Visible Light Communication "An Advanced Optical Wireless Communication Technology" Used in Li-Fi

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Abstract

Advent of information technology have enable the development of communication vertically and horizontally , the modern research has made the Visible Light Communication (VLC) technology, one of the advanced optical wireless communication technologies, which is green and clean in nature. Visible Light Communication, uses visible region (375nm-780nm) and is used as a more secure medium for data transmission.it achieves high data rates as compared to conventional wireless technologies like Wi-Fi, Bluetooth, Wi-max etc. the conventional technologies uses radio waves for communication. To overcome the shortage of bandwidth we can use light to transfer the data which is known as "DATA THROUGH ILLUMINATION". LED light bulb that varies in intensity is used and it cannot be followed by the naked eye. It is possible to encode various data in the light by varying the light at which the LEDs flicker on and off to give different strings of 1s and 0s.While using mixtures of red, green and blue LEDs to alter the light frequency encoding a different data channel. If we can't see the light then we cannot access the data easily hence the security would be snapped.

Keywords

Visible Light Communication (VLC), LED, Wi-Fi, Li-Fi, Multiplexing, Illumination, RBG

I. Introduction

Visible Light Communication (VLC) is based on white Light Emitting Diodes (LEDs) and are used for realizing ubiquitous wireless networks, because LEDs would be used for both illumination [1] and wireless transmission simultaneously. There are two common approaches to produce white light illumination by using LEDs. One involves blue colored LEDs with wide-band phosphors that produce the form white light. The alternative option is by means of red, green and blue (RGB) LEDs. The RGB solution is more used than phosphorous-based white LED because it improves the data rate, as in the latter case, the slow response of the phosphors can limit the modulation bandwidth whereas the power efficiency get reduced if it is combined with blue filter in order to reject the phosphorescent components [4]. Moreover the RGB LED scan be used for wavelength division multiplexing (WDM) which will increases the overall transmission capacity of network. However, to implement high speed wireless connectivity, the limited modulation bandwidth of the commercial LEDs (10-20 MHz) requires spectrally efficient modulation techniques, for .g. Orthogonal Frequency Division Multiplexing (OFDM) or Discrete Multi-Tone (DMT) [5].

II. Literature Survey

Development of the information communication Technology had made a very significant researches from traditional way of sending messages from smokes, birds, pigeons to the1st generations to the 5th generation

Sending messages from one place to other place to sending a bulk data of audio, Video and doing processing simultaneously. VLC is a communication medium for data, which uses visible light ranges between 400 THz (780 nm) and 800 THz (375 nm) as a optical carrier for data transmission and illumination. It uses fast pulses of light to transmit information wirelessly. The main components of this communication system are:

1) a high brightness white LED, Which used as a communication source and 2) a silicon photodiode which act as a good responder to visible wavelength region serving as the receiving element. LED can be switched on and off several times to produce digital strings of 1s and 0s as a data. Data can be encoded in the light to produce a new stream of data by varying the flickering rate of the LED bulb. It can work, by modulating the LED light and the data signal, the LED illumination act as a communication source .This paper uses the concept of the cost effective clean and green technology of the communication. It will simplify the essence of communication requirement of life at one end and also used to save the energy at another end. It will help in boosting our economy, as our power requirement will be at the saving end.
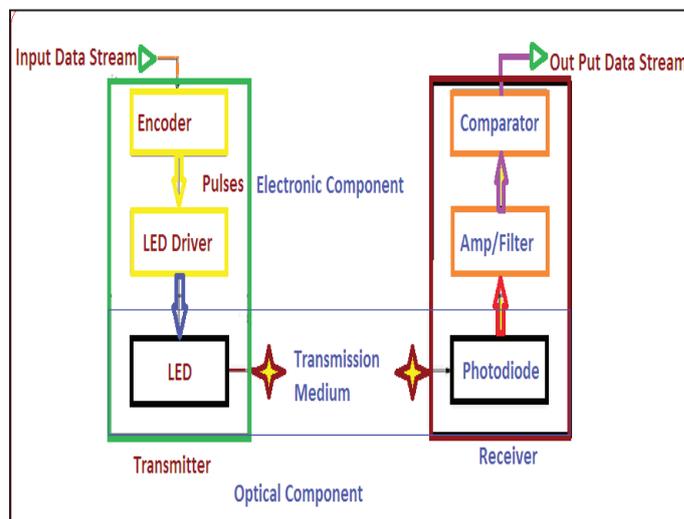
A. Research Methodology Used

Fig. 1:

Hardware will be designed using Software and Implemented on Hardware.

