Underwater Communication through Light Waves

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ABSTRACT

In recent times the underwater acoustic communication plays a vital role in the field of wireless communication. Underwater acoustic communication is used for the monitoring of obstacles and to protect the endangered species. In the earlier systems, electromagnetic waves were used, which was found to be with less efficiency. The proposed system is devoid of all such deformities and has better efficiency. This system presents the design and implementation of underwater communication through Li-Fi. The data or information is sent from the transmitter submarine to the receiver submarine. The system develops voice signal, which is transmitted using light waves with low noise. Initially, the voice signal is converted into digital values and these digital data values are converted to RGB values. RGB values obtained are transmitted as light waves to receiver submarine. The basic principle of the project is Visible Light Communication (VLC). The voice signals used in this system is designed to recognize languages and identify its location. In this technology has increased speed, improved bandwidth, and reduced noise. Thus the audio signal transmitting with the use of Li-Fi. The software design was implemented in Mat lab code and Graphical User Interface.

Index terms: Visible Light Communication (VLC), RGB, Li-Fi, Light.

1. INTRODUCTION

Now a day's almost all the people are using the internet to accomplish their task through wireless communication. The last 3 years has tried to develop in underwater acoustic communication. In recently improved their performance and robustness as compared to the initial communication system. An Electromagnetic wave travels poorly in sea water. High-speed communication in the underwater acoustic channel is changeling due to limited bandwidth, severe fading, data transmission speed and refractive [4]. Radio frequency and acoustical technology for the underwater communication suffer from low data transmission and multipath propagation. The light source has high data transmission in sea water. The laser/focus light based communication with using blue/green lasers is a potential technology for high bandwidth in underwater communication. The transmission of an audio signal in underwater communication between submarines.

Underwater acoustic communication is a technique of sending and receiving messages below water. There are several ways of employing such communication but the most common is by using hydrophones. Underwater communication is difficult due to factors such as multi-path propagation, time variations of the channel, small available bandwidth and strong signal attenuation, especially over long ranges. Compared to terrestrial communication, underwater communication has low data rates because it uses acoustic waves instead of electromagnetic waves. At the beginning of the 20th century, some ships communicated by underwater bells, the system being competitive with the primitive Maritime radio navigation service of the time. The later Fessenden oscillator allowed communication with submarines.

2. SYSTEM DESIGN

This system can be designed into both hardware and software. This project can also be completely implemented with the use of software alone and no hardware is required. The project can be done using

1. Mat lab R2014

The software design was implemented in Mat lab coding with the use of Graphical User Interface.

3. EXISTING SYSTEM

In underwater acoustic communication has low data transmission, smaller range and multipath reflection. The high speed communication in under water acoustic channel is challenging due to limited bandwidth and severe fading.

4. PROPOSED SYSTEM

In the proposed system is improve the data transmission speed and increase the range in Li-Fi technology through light waves. Thus the data acoustic underwater communication has a low bandwidth to compare the light waves

5. SYSTEM ARCHITECTURE

The light wave has used to transmit the voice data between two submarines. The Li-Fi technology has used in light waves through underwater communication. The Graphical user interface has used to the implementation. A block diagram of the project is shown fig-1

