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# Underwater Data Transmission using LI-FI

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***Abstract*— Underwater communication has traditionally been challenging due to the limitations of radio and acoustic wave propagation in water. Light Fidelity (Li- Fi), a visible light communication (VLC) technology, presents a promising solution for high-speed, short- range data transmission underwater. This paper explores the feasibility of using Li-Fi for underwater data and audio transmission, leveraging the high-speed capabilities of light signals.**

## I. INTRODUCTION

IR based underwater communication system that can be used for wireless communication of messages even through water. The system can prove to be a very cheap alternative to long heavy physical wires that run through seas, rivers and require large costs for laying those wires and their maintenance. Our system makes use of infrared transmitter receiver in order to achieve this system. Our system consists of two microcontroller-based circuits that have IR transmitter-receiver pairs as well as LCD displays for displaying the messages. Each system has a keyboard connected to it in order to type in messages. We use two water barrels in order to demonstrate underwater communication using signals passing through those containers. The system also has an acknowledgement receipt message that is sent back from the receiving circuit to the transmitting circuit on message receipt. This allows for efficient communication between two circuits wirelessly.[1]

## II. LITERATURE SURVEY

Prof. Ranjitha Rajan, Ms. Amala Susan Roy "Underwater optical wireless communications (UOWC)" International Journal of Engineering Research & Technology (IJERT) Underwater optical wireless communications (UOWC) have gained a considerable interest during the last years as an alternative means for broadband in inexpensive submarine communications. The UOWC present in a
numerous similarities compared to free space optical (FSO)communications or laser satellite links mainly due to the fact that they employ optical wavelengths to transfer secure information between dedicated point- to-point links.[1]

Bing Dong, Shoufeng Tong, National and Local Joint Engineering Research Center of Space Optoelectronics Technology, Changchun University of Science and Technology, Changchun, China, College of Optoelectronic Engineering, Changchun University of Science and Technology, Changchun, China. To improve the bit error rate (BER) of underwater wireless laser communication and increase communication speed, a duplex underwater wireless laser communication system is designed.[2]

Hanyu Kou University of Leeds (School of Electronic and Electrical Engineering Faculty of Engineering and Physical Sciences), This paper focuses on the development of computer technology has promoted the widespread application of unmanned technology. Remote monitoring of wireless devices is an application of unmanned technology.[3]

William C. Cox, Jim A. Simpson, Underwater communication between mobile ocean systems is of great interest to the scientific and military communities. The limited propagation distance of RF frequencies and low data rate of acoustic communication leave optical communication as a viable alternative for low latency, [4]

Amit A. Deshmukh "A Review Paper on Underwater Data Transmission Using Li Fi Technology" This paper discusses the potential of Li-Fi for underwater communication, highlighting its advantages over traditional methods and proposing a model for real-

time video transmission. To improve the remote monitoring of wireless devices, this study establishes a remote monitoring and decision-making framework based on wireless communication systems.[5]

## III. PROPOSED SYSTEM

IR based underwater communication system that can be used for wireless communication of messages even through water. Underwater communication system consists of two communications modules transmit and receive data utilizing infrared radiation. This system also has an acknowledgement receipt message that is sent back from the receiving circuit to the transmitting circuit on message receipt.

**Optimized Wavelength Selection:** Use blue or green LEDs/lasers for better penetration in water.

**Hybrid Communication Systems:** Combine Li-Fi with acoustic and RF communication to ensure continuous data transmission.

**Machine Learning-Based Signal Processing:** AI algorithms can predict and compensate for signal distortion and noise.

**Energy-Efficient Designs:** Use energy-efficient LEDs, low-power lasers, and advanced modulation schemes.

**Multi-Hop Relay Systems:** Implementing a network of underwater nodes can extend Li-Fi communication range.

**Limited Transmission Distance:** Due to absorption and scattering, Li-Fi signals weaken rapidly in water.

## IV METHODOLOGY

The flowchart depicts in fig.1, a fundamental communication process, likely between a transmitter (TX) and a receiver (RX). It lays out a step-by-step guide on how messages are sent, received, and acknowledged. The process initiates with the initialization of all devices involved in communication. This step encompasses the setup and configuration of hardware and software components such as the transmitter, receiver, and any communication interface (e.g., network connection, radio link). Once the devices are initialized, the transmitter takes the lead by sending a message to the receiver. Following the message transmission, the system enters a crucial decision point. It checks whether the transmitter has received an acknowledgment (ACK) from the receiver. An ACK is a signal sent by the receiver to confirm successful message reception. If the transmitter does not receive an ACK within a specified timeframe, it assumes that the message was lost or not received. In this scenario, the transmitter re-transmits the message, repeating this process until an ACK is received. This mechanism of re-transmission ensures that the message reaches its destination reliably.

