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Underwater visible light communication using LiFi

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***Abstract*—Now a days,transmission of data without using any network is a tough job to do. In this paper, audio and data is transmitted and gotten through the visible light. The collected data is gathered and processed by microcontroller is transmitted through LED, those data can be received by photo detector and displayed . It is an advanced technology and the accuracy is more. In this paper data communication, controlling the devices and as well as transmission of audio with help of visible light is achieved. In a normal life, WiFi is used as affordable technology but the radiations emitted from these are dangerous for health of human therefore Lifi is preferred to the wireless technologies like Wifi.Lifi transmits the data by using light. The security for transmission of the data is more when compared to other technologies. In industrial places, for transmission of file and data this technology is very useful because without any networks data can be transmitted through existing visible light. It is cost effective and user friendly. The data rate is faster than 10Mbps in Lifi technology .**

***Index Terms*—Li-Fi ,Underwater communication, LED, Transmitter, Receiver, Audio Playback Recorder, VLC.**

I. Introduction

The Li-fi concept is currently attracting a great interest, not least because it offers a genuine and very efficient alternative to RF. As a growing number of people and their recent device access wireless internet, the airwaves are becoming increasingly clogged and unavailability of free bandwidths to every device, making it more and more difficult to get a reliable, high speed signal. The opportunity to exploit a completely different part of the electromagnetic spectrum is very appealing. Li-Fi has other advantages over Wi-Fi, such as safe to use at nuclear power plants, thermal power stations where Wi-Fi cannot be used. In such stations RF waves can be harmful and can cause accident, to communicate in such regions only visible light spectrum can be safe. Apart from adverse regions Li-fi can also be used in all places where Wi-Fi can be used. Li-fi is present wherever there is availability of light, in turn eradicating the necessity of having hot-spots only at selected places. There are four criterion to judge on the working of Li-Fi and Wi-Fi that is, capacity, efficiency, availability and security. Both Li-fi and Wi-Fi uses electromagnetic spectrum for data transmission, but whereas Wi-Fi utilizes radio waves, LiFi uses visible light communication in the range of 100Mb/s. The present paper deals with the VLC which provide a wide and fast data rate like 500Mb/s. In this paper, the comparison is made between WiFi and LiFi technologies. This paper also discusses the working, implementation and improvements in Li-fi technology. The Li-Fi technology can be used for various purposes, it matters the data transmission through LEDs thus all the screens which illuminate light can be served as a platform for data communication. The screen of the mobile phone, television, bulbs can act as a source of light. On the other hand, the receiving platform, the photo detector can be replaced by a camera in mobile phone for scanning and retrieving data. Its other applications are Li-fi for desktops, smartcard Li-fi, Li-fi for schools, hospitals, Li-fi in cities, smart guides, museums, hotels, fairgrounds, events indoor and LBS (Location-based Services), access control and identification crisis, malls, airport and dangerous environments like thermal power plants.

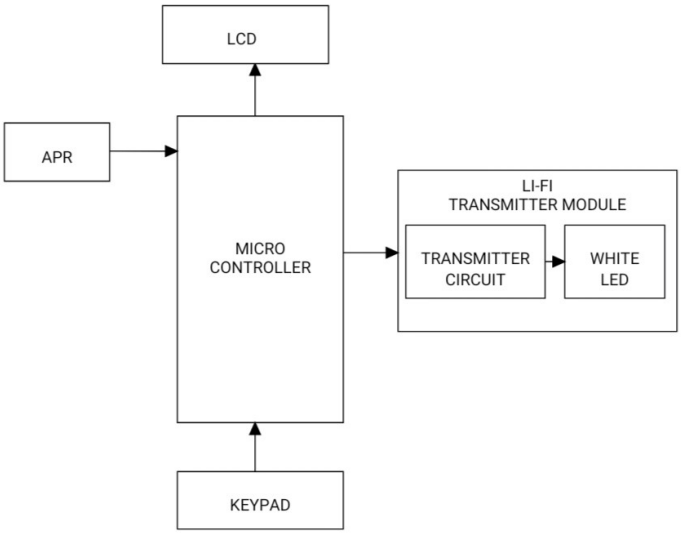

Fig. 1. Transmitter

II. Block Diagram

The block diagram shown in the figure 1 represents the operation of transmitter.The transmitter receives the data from audio playback recorder and keypad as a input.Thus the data collected from the input are being transmitted to the Li-Fi transmitter module.The data which is going to be transmit can be viewed in LCD.In the transmitter module the data has been transmitted through the LED by the transmitter circuit which is shown in figure 3 . The data that are transmitted by transmitter

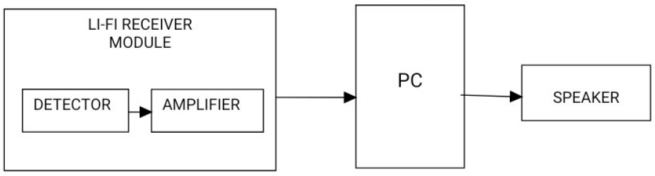

Fig. 2. Receiver

is received and processed in receiver.The process happening in receiver is shown in figure 2.Li-Fi receiver module consists a detector and an amplifier.When the transmitted data once reaches the detector the received signals are amplified with amplifier.The processed data is obtained to user through speaker.

