

LiFi Communication – An Introduction

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Abstract: Light Fidelity (LiFi) is a part of Visible Light Communication (VLC) technology developed to overcome the rate speeds of current conventional wireless communication methods, i.e., WiFi. This paper focuses on the basic working of a communication device using light as a medium. Our model consists of a single transmitter and a single receiver mounted on two isolated boards. We have used one of the most common microcontroller Arduino Nano for both transmitter and receiver. After the complete implementation of this project, we were able to transmit any number of simple messages from a PC to an isolated display using an LED as the main transmitter.

Keywords: Arduino ATmega328p Microcontroller, LiFi, Light Fidelity, Visible Light Communication.

1. Introduction

LiFi was first introduced by Prof. Harald Haas at TED Global Talks held in July 2011 [1]. Since then, this technology has been developed continuously and has shown many advantages over using radio waves as a medium for wireless transmission. LiFi is a wireless communication system that uses light emitting diodes (LEDs) to allow us to communicate between the whole network.

The development of LiFi rose due to the ever-increasing usage of the internet. Now, almost everywhere WiFi is used and with the increasing devices there is a reduced efficiency in the rate speeds of WiFi. This is also because there are limited sources of Radio frequency. And since solid state light sources are available everywhere nowadays, LiFi has emerged.

Wherever there are LEDs, there can be a stable and faster than ever internet connection.

This paper explains the very basic principles of how we can transmit data with the help of light and the same knowledge can help to develop more practical usage devices related to Light Fidelity.

2. How Does it Work?

LiFi transmission works on the basis of modulation of light [2]. A computer converts the data we need to transmit into binary and sends it to an LED driver which drives or modulates the LED accordingly.

On the receiving side there is a Light sensing device which senses the changes in intensity of light sent by the transmitter and using another computer converts it into required format.

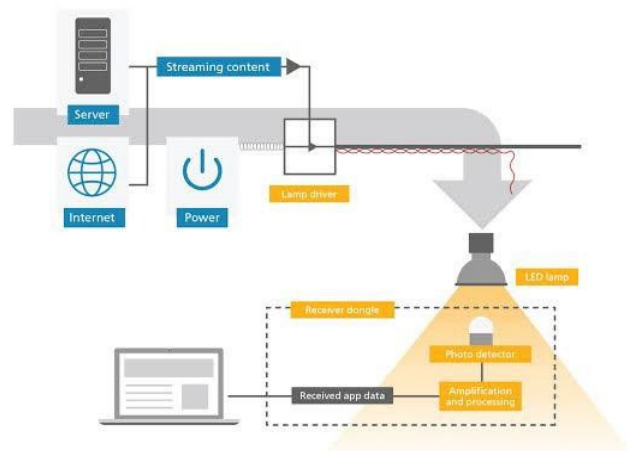


Fig. 1. Basic LiFi architecture

On a practical level there are many modulation techniques with different types of encoding such as SCM, OOK, MCM and some more [3]. But for the sake of simplicity, we have not included any encoding in our model as we just need to understand the basic working of LiFi transmission.

The following is a basic representation of the prototype of our setup with which we successfully transmitted a few messages through light.

This is the simplest LiFi Transmitter with a single LED and an ARDUINO NANO as the converter and the LED Driver. The message is sent from the PC connected to the NANO.

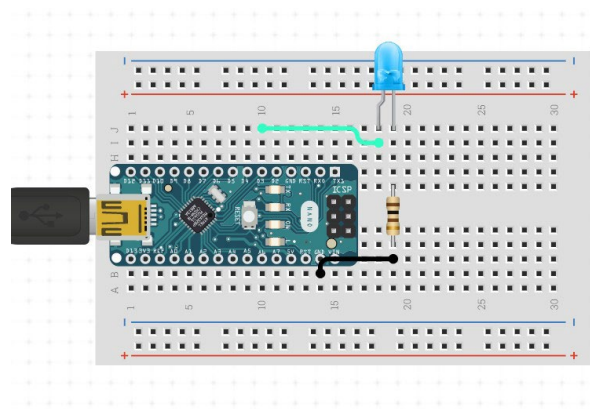


Fig. 2.

This is a receiver with a light sensor connected to another ARDUINO NANO.

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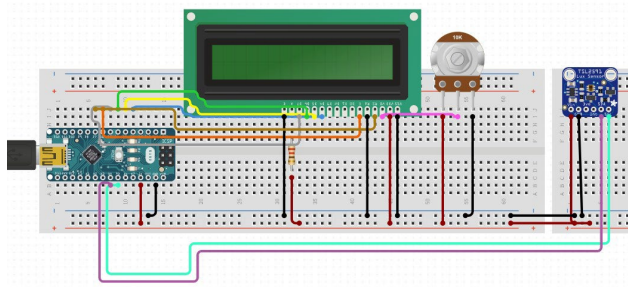


Fig. 3.

