FOREX Publication
Open Access | Rapid and quality publishing

International Journal of
Electrical and Electronics Research (IJEER)
Research Article | Volume 10, Issue 3 | Pages 627-631 | e-ISSN: 2347-470X

Text Transmission Using Visible Light Communication

N. J. AL-Chaabawi[1], H. Al- Furiji[2], A. Dahir Alramadan[3], M. AL-Shakban[4]

[1,3]College of Engineering, Department of Petroleum, University of Misan, Amarah ,Iraq, [1]nsf_jsm@uomisan.edu.iq, [3]alidh11@uomisan.edu.iq

[2,4]College of Science, Department of Physics, University of Misan, Amarah ,Iraq, [2]hasan_it@uomisan.edu.iq, [4]mundher.al-shakban@uomisan.edu.iq

***Correspondence:** N. J. AL-Chaabawi: Email : *nsf_jsm@uomisan.edu.iq*

ABSTRACT- Recently, WiFi wireless technology was used to send data by using radio signals, this paper will focus on LiFi technology which is an optical wireless networking technology that uses LEDs for the transmission of data using light-emitting diodes. LiFi production models were capable to transmit 150 megabits per second (Mbps). Visible light communication (VLC) is a facile method to overcome the spectrum crisis of radiofrequency. Light Fidelity (Li-Fi) is the wireless data transfer using LED. In this study LEDs have been used to transfer text between two computers using a processing software method, coding the Arduino Mega board by the Arduino software in both sender and receiver is observed. The system has worked better for a white LED than the red LED and IR LED. Experiments have shown that white is the most efficient color for transferring texts from one computer to another.

Keywords: Visible Light Communication (VLC), Wireless Communication, Li-Fi, File transfer, Light emitting diode (LED), Arduino software.

ARTICLE INFORMATION

Author(s): N. J. AL-Chaabawi, H. Al- Furiji, A. Dahir Alramadan and M. AL-Shakban;
Received: 13/07/2022; **Accepted**: 29/08/2022; **Published**: 15/09/2022;
E- ISSN: 2347-470X;
Paper Id: IJEER220719;
Citation: 10.37391/IJEER.100335
Webpage-link:
https://ijeer.forexjournal.co.in/archive/volume-10/ijeer-100335.html

Publisher's Note: FOREX Publication stays neutral with regard to jurisdictional claims in Published maps and institutional affiliations.

1. INTRODUCTION

Recently, there has been great interest in wireless data transmission by the method of visual optical communication (VLC) [1]. VLC provides security, large bandwidth and low cost compared to other wireless communication systems [2]. It utilizes LEDs to communicate information remotely, on the transmitter side VLC requires intensity modulation (IM). A photodiode (PD) at the receiver detects the signal using the direct detection approach (DD) [3]. Consequently, VLC has been considered a point-to-point data communication technique. VLC employs visible light sources such as (LEDs) and laser diodes, if the light is OFF we transmit a digital 0 and if the light is ON we transmit a digital 1[4-6].

Li-Fi is promising for wireless data coverage in a given area with high compactness. Essentially, Li-Fi focuses on transmitting multimedia data between two terminals using LEDs with wavelengths ranging from 380 to 780 nm [7]. In contrast with VLC, Li-Fi describes as a complete wireless networking system. The Li-Fi framework provides bi-directional multiuser communication, such as point-to-multipoint and multipoint-to-point communication; also, this framework has a large number of access points that build a wireless network of extremely small optical cells. These features make Li-Fi an attractive method for large scale use such as file transfer, home automation, Li-Fi hotspots, monitoring the activities, vehicular communication and ship to ship communication [8, 9].

2. LITERATURE REVIEW

Li-Fi is a wireless system developed by the German physicist and professor Harald Haas, which uses visible light to transmission data by terabit by a second velocity at a 100-fold speed of Wi-Fi instead of radio waves [10].

