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A

PROJECT STAGE-1 REPORT ON

Audio And Data Transmission Using LI-FI Technology

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IN

ELECTRONICS AND TELECOMMUNICATION

BY

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ACADEMIC YEAR: 2022-23

CERTIFICATE

"*Audio And Data Transmission Using LI-FI Technology*"

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is the record of bona fide work carried out by them in partial fulfillment of the requirement for the award of the Degree of **Bachelor of Engineering (Electronics and Telecommunication),** as prescribed by the Savitribai Phule Pune University in the Academic Year 2022-2023.

This project report has not been earlier submitted to any other Institute or University for the award of any degree.

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ABSTRACT

As the demand for high-speed data in wireless communications increases day by day with the significant increase of the number of users, Radio Frequency (RF) spectrum become one of the scantest resources in the world. RF technologies have limitations of the regulated spectrum, spectrum congestion, expensive licensing, low bandwidth and low-speed broadband connection. The available huge visible light communication (VLC) spectrum band ranges from 428 THz to 750 THz. So the new wireless technology known as light fidelity (Li-Fi) has become a new source for communication of data and it has been identified as a powerful and promising complementary and/or alternative to the existing radio frequency(RF) wireless communication technology which uses visible light as a medium to deliver high-speed data communication. Li-fi is an optical wireless communication technology which utilizes light emitted from Light-emitting diode bulb for simultaneous transmission of text and audio signals which is discussed in this paper.

Continuous improvements in wireless communication systems, e. g. 3G, 4G, etc.., require higher bandwidth and due to the lack of sufficient Radio Frequency spectrum, we should adopt a wireless system which will support wide bandwidth. So the new technology of Li-Fi came into the aid. Light fidelity (Li-Fi) is a new short range optical wireless communication technology which provides data transmission like text, audio, video by using Light-Emitting Diodes (LEDs) to transmit data depending on light illumination properties. It uses the visible light spectrum which is 10,000 times larger than the entire radio frequency spectrum. In this technology, LEDs are used to transmit data in the visible light spectrum. Lasers can also be used instead of LED but it requires

proper alignment between the transmitter and receiver. This technology can be compared with that of Wi-Fi and offers advantages like increased accessible spectrum, efficiency, security, low latency and much higher speed. Communication is achieved by switching LED lights or laser on and off at a data speed higher than what is perceptible to the human eye. This concept promises to solve issues such as the shortage of radio frequency bandwidth and boot out the disadvantages of Wi-Fi. Li-Fi is the upcoming and on growing technology acting as competent for various other developing and already invented technologies. Hence the future applications of the Li-Fi can be predicted and extended to different platforms and various walks of human life.

INDEX

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The motivation factor for this work was the inspiration given by our honorable principal **Dr. P. B. Mane.**

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Sign	Sign	Sign
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LIST OF FIGURES

LIST OF ABBREVIATIONS

LED	LIGHT EMITTING DIODE
BT	BLUETOOTH
LCD	LIQUID CRYSTAL DISPLAY
AMP	AMPLIFIER
IEEE	Institute of Electrical and Electronic Engg.
IC	Integrated Circuit

1. INTRODUCTION

As the demand for high-speed data in wireless communications increases day by day with the significant increase of the number of users, Radio Frequency (RF) spectrum become one of the scantest resources in the world. RF technologies have limitations of the regulated spectrum, spectrum congestion, expensive licensing, low bandwidth and low bandwidth and low-speed broadband connection.

So the new wireless technology known as light fidelity (Li-Fi) has become a new source for communication of data. which uses visible light as a medium to deliver high-speed data communication. It Uses available huge visible light communication (VLC) spectrum band ranges from 428 THz to 750 THz. Li – Fi Can be understood as the optical form the Wi – Fi. It actually refers to the 5G Visual Light Communication System where we use LED as a transmission medium to achieve the High Speed Communication among the devices just like the Wi – Fi. The utilization of Visual Spectra provides us the capability to transmit the data with speed of light but at the same time, brings its all limitations to it that it can't penetrate an opaque object like wall. But in the positive way it can utilized as the privacy and security tool or feature for the transmission.

Medical society- We cannot use Wi-Fi in hospitals and other medical institute because of the radio waves being used in data transfer but Li-FI can be a better and safer option in hospitals. Using Li-Fi one can also operate robotic surgeries without causing any harm to the patients.

Educational system- Li-Fi can be used in educational institute for better and faster internet, by using LED bulbs everyone can use same speed of network.

