

Subaqueous Information Transmission Based On Li-Fi Technology

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Abstract:

The present paper relates to “Subaqueous Information Transmission based on Li-Fi Technology”. Currently white boards are used by divers to communicate with each other, which is very problematic task. In this paper a model for providing assistance to divers is proposed that uses light sources to transmit the information. “Light Fidelity (Li-Fi) is a bidirectional, high speed and fully networked wireless optical communication”. Even if the light is blocked by a floating object, it is reflected or refracted by widening the angle, resulting in increased ability to reach the receiver section and if the light oscillates, the current still appropriate. There are two sections; a transmitter section, and a receiver section, wherein an audio signal transmitted by the diver passes through the transmitter which converts the audio signal into stream of light beam. The light beam is received at the receiver side and then converted into an audio signal again with the help of various components like PLL, photo detector, amplifiers, speaker etc.

Keywords: Li-Fi, VSC, LED, Photo Detector, Transmitter, Underwater, Receiver.

INTRODUCTION

The working of Li-Fi is similar to the working of Wi-Fi, the only difference between both the technologies is usage of light source rather than using radio frequency waves. Initially the scheme is established in “los Vegas” with the help of a couple of smart mobile phones over a distance of range ten meters[1]–[4]. The paper uses Li-Fi for subaquatic communications which is considered as a main challenge and previously various experiments have been done to make the procedure of communication easy[5]–[8][9], [10]. Many out of them are complicated structural designs as they need to handle water, typically salty water of sea. Introduction of Li-Fi in any implementation makes the implementation easy and simple as well. Realisation of Li-Fi is generally done by using Light emitting Diodes (LEDs). Li-Fi generally uses a wavelength range of light in order of four hundred nanometres to seven hundred nanometres, therefore its range is thousand times wider than the radio frequency signals[11]–[14].

When the LED of Li-Fi is in “ON” position, transmission of data in digital form ‘1’ is done and when the light LED is in “OFF” condition that means ‘0’ in the form of digital information is sent. The system is modest, secure, and threat free as it does not need licensed spectrum, base stations, complicated structure of antenna, and refined transmitter, etc[15].

Today, mostly systems use internet to realise their work via wireless communication. There are various researches have been done to enhance the underwater acoustic communication.

Second section of the paper explains about LI-FI technology, third section includes proposed system, forth section involves results obtained by the experimentation and lastly the conclusion is written in fifth section of the paper.

LI-FI TECHNOLOGY

In Li-Fi technology main part is involvement of high powered LED lights, the time period of reaction of light is smaller than one micro seconds therefore it is possible to turn on/off LEDs rapidly. The transition

of data takes place during the high frequency change in state of LED. For ON state a binary no. '1' is considered and in case of OFF state '0' is considered, the speed of whole procedure of data encoding and modulation technique can be implemented quicker than the identification by a human eye. A "photo detector" is situated at receiver side that receives the data transferred by the source of light produces an original data correspondingly. The methodology uninterruptedly obtains the light pulsations and then performs decoding operation on it for converting it into a continuous data current/flow which is conferred as visible light communication (VLC).

1. Devices used in visible light communication

Li-Fi technology uses two different components at transmitter and receiver side are given as:

A. LED lights/Florescent light source; and

The LED light is connected to a supply source for providing illumination, the intensity of illumination is possibly controlled by changing the amount of current supplied the LED light. While comparing the LEDs with Florescent light, Ten mb per sec. speed of transferring data can be generated by florescent lamps however the LEDs as a source of light offers the speed of transmitting data is five hundred mb per seconds[16], [17]. Therefore when we compare bot the sources it is good to use LEDs rather than using fluorescent lights for data transmission as LEDs deliver faster response[18]–[20].

