International Journal of Advanced Technology in Engineering and Science
Vol. No.3, Special Issue No. 01, November 2015
www.ijates.com
ijates
ISSN 2348 - 7550

IMPLEMENTATION OF HIGH SPEED DATA TRANSMISSION USING VLC

Sarah Monica . S[1], V. Muralidharan[2]

[1]UG Scholar/ECE.,[2]Assistant Professor/ECE Christ the King Engineering College, (India)

ABSTRACT

In recent trends, wireless communication Wi-Fi is gaining tremendous importance. Today connectivity is of greater concern. In-flight Wi-Fi is now accessible around 40%, but there subsist problems since connection is slow and unreliable. Wi-Fi is also menacing and by means of satellite which is economically unsurpassable. Hence to overcome this with a reliable one there comes LI-FI Technology. In this LED is used for data transmission by switching it ON(1) and OFF(0) posthastly in nanoseconds which is not seen by naked eyes. Li-Fi provides internet connectivity up to 10Gbps.We can employ this technology of wireless communication in more electromagnetic sensitive area that is in aircraft for traffic management.

Keywords: LED, VLC, Wi-Fi

I. INTRODUCTION

Light fidelity is an exciting quantum leap in 5G VLC system and the future of wireless internet access. Wi-Fi plays a role in aircraft communication but it's not durable and its getting lessen importance due to these following reasons given below [2]

- Physical Obstructions
- Network range and distance between devices
- Wireless network interference
- Signal sharing
- Network usage and load
- Wireless signal restriction

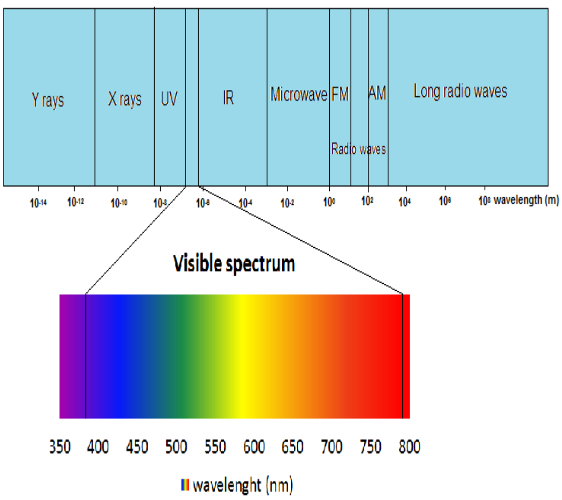
The above hitch ill in Wi-Fi technology can be overcome by Li-Fi technology. It's very simple, if the LED is ON, you transmit digital 1 if it's OFF you transmit a 0. The LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting data[5], [6].'Internet of Things' is an optical communication technology that's taking the world by storm. Light Fidelity or Li-Fi, is an exciting breakthrough in 5G visual light communication systems and the future of wireless Internet access. With Li-Fi, information hitches a ride along a spectrum of visible light. Light emitting diode (LED) bulbs transmit data when they are switched on and off so rapidly in nanoseconds, that the human eye cannot see it. This data is registered special equipment, making it possible to provide wireless Internet connectivity at a current experimental high-security buildings. As radio waves used by Wi-Fi get more congested and the demand for faster and more efficient wireless communication escalates, the future is bright for Li-Fi as a reliable, affordable and more secure solution. Smart phones will soon be able to download traffic information from traffic lights or a program guide from a television.

II. LITERATURE SURVEY

In 2011, Professor Harold Haas from the University of Edinburgh in the UK, suggested an idea called "Data through illumination" [4]. He used fibre optics to send data through LED light bulbs. Light modulation certainly is not a new concept, but Haas is looking to move things forward and enable connectivity through simple LED bulbs. With Li-Fi, we can connect to the internet simply by being within range of an LED beam, or we could conceivably transmit data using our car headlights. The ramifications of this are huge, especially with the internet of things in full swing and the much mooted spectrum crunch expected to bite increasingly hard in the coming years.

