

# **Li-Fi Based Audio Transmission With Home/Office Automation System**

Amit Jaykumar Chinchawade<sup>1</sup>, Prof. K. Sujatha<sup>2</sup>

M.E ( VLSI& Embedded Systems ) (Appeared), Department of Electronics & Tele-Communication Engineering,  
Shree Ramchandra College of Engineering Lonikand (Pune), Maharashtra India.<sup>1</sup>

Ph.D. H.O.D. Department of Electronics & Tele-Communication Engineering, Shree Ramchandra College of  
Engineering, Lonikand (Pune), Maharashtra India.<sup>2</sup>

**ABSTRACT:** Device to device communication using LED Light is the next step of the information revolution. Li-Fi (Light Fidelity) is a fast and cheap optical version of Wi-Fi. This technology is based on Visible Light Communication (VLC). LI-FI is a term of one used to describe visible light communication technology applied to high speed wireless communication. It acquired this name due to the similarity to WI-FI, only using light instead of radio. WI-FI is great for general wireless coverage within buildings and Li-fi is ideal for high density wireless data coverage in confined area and for relieving radio interference issues, so the two technologies can be considered complimentary. This project is aim to demonstrating the use of Li-Fi in audio communication and in Home or Office Automation for controlling the devices.

**KEYWORDS:** LED (Light Emitting Diode), Wi-Fi (Wireless Fidelity), Li-Fi (Light Fidelity),VLC (Visible Light Communication),RF (Radio Frequency). DTMF (Dual Tone Multiple Frequency), LDR (Light Dependant Register.)

## **I. INTRODUCTION**

Light Fidelity (Li-Fi ) is future technology which replaces the Wi-Fi. Because Li-Fi overcomes disadvantages of Wi-Fi like Data Transfer speed of Li-Fi is more than 1Gbps while in Wi-Fi it is about 150 Mbps. Li-Fi uses light as a carrier but Wi-Fi uses radio Spectrum. In Li-Fi Visible light Spectrum has 10,000 broad spectrums in comparison of radio frequency. Operating Frequency in Li-Fi is Hundreds of Tera Hz where as in Wi-Fi it is 2.4 GHz. Li-Fi is Cheaper than Wi-Fi because free band doesn't need license and it uses light. Li-Fi is abidirectional, high speed and fully networked wireless communication technology similar to Wi-Fi. This term was developed by Harald Haasand is a form of visible light communication and a subset of optical wireless communications (OWC) and could be a complement to RF communication (Wi-Fi or Cellular network), or even a replacement in contexts of data broadcasting. It is so far measured to be about 100 times faster than some Wi-Fi implementations, reaching speeds of 224 gigabits per second.Li-Fi technology in the audio transmission is must faster and secured communication. In Li-fi based Home /Office automation we can control number of devices using DTMF encoder. Here AT89C51 Microcontroller plays important role for switching the device. In future this technology can be used in industry automation for controlling varies machineries and robotics.

## **II. RELATED WORK**

Voice and data transmission is done previously by using varies technologies like wireless communication protocols to transmit data, such as infrared, Bluetooth, and Wi-Fi. Also the voice and data transmission is done by LDR and Laser torch. The voice and data transmission is done most popular is using wireless LAN. The home/office automation is done using the web server's core that manages, controls, and monitors users' home. Also the home/office automation is done using GSM and Bluetooth.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

The use of Li-Fi in the voice and data transmission and in home/office automation increases the speed of operation of voice and data transmission also the switching speed of devices i.e the devices ON and OFF speed is also increases. Use of Li-Fi is more secure, speedy and cheap communication.

### III.METHODOLOGY

In the process of voice communication through the visible light on the transmitter side voice is used as the input signal. This signal is converted to an electrical signal through a condenser or microphone. This electrical signal is amplified by the amplifier circuits and fed into the power LED. The light signal from the LED varies according to the intensity of the voice signal. The louder is voice the glow of the LED will be more. At the receiver side light dependant resister will receive the light signal and correspondingly generate an electrical signal proportional to it. This electrical signal is processed by a demodulator circuit, which is then fed to a speaker and it produces the audio signal which was at the input of the transmitter side.

User can activate their devices using this DTMF keypad as he/she wants to activate. The DTMF encoder encodes the user input and sends it to LED Driver. LED Driver sends output to LED to turn ON & OFF the LED as per input data. The LDR/Photo receiver receives the modulated signal and DTMF decoder demodulates it and sends it to Microcontroller to control the device. It results in turning ON or OFF specific device. The device switching is achieved by Relays. In this system, we are going to make DTMF based home/office automation.

