International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 04 | Apr -2017 www.irjet.net p-ISSN: 2395-0072

Transmission of Audio, DTMF and Serial Data Using LASER

Varchas Srinivas[1], Ritesh Agarwal[2], Shashank Shinde[3], Mr. N. S. Kulkarni[4]

[1, 2, 3] *Students, Dept. of Electronics & Telecommunication, SITS, Narhe, Pune, Maharashtra, India*
[4]*Asst. Professor, Dept. of Electronics & Telecommunication, SITS, Narhe, Pune, Maharashtra, India*

---***---

Abstract - *The paper addresses a technology that can be used for wireless line-of-sight communication. Generally RF signals are used to communicate between two stations but here we use LASER as the communicating medium. A LASER torch can transmit light waves from a few meters up to several kilometers. The project involves two modules - the first one is for audio and DTMF data transmission and the second one is for PC-to-PC communication. The first module can be used to send data from a 4x4 keypad in DTMF format via LASER to a receiver where it will be decoded. This module can also be used to send audio data by modulating a LASER beam. The second module involves a transceiver circuit which can be connected to the DB-9 port of two PC's which can then communicate with each other serially.*

Key Words: *LASER, communication, FSO, wireless*

1. INTRODUCTION

Since the time of inception, LASER has only been a system for funnelling light into places that are difficult to reach and to shed light on what cannot be seen. However, in today's world of science and technology, it has evolved into a phenomenon of significantly higher importance and use, despite the existence of various other modes of communication. Throughout the world, it is now being used to transmit all types of encoded data such as text, audio or video. When compared with conventional coaxial cable or twisted wire pairs LASERS offer lots of advantages [1]. As a result, huge sums of money are being spent everywhere to put light wave communication systems into operation.

LASER as a communication medium is a considerably decent substitute for present day communication systems. The problem of interference which plagues a system operating using electromagnetic waves ceases to exist with a LASER-based communication system. The future holds a lot of promise for the use of LASER in communication systems due to multiple advantages such as higher speeds, no prerequisite licenses or permits, and no requirements for bridges or routers. Also, as the wavelength LASERs fall outside the scope of spectrum analyzers and RF meters and hence can be used for wide range of applications. Besides these, there are no recurring line costs or issues related to portability, even though range is constrained to a few hundred meters. Communicating via LASER ensures a high level of security due to the narrow beam-like nature of the light emitted which makes sure that any potential eavesdropping will result in an interruption and thus will be clearly noticed, and immediate remedial measures can be taken. LASERs can also transmit through glass, depending on the transparency, refractive index and other properties of the glass. LASER transmitter and receiver units offer simple and stable systems with service free operation in the long term. Especially in inaccessible environments, wireless optical systems offer an economical alternative to expensive wired forms of communication. LASER can also be used in satellites, or to communicate with satellites. Furthermore, radars built using LASER can be utilized for a very precise or small range of measurement. It is for these reasons, that they can be used as a viable and efficient alternative to present modes of wired or wireless communication.

2. VISIBLE LIGHT COMMUNICATION

Visible light communication (VLC) is a communication technology in which a visible light source is used as a signal transmitter. The air is used as the transmission medium, and the signal is received using a photodiode or a phototransistor. Visible light is considered a better medium for communication than standard wireless systems. Visible light's frequency spectrum bandwidth (430 THz - 750 THz) is much larger than the radio frequency bandwidth(3 KHz - 300 GHz), and this proves to be advantageous as more users can be accommodated and higher transfer rates can be achieved, as each user can use a larger portion of the bandwidth to transfer information. Sheer abundance of light sources is one of the other main advantages. Light sources are present everywhere, and using them for communication in addition to lighting adds to their functionality and makes them more efficient. Most commercial or corporate buildings, restaurants etc. have lights on throughout the day or at least for the duration of hours of operation either way. Using such sources for the purpose of data transmission can change the way we look at communication [2].

