COMMUNICATION USING LI-FI

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ABSTRACT

Li-Fi or Light Fidelity refers to Visible Light Communication systems using light-emitting diodes as a medium for high-speed communication in a similar manner as Wi-Fi. Li-Fi or New Life of data communication is a better alternative to Wi-Fi in wireless communication. The concept of Li-Fi is data communication by fast flickering of light which is not detected by human eye but it is focused on photo detector which converts the on-off state into binary digital data. A Solar cell or photodiode is an electrical device that converts the energy of Light directly to electric signal or analog signal by the photovoltaic effect. Photodiode further processes to feed the incoming data to the corresponding speakers via APR.

Li-Fi has more capacity in terms of bandwidth in visible region than bandwidth in the radio frequency range.

Keywords : Li-Fi, APR, Wi-Fi

I .INTRODUCTION

In the era of overcrowded (data communication) world, Li-Fi is a new way of wireless communication that uses LED lights to transmit data wirelessly. Transmission of data is one of the most important day to day activities in the fast growing world. The current wireless networks that connect us to the Internet are very slow when multiple devices are connected. Also with the increase in the number of devices which access the Internet, the availability of fixed bandwidth makes it much more difficult to enjoy high data transfer rates and to connect a secure network. Radio waves are just a small part of the electromagnetic spectrum available for data transfer. Li-Fi has got a much broader spectrum for transmission compared to conventional methods of wireless communications that rely on radio waves. The basic ideology behind this technology is that the data can be transferred through LED light by varying light intensities faster than the human eyes can perceive. This technology uses a part of the electromagnetic spectrum that is still not greatly utilized- The Visible Spectrum, instead of Gigahertz radio waves for data transfer.

II .VISIBLE LIGHT COMMUNICATION

Inspite of continuous improvements in wireless communication systems, e.g. 3G, 4G, etc., a coming crisis is expected due to the lack of sufficient Radio Frequency (RF) resources, this limitation in bandwidth can't support the growth in demand for high data rates and the large numbers of communication systems, as shown in Figure 1, within the bandwidths between 300 kHz and 4 GHz. That's known as "Spectrum Crunch". [1]

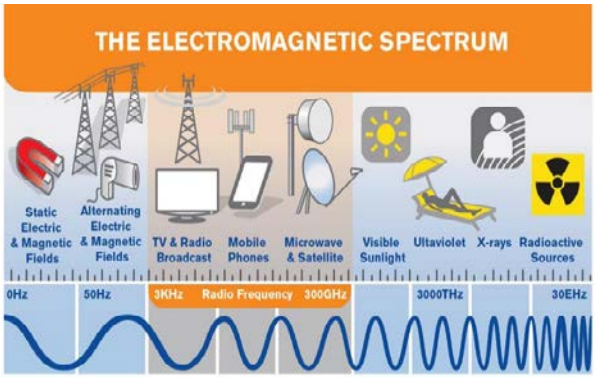


Fig 1. Multiple communication systems cause Spectrum Crunch.

VLC is an optical communication technology that use visible light rays, these rays locate between [400-800] THz, as optical carrier for data transmission by illumination. It uses fast pulses of light, which cannot be detected by the human eye, to transmit data. [4] [5] It includes any use of the visible light portion of the electromagnetic spectrum to transmit information. The VLC standardization process is conducted within IEEE wireless personal area networks working group (802.15).

One of VLC's features is providing wide bandwidth as illustrated in Figure 2. We can obviously see that usage the optical portion of spectrum guarantees about 10,000 times greater

bandwidth compares to the usage of the RF frequencies. [7]

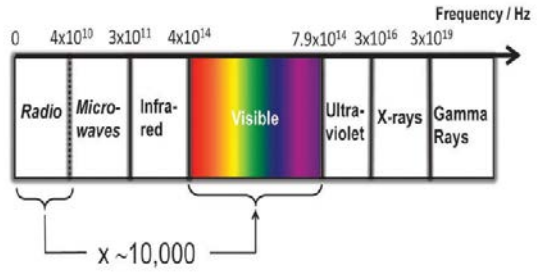


Fig 2. Location of visible light and RF frequencies at electromagnetic spectrum.

III . WORKING OF Li-Fi COMMUNICATION

Experts of physical matter make it clear that the light pulses are imperceptible to the human eye, without causing damage or discomfort of any kind. In addition, any lamp or flashlight can become a hotspot. How Li-fi works is simple: You have a light on one end (an LED), and a photodetector (light sensor) on the other. If the LED is ON, the photo detector registers a binary one;otherwise it's a binary zero. Flash the LED enough times and you build up a message. Use an array of LEDs, and perhaps a few different colors, and very soon you are dealing with data rates in the range of hundreds or megabits per second, this is accomplished by the flickering of LED light bulbs to create binary code (on = 1, off = 0), and is done at higher rates than the human eye can detect.