### IV.BLOCK DIAGRAM

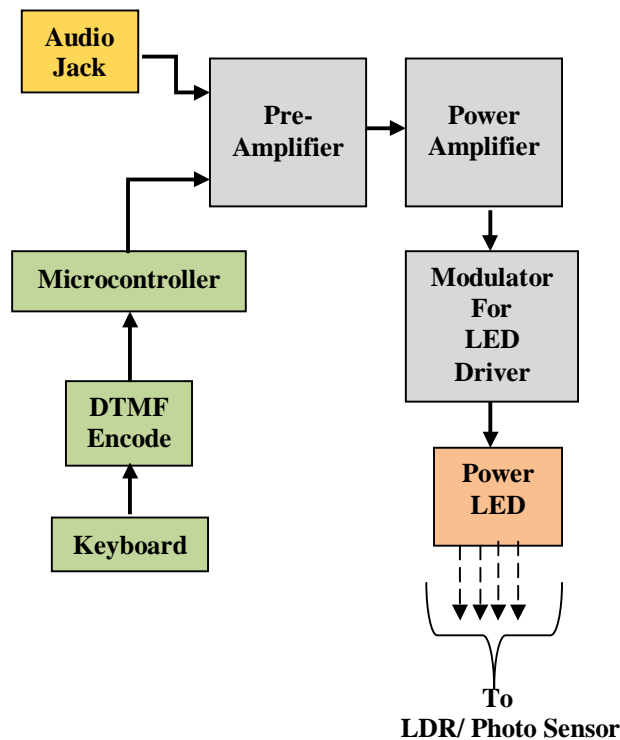


Fig.1 Block Diagram Of Transmitter.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

Above figure No. 1 shows the Block Diagram Of Transmitter. It consist of Audio Jack, Pre- amplifier, Power-amplifier, Microcontroller, DTMF Encoder, Key pad, Modular of LED Driver and LED. Each block is explained below.

**Audio Jack:-**It is a Mobile connector used to connect the mobile phones with the audio device. Here it is used to connect the mobile device or any other device like IPAD, MP3 Player, Laptops, Personal Computers etc. with Li-Fi as input audio signal.

**Microcontroller:-** Here AT89C51 microcontroller used to receive the DTMF code encoded by DTMD encoder and sent to Pre-Amplifier.

**DTMF Encoder:-**A DTMF (dual tone multiple frequency) isa keystrokes or digit information into dual tone. Each key on the keypad is uniquely identified by its row and its column frequency.The encoder portion and tone generation part of a DTMF codec is based on two programmable;second order digital sinusoidal oscillators, one for the row the other one for the column tone. Twooscillators instead of eight facilitate the code and reduce the code size. When any of the key like “1”, “2”, “\*”, “#” etc is pressed particular code is transmitted. This code is consist of two frequency among which one is higher frequency and second one is lower frequency. Following table shows the combination of frequency for respected keys.Here we can control the devices by using the DTMF encoder.

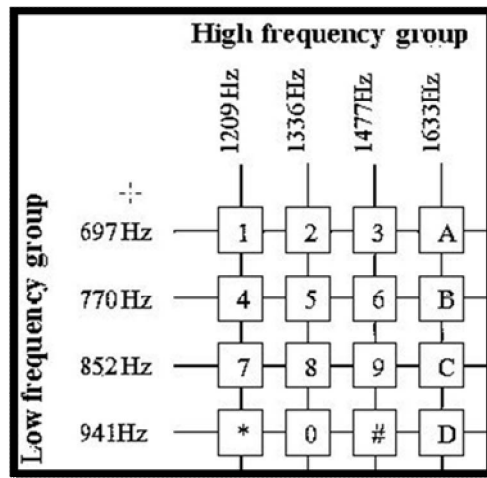


Fig. 2 4x4 Key Matrix.

**Keyboard:-** Above figure No. 2 indicates the a 4x4 key matrix key board, used to generate the DTMF code combinations. It contains 16 keys. The key combination can send the particular frequency to switch ON or OFF the Device. According to these key combination the particular devices are switched ON or OFF.

**Pre-Amplifier:-** A pre-amplifier is an electronic amplifier that amplifies low-power audio signals. It amplifies the voltage level of the audio signal as well as the DTFM code received from the DTMF encoder.

**Power Amplifier:-** An audio power amplifier is an electronic amplifier that amplifies low-power audio signals from Audio jack or MIC.In power amplifier stage. Amplifies both current and voltage sufficiently then transmitted through light.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

**Modulator for LED Driver:**-The heart of this technology is a new generation high brightness LED's. These LED's varies in intensity so fast that Human Eye cannot detect it. The modulator used behind the LED is used to ON/OFF the LED according to data. If LED is On, then transmit a Digital data 1, and if LED is OFF, then transmit a digital data 0.