LI-FI is a new technology which uses visible light for communication instead of radio waves. It refers to 5G Visible Light Communication systems using Light Emitting Diodes as a medium to high-speed communication in a similar manner as WI-FI [6]. It can help to conserve a large amount of electricity by transmitting data through light bulbs and other such lighting equipments. It can be used in aircrafts without causing any kind of interference. LI-FI uses light as a carrier as opposed to traditional use of radio waves as in WI-FI and this means that it cannot penetrate walls, which the radio waves are able to. It is typically implemented using white LED bulbs at the downlink transmitter [1]. By varying the current through the LED at a very high speed, we can vary the output at very high speeds. This is the principle of the LI-FI. The working of the LI-FI is itself very simple—if the LED is ON, the signal transmitted is a digital 1 whereas if it is OFF, the signal transmitted is a digital 0. By varying the rate at which the LEDs flicker, we can encode various data and transmit it.

Li-Fi is no longer a concept or an idea but a proven technology, albeit still at its infancy. Already, several experts in the field of communication have attested that Li-Fi technology would soon become a standard adjunct to Wi-Fi. That is, until its inherent limitations could be overcome. Since it is light-based, its major drawback is that it won't be able to penetrate solid objects such as walls. Though it could also mean privacy for the personal user, it also questions its use for large scale delivery of data transmissions.



III. EXISTING METHOD

Wireless Fidelity (Wi-Fi) uses radio waves to send and receive information. in fact, its lot like two way radio communication. A PC or Wi-Fi devices translates the data into radio signals and transmits using antenna. A wireless access point receives the signal, decodes it, then sends info to internet

Table 1: Various Standards Used and Their Data Rate Speed

Standard	Release date	Speed
802.11b	1999	11Mbps
802.11a	1999	54Mbps
802.11g	2002	54Mbps
802.11n	2007	72-600Mbps
802.11ac	2013	433Mbps-1.3Gbps

Earlier 802.11a/b/g networks relied on single antenna and single data stream. With the introduction of 802.11n specification, Wi-Fi can harness the power of up to three antennas and streams to dramatically improve speed, range and reliability.802.11ac builds on these improvement with capability to transmit to and receive from multiple users at the same time(instead of one at a time) by using multiuser MIMO(MU-MIMO) technology.80.11ac supports up to three antennas and streams today and will be able to support up to eight antennas in the future. Throughput which is more accurate measurement of Wi-Fi network speed takes into account all the bits eaten up by network overhead and environmental factors. Although the touted data- rate speeds don't happen in the real world, they still serve as a useful benchmark. In general, the higher the data-rate speeds, the higher the corresponding throughput. In addition, the data rate drops with each new connected device.

In Wi-Fi throughput is not ideal is various accordingly to the thrive in a crowded Wi-Fi world [5]. All this congestion is already straining the capabilities of the existing Wi-Fi standard 802.11n, and slowing down your digital life. As the 802.11 specification[8] evolved to support higher throughput, the bandwidth requirements also increased to support them.802.11n uses double the radio spectrum/ bandwidth(40Mhz) compared to 802.111a or 802.11g(20Mhz)[citation needed].This means there can be only 802.11n network on the 2.4Ghz band at a given location, without interference to/from other WLAN traffic. 802.11n can also be set to limit itself to 20 MHz bandwidth to prevent interference in dense community. Now many newer consumer devices support the latest 802.11ac standard, which uses the 5Ghz band exclusively and is capable of multi-station WLAN throughput of at least 1Gigabit per second. Wi-Fi connections can be disrupted or the internet speed lowered by having other devices in the same area. Many 2.4Ghz 802.11b and 802.11g access-points default to the same channel on initial startup, contributing to congestion on certain channels. Wi-Fi pollution, or an excessive number of access points in the area, especially on the neighbouring channel, can prevent access and interference with other devices use of other access points, caused by overlapping channels in the 802.11g/b spectrum, as well as with decreased signal-to-noise ratio (SNR) between access points. This can become a problem in high density-areas, such as large apartment complexes or office buildings with many Wi-Fi access points.