The working of Li-Fi is very simple. There is a light emitter on one end, for example, an LED, and a photo detector (light sensor) on the other. The photo detector registers a binary one when the LED is on; and a binary zero if the LED is off. To build up a message, flash the LED numerous times or use an array of LEDs of perhaps a few different colors, to obtain data rates in the range of hundreds of megabits per second. The block diagram of Li-Fi system is shown in Fig. 3.

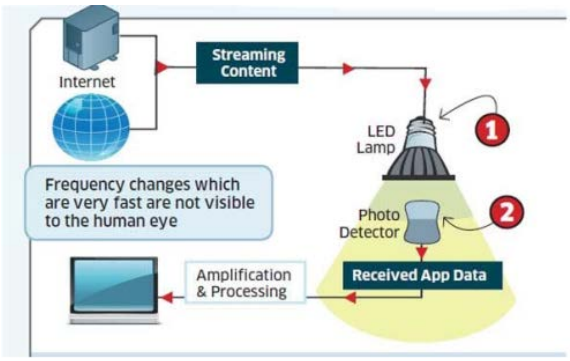


Fig 3. Location of visible light and RF frequencies at electromagnetic spectrum.

IV. PROPOSED SYSTEM

In this paper, the system as given in Fig. 4 is proposed.

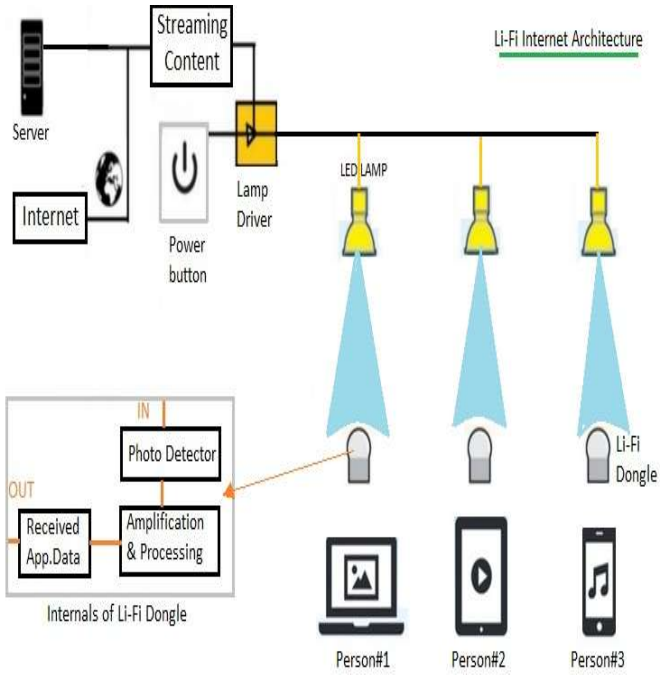


Fig 4. Proposed system

Li-Fi technology is implemented using white LED light bulbs for illumination by applying a constant current. If the LED is on, it transmits a digital 1 otherwise it transmits a digital 0. The LEDs can be switched on and off quickly to transmit data that can't be detected by a human eye. [2] So what we need for sending data are some LEDs and a controller that codes data into those LEDs and for receiving data, we need an Image Sensor, Photodiode which is used as a detector, these components are shown in Figure 5.

- High brightness Light-Emitting Diodes (LEDs) or any light sources, which acts as transmitter.
- A silicon photodiode has the roll of a detector and it shows a good response to visible wavelength.
- Communication channel is air or fibre optics

Fig 5. Components of Li-Fi system

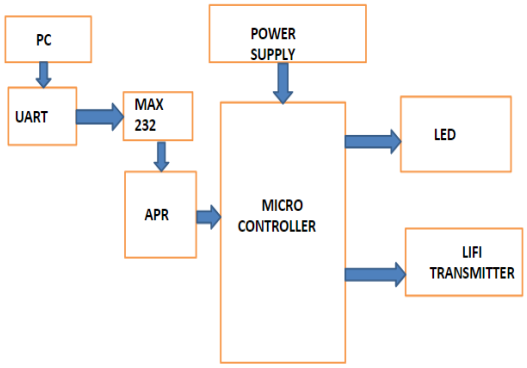
HARDWARE COMPONENTS:

1. Transmitter Section

The system architecture consists of a transmit section and a receive section. The transmit section consists of the data input which is then fed into a switching control system. Based on the data, the switching control generates a stream of 1s and 0s thereby encoding the data in binary. The output of this control is given to the array of LEDs which turn OFF and ON at extremely high speeds. This ON-OFF modulation of the LED light transmits the data. LED is the choice for light source since it consumes very less power when compared to fluorescent lamp or a

Fig 6. Receiver Section

light bulb. LEDs are also fast switching with good



visibility. Transmitter section shown in fig.6

2. Receiver Section

The receiver section consists LDR as a receiver having high sensitivity. We can also use the photo detector for same purpose. LDR decode the incoming demodulates the incoming received signal based on the sequence of1s and 0s. The demodulated signal is then sent to a signal conditioning unit than fed to PIC microcontroller, which decode that signal and then given to an output device such as an LCD display. Receiver section shown in Fig.7.

