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High Speed Transmission of Data or Video Over Visible Light Using Li-Fi

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***Abstract*—We use a number of wireless devices to access the internet in a modern world of technology. Wireless communication is used by most of these devices. Because of the lack of radio spectrum, we can't use the electromagnetic spectrum for a longer period of time. This will lead to network complexity, bandwidth shortages, and increase the risk of interferences between radio frequencies. A new technology in wireless communication called Li-Fi uses light instead of using radio waves to transmission of data and it has an assured future. Data is transferred using light-emitting diodes in the visible spectrum.When compared to Wi-fi, it offers a less delay, higher efficiency, and the ability to transfer high amounts of data. Data is secure using Li-fi because it cannot penetrate walls, so it cannot be hacked. In this paper, the aim is to design Li-fi transceivers for high-speed data and video transmission.**

Keywords— Li-Fi, VLC, Wi-Fi, Light Emitting Diode and data transmission.

I.INTRODUCTION

Professor Harald Haas coined Li-Fi (light fidelity) at TED Global in 2011 Li-Fi is an optical system that uses light emitting diodes to communicate. The electronic device uses Li-Fi that connects to the network without using wire. The transceiver is responsible for helping Li-Fi to communicate between nodes by transmitting and receiving data. By modulating the transceiver, Utilizes the light to carry data on the LED. High speed data transmission done through LED bulbs. LED bulbs can have very high data rates and have very high intensity [9].The coming of Li-Fi is to get the better of current advancement. Due to the shortage of radio frequency wealth, the usage of Wi-Fi has been reduced. As this fresh technology comes, the use of the internet has increased.

According to this technology, there are many differences associated with Wi-Fi, such as data transmission speed, traffic density, and security. A greater number of Wi-Fi devices may result in more traffic. In Wi-Fi technology, if the number of users is increased, more routers can't be added, so we use light for transmission. A big issue at present is the safety and efficiency of the internet. It is claimed that Li-Fi is much faster than Wi-Fi [13].In comparison with Wi-Fi, Li-Fi is thousands of times rapid [8].According to the spread of the signal, Li-Fi has better internet safety thanWi-Fi. In Li-Fi, light cannot penetrate the wall because it has light characteristics. When we communicate with Li-Fi in interior space, if there is an outflow in the wall, we can accessthe internet by limiting the range of an LED beam also we can use our car headlights to transmit data. In the coming years,[11] there is a drastic growth in spectrum crunch, internet of things and this will lead to huge ramifications.

II. LITERATURE SURVEY

Visible light communication (VLC) gives information about modulating light in an optical region that is conspicuous to human eye by wireless communication. In the wireless communication field, 3G, 4G, 5G and other technologies keep developing at an almost constant pace. A forthcoming crisis is anticipated due to the lack of adequate Radio Frequency [15], this restriction in bandwidth cannot handle the development in demand for more data rates and more multitude of communication systems.The expansion or enhancement of wireless services and the user demand also being exaggerated for these services, but the Radio Frequency spectrum available for their use is modest. So, Li-Fi then became a fresh technology. VLC is a medium for data communication, it

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utilizes visible light to transmit data, utilizing a range between 400 and 800 THz (780–375 nm).

The VLC technology belongs to the optical wireless communication technology group. The 5G Visible Light Communication is based on the usage of light emitting diodes (LEDs) identical to WI-FI and uses LEDs as a medium for faster communication [11]. It transmits the data through bulbs and other lighting apparatus to conserve a large amount of electricity. It cannot cause interference, so it can be used in aircraft. For data transmission Wi-Fi uses radio waves but here, light as a conveyor and it cannot overflow walls. The Li-Fi transmitter is commonly equipped with white LED bulbs [5]. Changing the speed of the current flowing through the LED, we can change the output rapidly. The functioning of the LI-FI is uncomplicated— The LED transmits digit 1 when it is ON, and digit 0 when it is off.

By varying the LEDs flicker rate, various data can be encoded and transmitted. Li-fi has beat existing technologies, consisting of LED as the medium for transmitter and receiver being a photodetector, to make a LED working correctly Lamp driver has been used, amplification and processing are two methods that are conducted to control the signals that comes out from a photodetector. An LED needs a driver to operate properly, and an amplification circuit and processing circuit manage the signal generated from the photodetector.

III. PROPOSED SYSTEM

In this applied science, transmitting data in the visible spectrum is done with LEDs. There are more advantages to it than Wi-Fi, including increased spectrum accessibility, ability, secured, lower latency and faster speed. In order to communicate, LEDs are switched on and off at a higher speed that cannot be sensible to human eyes.