Table 2: Comparison of Speed of Various Wireless Technologies Technology Speed Wi-Fi – Ieee

802.11n	**150Mbps**
Bluetooth	**3Mbps**
IrDA	**4Mbps**
Li-Fi	**>1Gbps**

IV. PROPOSED METHOD

LI-FI means transmission of data through illumination (i.e. sending data through a LED light bulb) that varies in intensity faster than human eye can follow and its not visible to our naked eyes**.**

5.1 Audio and Video Transmission

S/PDIF Converter (Sony/ Phillips Digital Interface) is most commonly used standard format for digital data transmission. S/PDIF is a data link layer protocol, which contains a set of physical layer specifications for carrying digital audio signals between devices and components over either optical or electrical cables. Its employing small differences in the protocol and requiring less expensive hardware. In S/PDIF, the digital data stream is encoded using the bi-phase mark code (BMC) also known as the differential Manchester encoding, which is a kind of phase modulation in which clock and data signals are combined to form a single two-level self-synchronizing bit stream (see Figure 1), where the level change occurs at the beginning of every bit period. Its a differential encoding scheme, it uses the presence or absence of transitions to indicate a logic values. Logics 1 and 0 are represented by mid-bit and no mid-bit level changes thereby offering built-in synchronization capabilities[6]

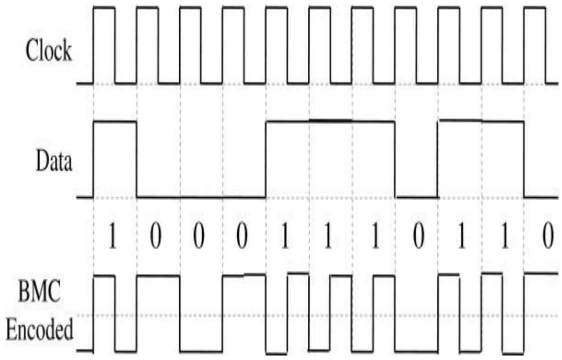


Fig. 1: Clock, Data and BMC Encoded Signal

Analog TVs adopt a composite video signal commonly used analog video interface. Composite video is also referred to s CVBS(Colour Video Blanking and Sync) or the composite video baseband signal, which combines the brightness information (luma), the colour information (chroma), and the synchronizing signal just on one line as shown in the below figure2.

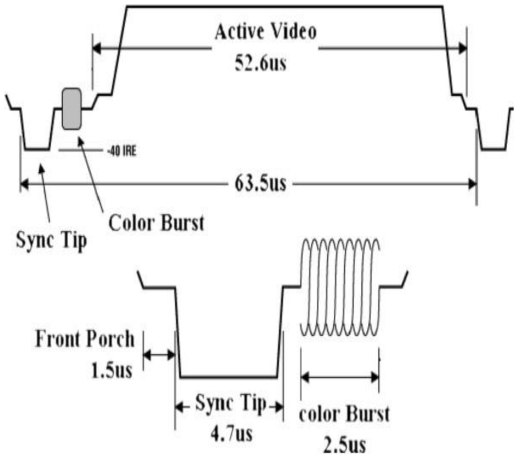


Fig. 2: The All-White NTSC Composite Video Signal.

There are three standard analog TV formats such as Phase Alternating Line(PAL), National Television System Committee (NTSC), and Sequential Colour with Memory (SECAM). PAL uses 4.43 MHZ, NTSC uses 3.58 Mhz, and SECAM uses 4.53 MHZ colour subcarriers. A very high bit rate is required if we use analog-to-digital conversion (ADC) for video transmission. For example, with an 8-bit ADC, the sampling rate must be 10MS/s and the resulting output data rate from the ADC, the sampling rate must be 10MS?s and the resulting output data rate from the ADC for video transmission will be 80Mb/s. The maximum modulation frequency of the ordinary high-brightness LED is around 20Mhz, which is not sufficient to support 80 Mb/s. Therefore, one solution would be to employ pulse time modulation schemes such as Pulse Width Modulation (PWM), Pulse Frequency Modulation (PFM),Square wave FM,etc..,

5.2 Audio and Video Transmitter

The schematic diagrams of audio and video transmitter modules are illustrated in Figure3. In Figure3a, the analog audio signal is amplified and digitized prior to being converted into an S/PDIF format. The S/PDIF audio signal drives a 4 × 5 white LED cluster made up of blue LEDs with yellow phosphor. In Figure 3b, the amplified analog video signal that passed through a band-pass filter is compared with the reference saw tooth carrier signal, which generates the naturally sampled PWM signal that drives a 5*5 red LED cluster. The colours of the LEDs for each signal depend on the transmitted optical power.