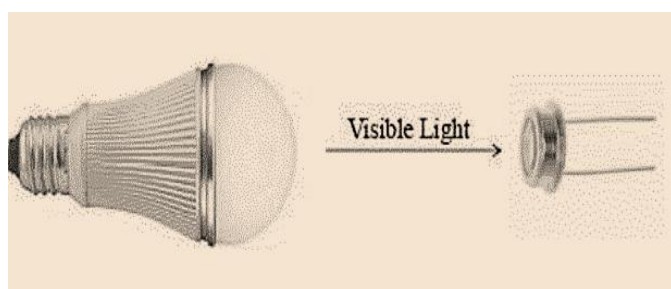


Figure 1 LED light for VLC

B. Photo detector.

Different device that can be used as photo detector at reciver side are given as:

- pin diode
- avalanche photo diode
- image sensor as shown



Figure 2 Photo Detector

Figure 2 shows the representation of pin diode, avalanche photo diode, and image sensor which are used at receiver side to receive the data transmitted by the light source at transmitter side[21]–[24].

2. Working:

Li-Fi provides downlink transmission. Figure 3 shows the connections of different modules for LI-FI communication. A power source is provided in the system for supplying electrical power. A lamp driver is interlinked between power source and a LED source of light to drive the LED light according to the data provided to it. The transmission of data takes place in the form of light beam. Below the transmitter section a receiver section is represented that receives the signal from transmitter section detects the variation in light then correspondingly detach that data from the LED. After that produces an electrical form of signal according to illumination intensity. This electrical signal is directed towards a computer connected at receiver end to other associated electronic devices[25], [26].

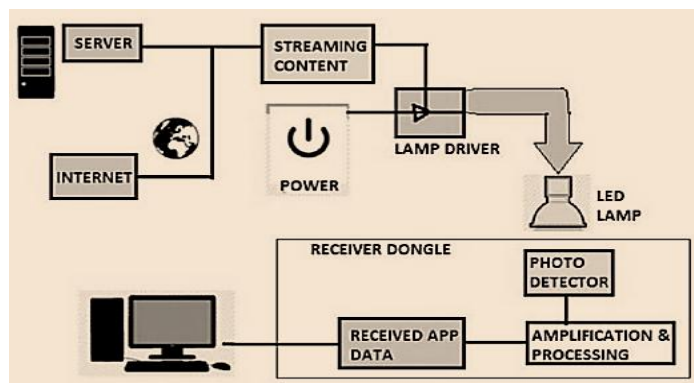


Figure 3 Li-Fi system representation

A. PROPOSED SYSTEM

The present paper introduces LI-Fi technology for underwater transmission. Here, a voice signal is transmitted using light beams.

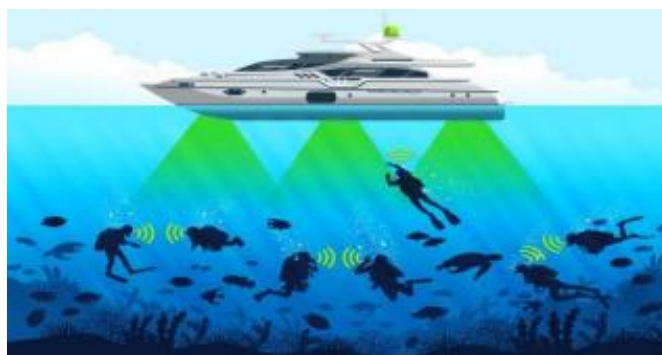


Figure 4 Underwater visible light communication

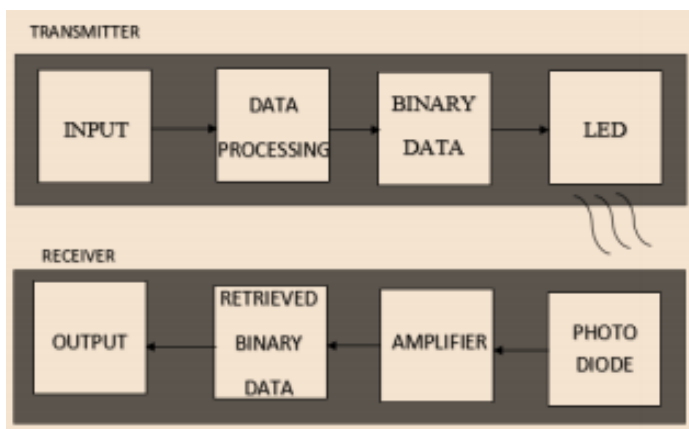


Figure 5 Basic block representation

When power is switched on and continuous current is supplied to a source of light i.e LED bulb, it instantly starts producing a photon beam which generally detected as visible light. If any change in supply current is done, then the LED bulb slightly fluctuates light intensity up/down. The modulation

of out coming and the optical output can be done at enormously high speed because the LED bulbs are made up of semiconductor, which is then detected by photo detector and converted into electrical signal.