LEDs transmit light and a photodetector is supplied with the light signal and signal processing element attached to the photodetector and the amplification processes and converts data into current stream able as shown in figure 1. Then, the information is fed into a signal-processing LED light bulb, which sends data (embedded in its beam) to the photo-detected sensor (photodiode) at high speeds [10, 21].

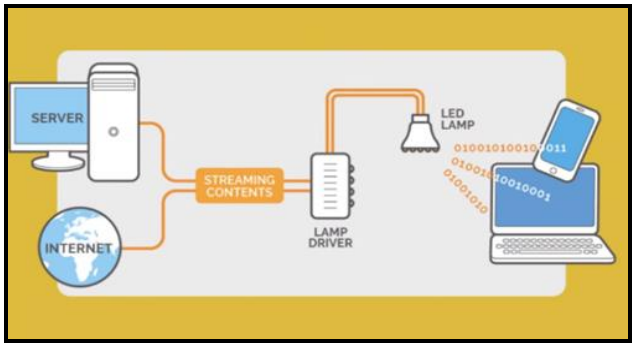

Figure 1: shows the system of sender and receiver processing for the Li-Fi technology [10]

FOREX Publication
Open Access | Rapid and quality publishing
International Journal of Electrical and Electronics Research (IJEER)
Research Article | Volume 10, Issue 3 | Pages 627-631 | e-ISSN: 2347-470X

The minor changes in rapid LED bulb dimming are then converted into an electrical signal via the receiver. The signal is converted back into an internet-functioning data stream that recognizes video, web and audio applications. LiFi can be operated outside, indoors, lights can be obscured and are not solely visible. Pure LiFi's platform is also LED agnostic, which means it can be used for a wide range of standard LEDs [11].

The LiFi operation is easy, but strong. A continuous stream of photons is released from an LED light bulb with a steady current, which is perceived as illumination. LED bulbs are semiconductor devices that allow current and hence light to be modulated at extremely fast rates and sensed by a photodetector. This method can be used to relay high-speed information from the LED light bulb [10]. Connection by radiofrequency means radio circuitry, antennas and sophisticated receivers, while LiFi is much easier and utilizes methods of direct modulation close to those used by infrasound low-cost communications systems, such as remote controls. High-intensity LED light bulbs can reach very high data rates.
The LED light bulb is a semiconductor light source, which ensures that the LED is driven by a constant current of electricity. It can be dipped and domed up and down at an incredibly high speed without being visible to the human eye [11, 20].

LiFi has a wide range of features. Data can be stored anywhere there is an LED light. LiFi is a platform application that can expand wireless networking technologies beyond our present understanding. Implementing LiFi has real-world implementations and advantages today. Stable wireless communications and networking in RF hostile areas such as petrochemical plants and hospitals are possible with LiFi. LiFi also offers high-speed, comprehensive and secure networks for enterprise environments and a gateway for smart houses, transport, towns and countries [12, 19].

LiFi will have a significant effect on the internet of things (IoT), allowing for even higher data transmission rates and the ability for many more users to link to one another. Furthermore, LiFi holds great promise for overcoming WiFi's current limitations by allowing for data-intensive connectivity over short distances. LiFi is safer than WiFi because of its short range. It can be classified as a green technology for device-to-device connectivity in the internet of things (IoT) because it does not pollute the environment. Li-Fi devices use less energy [13-16].
However, visible light cannot move through opaque objects and contact requires line of sight, its range would be limited, to begin with. More capable LED bulbs need to be mounted in many locations to enjoy maximum connectivity. Furthermore, LiFi demands that the light bulb being turned on at all times to have communication.

LiFi is likely to encounter interference from outside visible light, such as sunlight and lamps, and thus create interruptions in conversation. Besides, the costs of installing visual light contact systems as an addition to lightning systems are substantial [10, 11].