**Power LED:** - It is a High brightness LED used to transmit the Data and voice.

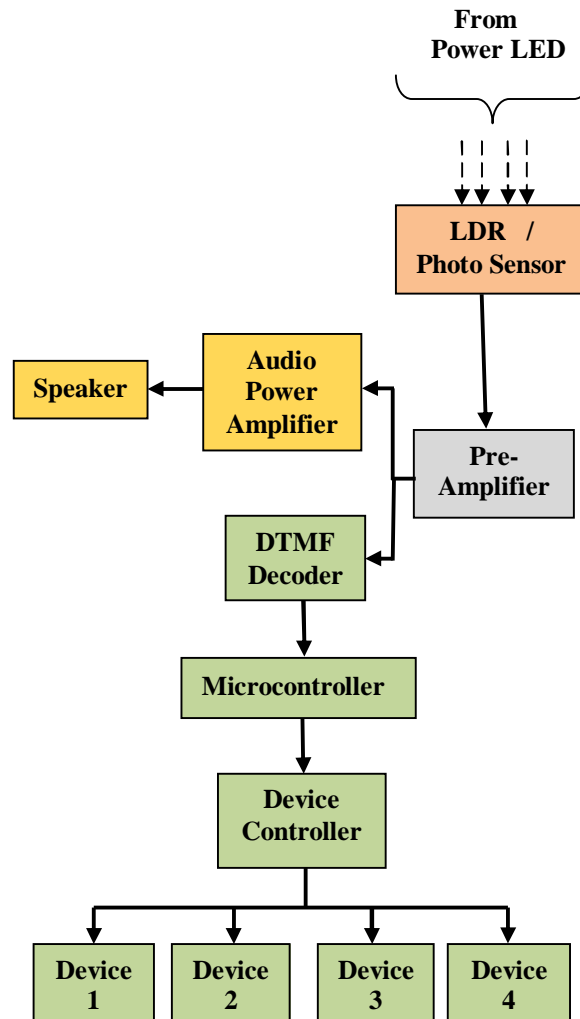


Fig.3. Block Diagram Of Receiver.

Above figure No. 3 shows the Block Diagram Of Receiver. It consist of LDR, Pre- amplifier, Audio Power- amplifier, DTMF Decoder, Microcontroller, Device Controller and relays. Each block is explained below.

**LDR/ Photo Sensor:-** A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity depend on the incident Light. Hence, they are light sensitive devices. The resistance of a photo resistor decreases with increasing light intensity.

**Pre- Amplifier:-** Pre-amplifier, sufficiently Amplifies voltage levelof signal received from LDR or Photo sensor and then transmitted to Audio Power Amplifier and DTMF Decoder.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

**Audio Power Amplifier:-** An audio power amplifier is an electronic amplifier that amplifies low-power audio signals (signals composed primarily of frequencies between 20 - 20 000 Hz, the human range of hearing) to a level suitable for driving loudspeakers. It is the final electronic stage in a typical audio playback chain.

**Speaker:-** Speaker is a output device, used generates the voice which is input from the Audio jack or MIC.

**DTMF Decoder:-** This DTMF (Dual Tone Multi Frequency) decoder circuit identifies or decodes the key pressed on the remote keyboard and sends information to Microcontroller, for switching ON or OFF the specific device.

**Microcontroller:-** Here AT89C51 microcontroller used to control the devices connected to Device controller as per the input from DTMF encoder. It turn ON or OFF the specific relay as per input from keyboard. Also it shows the information about switching device on LCD Display.

**LDC Display:-** Here 16x2 LCD Display is used to shows the information about switching device on LCD Display. Example- Device-1, Device-2, Device-3 & Device-4.

**Device controller:-** Here device controller is a Relay, which is controlled by Microcontroller to turn ON/OFF the devices.

**Device 1 to Device 4:-** Here 4 devices are connected to four different relays. These devices may be T.V, A.C, Fan, Bulb etc. We can connect any devices to these relays.

### V. PRACTICAL IMPLEMENTATION

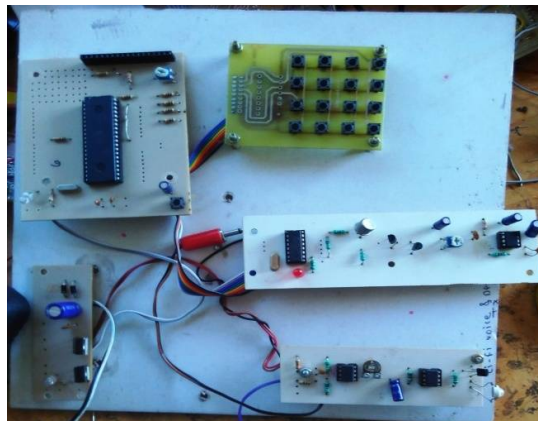


Fig. 4 Practical Implementation of Transmitter.