There are 2 different section of audio transmission of submarines.

Figure 6 & 7 shows block representation of transmitter section and receiver section respectively.

A. Transmitter section

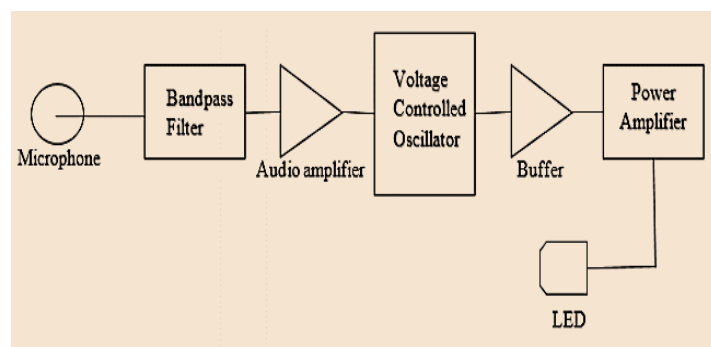


Figure 6 Transmitter section

Here, in this section a microphone is used which converts the audio signal into an electrical signal. The output of the microphone is transmitted to a band pass filter for attenuating the signal. An amplifier amplifies the amplitude of the attenuated signal connected to the band-pass filter. As changes in amplitude of the signal and fading of signal are avoidable therefore in this paper frequency modulation is preferred over amplitude modulation. Frequency modulation of the signal is done by connecting a Voltage Controlled Oscillator to the amplifier[27], [28]. A buffer is used to transform electrical impedance. After this amplification of the signal is required again therefore a power amplifier is attached to the buffer and finally the signal is fed to LED which transmit data in very few seconds generally in nanoseconds while switching on/off LED.

Components:

1. Band-pass Filter
2. Buffer
3. Audio Amplifier
4. Microphone
5. Voltage Controlled Oscillator

6. Light emitting diode
7. Power Amplifier

B. Receiver section

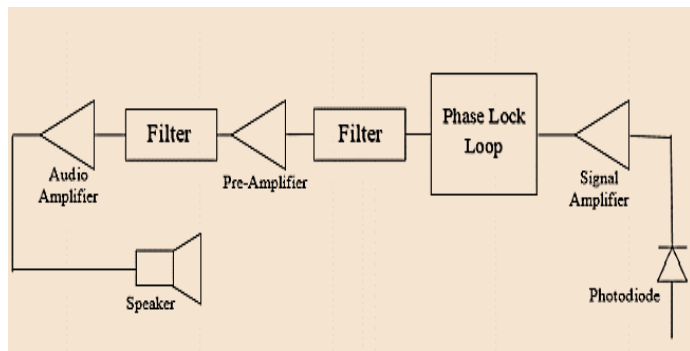


Figure 7 Receiver section

At receiver, light beam is received by the photo diode is converted into electrical signal. Phase locked loop (PLL) has an integral part: voltage controlled oscillator (VCO). After additional filtering and amplification, the audio signal comes out of a speaker.

Components:

1. Photodiode
2. PLL
3. Speaker

RESULTS

A model for subaquatic/underwater communication is implemented using a wireless Li-Fi technology. Tests are done practically by implementing a model, wherein an audio signal is transferred from transmitter side to the receiver side and vice versa. Divers can communicate with each other with the help of this implementation.



Figure 8 Board design

Figure 8 show the board design of the proposed model.

CONCLUSION

The model proposed in present paper is beneficial for underwater communication with quicker speed of transmission in order of Gbps. The paper overcomes all the difficulties generally faced in the underwater communication. It is observed that the paper provides safe communication at lower cost than other ways of communication, thus the chances to hack the system are less. As it is efficient while concerning about security so the system can be applied in Indian Navy for providing the communication between ships.

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