IV. VISIBLE LIGHT COMMUNICATION SYSTEM DESIGN

There are two sections in visible light communication system: the transmitter and the receiver.

This system was mainly comprised of Arduino UNOs, MCUs, amplifier modules, a filter module, LED drivers, transmitting and receiving circuits. Now, let's take a closer look at this system's communication process: First and foremost, the PC is a primarily a device for producing data, it transmits the data to Arduino UNO using UART cable which is programmed to modulates the data. A visible channel transmits the signal to photodiodes, which receive it. After the amplification and modulation procedure, the data is transmitted and it is received at the receiver side.

4.1. Transmitter Section:

In this section,there is a Li-Fi transmitter, Arduino UNO, LED driver.

In the process, the video has been transmitted through UART cable which is ported in the PC by connecting to the respective port. Hence, the transmission of data rate is so high, so the light flickers at high speed. The human eye perceives it as a constant source of light.

The transmitted data will be digits (zeros and ones). When the digital signal drives the LED, for 1 the LED turning led ON and for 0 the LED turning led OFF.Fig.1 shows the schematic diagram of the Li-Fi transmitter.

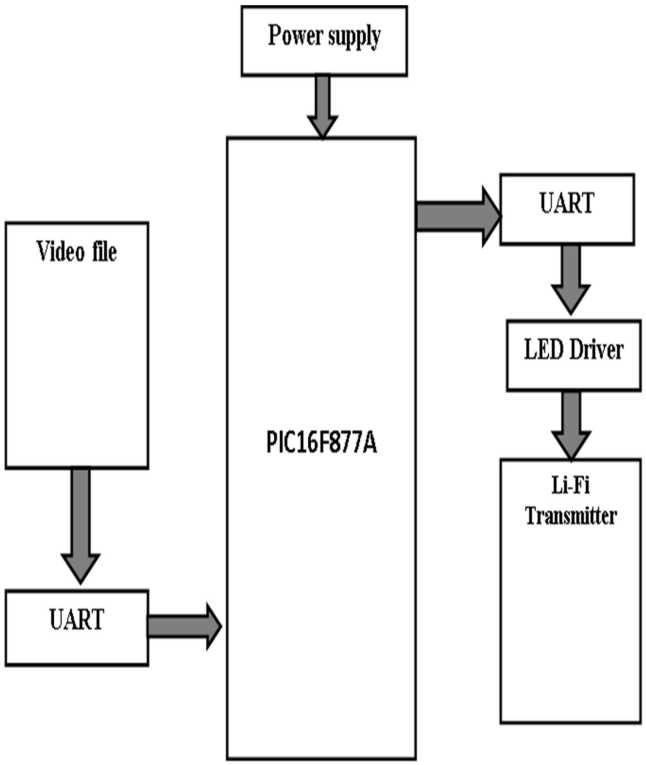

Fig 1: Transmitter module of Li-Fi

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Fig 2: Li-Fi transmitter kit

4.2. Receiver Section:

In this section, there is a Li-Fi receiving module, Arduino UNO, and an amplifier.

In the receiver module there is a photo detector. A photodetector detects the data and transmits it via light, the data is then passed to an amplifier, all these processes is done when the light fall over a photodetector. Data will be extracted from the received signal by a microcontroller after amplification and passage to it. By using digital to analog converter, the digital data will be transformed to analog data. The errors are detected by the microcontroller based on the intensity of light, and the error-controlled video signal is received to the connected PC. The video signal is received when it reaches the exact baud rate, then the video will be ready to play. Fig.3 shows the schematic diagram of the Li-Fi receiver.