III. Hardware Requirements

A. Microcontroller

The Arduino UNO is a microcontroller board based on the ATmega328. It has 14 digital i/o pins (of which 6 pins can be used as Pulse Width Modulation outputs), 6 analog inputs, a 16MHz crystal oscillator, a USB connection port,an ICSP header,a reset button and a power jack. It contains everything that are needed to support the microcontroller; simply connect it to a PC with a USB cable or power it with a AC to DC adapter or battery to get started. The UNO differs from all other boards in that it does not use the FTDI USB to serial driver chip. Instead, UNO uses the Atmega8U2 programmed as a USB to serial converter.

B. Li-Fi Transmitter and Receiver Module

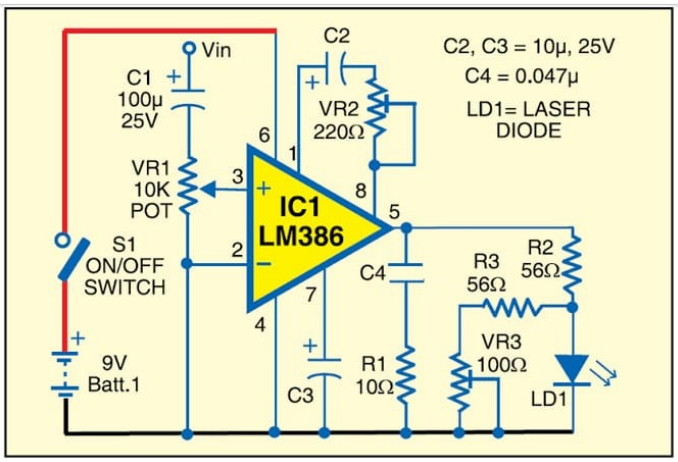

Fig. 3. LiFi Transmitter circuit

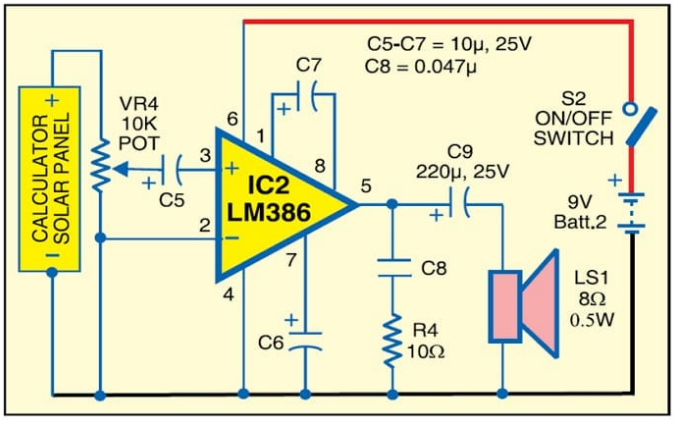

Fig. 4. LiFi Receiver circuit

LiFi uses the visible light part of the electromagnetic spectrum to transmit data at extremely high speeds.Li-Fi module is shown in figure 5. This technology is in contrast to established forms of wireless communications like Wifi which use traditional radio frequency signals to transmit data. With Lifi, data is transmitted by modulating the light intensity, which is received by a photosensitive detector and light signal is demodulated into electronic signal.Lifi transmitter and receiver circuit are shown in figure 3 and figure 4 respectively. This modulation is performed in such a way that it is not visible to the naked human eye. Lifi is a category of Optical Wireless Communications (OWC). OWC include IR and UV communications as well as visible light. However, Lifi is unique in that the same visible light used for illumination may also be used for communication.

Fig. 5. LiFi Module

C. LCD

It is a flat-panel display or other electronic visual display which uses light-modulating properties of liquid crystals. Liquid crystals do not directly emit light. LCDs are available to display arbitrary images (as in a general purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as predefined words, numberdigits, and 7 segment displays as in a digital clocks.

D. Power Supply

Power supply is an electrical device which supplies electric power to an electrical load. The power supplies primary function is to convert electric current from a source to the correct frequency, voltage, and current to power the load. Hence power supplies are sometimes referred to as electric power converters.

E. Audio Playback Recorder

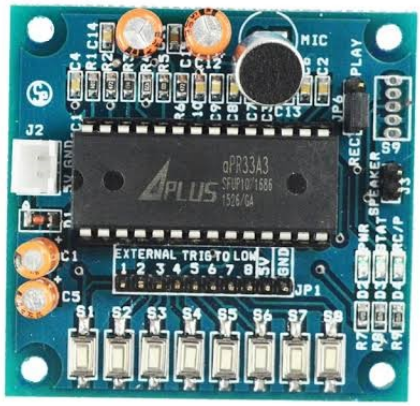

Fig. 6. Audio Playback Recorder

There are several types of voice recorder and playback systems available in the market but most of them are costly and their circuits are complex to assemble. Here is a simple voice recorder which is shown in figure 6 .It is used as a playback system for recording and playback of voice messages .We can send a voice message for our friends and family whenever you go out, that they can hear by pressing the 'play' button. This Audio playback recorder is built around a recording and playback chip that supports voice recording for nearly 16 to 30 seconds and it can be clearly reproduced. It can be used in different types of applications such as railway announcement systems, door bells, and automatic telephone answering devices.