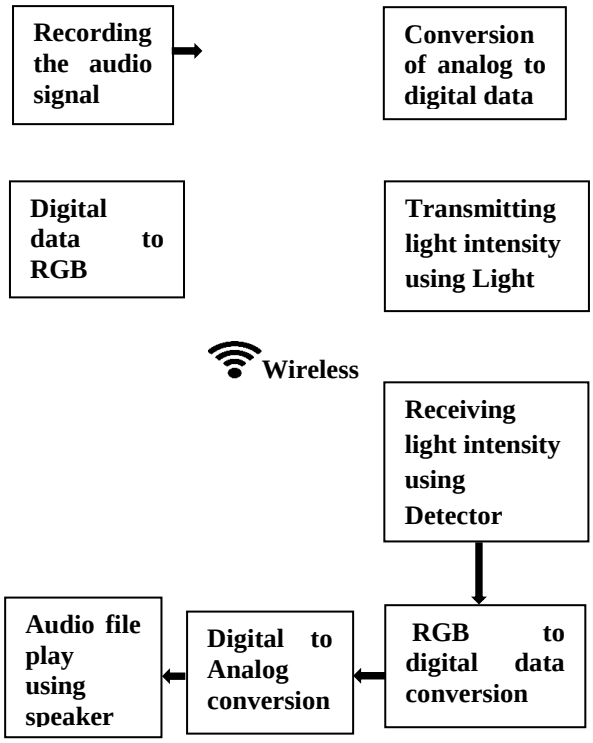

Fig-1: Process of UWC

5.1. Transmitter

The audio transmission of submarines has two sections. It has transmitter and receiver. The transmission section has four working process and the receiver section also the four working process.

5.1.1. Recording the audio signal

The first block represents recording the audio signal. An audio signal is an analog signal. The voice signal is an audio signal. The voice signal has added some noise. Our ears are very sensitive to hear the sound, which is physically just different variations in air pressure.

Sound: Time→ Pressure…… (1)

It is representation of sound signal

Pressure is a set consisting of possible values of air pressure, and Time is a set representing the time interval over which the signal lasts. A 1 sec segment of an audio or voice signal is a function of the

Voice: [0, 1] → Pressure……..…….… (2)

Where [0, 1] represents 1 sec of time.

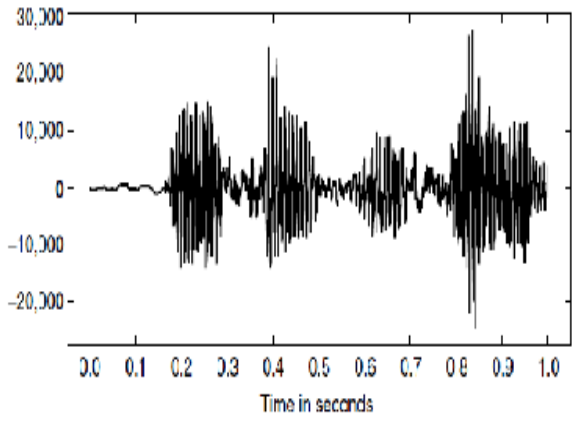

Fig-2: Speech fragment waveform

A function is plotted in such a plot is called as the waveform. It has different negative and the positive values. The average value is zero. The air pressure cannot be negative, so the voice signal has always the positive integer. This waveform is called as voice signal waveform. Use the audio recording player with the record an audio signal with the help of the laptop.

5.1.2. Analog to digital conversion

The analog signal is a waveform signal, so it can't send directly. It converts the digital data value and then it send the output value. The simplest digital signal has two different states are called binary. All whole numbers can be represented in binary form as strings of ones and zeros. The discrete-time signal is a digital value. Digital signals propagate more efficiently than analog signals. The digital value was noted as the fig-3.

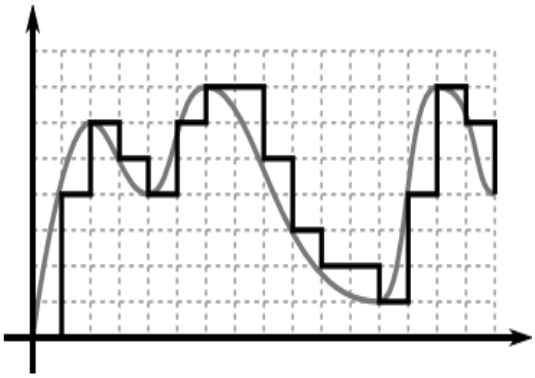

Fig-3: Digital waveform

5.1.3. Digital data to RGB conversion

The RGB means red, green and blue color. That RGB value is called as intensity. The black and white image has low intensity and low grayscale value because it has only the mixture of two colors.