2.1 Materials and Methods

Processing software is used to instruct the Arduino Mega as shown in *figure 2* at the transmitter side, the program is written in the C language. The ASCII characters are converted to the integer form before is sent to the Arduino using the serial port via cable. Arduino Mega is used for the file transfer from one PC to another PC. The Arduino works according to the project coded in Arduino. This Arduino class has 8 digital pins, 5 analogue pins and power supplies such as 5volts and 3 volts. We will use the pin A5 analogue of the Arduino as the output pin as shown in *figure 2*.

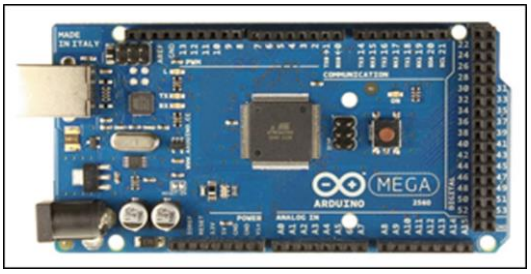

Figure 2: Arduino Mega [14]

3. RESULTS AND DISCUSSION

On the transmitter side the character saves as a binary system in a matrix form, the PC should contain ARDUINO IDE to convert the character into integer and then its binary format. Transmit the binary conversion to the receiver via LEDs.

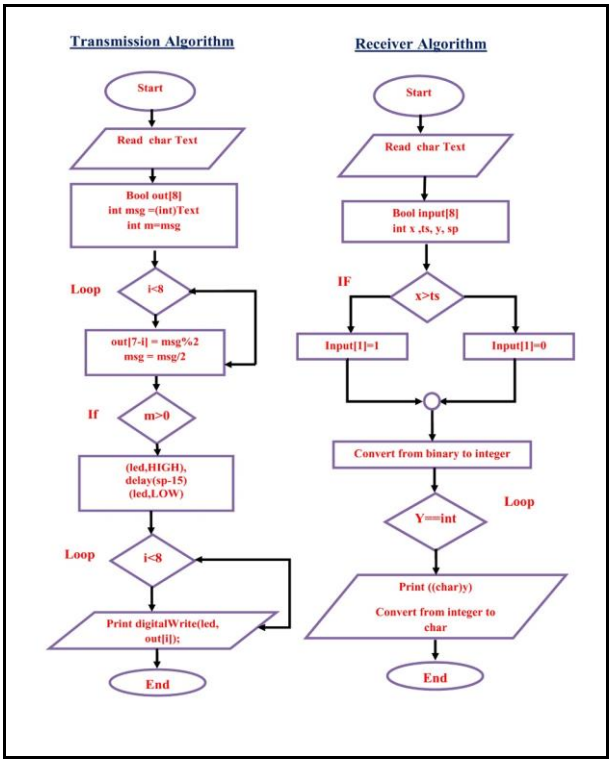

Figure 3: The algorithm of the transmitter and receiver side (as we proposed)

FOREX Publication
Open Access | Rapid and quality publishing
International Journal of Electrical and Electronics Research (IJEER)
Research Article | Volume 10, Issue 3 | Pages 627-631 | e-ISSN: 2347-470X

On the receiver side, the exact opposite operation takes place the light received from the LED is detected by the phototransistor (LDR), the output is saved in a matrix and convert from binary format to Integer using C language. *Figure 3* can be extract in both column.

Text message files are sent successfully from the transmitter to the receiver using the VLC technique. The algorithm of the transmitter and receiver sides is shown in *figure 2*. The program in both circuits was written in C language. *Figures 4 and 6* show the cable connection for transmitter and receiver circuits.