We can possibly use any type of light sensor for this to work. We would just need to tweak the code as per the sensor. The received message from the transmitter is displayed on the LCD.

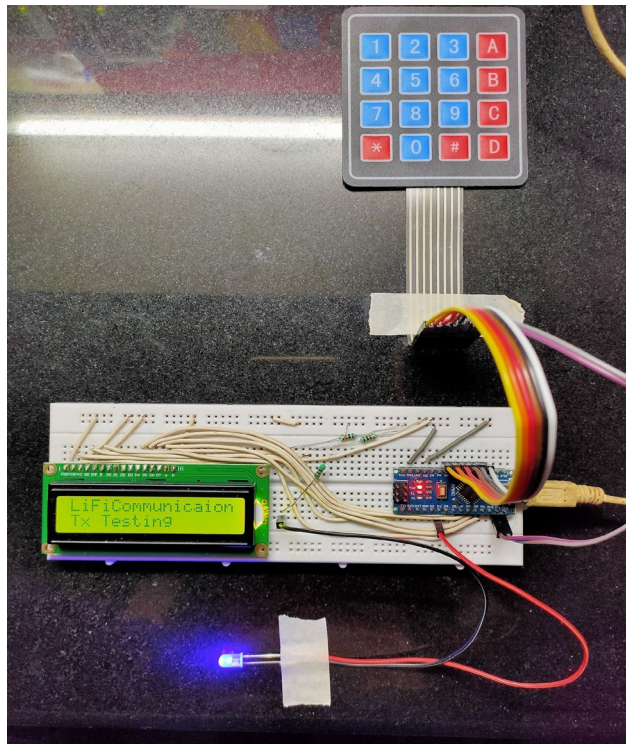
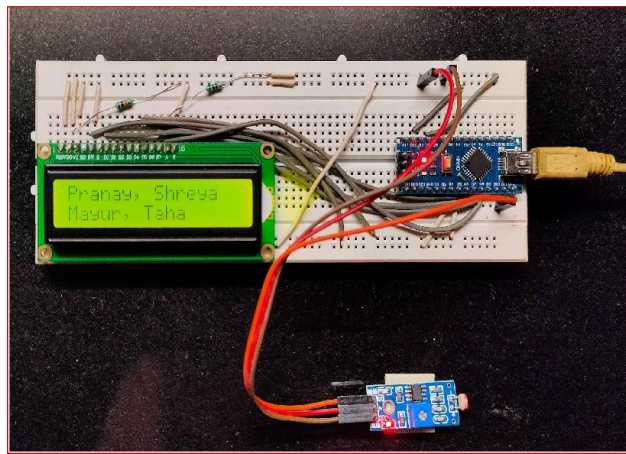


Fig. 4. Hardware prototype

We have used a Light Dependent Resistor Module as the receiving sensor.

Initially we had connected a 4X4 matrix keypad for the input but then we directly used the PC to send messages.

Here is a link for the Video Demonstration of our model - [VID20210525114423~2.mp4](https://www.youtube.com/watch?v=VID20210525114423~2.mp4)

3. Conclusion

After completing this model and experimenting with it, we can understand how we can transmit and receive data via a light. And we can implement this on a higher level with the help of rather complicated steps including adding MAC and PHYSICAL layers which basically move data packets to and from one Network interface to another.

Understanding LiFi is very important in the IoT field as it is growing at a rapid rate and soon might be the new conventional method of internet usage.

Table 1
Difference between LiFi and WiFi [4], [1]

Parameter	LiFi	WiFi
Transceiver	LED	Antenna
Average Operating speed	Almost greater than 10Gbps	150-600Mbps
Frequency Band	1000s of THz	2.4GHz
Topology	Point to Point	Point to Multipoint
Data Transmission	Bits	Radio waves
Security	More Secure as Light can't penetrate through opaque walls limiting the network usage within the room.	Less secure as Radiowaves can pass the walls of the room effectively allowing anyone to intercept the network.

References

- [1] E. Ramadhani and G. P. Mahardika, "The Technology of {LiFi}: A Brief Introduction," in 2018 IOP Conf. Ser.: Mater. Sci. Eng. 325 012013.
- [2] H. Haas, L. Yin, Y. Wang and C. Chen, "What is LiFi?," in *Journal of Lightwave Technology*, vol. 34, no. 6, pp. 1533-1544, March, 2016.
- [3] Prateek Gawande, Aditya Sharma, Prashant Kushwaha, "Various Modulation Techniques for LiFi", November 2016.
- [4] G. Blinowski, "Security issues in visible light communication systems," *IFAC-Papers online*, vol. 28, no. 4, pp. 234-239, 2015.
- [5] pureLiFi, 2017 Shedding Light on LiFi PureLiFi. <https://purelifi.com/wp-content/uploads/2017/06/Shedding-Light-On-LiFi-webv2.pdf>