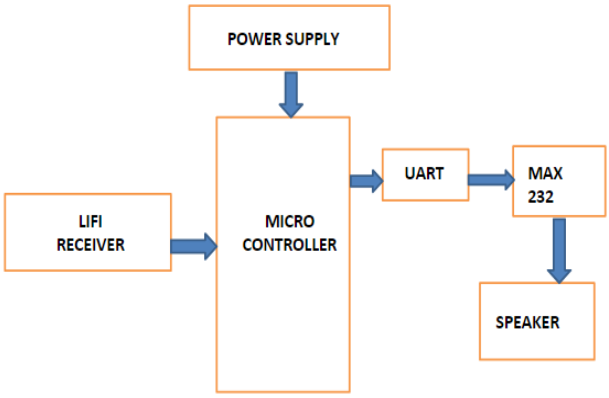


Fig 7.Receiver Section

V. COMPARISON OF WI-FI AND LI-FI

A. Problems in Wi-Fi

The following are the basic issues with radio waves:

a) Capacity: Wireless data is transmitted through radio waves which are limited and expensive. It has a limited bandwidth. With the rapidly growing world and development of technologies like 3G, 4G and so on we are running out of spectrum.

b) Efficiency: There are 1.4 million cellular radio base stations that consume massive amount of energy. Most of the energy is used for cooling down the base station instead of transmission. Therefore efficiency of such base stations is only 5%.

c) Availability: Availability of radio waves is a big concern. It is not advisable to use mobile phones in aeroplanes and at places like petrochemical plants and petrol pumps.

d) Security: Radio waves can penetrate through walls. They can be intercepted. If someone has knowledge and bad intentions, they may misuse it. This causes a major security concern for Wi-Fi.

B. Advantages of Li-Fi

➡The data transfer rate for internet application is higher.

➡ It provides high amount of security as data communication is line of sight (LOS). Moreover lifi signal covers low region does not pass through the walls. This will avoid unwanted access of lifi signal by unauthorized persons.

➡ The lifi devices consume low power for operation and hence used in IoT applications.

➡ It uses optical spectrum and hence avoids already crowded RF spectrum.

➡ As it operates on optical bands which are not harmful like RF spectrum. Hence there is no health concerns in LiFi based system.

➡ There is great amount of energy reduction in lighting industry which uses LiFi based devices.

➡ It is easy to install.

C. Disadvantages of Li-Fi

One of the major demerits of this technology is that the artificial light cannot penetrate into walls and other opaque materials which radio waves can do. So a Li-Fi enabled end device (through its inbuilt photo-receiver) will never be as fast and handy as a Wi-Fi enabled device in the open air.

Also, another shortcoming is that it only works in direct line of sight. Still, Li-Fi could emerge as a boon to the rapidly depleting bandwidth of radio waves. And it will certainly be the first choice for accessing internet in a confined room at cheaper cost.

VI. CONCLUSION

Li-Fi is the upcoming and on growing technology acting as competent for various other developing and already invented technologies. Since light is d major source for transmission in this technology it is very advantageous and implementable in various fields that can't be done with the Wi-Fi and other technologies. Hence the future applications of the Li-Fi can be predicted and extended to different platforms like education fields, medical field, industrial areas and many other fields. The possibilities are numerous and can be explored further. If this technology can be put into practical use, every bulb can be used something like a WiFi hotspot to transmit wireless data and we will proceed towards the cleaner, Greener, Safer and Brighter future.

VII. APPLICATIONS

1. Replacement for other technologies as compared with other wireless technology Li-Fi have great features, for money applications we can use Li-Fi as a wireless technology.

2. Road Safety and Traffic Management- Li-Fi can be used for communication between the LED lights of vehicles. It can also be implemented in the traffic lights for vehicle to roadside communication to update traffic information.

3. Public internet access through street lamps- Any lighting devices like street lamps, etc. are performed as a hotspot. It means that the any light able to spread internet using visual light communication which helps us to low cost architecture for a hotspot. The hotspot is a limited region in which some amount of device can access the internet connectivity.

4. Auto-piloted cars that communicate through their headlights which is useful to exchange traffic information between heavy traffic.

5. Point to point data communication between no. of devices.

6. Hazardous Environments: Li-Fi is a safe alternative to RF communication in environments such as mines and petrochemical plants which are susceptible to electromagnetic interferences.

7. Underwater Communication- for underwater communication use of radiofrequencies (RF) & use of Sound waves is impractical due to strong signal absorption. Li-Fi can be employed in such cases for underwater communication.

VIII. REFERENCES

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