3. LASER

The main property of LASERs which differentiate them from other light sources is their spatial coherence, due to which LASER beams are typically narrow and diffraction-limited. LASERs can have very low divergence in order to concentrate their power to a small area even at a great

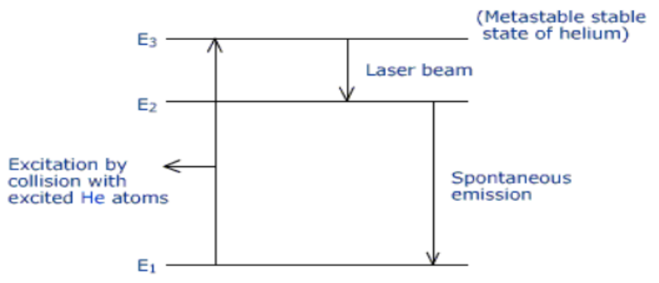

Fig – 1: Diagram of Stimulated Emission in a Helium-Neon LASER [10]

distance. Every atom has electrons at certain fixed energy levels. When excited, an electron goes to the higher energy level. After a certain time in the high energy level, it returns back to original energy level by emitting energy in the form of light (photons). A photon with energy E2-E1, when incident on an atom which has an electron in the conduction band, causes it to return to the lower energy level by emitting a second photon, which has the same phase, frequency and polarization as the first. This entire process is known as stimulated emission of light and properties of LASERs such as narrow spectral width, highly directed beam and high intensity exist only due to this phenomenon [3].

4. PROPOSED MODEL

Since the time when research and experimentation on LASERs began, there have been many LASER based projects made in which a computer was used to input the data. In this project, we have attempted to improve on this by using a4x4 keypad. We have also tried to enhance it by building a circuit to transmit and receive audio via LASER. In the realm of communication, LASER-based communication is a modern technology, with the number of users of this technology steadily on the rise. Hence, bandwidth allocation, power requirement, and dispersion parameters are becoming a major issues which need to be resolved.

There are various methods to implement this project but due to scarcity of resources & components, we decided to use simple modulation and demodulation techniques. Hence we have designed a LASER-based communication system that people in terms of a convenient and friendly system. Also, it reduces the complexity of communication in scenarios where any form of wired communication is difficult to implement and expensive.

The model proposed for this project includes two separate modules – one for transmitting and receiving audio & DTMF data and the other module to enable communication between two PC's via a LASER transceiver.