The Block diagrams shown above have the two main sections:
- **Software section.** It is basically the software section of the system, shown the circuit diagram shown below.
- **Hardware Section.**
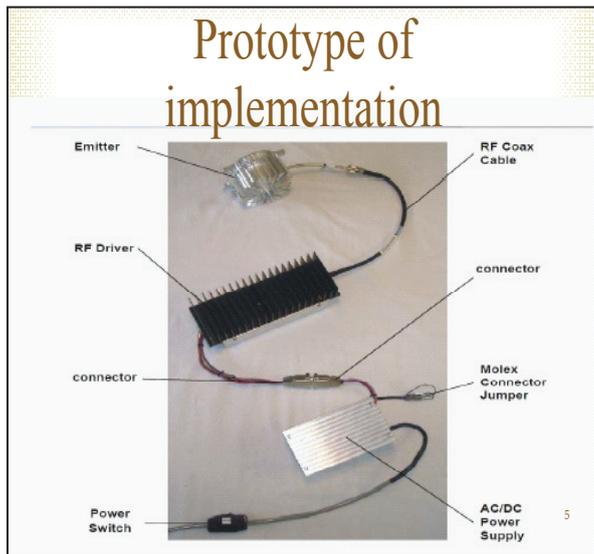
Prototyping of Implementation:

Fig. 2: Showing the details of the prototype cct for implementation

Details about the circuit of prototype have been shown in the picture showing.

1. Emitter
2. RF driver
3. Radio frequency coaxial cable
4. Molex connect jumper
5. Connectors
6. Power supply
7. AC/DC power supply.

B. Comparison Between VLC & Wi-Fi

Comparision is based on the various PARAMETER of VLC V/S Wi-Fi. The increasing growth of LEDs (Light Emitting Diodes) for lighting provides the opportunity to incorporate VLC technology into a LED environments. VLC is particularly suitable for many popular internet applications which requires "content consumption" such as video and audio downloads, live streaming, etc. These applications requires a heavy downlink bandwidth, but require minimal uplink capacity. In this way, the majority of the internet traffic is off-loaded from existing RF channels, thus also extending cellular and Wi-Fi capacities. Some people claims that they are hypersensitive to radio frequencies and are looking for an alternative. Li-Fi is a good solution to overcome this problem. Instead it is a boon to the modern communication Engineering.

	Property	VLC	RF
	Bandwidth	Unlimited, 400nm~700nm	Regulatory, BW Limited
	EMI	No	High
	Line of Sight	Yes	No
	Standard	Beginning (IG-VLC)	Matured
	Hazard	No	Yes
Mobile To Mobile	Visibility (Security)	Yes	No
	Power Consumption	Relatively low	Medium
	Distance	Short	Medium
Infra to Mobile	Visibility (Security)	Yes	No
	Infra	LED Illumination	Access Point
	Mobility	Limited	Yes
	Coverage	Narrow	Wide

Fig. 3: Showing the Comparision of VLC(Li_Fi) V/S R.F.(Radio Frequency

C. Results

Data can be transmitted through light easily. If this technology is practically used then every bulb can be made to transmit wireless data and we will ultimately proceeding to greener, cleaner and safer future. This can also solves the major issues like shortage of radio-frequency bandwidth and can be realized in aircrafts or hospitals applications. Hence by using this technology the data transmission rate can be increased where the air waves are clogged due to increase in consumption of wireless internet.

D. Applications of VLC. (Li-Fi)

Li-Fi, have a wide range of applications and advantages , over the existing Technology of data communications, beside the energy efficient communication system, it has a trendies superiority of all other data communication system. The speed and vide spectrum availability on the VLC is one of the important characteristics. Important advantages and applications may be summaries as under:

1. Real time Medical Observations

For a long time, medical technology has lagged behind the rest of the wireless world. Operation Theatres do not allow Wi-Fi over radiation concerns, and there is also a lack of dedicated spectrum. In hospitals, interference from cell phones and computers can block signals of monitoring equipment. Li-Fi can used to solve both the problems: lights are not only allowed in operating rooms, but tend to be the most glaring fixtures in the room. And, as Harald Haas mention in his TED Talk, Li-Fi has 10,000 times the spectrum of Wi-Fi, hence we can, dedicate the red light to medical data.

2. Airlines

Airline Wi-Fi. United is planning on speeds as high as 9.8 Mbps per plane. Li-Fi could easily introduce that sort of speed to each seat's reading light.

3. Smarter Power Plants

Wi-Fi and many other radiation types are bad for sensitive areas. But power plants need a fast, inter-connected data systems to monitor things such as demand, grid integrity and core temperature (in nuclear plants). The savings of proper monitoring at a single power plant can add up to hundreds or thousands of dollars. Li-Fi offers safe, abundant connectivity for all the sensitive locations. Not only it would save money, but the draw on a power plant's own reserves could be lessened if they haven't yet converted to LED lighting.

4. Undersea Awesomeness

Remotely Operated underwater Vehicles, toys of treasure seekers and James Cameron, all are operated with large cables that supply power as well as used 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 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.

5. It Could Keep You Informed and Save Lives

If there's an earthquake in New York. Or a hurricane. Take your pick — it's a wacky city. The average New Yorker may not know what the protocols are for those kinds of disasters. Until they

pass under a street light. Remember, with Li-Fi, if there's a light, you're online. Subway stations and tunnels, common dead zones for most emergency communications, pose no obstruction. Also less stressing cities could opt to provide cheap high-speed Web access to every street corner.