Vertical Space × Horizontal Space →Intensity... (3)

Intensity = [black, white]…….…. (4)

The color picture has many color. The RGB values assigned by Color Image at any point *(x*, y). The RGB intensity has 256 values [0-255].

(r, g, b) = Color Image(x, y)…… (5)

Color Image intensity is denoted as,

Vertical Space × Horizontal Space→$Intensity^3$.. (6)

This method is used to convert the digital data value into RGB light intensity value. This process was converting with the help of mat lab coding process.

5.1.4. Transmitting light intensity

The transmitting light intensity block was used to transmit the light intensity image with the use of light waves. The light waves have high data transmission speed and high bandwidth. The light source has two different types that are natural and

man-made. The man-made light source has LED, LASER, FOCUS LIGHT, etc. The LASER light has transmitted high data transmission speed and high efficiency [3]. The light source used to transmit the light intensity to transmitting section to receiving section.

5.2 Receiver

The receiver section has four different process. All the sections was processed with the help of coding technique.

5.2.1. Receiving light intensity

Thus the receiving light intensity means to receive the light intensity image. The light intensity image has the mixture of RGB colors. The grayscale value is displayed the command window. To receive the light intensity value with the use of detector. The Detector means to get the value and display the image. This is the processing technique of receiver side light intensity.

5.2.2. RGB to digital data conversion

The RGB has easily converted to digital data. All the image segments have fully different digital values. The grayscale value has totally 256. Thus the light intensity value has returned to the digital data value. The digital data value is displayed in the command window. Different images are represented by functions with different spatial domains, different ranges, and different assignments of color values to points in the domain. That process is called conversion of RGB to digital data.

.4.2.3. Digital to analog conversion

The digital to analog conversion means to convert the digital data value into analog signals. The digital data value is only ones and zeroes. The analog signal is a sinusoidal wave. The one value is changed into the different waveform. The signals are said to be digital data signals because they are defined only at discrete points in time. A discrete-time one-second voice signal in a computer is a function,

$$\text{Computer Voice: DiscreteTime} \rightarrow \text{Integers16} \ldots\ldots (7)$$

5.2.3. Play the audio signal

The audio is an analog signal. The voice signal is an analog signal. The above block sends the analog signal. Thus the audio signal plays the receiver side with the help of speaker. This final process is called the play the audio signal.

5.3 Mat lab

Mat lab is a multi-paradigm numerical computing environment and fourth-generation programming language. A proprietary programming language developed by Math works, Mat lab allows matrix manipulation, plotting of functions and data, implementation of algorithms, the creation of user interface, and interfacing with programs written in other languages, including C,C++,Java, and python. Mat lab includes a variety of tools for efficient algorithm development, including command window, Mat lab editor, code analyzer, Mat lab profiler, Simulink and graphical user interface. Thus the graphical user interface used to complete that project. This process is fully based on graphics and coding method.

5.4 Graphical user interface

GUIs (also known as Graphical User Interfaces or UIs) provide point-and-click control of software applications, eliminating the need to learn a language or type commands in order to run the application. MATLAB apps are self-contained.
MATLAB programs with GUI front ends that automate a task or calculation. The GUI typically contains corresponding UIs, for other users. The principles of good GUI design are, for the most part, timeless and universal. The Guide Tools include the already-mentioned Property Editor, the Call-back Editor, the Alignment Tool, and the
Menu Editor Etc.

Design Process Steps:-

- Define the task
- Draw the GUI
- Test the Design
- Write the Code (use Guide)
- Test the Code

It controls such as menus, toolbars, buttons, and sliders etc. You can also create your own custom apps. Thus the processor has 6push button. The first three has transmitter section and the next three was receiver section. Transmitter pushbutton has processed in record the signal, conversion process and send the signal. Receiver side has receive the signal, conversion and play the audio signal.

6. RESULT AND DISCUSSION

One of the Mat lab developmental tools is GUI. This project used to totally six pushbuttons, 3 for transmitter section and the next 3 for receiver section. Thus the transmitter section output has shown in fig-4.