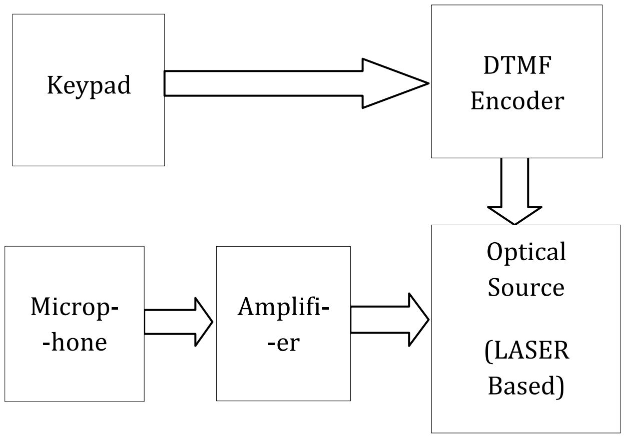

Fig - 2: Block Diagram of Audio + DTMF Transmitter

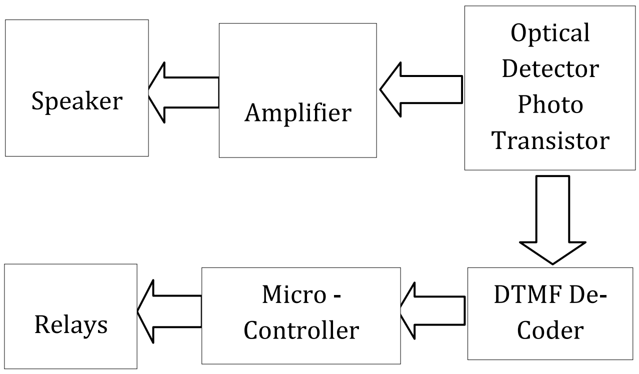

Fig - 3: Block Diagram of Audio + DTMF Receiver

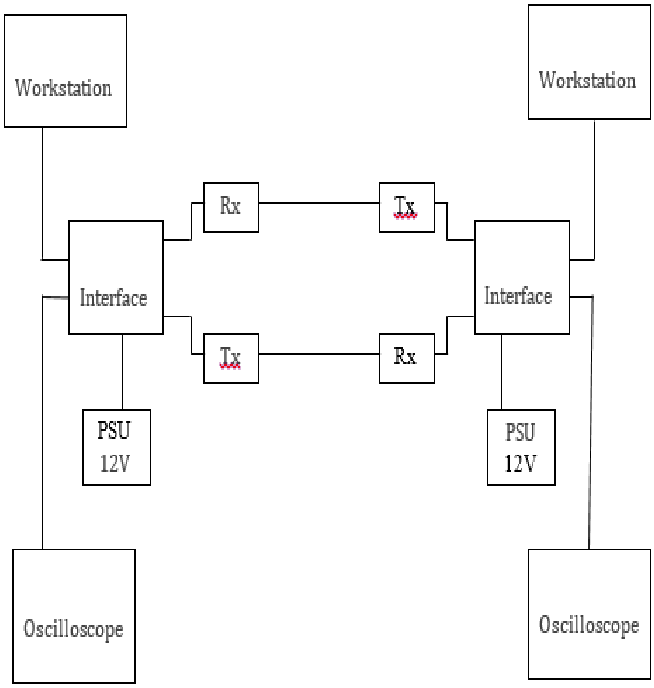

Fig - 4: Block Diagram of PC-to-PC Communication

In the first module, the audio and DTMF data is used to modulate a LASER carrier which is then received at the other end by a phototransistor, decoded/demodulated and given as output. The other module consists of two LASER transceivers that can be connected to the serial ports of any two PC's and positioned relatively in such a way so as to enable line-of-sight serial communication between the two PC's in which text data can be sent and received.

5. PRINCIPLE OF OPERATION

5.1 Audio + DTMF Transmitter

For the DTMF transmission, the goal is to achieve the transmission of data from a 4X4 keypad via LASER. For this, a 4X4 keypad is connected to the IC UM91215B. This IC accepts key-press data from the keypad and encodes it in DTMF format, i.e. for every key pressed, two different pre-assigned frequencies are given out by the IC which are then amplified using IC LM 358 and made to modulate the LASER. For the audio transmission, audio input is given via a 3.5mm jack, which is amplified by IC LM358 and then it modulates the LASER's amplitude and transmitted.

5.2 Audio + Data Receiver

The LASER is detected by a phototransistor which also converts it back to electrical form, after which the signal is amplified. The DTMF data is given to a DTMF decoder MT 8870, after this, both the signals are given to the microcontroller AT 89C51 for further and final processing. The audio signal is given to the speaker for output. The decoded DTMF data, however is used by the microcontroller to switch on LED's connected through relays to show which key was pressed initially.