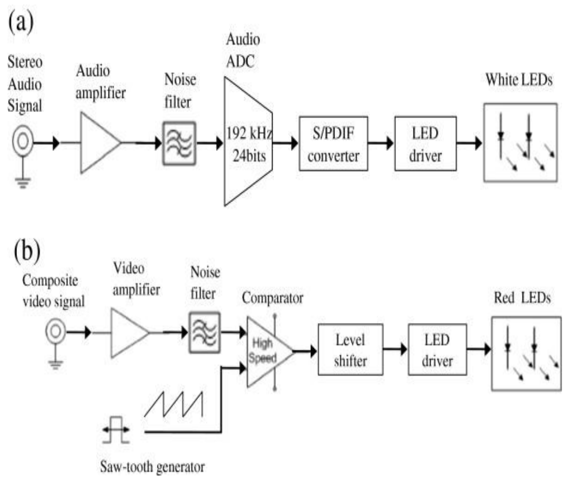


Fig. 3: The transmitter system block diagrams: (a) audio and (b) video.

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ISSN 2348 - 7550

The output of the ADC is an Inter-IC Sound (I2S) signal, which includes a master clock, bit clock, left right clock, and data clock. The I2S signal is then converted to the S/PDIF signal. The S/PDIF signal data stream consists of a series of 1 and 0 digital bits that describe the audio waveforms. The colour subcarrier frequencies, $f_{c\text{-sub}}$, of the analog video signal are 4.43361875 and 3.579545 MHz for PAL and NTSC, respectively. The composite video signal following amplification and filter is compared with the linear ramp carrier signal at a frequency of 15Mhz, which is only four or five times $f_{c\text{-sub}}$, using a high-speed comparator (with the propagation delay and rise/fall times of 4.5 and 1.5ns respectively).

5.3 Audio and Video Reception

Two different types of PDs were used for the audio and video signals. For the audio part, the output of a low-speed PD (i.e., 15 Mb/s with a receiver sensitivity of -24 dBm) is first passed through the S/PDIF module followed by a high-quality stereo audio digital-to-analog converter (DAC) module. We have chosen a 192-kHz, 24-bit advanced segment stereo DAC for a high-quality audio signal. Filtering and amplification ensures the required audio output level. For the video link, a high-speed PD (i.e., 50 Mb/s with a receiver sensitivity of -17.5 dBm) followed by the PWM demodulator, a 3-MHz filter, and a video amplifier are used to recover the video signal. Figure 8 shows the audio and video receiver modules [6].