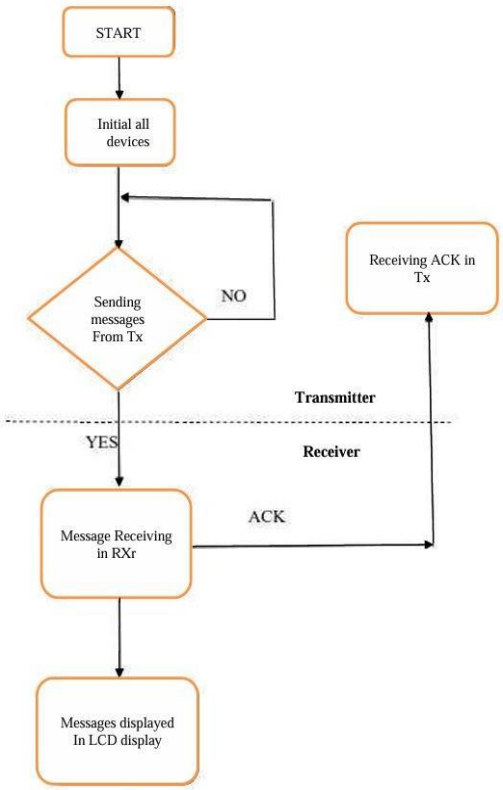


**Fig 1:** Flow Chart of Underwater data transmission using LI-FI

### A. TRANSMITTER

The block diagram presents a comprehensive overview of a transmitter system, likely designed for optical communication. The system is structured in a sequential manner, with each block performing a specific function and contributing to the overall transmission process. The process begins with user input, which is received through switches. These switches could be used to control various parameters of the transmission, such as mode selection or power levels. The input from the switches is then processed by a microcontroller, the central processing unit of the system. The microcontroller acts as the brain of the system, interpreting the user input and controlling the

operation of the other components based on the received instructions. The processed data is then passed to an encoder. The encoder plays a crucial role in preparing the data for optical transmission. It converts the data into a format suitable for modulation, a technique used to encode information onto the light carrier wave.

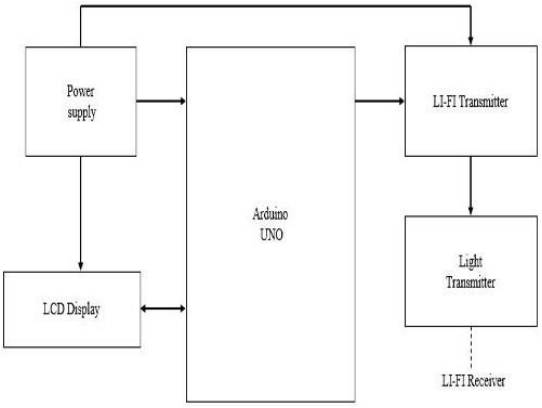


**Fig 2:** Transmitter System of underwater wireless communication where data is sent.

## B. RECEIVER

This block diagram illustrates the fundamental components and their arrangement within a receiver system, likely designed for optical communication. The system is structured to efficiently receive and process incoming optical signals, extract the embedded information, and ultimately present it to the user.

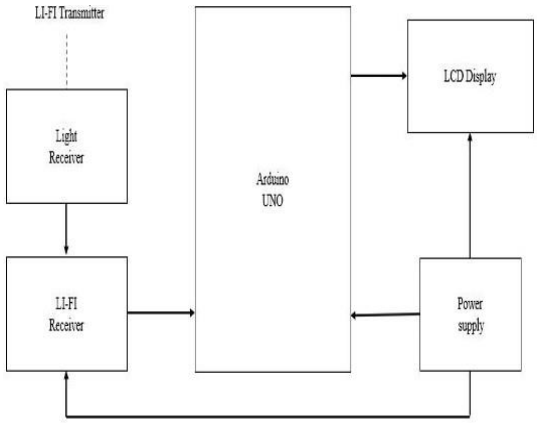


**Fig 3:** Receiver System of underwater wireless communication where data is decoded and depicted

This block diagram illustrates the fundamental components and their arrangement within a receiver system, likely designed for optical communication. The system is structured to efficiently receive and process incoming optical signals, extract the embedded information, and ultimately present it to the user. The process begins with the reception of the optical signal at the light receiver. This crucial component converts the incoming light energy into an electrical signal, effectively bridging the gap between the optical domain and the electrical domain.

## C. AUDIO TRANSMISSION

The provided block diagram illustrates a system for underwater audio transmission using LI-FI technology. LI-FI, or Light Fidelity, utilizes light waves for communication, offering potential advantages over traditional underwater acoustic methods in terms of data rate and security. The system comprises a transmitter and a receiver section. In the transmitter, the audio signal from a music player is processed by a microcontroller.

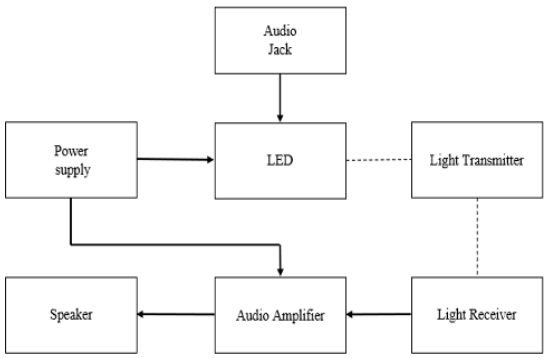


**Fig 4:** Block Diagram of Audio Transmitter & Audio Receiver

Underwater Li-Fi technology is still in its early stages of development, but it holds significant promise revolutionizing underwater communication. Ongoing research focuses on addressing the challenges related to water attenuation, turbidity, ambient light, and system robustness.