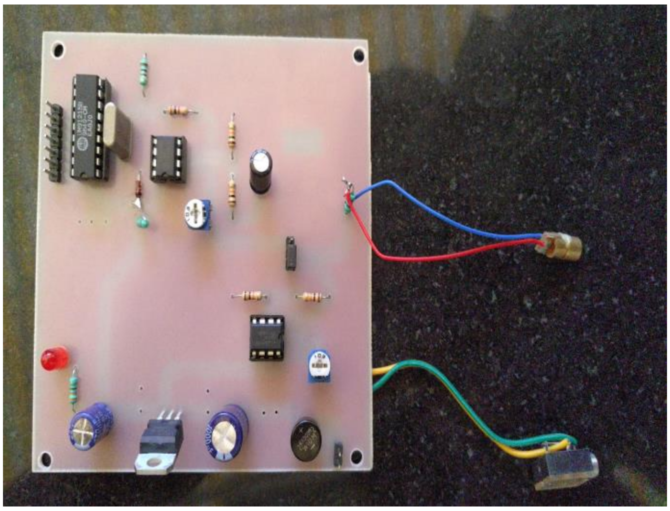

Fig – 5: Audio/DTMF Transmitter

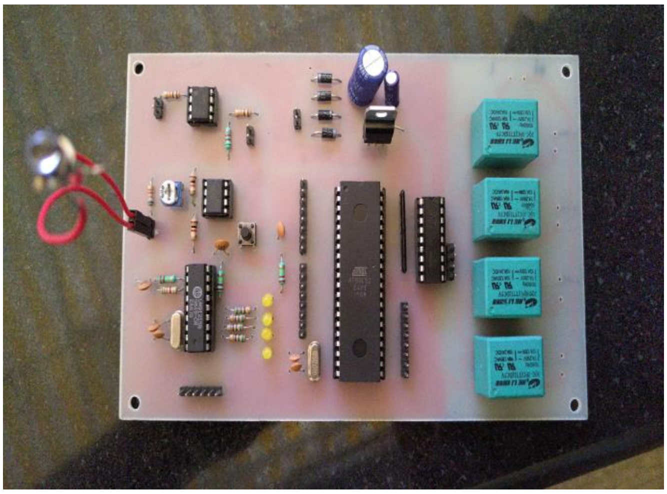

Fig – 6: Audio/DTMF Receiver

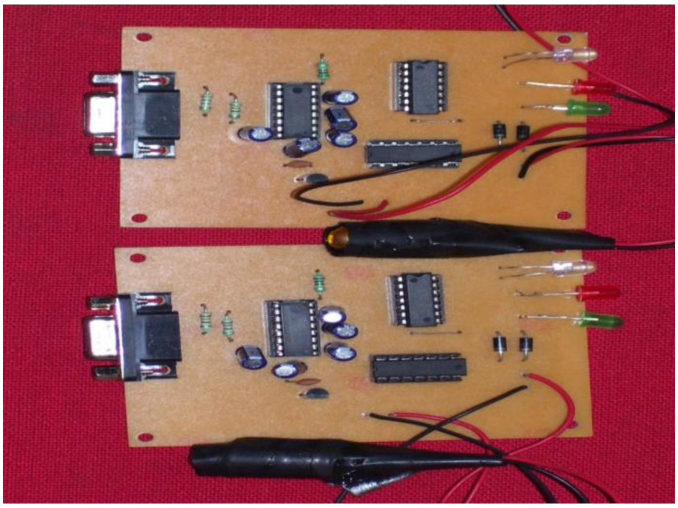

Fig - 7: PC-to-PC Transceiver

5.3 PC-to-PC Transceiver

The LASER transceiver consists of a DB9 port through which it can be connected to a PC having such a port using a serial cable. The IC MAX 232 acts as the interface between the LASER/photodiode and the PC by converting RS232 level signal to TTL level signals and thus modulating the LASER and by receiving TTL level signals from the photodiode and converting them into RS232 signals that can communicate with the PC serial port, as done in [4]. It uses PWM to modulate the LASER.

6. RESULTS AND DISCUSSION

Free-space LASER communication performance directly depends on the efficiency and sensitivity of optical transmitters and receivers. However, until recently, fiber-optic networks were not built around these ideas or concepts. It is only since the demand for bandwidth has approached the limitations of existing fiber-optic links, that more sensitive receivers are being designed with the objective of improving network performance in terms of power and bandwidth efficiency [5].

The main advantage of transmitting information via LASER is the potential increase in the information transfer rate. This rate is dependent on the bandwidth of the carrier signal which has been modulated with data. Therefore, increasing the carrier frequency range from RF or microwaves to that of optical waves increases the information capacity of a communication system by multiple orders of magnitude [6]. If the LASER beam has to transverse distances shorter than 200-500 m or so, finite movement and sway of the local buildings attached to the system may shift the transmitted beam away from the receiving telescope aperture and outside the angular acceptance angle of the system. In this case, or in the case of high atmospheric turbulence, an active tracking device may have to be used to align the beam onto the receiver using a small mirror, lens translation stage, or detector/LASER translation stage. Active tracking is not necessary if sufficient LASER power can be made available, if the divergence of the beam can be expanded and if the building and alignment are stable [7].

