies low magnitude input variation received from the audio source, using 3.5mm standard jack. This amplified signal is fed to LASER via mode selection switch.

Gain – bandwidth product is always constant. Increasing the gain higher will decrease the bandwidth. Bandwidth of audio signal is 20Hz to 20KHz. Potentiometer is provided to set the gain so the trade-off can be matched for appropriate audio source.

Data transfer is achieved using DTMF tones. Keypad interfaced to the DTMF encoder acts as an input for data. As the key is pressed particular rows and columns get shorted, which is sensed by the encoder and generates DTMF tone at the output. This tone again is amplified using LM 386 and fed to LASER via mode selection switch.

LASER light resulted consists of variation with respect to input signal. This light modulation carries information which is transmitted at receiver side.

B. Receiver

Receiver section decodes the light variation and converts back to original form.

Photo diode BPW 34 is used to sense light variation. BPW 34 has a very small response time in nano seconds, which suits the best for the proposed application. Signal received by photo diode is amplified using LM386 amplifier whose gain can be fixed using a potentiometer. Audio amplifier amplifies the signal and feds to 4ohm speaker for playing.

Data received from photo diode is fed to the DTFM decoder after one stage of amplification, when the receiver is configured in data mode. DTMF decoder 8870 reads the input signal and converts it into respective binary code. This binary code is read by the microcontroller using GPIO pins, and based on the code received microcontroller operates particular devices. Relays are used as a switching circuit for controlling AC loads.

ULN 2803 is an 8 channel sinking amplifier which controls the power fed to the relay coils. This driver IC gets the input from microcontroller ATMEGA 328.

Regulated power supply is designed using a 7805 voltage regulator, bridge rectifier DB 104, filtering capacitors and a 0-12V step down transformer.

V. RESULT AND DISCUSSION

Better transmission efficiency, low power consumption, high bit rate and low bit error rate are main advantages using laser light over RF communication and fiberoptics. Also we can transmit text files over speed of 10000 bits per second. This model widely used at Metropolitan area network. We can go to Automatic Alignment System in future using this method increasing further scope for development.

VI. CONCLUSION

The project will build a data transmission system, which would transmit both audio signals and the data through the DTMF keypad, attached to the microprocessor, which in turn helps drive the load attached, so that the correct working of the system can be verified. Wireless laser transmission system will be used, which reduces the losses occurring in the existing transmission systems. The emphasis of the project is to study various wireless technologies that are used for data communication between two microcontroller controlled devices. The project is completely based on wireless communication system. Although, wireless communication predominantly means the use of radio frequency for communication, we will be exploring the use of light based carriers for transfer of information.

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