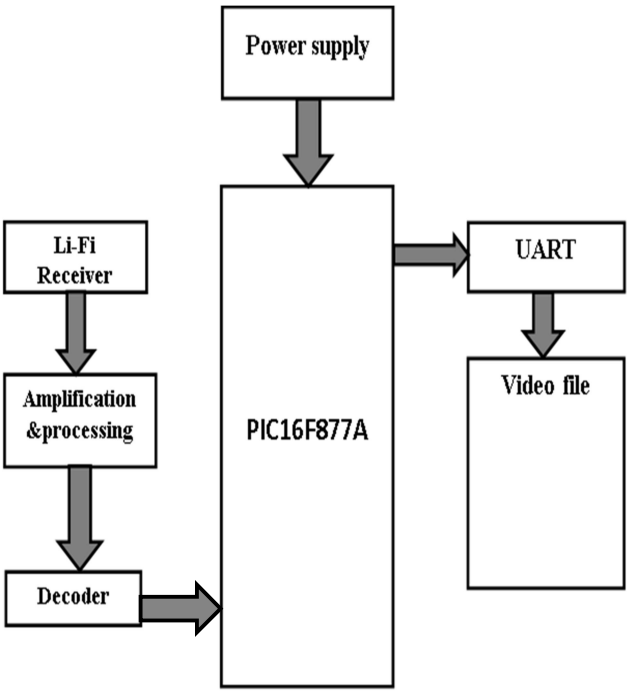

Fig 3: Receiver module of Li-Fi

Figure 4: Li-Fi receiver kit

In fig 2 and fig 4, Data cannot be transferred if an obstacle is between the transmitter and receiver. i.e., transmitter and receiver antennas should be lined up.It requires Line of Sight.

Table I: Li-Fi versus Wi-Fi comparison

Li-Fi	**Wi-Fi**
Li-Fi - Light Fidelity	Wi-Fi - Wireless Fidelity
Coined by Prof. Harald Haas in 2011	Coined By National Cash Register Co in 1991
Transmission of data using light with a help of led bulbs	Transmission of data using radio waves with a help of Wi-Fi router
Data transfer speed up to 224 GB per second	It's data transmission speed varies from 150Mbps to 2Gbps

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The walls prevent light from passing through, so the data transfer is highly secure	The walls can transmit radio waves, so data can't be transferred as much secure
The radio spectrum has ten thousand times the frequency	2.4Ghz, 4.9Ghz and 5Ghz
Around 10 to 15 meters	Around 32 meters (Variations depending on transmission power and the types of antennas)
Utilized in a high-density environment	Utilized in an environment with small density due to issues related to interference
Light Emitting Diode (bulb), LED drivers and photo sensor	Wireless routers, Modem and accessing points
Utilized in hospitals, aviation's, deep oceanic exploration etc.	The Wi-Fi hotspot is used to access the internet.

V. HARDWARE COMPONENTS

*5.1) ARDUINO UNO:*Fig 5 shows Arduino UNO,coined by Arduino.cc. It is based on the microcontroller ATmega328P from Microchip, it is open-source. There are analog and digital input/output pins on the board that can interface with expansion boards and other circuits.

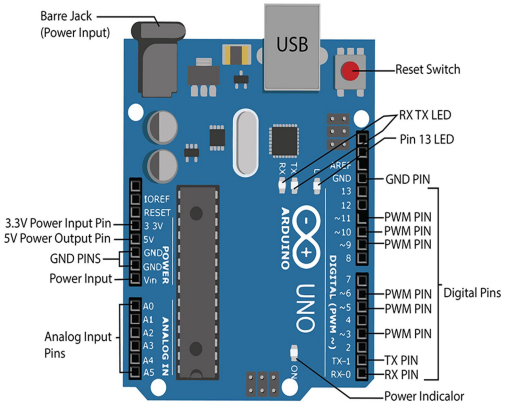

Fig 5: ARDUINO UNO

*5.2) UART:*The Universal Asynchronous Receiver Transmitter (UART) is shown in fig 6, it is a basic serial Input/output module present on the dsPIC30F family of devices. It is an asynchronous system that have capable of communicating with peripherals, such as PC, interfaces of RS-232, and RS-485.

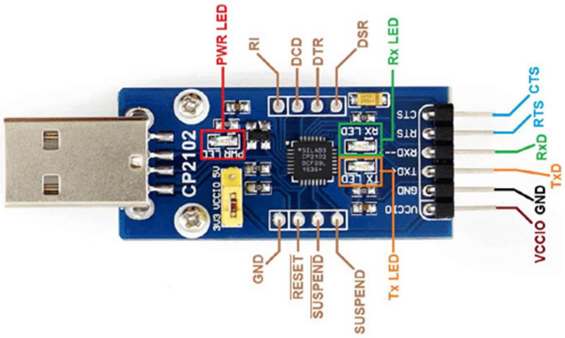

Fig 6: UART

*5.3) LED DRIVER:*An LED driver is shown in fig 7, it is an electrical device that regulates power to an LED or a string of LEDs. Basically, the forward voltage is the voltage required to conduct electricity and light up a light emitting diode. With increased temperature, decreases in the forward voltage of an LED,which causes the LED to draw more power.

Fig 7: LED DRIVER

*5.4) RS232:*RS232 is shown in fig 8. In communications, Data Terminal Equipment and Data Circuit-terminating Equipment use the RS-232 standard for serial binary data transmissions. It is generally found on serial ports on computers.