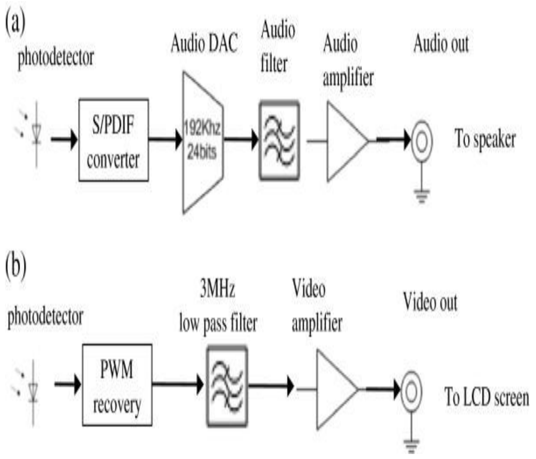


Fig. 4: Receiver system block diagram
(a)Audio (b) Video

V. IMPLEMENTATION AND RESULT

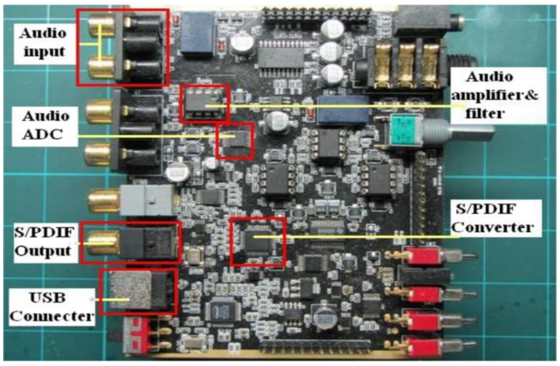


Fig. 5: Audio Transmitter Module

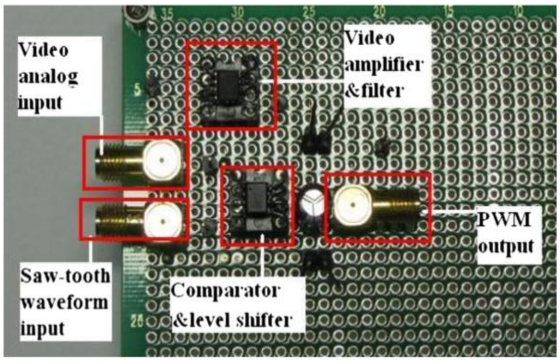


Fig. 6: Video Transmitter Module

There are a number of ICs available for the audio ADC. Here we have chosen a very simple chip (AK5386 from Asahi-Kasei, Chiyoda, Tokyo, Japan), which is a stereo A/D converter with a wide-ranging sampling rate from 8 to 216 kHz, widely used in both consumer and professional audio systems. The technology is based on enhanced dual-bit ΔΣ scheme, thus offering a high accuracy and a low cost.

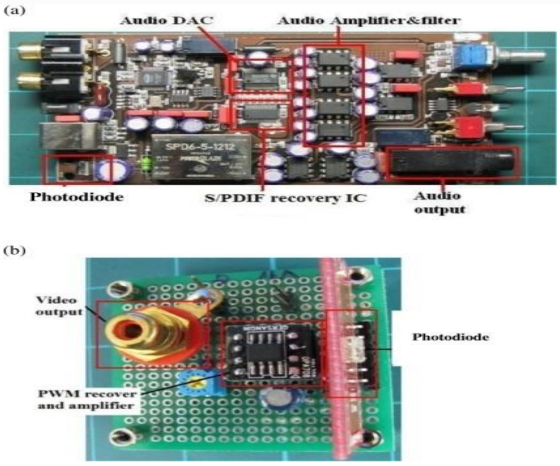


Fig. 7. (a) Audio Receiver Module

(b) Video Receiver Module

The transmission of audio and video signals using the developed modules has been demonstrated experimentally. The experimental setup is shown in Figure 8. A DVD player is used to generate both the audio and video signals. The white and red light sources are used for transmission of audio and video signals, respectively. At the receiver, LCD TV and speakers are used to monitor the quality of the video and audio signals following post photo detection processing. As shown in Figure 9, transmitters and receivers were placed in a directed diffuse link configuration, with 10-cm spacing between the two transmitter modules. The transmission span was set at 50 cm with no lenses. The link distance can be extended by using appropriate optics both at the source and the receiver or increasing the transmit power within the eye safety limit.

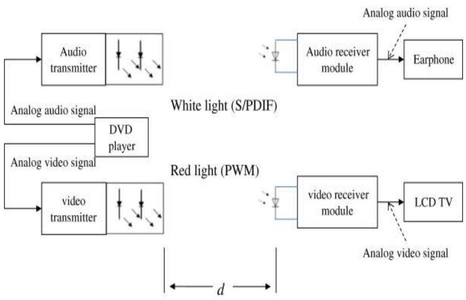
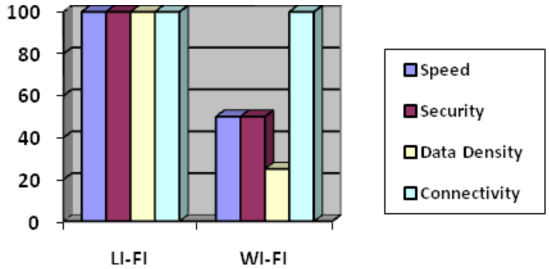


Fig. 8: The Overall Experimental Setup



Comparsion Between Li-Fi & Wi-Fi

VI. CONCLUSION

Li-Fi is an emerging technology in world of internet .This just uses incoherent light source i.e. LED is used here. The transfer of the data can be with the help of all kinds of light, no matter the part of the spectrum that they belong. That is, the light can belong to the invisible, ultraviolet or the visible part of the spectrum. Also, the speed of the communication is more than sufficient for downloading movies, games, music and all in very less time. Though Wi-Fi gives us speed up to 150mbps as per IEEE 802.11n, it is still insufficient to accommodate number of desired users. Li-Fi has 1000 times wider bandwidth than Wi-Fi. Also it provides more security as it cannot penetrate through walls. By using an array of LED speed up to 10Gbps can be obtained. Thus Li-Fi can be used as an alternate to high speed wireless network for communication.

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