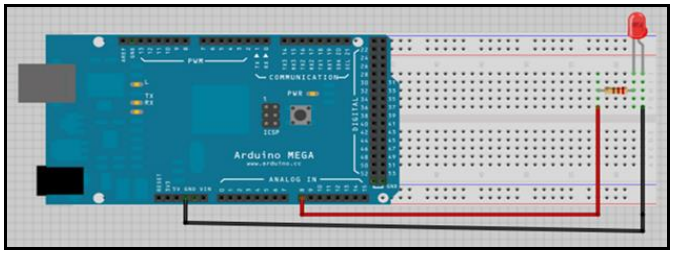

Figure 4: transmitter circuit

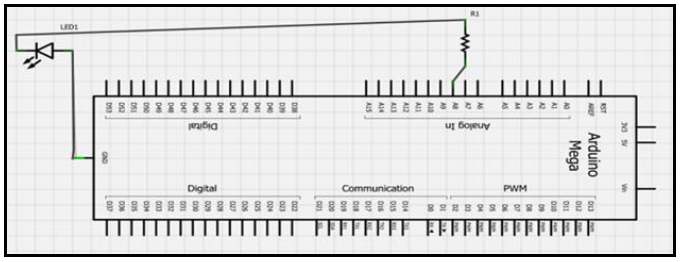

Figure 5: transmitter diagram

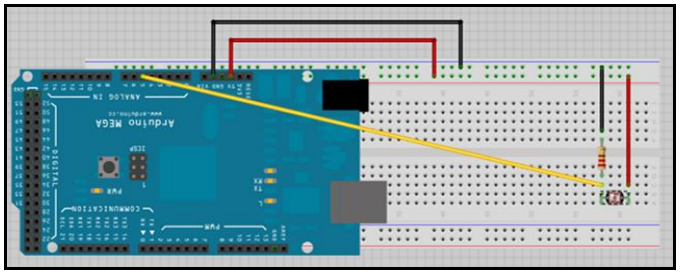

Figure 6: receiver circuit

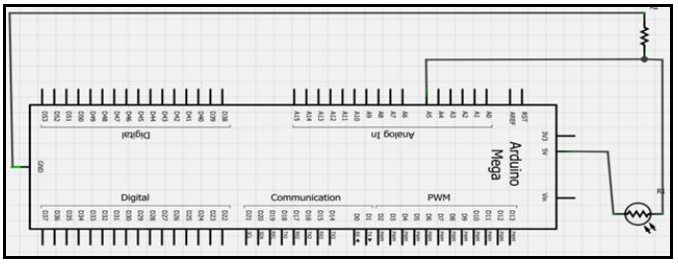

Figure 7: receiver diagram

The effects of light intensity and the color of light on the quality of transmitting information between the transmitter and the response circuits were studied.

In present fields, Dahri et al. [17] reported that the LEDs in red color have suitable and good responses as photodiode with its long wave-length in visible spectrum.

Firstly, measurements of the effect of a small resistance connected in series with the transmitter circuit were obtained with method of Smolik et al. [18], the resistance is usually placed to protect the diode. The distance between the LED and the LDR was 15 cm, and the intensity was measured at that distance for the blue, red, green and white led. There was a relatively large discrepancy between the results of the intensity measurements when we using the 220-ohm resistance and the 120 and 330-ohm resistors, according to *figure 5*. Where the 220 resistance gave a little light intensity, which indicates that the resistance used affects the intensity of the light.

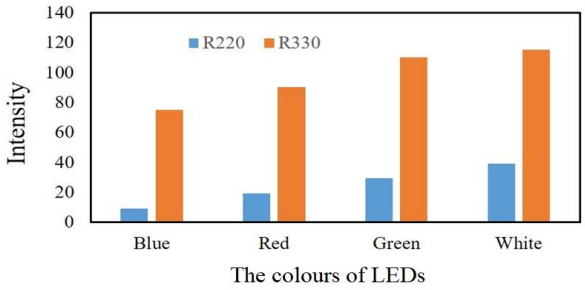

Figure 8: The values of intensity of light at the distance of 15 cm

TABLE 1. The results of experiment in uninsulated medium

	Without resistance				With resistance			
Distance (cm)	Blue	Red	Green	White	Blue	Red	Green	White
5	1	0	1	0	1	0	1	0
10	1	1	1	0	0	1	0	1
15	0	1	0	0	0	0	0	1
20	0	0	0	1	0	0	0	1
25	0	0	0	0	0	0	0	1
30	0	0	0	0	0	0	0	1
45	0	0	0	1	0	0	0	1
60	0	0	0	1	0	0	0	0
80	0	0	0	1	0	0	0	0
legend	1= success				0=fail			