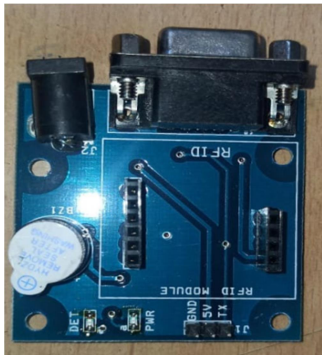

Fig 8:RS232

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Fig 9: Snapshot of Transmitter and Receiver

VI.STUDY RESULT

In this paper we have transmitted the video successfully by using Li-Fi technology. Here we have made a comparison between Wi-Fi and Li-Fi speed and the time taken to receive the Data.

Table II: Experimental Wi-Fi in different video size

No	Video Size	Time taken to Receive (WI-FI)	
		Theoretical	*Actual*
1	1GB	1min30sec	1
2	5GB	8min30sec	2
3	10GB	16min	3
4	15GB	25min	4

In this tableII, we have transferred a various size of video through Wi-Fi and noted their time taken to receive. In theoretically the average speed of Wi-Fi is 10 Mbps but the actual average speed is 5.5Mbs.

Table III: Experimental Li-Fi in different video size

No	Video Size	Time taken to Receive (LI-FI)	
		Theoretical	*Actual*
1	1GB	1sec	11.11sec
2	5GB	5sec	55.56sec
3	10GB	10sec	1.8min
4	15GB	15sec	2.7min

In this tableIII, we have transferred a various size of video through LI-Fi and noted their time taken to receive. Actually, the Li-Fi speed is 224GB/s. In theoretically the average speed of Li-Fi is 1GB/s, but the actual speed is 90Mbs, this time delay is due to USB to RS232 converter which is used to transmit/receive the video.

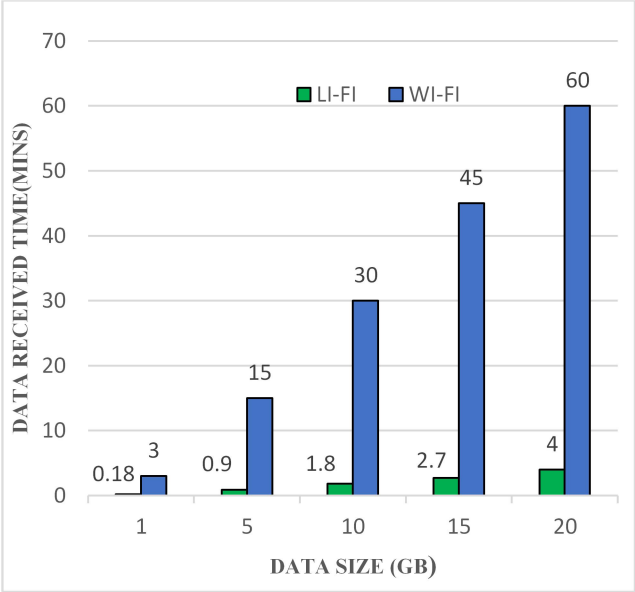

Fig 10: Li-Fi and Wi-Fi Data transfer

In this Fig 10, we have made a comparison to show the speed of Li-Fi and Wi-Fi. In LI-Fi, the time taken to receive the data is lessthan Wi-Fi. It shows that the Li-Fi is rapid than Wi-Fi.

VII.CONCLUSION

In this, we proposed a real-time high- quality video/picture signal transmission using LED. As compared to Wi-Fi, this is much better. The use of Li-Fi technology will become more popular in the future, as it will enable cleaner, greener, safer communications and have a positive impact on the environment. This technology uses light to transmit the data and the coverage distance is about 10-15m. There will be a consumable of light everywhere so there will be great scope for Li-Fi. In addition to providing more security, minimal cost, the transmission of data is easy, and communication is reliable. Li-Fi can be utilized in applications like industry, medico, army, and aviation.Optical wireless communication is set to become the most assuring technologies for the future.

VIII.FUTURE WORK

VLC's future Right now, as a connectivity source, Li-Fi cannot replace Wi-Fi at the moment but there are several companies in the Li-Fi market that are working hard to

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develop Li-Fi products and market Li-Fi as a primary connectivity technology. Every day, the need for faster data transfer and access to high-speed internet grows, and light fidelity may be the technology that can meet these needs. The future of the internet is looking bright with the rise of Li-Fi. It is an exciting time and we all look forward to it.

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