LASER Li-Fi Based SMS Communication

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Abstract – Now-a-days many people are using internet to accomplish their task through wired or wireless network. As no. of users get increased in wireless network speed decreases proportionally. Though Wi-Fi gives us speed up to 150 Mbps as per IEEE 802.11n, it is still insufficient to accommodate no. of desired users. To remedy this limitation of Wi-Fi, we are introducing concept of Li-Fi. As per Germen physicist Harald Haas "data through illumination" – taking the fibber out of fiber optic by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. Haas says his invention, which he calls D-LIGHT, can produce data rates faster than 10 Mbps, which is speedier than your average broadband connection. The LASER Li-Fi is the advanced version of Li-Fi where we use LASER at the place of LED. The on-off activity of LASER is fast in comparison of LED. Data transfer speed of LASER Li-Fi is upto 10Gbps while LED Li-Fi data transfer speed is only 1Gbps. LASER is used for better performance and high data transfer speed.

Index Terms – Visual light Communication (VLC), Li-Fi, Wi-Fi, LCD, ASCII, LASER.

1. INTRODUCTION

Li-Fi (Light Fidelity) is a wireless technology which is based on light as its name indicates not on radio waves. This technology was invented by German physicist Harald Haas from the University of Edinburgh. He demonstrated it in the year 2012. Li-Fi is an alternative of Wi-Fi that transmit data using the spectrum of visible light. Li-Fi technology used LED or LASER for transmit the data wirelessly. Li-Fi is the fast and cheap optical version of Wi-Fi. LASER Li-Fi is an another aspect of Li-Fi where I use LASER at the place of LED light bulb. As a replacement of Wi-Fi modems, Li-Fi would use transceiver-fitted LED lamps that can glow a room as well as transmit and receive information. Li-Fi is transmission of data through illumination i.e. sending data through a LED light bulb or LASER that varies in intensity faster than human eye can follow. The transfer of the data can be with the help of all kind of light i.e. light may be invisible, ultraviolet or visible part of spectrum. The band spectrum is as shown in figure below.

Fig. 1: Band spectrum

2. LI-FI DESIGN PARAMETERS

Li-Fi architecture consist LED bulbs, lamps or LASER for data transmission. Important factors we should consider while designing Li-Fi as following:

- Presence of Light.
- Line of Sight.
- For better performance use LASER.

These are three important parameters which are considered by us during the design of Li-Fi. Presence of light and LOS are the two basic factors. The third factor LASER considered only for better performance. The better performance directly relates to the high data transfer speed of the wireless network.

3. FEATURES OF DESIGN

- High data speed.
- Wireless system.
- Uses visible light.
- No capacity limitation.
- Security due to password.
- Security due to address matching.

4. CIRCUIT IMPLEMENTATION

Li-Fi is typically implemented using LASER at the downlink transmitter. These devices are normally used for illumination only by applying a constant current. In this paper we show that how we transfer the data from the one unit to second unit with Li-Fi. In this project we transfer the ASCII data. First of all we type the ASCII data with the help of the switches and save this data in the unit. This data is display on the LCD screen at the same time. Now we send this data via serial communication from one unit to another unit. Data send with the address code, if the address code is not match then data is not transfer. Data send through the encryption code and decrypt by the password only. Data send to receiver via serial communication. Data transfer and if not receive then not response message is on the screen. Figure shows the transmitter section and receiver section.

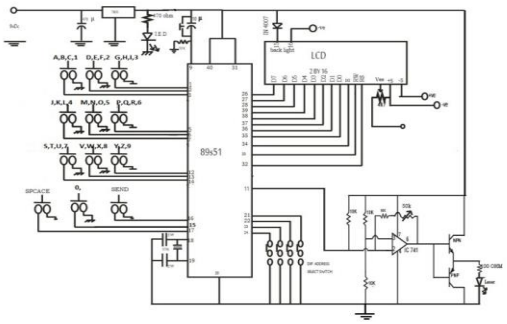

Fig. 2: Li-Fi transmitter circuit diagram

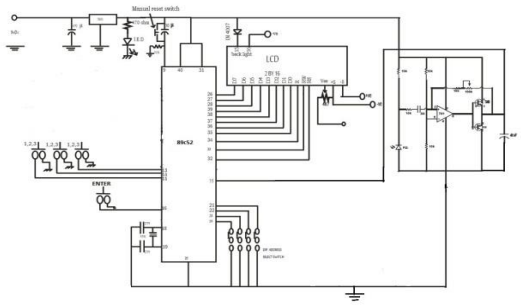

Fig. 3: Li-Fi receiver circuit diagram

Fig. 4: Transmitter circuit

Fig. 5: Receiver circuit

The whole implementation divides into following parts:

- 5 volt regulated power supply.
- Keypad (multi code from one key).
- Microcontroller interface.
- LCD detail.
- Serial communication.
- Programming.