It is observed that we can increase the efficiency by changing the parameters such as the type of LASER diode and photodiode used. Since the transmission and reception command is given manually, we were able to transmit the data at baud rates up to 9600. Thus it was clear that any kind of data transmission can be performed faster if we create a specific software for transmitter and receiver [2].

Any particulate matter present in the atmosphere, like fog, rain, dust, snow, smoke, or any other aerosol attenuate the signal-carrying LASER beam, which until a certain limit can be compensated by having a high signal gain. Molecular absorption may be minimized by appropriate selection of the optical wavelength [8]. LASER communication has many advantages over other wireless technologies such as microwave or RF spread spectrum communication. These advantages include much higher data rates and increased security because of the focused and narrow nature of LASER beams, which makes detection, interception and jamming very difficult, as explained before. Because of its superior security, LASER-com is ideal for the wireless transfer any kind of sensitive information. Another major advantage of LASER-com over RF is that no licensing or frequency allocation is required. In most large urban areas, it is almost impossible to obtain specific frequency allocations for transmission via RF or microwave medium. Also, LASER communication systems are mostly portable, which make them ideal for disaster recovery and temporary installations [9].

7. CONCLUSION

The transmission of high-speed computer network data has been successfully demonstrated using free-space LASER communication. A parallel circuit has also been designed and built for the transmission of audio using LASER. The transmitter and receiver circuit were designed separately to perform these functions. The audio signal was successfully modulated on a LASER beam and transmitted to a higher distance without any issues. DTMF data transfer using LASER has also been demonstrated. The complete hardware circuit has successfully performed its desired function as per design i.e. the transfer data from the transmitter circuit to the receiver's circuit via unguided media to enable communication using LASER.

REFERENCES

[1] Amit Agrawal, Gaurav Kumar, Maheshwari Narayan Singh, Pradeep Kumar, Pransu Mathur, "Data transmission using LASER light", International Journal of Advanced Computer Technology (IJACT) , vol. 1, Issue-2, p. 31-38.

[2] Liju Sajan, Lince Mathew, Abraham Thomas, Sarun Sathyan, Bibin Baby, "Wireless data transfer using visible light communication", IJRET: International Journal of Research in Engineering and Technology, Volume: 04 Special Issue: 03, April 2015, p. 52-55.

[3] Gibin Mathew Padayattil, Dixon Poly, Preejo K. Paulson, Miranda Thomas, Jitha Joseph, "Highly efficient free space LASER communication", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering , Vol. 4, Issue 4, April 2015 p. 2037-2044.

[4] Bhuvaneswari Balachander, "LASER based data signal transmission

using free space optics", Volume : 2 , Issue : 12 , December 2013, p. 204-205

[5] David O. Caplan, "LASER communication transmitter and receiver design", J. Opt. Fiber. Commun. Rep. 4, 225–362 (2007).

[6] Arun K. Majumdar, "Free-space LASER communication performance in the atmospheric channel", J. Opt. Fiber. Commun. Rep. 2, 345–396 (2005).

[7] Dennis Killinger, "Free space optics for LASER communication through the air", Optics & Photonics News October 2002, p. 36-42.

[8] Jennifer C. Ricklin, Stephen M. Hammel, Frank D. Eaton, Svetlana L. Lachinova, "Atmospheric channel effects on free-space LASER communication", J. Opt. Fiber. Commun. Rep. 3, 111–158 (2006).

[9] Isaac I. Kim, Ron Stieger , Joseph A. Koontz , Carter Moursund, Micah Barclay , Prasanna Adhikari, John Schuster , Eric Korevaar, "Wireless optical transmission of fast ethernet", FDDI, ATM, and ESCON protocol data using the TerraLink LASER communication system, Opt. Eng. 37(12) 3143–3155 (December 1998).

[10] Navneesh Singh Malhotra, Harman Malhotra, "Transmission of sound using LASERS", International Journal of Advanced Research in Computer Science & Technology (IJARCST 2014), Vol. 2, Issue 3 (July - Sept. 2014), p. 137-140.