Underwater application- underwater remotely operated vehicles uses lager cables for suppling power and to send and receive data for operations, but the cables used are not long enough and make the operation limited to a point. Here Li-Fi can be used to make the exploration much more. Li-Fi can also be used in many underwater military operations were Wi-Fi fails.

Radioactive and other power plants- Wi-Fi cannot be used in power plants because of the radio waves and increases the cost of speed and other temperature modulations systems. Li-Fi could offer safe, abundant connectivity for all areas of the locations. This can save money as compared to the currently implemented solutions. Also, the pressure on a power plant could be lessened

VLC (Visible Light Communication) is the type of communication technique that uses the Visual Light having frequency between 400 THz (780 nm) – 800 THz (375 nm) as a carrier for the Data Transmission and Illumination. The Core Components of this VLC are as follows: a. A **LED Bulb** (Transmitter) b. A **Photodiode** (Receiver) Encoding and Decoding the data involve in communication while transmitting/ receiving it, is one of the most important step that need to be follow to accomplish an error free transmission. Therefore, we can use various Encoding/Decoding techniques like 4B/5B, NRZ, Manchester, Differential Manchester, etc. with dedicated quantization bit. To accomplish this, we just need a microcontroller and a transceiver. By this we can theoretically achieve the speed of 10 Gigabytes per second.

The transmission process through the basic design module of Arduino, 4*4 Keyboard, LED, Photodetector, an LCD panel and other basic components by which data have been transmitted through visual light. Firstly, the input is given in the form of text via 4*4 Keyboard and here Bluetooth have been used to transfer data by compiling and uploading to Arduino. This way tangle free connection are being got. The data transmitted to Arduino Uno is in the form of Alphanumeric value. The alphanumeric value is converted to a binary value. The binary values from Arduino being sent to the LED. The main purpose of the LED here is to transmit the received values from Arduino to the photodiode. The LED's transmit data by flickering.

Further, in the receiver section, the photodetector receives the flickers in the form of Binary data and then again it is sent to the Arduino on the receiver section for conversion. Here the binary data is converted to ASCII value. At last in the receiver side has a dictionary in form of codes which converts the ASCII value again to alphanumeric character. The text transmission circuit diagram is explained and shows the connection of the circuits where the keypad connection from R0 to C2 is connected to Arduino Uno in the following ways. The LCD screen in the transmitter section is used to check the characters which are being transmitted.

2. LITERATURE REVIEW

SUMMARY OF LITERATURE SURVEY:

- **IEEE ANTS 2019 :** Visible Light Communication (VLC) is the term which was the method that uses visible light for Data transmissions. Due to the insufficient Radio Frequency (RF) resources, and the limitations in bandwidth, the demand for faster data transmission becomes a big problem to be solved. This problem is rectified by the emerging Li-Fi technology which provides faster data transmission with a more secure environment. Therefore, VLC became an emerging technology and was included in 5g. This paper focuses on audio and video transmissions in VLC methodology using Li-Fi (light fidelity) module. A real-time transmitter and receiver system to check the performance and verify the audio and video transmission using Li-Fi under varying conditions such as distance, intensity, and quality. The main Objective is to design a transmitter and receiver using a Li-Fi setup for audio and video transfer and to test the setup under varying conditions. The use of VLC has gained particular interest due to its fast data rates and traffic overloading techniques. The main advantage of VLC is quick data rates with minimum power consumption. and small setup cost makes it as an emerging technology that can be included and used in upcoming technologies such as 5g networks.

- **IEEE(I-SMAC)2020 :** As the demand for high-speed data in wireless communications increases day by day with the significant increase of the number of users, Radio Frequency (RF) spectrum become one of the scantest resources in the world. RF technologies have limitations of the regulated spectrum, spectrum congestion, expensive licensing, low bandwidth and low bandwidth and low-speed broadband connection. The available huge visible light communication (VLC) spectrum band ranges from 428 THz to 750 THz. so the new wireless technology known as light fidelity (Li-Fi) has become a new source for communication of data and it has been identified as a powerful and promising complementary and/or alternative to the existing radio frequency (RF) wireless communication technology which uses visible light as a medium to deliver high-speed data communication. Li-fi is an optical

wireless communication technology which utilizes light emitted from Light-emitting diode bulb for simultaneous transmission of text and audio signal.

- **JETIR 2019 :** Continuous improvements in wireless communication systems, e.g. 3G, 4G, etc.., require higher bandwidth and due to the lack of sufficient Radio Frequency spectrum, we should adopt a wireless system which will support wide bandwidth. So the new technology of Li-Fi came into the aid. Light fidelity (Li-Fi) is a new short range optical wireless communication technology which provides data transmission like text, audio, video by using Light-Emitting Diodes (LEDs) to transmit data depending on light illumination properties. It uses the visible light spectrum which is 10,000 times larger than the entire radio frequency spectrum.