E. Advantages of Li-Fi

Although the use of light in order to transmit data can be limited in comparison to radio waves, there is a great amount of possibilities that can be developed due to LI-FI technology. In essence, a single pixel of a monitor could transmit a single channel of information to a source. Although LI-FI Technology is still in its infant stage, the usefulness of this LI-Fi Technology has Implications for a great amount of Goods.

1. Distance Coverage

The sheer range of transmitting information could be worth the decrease in Data Speeds. In this context the ROJNA project in the Czech Republic can transmit a 10 Mbit/s Ethernet –type link just under a mile. As developments of this aspect continue, the range could be entirely up to the strength of the light which is emitting the information. Although the speeds are less than what they are gigabit Ethernet. The power of beam can allow DVD-quality streaming of video to any location connected to the LI-Fi device.

2. Cost

Instead of running close to a mile worth of cable, The LED –powered LI-FI connection could be used to beam the information directly to the destination. Using a point-to-point array, office buildings can stay connected to each other without the use of additional cables being laid from one access point to another. The only problem the two buildings would be faced with as obstruction by solid objects or dense weather patterns such as heavy fog or snow.

3. Traffic Updates

Could you imagine having a car that uses a GPS System that receives? Information from traffic lights informing you of accidents and/or delays up ahead? This is a kind of system like that already in play for GPS navigational systems. But the traffic lights could be updating drivers using basic information or streaming video directly from news broadcasts.

4. Games Consoles

An innovative idea would be to put sensors on a Television in order to Receive information from game consoles. This would allow the unit to be place literally anywhere within the room as long as there is a direct line of sight to the sensor. Could you imagine a game system like the Xbox using a Kinect and all of it being completely wireless except for the power going into the unit. That could be tackled once wireless energy is perfected for practical home use.

6. Television Interaction

Instead of using apps or additional installations, you could theoretically hold you phone up as you sit on the couch and have every piece of information regarding the show or movie you are currently watching sent to your display-even recording directly to your mobile device. Of course, this may spawn some kind of copyright lawsuit because you are illegally coping a movie or Television Show, but you still get the idea. There are a numbers of reasons why investing in LI-Fi technology can have a great

benefit to the future of wireless networking. Although there are a few aspect that need to be ironed out before it can be introduced on a wide scale of practicality, the future looks to be very promising. Even if the technology was merely developed as a small scale indoor application to beam information directly to a computer system without the use of Ethernet cable being strewn about the floor, visible light communications could set the benchmark higher for wireless transmissions. Beside the above it is also proven and may come forward in the days ahead with the developments of the LI-FI Technology.

1. High speed, as high as 500mbps or 30GB per minute
2. Li- Fi uses light rather than radio frequency signals,
3. VLC could be used safely in aircraft,
4. Integrated into medical devices and in hospitals as this technology does not deal with radio waves, so it can easily be used in such places where Bluetooth, infrared, Wi-Fi and internet are banned. In this way, it will be most helpful transferring medium for us.
5. Under water in sea Wi-Fi does not work at.
6. There are around 19 billion bulbs worldwide, they just need to be replaced with LED ones that transmit data. We reckon VLC is at a factor of ten, cheaper than WI-FI.
7. Security is another benefit, he points out, since light does not penetrate through walls.
8. In streets for traffic control. Cars have LED based headlights, LED based backlights, and Car can communicate each other and prevent accidents in the way that they exchange Information. Traffic light can communicate to the car and so on.
9. By implementing the Technology worldwide every street lamp would be a free access point.
10. Li-Fi may solve issues such as the shortage of radio frequency bandwidth.

F. Disadvantages

Still there are some backdrops like it can only transmit when in the line of sight well it can be sorted out someday and will be used in some applications.

III. Conclusion

As Li-Fi technology is in its inception stage , as no research of its arena and morphs has been carried out yet in the international sphere till now. Recently, some work has been done by China, but the cost is very high, which is not feasible. And still its inception stages, furthermore this is an attempt in this direction. With the Development of the technology, and its application for the industrial use. It can be put in to practical application. Every bulb/LED can be used something like a WIFI hotspot to transmits wireless data. By the implementation of the technology we will proceed towards the cleaner, greener and safer brighter future. The possibilities are numerous and can be explored further. The concept of Li-Fi is attracting a great interest, because it may provide a very efficient and genuine alternative to radio-based wireless. Proposed research Scheme shall be shown as a result oriented study of high speed wireless data transmission and reception using visible light spectrum and in addition to transfer the power through wireless and be an efficient energy saving alternative of Wi-Fi .As increase in number of people and their many devices consuming wireless internet, the airwaves get clogged, making it more and more difficult to get a reliable, high-speed signal. This may also use to solve issues such as the shortage of radio-frequency bandwidth and it also allows internet where traditional radio based

wireless cannot used such as aircraft or hospitals, having many other tremendous Applications. This concept has opened a lot of scope for further and future research in this area. As ,our nation is leading towards the Digital India concept may be true ,which may not only make the country financially empowered but also the covered the nation with high speed economic data utilized services. In case researcher get together on the topics for further development.

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