Above figure No.4 shows the Transmitter circuit model of Li-Fi based Audio transmission with Home or Office automation system. It consists of Audio jack and Microphone for input voice signal to Li-Fi System. It's output is connected to Pre-Amplifier for amplification of lower voice signal. LM741 is used as Pre-amplifier. Another input to Pre-amplifier is from DTMF Encoder. DTMF Encoder encodes the data as key pressed and sends to Pre-amplifier. The TCM5089 is used for DTMF encoder. The output of pre-amplifier is given to Power Amplifier to boost up both current and voltage level of signal. The LM741 is used as Power Amplifier. The LED modulator can control the LED or modulate the data as per input. It turn ON LED if data is '1' and turn OFF the LED if data is '0'.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

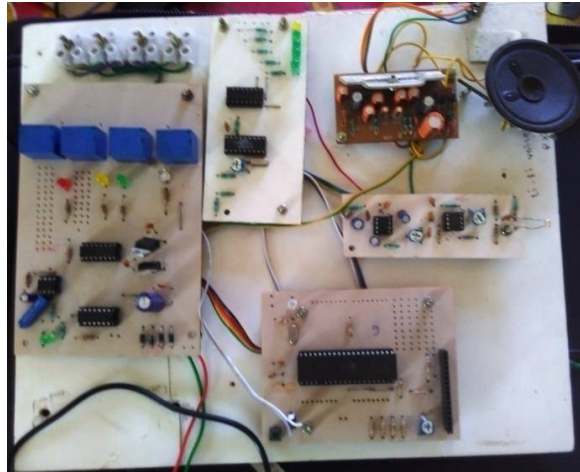


Fig. 5, Practical Implementation of Receiver.

Above figure No.5 shows the Receiver circuit model of Li-Fi based Audio transmission with Home or Office automation system. It consists of LDR or Photo sensor as input to receive the coded data from the Power LED. It receives the data '1' or '0' as per blinking of LED. Then the output of LDR or Photo sensor is given to Pre-amplifier. LM358 is used as pre-amplifier. At the pre-amplifier stage LM358 picks the transmitted signal through LDR, which catches the very low pitch sound waves and data signals. Pre-amplifier amplifies the voltage level of sound waves and data signals sufficiently. Its output is given to Audio power amplifier and DTMF Decoder. The LM386 is used as Audio power amplifier which amplifies the low level audio signal to sufficiently drive the loudspeaker. MT 8870 is used for DTMF Decoder. The DTMF Decoder decodes the coded key combinations form DTMF encoder and gives output to AT89C51 Microcontroller to switch ON/OFF the particular Relay. Relay will turn ON or OFF the particular device.

## VI.OBSERVATIONS

Sr. No.	Parameter	Observations
1)	Max. Length of Communication between Transmitter & Receiver.	2 Meter
2)	Response time of relay after key pressed.	10ms
3)	Max. Audio output from Loudspeaker.	85 to 95 dB
4)	Variation of voice & Data transfer rate in Light.	Does not vary the voice & Data transfer rate in presence Light.

Table No.- 1, Observations on varies Parameters.

Above Table No. 1 indicates the observations on varies parameters such as the Max. Length of Communication between Transmitter & Receiver is 2 Meter, Response time of relay after key pressed is 10 ms, Max. Audio output from Loudspeaker is 85 to 95 dB, Does not vary the voice & Data transfer rate in presence Light.

## VII. RESULT

Li-Fi based Audio transmission is the live transmission of Audio signals without any signal loss. The sound clarity is clear and sound's loud.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

The DTMF encoder and decoder is used for Li-Fi based Home or Office automation system. According to key combinations the devices are controlled.

## VIII. APPLICATIONS

Li-Fi can be used in various areas like Hospitals automation because Operating rooms do not allow Wi-Fi it radiates the harmful signal also interference from cell phones and computers can block signals from monitoring equipment. Li-Fi can be used in petrochemical industries automations where use of radio spectrum is very dangerous. Li-Fi can also be used in Power plants as Wi-Fi and many other radiation types are very bad for such sensitive areas. Li-Fi can also be used in under water systems for audio communications and device controls where Wi-Fi does not work.

## IX. CONCLUSIONS

Li-Fi technology is faster, cheaper and secure communication as compared with Wi-Fi. This technology will implement for industrial equipment controls, internet communication, patient monitoring systems etc.