The 5 V. regulated power supply used for operate the whole circuit. For regulate output voltage I use voltage regulator. Here IC7805 used as 5V. voltage regulator. In transmitter section AT89c51 and in receiver section AT89c52 are used as microcontroller. These both are from 8051 family. The basic difference between AT89c51 and 8051 is that 8051 transfer data bits parallel while AT89c51 or AT89c52 both transfer data serially. I use serial data transfer in this project.

Keypad section is the input part of this project. In the keypad, first of all we use push-to-on switches. These types of switch are two-pin-switch. All the switches are connected to microcontroller port P1 and port P3. The input part of transmitter as follows –

ABC1	DEF2	GHI3
JKL4	MNO5 PQR6	
STU7	VWX8 YZ9	
	0	
Backspace		Send

At receiver side there are three buttons are used for password and a button used for Enter. The password is in the form of numeric characters. The output part of receiver as follows –

0 to 9	0 to 9	0 to 9
	Enter	

5. LASER PARAMETERS

LASER parameters are directly relates to the wavelength and frequency of the LASER.

Class of LASER – 3(III).

Sub-class of LASER – B.

Wavelength of LASER – 635nm.

Frequency of LASER – 472 THz.

Output power – 499 mW.

Colour of LASER – Red.

6. BLOCK DIAGRAM

Block diagram of Li-Fi communication is shown in figure below. The input is given through keypad shown on the input LCD screen. This input is sent through the LASER. The

LASER beam is detected by the photo-detector at the receiver side. After receiving the signal at photo-detector, amplification process is performed on the signal detected at receiver side. Then the received data shown on the LCD screen connected to the receiver. There are addresses circuitry is used at both transmitter and receiver side. Only when the addresses at the transmitter end and receiver end are same, the data transmitted otherwise the data doesn't transmitted. There is synchronization between transmitter and receiver circuit. When the addresses of the transmitter and receiver are matched then the data transfer between transmitter and receiver otherwise the data transfer cancelled.

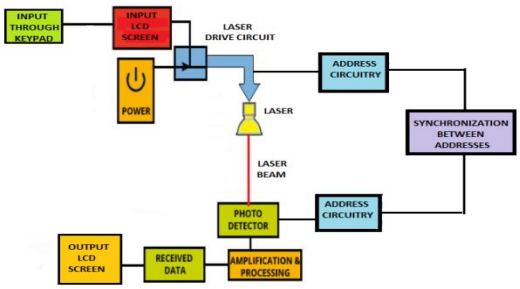

Fig. 6: Block diagram of Li-Fi communication

7. VLC FACTOR

VLC represents only a fraction of what appears to be a much larger movement towards optical wireless technologies in general. Li-Fi comprises several optical wireless technologies such as optical wireless communication, navigation and gesture recognition applied for natural user interfaces. Thus, it provides a completely new set of optical technologies and techniques to offer users add-on as well as complementary functionalities compared to well-known and established RF services. This could reach from a new user experience regarding communication speeds in the gigabit class to bridge the well-known spectrum crunch, over to precise indoor positioning or controlling video games, machines or robots with entirely new natural user interfaces. Finally, these and many more could be merged to a full- featured Li-Fi cloud providing wireless services for other future applications as well.

8. POSITIVE POINTS

- Free band doesn't need license.
- Cheaper than Wi-Fi.
- Less energy consumption.
- Lower electricity costs.
- Secured access.
- Higher speed than Wi-Fi.
- 10,000 times the frequency spectrum of radio.

9. ISSUES WITH LI-FI

- Light can't pass through objects.
- Interference from external light sources.
- Need for a clear LOS.
- Mobility issue.

10. BEST HOTSPOTS

- Under ocean communication.
- For medical purpose in hospitals.
- In petrochemical plants.
- Traffic and street lights.