IV. Software Requirements

A. MPLAB IDE

Microchip has a large suite of software and hardware development tools integrated within one software package called MPLAB Integrated Development Environment (IDE). It is called an Integrated Development Environment, or IDE, because it provides a single integrated environment to develop code for embedded microcontrollers. MPLAB IDE runs as a 32-bit application on Microsoft Windows, is easy to use and includes a host of free software components for fast application development and super-charged debugging. Moving between tools is a snap, and upgrading from the free software simulator to hardware debug and programming tools is done in a flash because MPLAB IDE has the same UI for all tools.

B. Embedded C

Embedded C is a set of language extensions for the C programming language by the C standards Committee to address commonality issues that exist between C extensions for different embedded systems. Embedded C programming typically needs non standard extensions for the C language to support enhanced microprocessor features like basic input/output operations and multiple distinct memory banks.

V. Overview

In this paper, the implementation and analysis of two stereo audio transmitting methods referred to as Pulse Code Modulation streaming and MP3 streaming over Visible Light Communication are presented. Audio transferring is an essential component in home entertainment.The communication architecture implemented is composed of software and hardware subsections. Hardware components are implemented using low cost components such as photodiode as the receiver, Light Emitting Diodes as the transmitter and a universal serial bus (USB) module as the interface between the software and hardware subsection. The software subsection produces a transmission-ready binary data stream from audio files and the hardware subsystem transmits the binary stream over a free space Visible Light Communication link.

VI. Advantages

A. Efficiency

Li-Fi works on visible light technology. Since homes and offices already have LED bulbs for lighting purposes, the same source of light can be used to transmit data. Hence, it is very

efficient in terms of costs as well as energy. Light must be on to transmit data, so when there is no need for light, it can be reduced to a point where it appears off to human eye, but is actually still on and working.

B. Availability

Wherever there is a light source, there can be Internet. Light bulbs are present everywhere – in homes, offices, shops, malls and even planes, meaning that high-speed data transmission could be available everywhere.

C. Security

One main advantage of Li-Fi is security. Since light cannot pass through opaque structures, Li-Fi Internet is available only to the users within a room and cannot be breached by users in other rooms or buildings.

D. Speed

The speed of voice communication and data transmission .

E. Cost

Li-Fi is very cheap, because it does not required any licence like Wi-Fi. Due to use of Li-Fi the device switching is very simple.

VII. Applications

- This project can be used for audio transmission in military operations, fisherman security.
- This project can be paved the way for excavation activities under the sea.

VIII. Existing System

The traditional method of communication was done by line signals, but this has been replaced by voice communication, and line signals are now used in emergencies when voice communications have failed. Surface supplied divers wear helmet attached with a closed circuit video camera that allows the surface team to monitor the activity of divers and to inspect the tasks.This can also be used to transmit hand signals to the surface if voice communications fails.A diver can write text messages on underwater slates for communication with other divers, and there are some dive computers which allow a limited number of programmed text messages that can be sent to other divers throgh water or to the surface person with compatible device.

IX. Proposed System

Visible light communication (VLC) based underwater communication, which uses visible light range between375nm and 780nm as optical carrier for data transmission and illumination. It uses fast pulses of light to transmit information wirelessly .VLC uses white Light Emitting Diodes (LED), which send collected data by flashing light at speeds undetectable to the human eye. One major advantage of VLC is that we can use the infrastructure around us without having to make any changes to it. LEDs' ability to transfer information signals over light (light which is between 400THz to 800THz of frequency and whose wavelength is between 400nm to 700nm) makes it a very good communication medium. The LED lighting system can achieve lower power consumption and has a longer lifetime compared to the fluorescent lamp system.

X. Conclusion

This paper gives the overall view of a system which are useful for the one to one underwater communication at faster speed . It overcomes the problem which occurs in communication and give the secure communication. Our system is effective for security purpose of the ships. If this system is used in Navy, it would be more effective for long distance communication. So it would be efficient if our system would be implemented for underwater communication. The Communication range of Li FI is higher, it does not disperse under water, power consumption is lesser, the packaging is smaller, higher data transmission speed can be achieved. With all these advantages we conclude that Li-Fi is a better technology that can be used for underwater communication when compared to acoustic methods of communication underwater.

XI. Future Scope Of This Paper

A higher end camera and laser can be used to achieve better efficiency and higher transmission speed. A camera and a laser can be used at both receiver and transmission end to establish two-way communication. This paper can be used in Robotics control. This paper can be used in Heavy machinery controls in varies industries

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