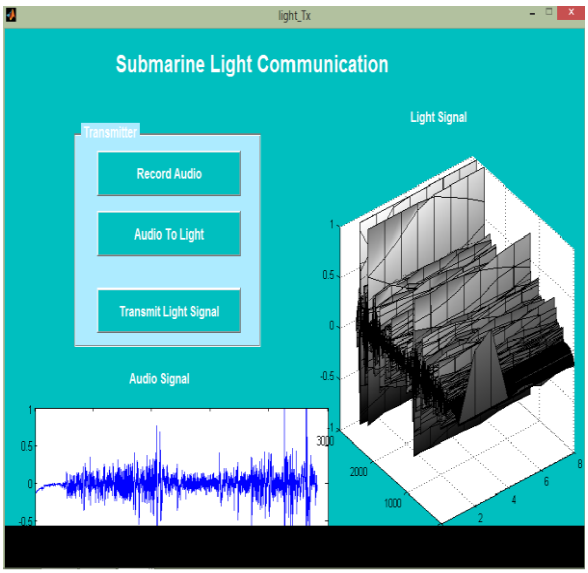

Fig-4: Transmitter output

Consider the transmission section is a transmitter submarine. The transmitter section has used three pushbuttons. The first pushbutton has used to record the audio signal. The audio signal recorder has fully already assigned, the time period, when you start the speaking and when you stop the speaking.

If increase the time period means to change the GUI coding. The second pushbutton has used to transmission of analog to digital signal because voice signal is an analog signal. Thus signal can't send directly, so its convert the digital signal and it sends. Then its convert the light intensity. Light intensity means to measure the grayscale value of the digital signal. The third pushbutton is used to transmit the light intensity with the help of light source. The laser light is the main light source of the transmission. This is the process of transmission section.

Thus the receiver section output has shown in fig-5.

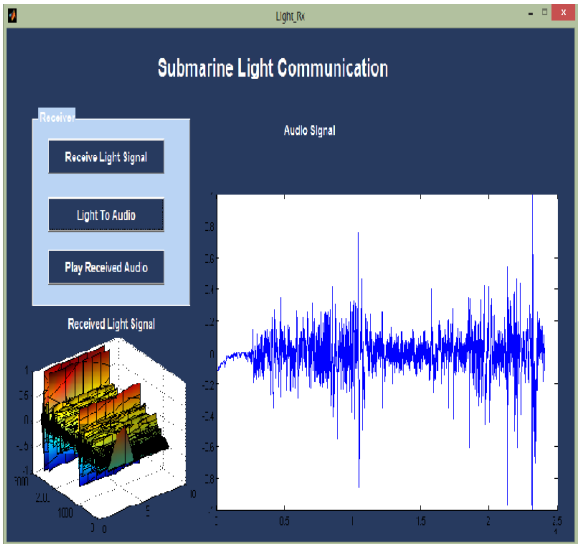

Fig-5: Receiver output

Consider the receiver section is a receiver submarine. The receiver section has the receiver has used three pushbuttons. The first pushbutton is used to receive the light intensity using light waves. To get the output with the help of a detector. The second pushbutton has used to convert the light into the audio signal. This button has processed in two process levels. Light intensity is converted into the digital data value and the digital data value is converted into analog audio signals. Thus the third pushbutton has used to get the analog audio signal and play the audio signal. At finally to receive the audio signal in the receiver submarine.

7. CONCLUSION

Li-Fi technology is upcoming and on growing technology acting as competent for various other developing and already invented technologies. Since light is a major source of transmission in this technology it is very advantage and implements in the various field. Li-Fi has the advantage of being useful in electromagnetic sensitive areas such as in aircraft cabins, hospitals and nuclear power plants without causing electromagnetic interference. The visible light spectrum is 10,000 times larger than the entire radio frequency spectrum. Researchers have reached data rates of over 224 Gbits/s. This technology used to transmit the audio signal in underwater communications between two submarines. This method is very convenient of the underwater communication because it has the high data transmission speed and high bandwidth with low noise.

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