The intensity of external light was between (15 to 22) in LUX meter, the effect of external light on the quality of text transmission for different distances between the transmitter and receiver circuits was studied. In this experiment, 75 letters were sent, which are duplicate letters of the phrase (light fidelity). The distances were from 5 to 80 cm. Without resistance, it was found that white light is the best color that can be used to transmit information successfully, unlike other colors. When re-testing the experiment, but after linking resistance with the diode used, an improvement was found in transmitting information at distances of up to 60 and 80 cm,

FOREX Publication
Open Access | Rapid and quality publishing
International Journal of Electrical and Electronics Research (IJEER)
Research Article | Volume 10, Issue 3 | Pages 627-631 | e-ISSN: 2347-470X

for white light, which indicates that the use of resistance has a positive effect on the transition process and the white color is the least affected by the light of the external light.

TABLE 2. The results of experiment in isolated medium

	Without resistance				With resistance			
Distance (cm)	Blue	Red	Green	White	Blue	Red	Green	White
5	1	1	1	0	0	1	1	1
10	0	1	1	1	0	1	0	0
15	0	1	1	1	0	0	0	1
20	0	0	0	1	0	0	0	1
legend	1= success				0=fail			

If an experiment was isolated from ambient light where the ambient light was measured, its value was 0-3, as shown in *tables 2*, the white colour showed a good improvement in transmitting information compared to other colors. It can be concluded that the white colour is less affected by the external environment, as well as more efficient than other colors in transmitting the information.

4. CONCLUSIONS

In present study, we have used the Arduino to send a text file between two PCs. The LED is connected to one of the digital pins of the Arduino, and the corresponding LDR is obtained by the digital pins. The light from the LED is detected by using LDR and the data is sent to the Arduino which is enough for the file transfer from one PC to another PC. The experiments have proven that white color is the most efficient color for transferring texts from one computer to another, as well as the white color, is less affected by external light.

5. ACKNOWLEDGMENTS

Without the ongoing support of the Department of Physics in the college of science, this endeavor would not have been possible. I am especially indebted to Dr. Mundher AL-Shakban, Chairman of the Department of Physics, and Mrs. Shima Baanon, Chief of the Laboratory Officer, who have actively sought to give me protected academic time to pursue my research goals and who have been supportive of my research ambitions.

REFERENCES

[1] X. Bao, G. Yu, J. Dai and X. Zhu, "Li-Fi: Light fidelity-a survey", Wireless Networks, vol. 21, no. 6, pp. 1879-1889, 2015.

[2] Rajesh, K. Satya, and V. Uma Lakshmi. "A Study on Next Generation Networks with Li-Fi Technology." International Journal of Innovative Research in Advanced Engineering (IJIRAE), vol. 3, no. 12, pp. 62-64, 2016.

[3] K. Krishnaraj, G. Saradhambal, "Advanced Data Communication for Mobile Li-Fi Technology", International Journal of Scientific Research in Computer Science, Engineering and Information Technology, vol. 2, no. 2, pp. 345-352, 2017.

[4] A. S. Hamza, J. S. Deogun and D. R. Alexander, "Classification Framework for Free Space Optical Communication Links and Systems," in IEEE Communications Surveys & Tutorials, vol. 21, no. 2, pp. 1346-1382, Second quarter 2019.

[5] Charahte, D., et al., "Design of Vehicle to Vehicle Data Transmission using Li-Fi Technology.", IOSR Journal of Computer Engineering (IOSR-JCE), vol. 3, no. 8, pp. 26-29, 2015.