Underwater ROVs, those favorite toys of treasure seekers, operate from large cables that supply their power and allow them to receive signals from their pilots above. ROVs work great, except when the tether isn't long enough to explore an area or when it gets stuck on something. If their wires are cut and replaced with light – say from a submerged, high powered lamp – then they would be much freer to explore. They could also use their headlamps to communicate with each other, processing data autonomously and referring findings periodically back to the surface, all the while obtaining their next batch to orders.

11. LI-FI Vs. WI-FI

The difference between Li-fi and Wi-Fi is given below in the figure.

S. No.	Parameters	Wireless Technologies	
		Light Fidelity	Wireless Fidelity
1.	Speed for data transfer	Faster transfer speed (>1 Gbps)	Data Transfer speed (150 Mbps)
2.	Medium through which data transfers occurs	Used Light as a carrier	Used Radio spectrum
3.	Spectrum Range	Visible light spectrum has 10,000 time broad spectrum in comparison to radio frequency	Radio frequency spectrum range is less than visible light spectrum.
4.	Cost	Cheaper than Wi-Fi because free band doesn't need license and it uses light.	Expensive in comparison to Li-Fi because its uses radio spectrum.
5.	Network topology	Point to point	Point to point
6.	Operating frequency	Hundreds of Tera Hz	2.4 GHz

Fig. 7: Li-Fi vs. Wi-Fi

The bandwidth of visible spectrum is 10,000 more than the radio frequency spectrum and is absolutely untouched and free to use. The data density of Li-Fi technology is 100 times better than Wi-Fi as light is less prone to interference or spreading out when compared RF waves. High intensity light output, greater bandwidths and low interference provides high speed data rates.

The components required for Li-Fi technology is very less when compared to RF technology and thus it is a low cost technology. The data transmission via LED light requires less

power making it energy efficient. Li-Fi working is very much environmental friendly when compared to RF technology that is actually not propagated in water.

There is no question of health and safety concerns related to Li-Fi technology. Radio frequencies generally interfere with other electronic circuitry which makes it non-hazardous to the environment.

Li-Fi signals are less interpreted as the signals are confined within an illumination area that is a closed network and does not travel through the walls. Sometimes user can see the data transfer so make the transmission under control.

12. USES

For a long time, medical technology has lagged behind the rest of the wireless world. Operating rooms do not allow Wi-Fi over radiation concerns and there is also that whole lack of dedicated spectrum while Wi-Fi is in place in many hospitals, interference from cell phones and computers can block signals from monitoring equipment.

Wi-Fi and many other radiation types are bad for sensitive areas like those surrounding power plants. But power plants need fast and inter-connected data systems to monitor things like demand, grid intensity and (in nuclear plants) core temperature.

13. STANDARDS

Li-Fi is wireless and uses similar 802.11 protocols but it uses visible light communication which has much wider bandwidth. The general term VLC, visible light communication, includes any use of the visible light portion of the EM spectrum to transmit information.

14. SIMULATION

Simulation is the imitation of the operation of a real-world process or system over time. In the simulation the data on the transmitter side shown on transmitter LCD screen. As well as the send button pressed the data transmitted to the receiver. The received data is shown on the LCD at receiver side.

At transmitter,

When send button pressed at transmitter then at receiver first we listen beep…..beep…..and then a message shown on LCD at receiver side. The message is “ENTER PASSWORD”.

After enter the password the received message is shown on the LCD at receiver as

15. RESULT

The output of this project is to transmit the signal from transmitter end in the form of light and to obtain that signal at receiver end. After receiving the signal, it displayed on the LCD screen at receiver end. This model is secure due to visible light spectrum.

16. CONCLUSION

LASER Li-Fi is the advanced version of Li-Fi where I use LASER instead of LED light bulb. Due to use of LASER the data transfer rate increases upto 10 Gbps. The concept of Li-Fi is now attracts a great deal of attention, not least because it may offer a real and efficient another to radio based wireless. As the increasing number of peoples and their devices access wireless internet, the air waves are becoming gradually more crammed, making it more and more difficult to get a consistent, high speed signal so Li-Fi has a brilliant future.

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Vibhu Bindal is currently pursuing his B.Tech. in Electronices & communication Engineering. Optical Commmunication is his one of the favourite subjects. He completed his industrial training from HCL, Noida.