Li-Fi based automation can control the number of devices by using the DTMF encoder. Different key combinations can control the number of devices. In future three phase devices can be controlled by using Li-Fi technology.

## X. ACKNOWLEDGEMENT

I take this opportunity to express my profound gratitude and deep regards to my guide Prof. K.Sujatha madam for her exemplary guidance, monitoring and constant encouragement throughout the course of this seminar. The blessing, help and guidance given by her time to time shall carry me a long way in the journey of life on which I am about to embark.

I would like to express my special thanks of gratitude to our PG coordinator Prof. Harshvardhan Upadhyay sir as well as our principal Dr. A.D. Desai who gave me the golden opportunity to do this wonderful Seminar on the topic "Transparent Electronics Technology.", which also helped me in doing a lot of Research and I came to know about so many new things I am really thankful to them.

I am obliged to staff members of SRCOE, Lonikand, Pune for the valuable information provided by them in their respective fields. I am grateful for their cooperation during the period of my assignment.

## REFERENCES

- [1] D. Tsonev, S. Videv and H. Haas "Light Fidelity (Li-Fi): Towards All-Optical Networking", Institute for Digital Communications, Li-Fi R&D Centre, The University of Edinburgh, EH9 3JL, Edinburgh, UK.
- [2] T.Komine and M.Nakagawa, "Fundamental analysis for visible light communication systems using LED Lights," IEEE Trans. Consumer Electronics, vol. 59, no.1, Feb, 2004.
- [3] M.Kavehrad, "Sustainable Energy Efficient Wireless Applications Using Light," IEEE Commun. Mag., vol. 48, no. 12, Dec. 2010, pp. 66-73.
- [4] P. Amirshahi, M. Kavehrad, "Broadband Access over Medium and Low Voltage Powerlines and use of White Light Emitting Diodes for Indoor Communications," IEEE Consumer
- [5] NaliniBagal, Prof. ShivaniPandita, A Review: Real-Time Wireless Audio-Video Transmission, International Journal of Emerging Technology and Advanced Engineering, (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 5, Issue 4, April 2015)
- [6] World Academy of Science, Engineering and Technology International Journal of Computer, Electrical, Automation, Control and Information Engineering Vol:6, No:8, 2012, titled as Design and Implementation of a Wi-Fi Based Home Automation System.
- [7] Md. Kayesar Ahmed, Anmona Shabnam Pranti. Low Cost Voice Communication Device Design Using Ordinary Laser Torch and LDR Available in Bangladesh, www.lificonsortium.org. International Journal of Electronics and Electrical Engineering Vol. 1, No. 4, December, 2013.
- [8] M.Kavehrad, "Sustainable Energy Efficient Wireless Applications Using Light," IEEE Commun. Mag., vol. 48, no. 12, Dec. 2010, pp. 66-73.
- [9] Dinesh Suresh Bhadane, Monali D. Wani, Sanjeev. A. Shukla, Aniket R. Yeole, Titled A Review on Home Control Automation Using GSM and Bluetooth, International Journal of Advanced Research in Computer Science and Software Engineering Research Paper. Volume 5, Issue 2, February 2015 ISSN: 2277 128X
- [10] T.D.C. Little, P. Dib, K. Shah, N. Barraford, and B. Gallagher, "Using LED Lighting for Ubiquitous Indoor Wireless Networking", IEEE International Conference on Wireless & Mobile Computing, 10.1109/WiMob.2008.57.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

- [11] D. C. O'Brien, "Indoor optical wireless communications: recent developments and future challenges," in Free-Space Laser Communications IX, San Diego, CA, USA, 2009, pp. 74640B-12.
- [12] M.G. Craford, "LEDs challenge the incandescents," IEEE Circuits Devices Mag., vol. 8, pp. 24-29, Sept. 1992.
- [13] Y. Tanaka et al., "Indoor Visible Light Data Transmission System Utilizing White LED Lights," IEICE Trans. Commun., vol. E86-B, no. 8, Aug. 2003, pp. 2440-54.

## BIOGRAPHY

### **Mr. Amit Jaykumar Chinchawade.**

M.E ( VLSI& Embedded Systems ) (Appeared).  
Dept. Electronics & Tele-Communication Engineering,  
Shree Ramchandra College of engineering, Lonikand (Pune),  
Maharashtra India.



### **Prof. K. Sujatha. (Ph.D)**

H.O.D.  
Dept. Electronics & Tele-Communication Engineering,  
Shree Ramchandra college of engineering, Lonikand (Pune),  
Maharashtra India.