[6] S. Damodaran, T. Shaikh and N. K. Taylor, "Using Mobile Phone Based Camera to Read Information from a Li-Fi Source," 2016 21st International Conference on Engineering of Complex Computer Systems (ICECCS), 2016, pp. 165-170.

[7] Dobroslav Tsonev, Stefan Videv, and Harald Haas, "Towards a 100 Gb/s visible light wireless access network," Opt. Express 23, 1627-1637 (2015).

[8] Shah, V., et al., "2D image transmission using light fidelity technology", Int. J. Innov. Adv. Comput. Sci. (IJIACS), 2015, vol. 4, no. 4, pp. 121-126.

[9] Singh, G., et al., "Transmission of Data Using Li-Fi Technology", International Journal of Computer Science Trends and Technology (I JCST), 2016, vol. 4, no. 2, pp. 245-250.

[10] G.Madhuri, K. Anjali, and R. Sakthi Prabha. "Transmission of data, audio and text signal using Li-fi technology." IOP Conference Series: Materials Science and Engineering. Vol. 872. No. 1. IOP Publishing, 2020.

[11] A. Shetty, "A comparative study and analysis on Li-Fi and Wi-Fi." International Journal of Computer Applications 150: 43-48, 2016.

[12] O. Luis Bica, N.Paulino, J. P.Oliveira, R.Santos-Tavares, N. Pereira, and J. Goes. "Undergraduate electronics projects based on the design of an optical wireless audio transmission system." IEEE Transactions on Education 60.2, pp.105-111, 2016.

[13] G. Singh. "Li-Fi (Light Fidelity)-An Overview to future Wireless technology in Field of Data Communication." Journal of Network Communications and Emerging Technologies (JNCET) 5.1 (2015).

[14] T. Cousin and B. Gennette, "Arduino Ethernet Shield on Arduino Mega Pin Usage!" Arduino Stack Exchange, 2022. [Online]. Available: https://arduino.stackexchange.com/questions/33019/arduino-ethernet-shield-on-arduino-mega-pin-usage. [Accessed: 05- May- 2022].

[15] R. Ildarabadi, A.M. Gholizadeh. "Adjust Brightness Of Led Lights In Accordance With Ambient Light." IJTPE Journal, vol. 12, no. 4, pp. 11-18, 2020.

[16] R. Ildarabadi, A.M. Gholizadeh. "Circad Efficiency of Light-Emitting Diode Radiation for General Lighting. IJTPE Journal, vol. 14, no. 1, pp. 172-176, 2022.

[17] F. A., Dahri, F. A., A. Umrani Baqai and H. B. Mangrio, Design and implementation of LED–LED indoor visible light communication system. Physical communication, 38, 100981, 2020.

[18] W. Smolik, J. Kryszyn, T.Olszewski, and R. Szabatin, Methods of small capacitance measurement in electrical capacitance tomography. Informatyka, Automatyka, Pomiary w Gospodarce i Ochronie Środowiska, 7: 105-110, 2017.

[19] R. P. S. Bhadoriya, "Directivity and Bandwidth Enhancement of Patch Antenna using Metamaterial," IJEER, vol. 9, no. 2, pp. 6–9, Jun. 2021, doi: 10.37391/IJEER.090201

[20] Garima Bajpai and Umesh Barandiya, Design of RF Energy Harvesting Circuit for Low Power Devices. International Journal of Electrical & Electronics Research. (IJEER) Volume 4, Issue 1, Pages 16-19, March 2016.

[21] Pankaj Agrawal, Bharat Mishra, and Akhilesh Tiwari, Effect of Parallel Capacitor in Matching Network of RF Energy Harvesting Circuit.International

FOREX Publication
Open Access | Rapid and quality publishing

International Journal of
Electrical and Electronics Research (IJEER)
Research Article | Volume 10, Issue 3 | Pages 627-631 | e-ISSN: 2347-470X

Journal of Electrical & Electronics Research (IJEER) November 30, 2019 | Volume 7, Issue 4.