## V. RESULT AND DISCUSSION

Underwater data transmission using Li-Fi involves transmitting data through light waves, offering a high-speed alternative to traditional acoustic communication. The transmitter in a Li-Fi system typically uses high-intensity LEDs or laser diodes to modulate and emit light signals carrying encoded data. The results observed from the transmitter side indicate effective modulation

techniques like On-Off Keying (OOK) and Pulse Width Modulation (PWM) can achieve data rates up to several hundred Mbps in clear water conditions. However, the transmission range is highly dependent on water clarity, with optimal performance in clear water reaching distances of up to 10 meters, while in turbid water, it drops significantly. Power intensity also plays a crucial role, with higher power leading to better range but at the cost of increased energy consumption.

## OVERVIEW OF UNDERWATER DATA TRANSMISSION

The following figure shows the result of the proposed systems:

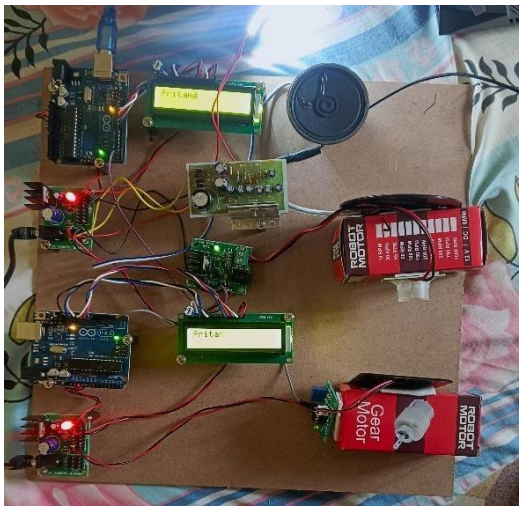


**Fig 5:** Tested Result

Underwater data transmission is a challenging area of wireless communication due to the unique properties of water that impede traditional wireless signals, such as radio waves. In such environments, communication systems like acoustic waves and radio frequency (RF) signals face significant limitations, including high attenuation, noise, and slow data transfer rates.

This makes them unsuitable for high-speed, real-time communication, particularly in deep-sea and highly turbid waters. A promising alternative to these conventional methods is Li-Fi (Light Fidelity), which leverages visible light communication (VLC) to transmit data. Unlike acoustic or RF-based systems, Li-Fi utilizes light waves, offering substantial advantages in underwater data transmission, such as high bandwidth, low latency, and resistance to noise. The use of Li-Fi for underwater communication is an emerging technology that holds the potential to revolutionize the way we collect data, interact with underwater systems, and perform marine research.

## CONCLUSION

In conclusion, underwater data transmission using Li- Fi presents a compelling alternative to traditional acoustic methods. While acoustic communication suffers from limitations in data rate, range, and latency, Li-Fi offers the potential for significantly higher data rates and lower latency, paving the way for real-time underwater applications. The use of light for communication allows for faster data transfer, enabling high-definition video streaming, remote operation of underwater vehicles, and improved environmental monitoring. Although challenges remain, such as the limited range due to light absorption and scattering in water, ongoing research into more powerful light sources, optimized modulation techniques, and robust receiver designs is steadily addressing these issues.

## REFERENCES

[1] N. R. Krishnamoorthy Petal. "An Automated Underwater Wireless Communication System Using Li-Fi with IoT Support and GPS Positioning" The paper discusses a Li-Fi based underwater communication system integrated with IoT and GPS capabilities to enhance data transmission efficiency (2021).

[2] Prof. Ranjitha Rajan, Ms. Amala Susan Roy "Underwater optical wireless communications (UOWC)" International Journal of Engineering Research & Technology (IJERT) have gained a considerable interest during the last years as an alternative means for broadband inexpensive submarine communications (2021).

[3] Bing Dong, Shoufeng Tong, "Research on duplex underwater wireless laser communication system" National and Local Joint Engineering Research Center of Space Optoelectronics Technology (2022).

[4] William C. Cox, Jim A. "Underwater optical communication using software-defined radio over LED and laser-based links." Underwater communication between mobile ocean systems is of

great interest to the scientific and military communities (2019).

[5] Amit A. Deshmukh "A Review Paper on Underwater Data Transmission Using Li Fi Technology" This paper discusses the potential of Li- Fi for underwater communication, highlighting its advantages over traditional methods and proposing a model for real-time video transmission (2022).

[6] Arun Kumar Petal. "Development of Data Transmission Model for Under Water Communication using Li-Fi Technology" This study focuses on creating a data transmission model utilizing Li-Fi technology for underwater communication, (2022).

[7] Vijaya Kumar, S.S. K. Praneeth " Data Transmission Through Li-Fi in Underwater" This study proposes a method for transmitting data underwater using Li-Fi technology (2019).