- **ICMSMT 2020 :** The light fidelity technology refers to visible light communication that uses light as a medium to deliver high speed data which is much greater than that of Wi Fi. Li Fi data is transmitted in several bit streams and the receiver side consisting an IR detector decodes the message. The transmission happens in the form of binary data where 0 means LED in OFF state and 1 means that the LED is in the ON state. Transmitter and receiver sections contain Arduino which is programmed using Arduino IDE. High power intensity led are used in the Li Fi transmitter. In receiver section photodiode module is used to detect the light signal generated by the Li Fi transmitter. In this we are transmitting the 2 different data using light they are Audio signal and Text Signal

- **ICCIS 2020 :** Handling data transmission for radio signals became one of the most important concerns, giving birth to Light as a significant alternative. Visible Light Communication (VLC) arose as an effective option for data communication. Light Fidelity (Li-Fi) is one of VLC technologies and represents a new technique operating with light signals in order to transmit data a source to a destination. It guarantees several benefits and can overcome different limitations of Wi-Fi technologies including security issues, media obstacles, and radio interference. Li-Fi technologies are adopted for experimental usage and does not extensively arise in industry. The adoption of Li-Fi technology in industry, it is necessary to measure the performance of

data transmission several data types requiring to be supported. The purpose of this paper is to investigate the performance of data communication using VLC. This research is based on an implementation for different types of data transmission through Li-Fi. The methodology that has been adopted for this study consists on a simulation topology by NS3 which has been built to study the performance TCP and UDP protocols in Li-Fi environment for VLC communication. Various types of data have been transmitted through an appropriate designed model. The simulation results show the differences between the two common algorithms. The implementation explained the needs for Li-Fi data transmission. Indeed, this work show a successful audio, text, and images transfer through VLC technology.

- **NEVO 2021 :** Wireless-fidelity (Wi-Fi) and Bluetooth are examples of current wireless communication technologies that utilize the radio waves as primary source for data transport. Despite the widespread use of these technologies, there is a pressing need to investigate new methods for transmitting data wirelessly and efficiently. The reason for this is due to the band of radio frequency (RF) present limits, which has overpopulation and disturbance signals from other RF applications. More research work has been done to prove that visible light may be used as a wireless source for data transport in order to investigate alternatives. As a result, a German physicist named Harald Haas presented a new technology called light-fidelity (Li-Fi). This is a wireless technology that uses visible light instead of the radio wave as a communication medium. The scientific community has recently been drawn to Li-Fi technology. Wireless technology has advanced to the point that it is now necessary to send large amounts of data on a daily basis. Electromagnetic waves, or radio waves, are the most common technique of transmitting data wirelessly. Due to limited spectrum availability and encroachment, radio waves can only support a lower bandwidth. Data transmission via visible light communication is one solution to this problem (VLC). Wi-Fi is used to provide wireless coverage within a building, but Li-Fi is ideal for providing high-density wireless data coverage in a confined area while reducing radio interference. We use LEDs at the transmitter end and photo detectors at the receiver end to send multimedia data between two terminals utilizing Li-Fi.

3. AIM AND OBJECTIVES

3.1 Aim: Audio And Data Transmission using Li-Fi Technology

3.2 Objectives: To Transfer Audio And Data Using Visible Light Communication (VLC), Light Fidelity (Li-Fi) Technology Has Been Designed. This Project Aims To Develop a System For Faster And More Secure Transmission of Data.

3.3 Methodology: If the LED is on, we transmit a digital 1, if it's off you transmit a 0. The LED can be switched on and off very quickly, which gives nice opportunities for transmitting data. Hence all that is required is some LEDs and a controller that code data into those LEDs. All has to do is to vary the rate at which the LED's flicker depending upon the data we want to encode. The flashing of the light actually happens much faster that human eyes cannot detect, so the output appears constant, allowing for a Li-Fi data connection to resemble a simple LED bulb When LED is ON microchip convert digital data in form of light. On the other end this light is detected by the photo detector. Then this light is amplified and fed to the device. If the LED is ON, transmit a digital 1, if it's OFF you transmit a digit 0.

3.4 Specifications of the System :

Li-Fi can be used were Wi-Fi doesn't work, since Li-Fi uses visible light the applications are safe to use in many regions such as hospitals nuclear power plants, etc. here are some regions were Li-Fi can be used and improve the conditions of world in a drastic way.

4. BLOCK DIAGRAM OF THE SYSTEM AND ITS EXPLANATION

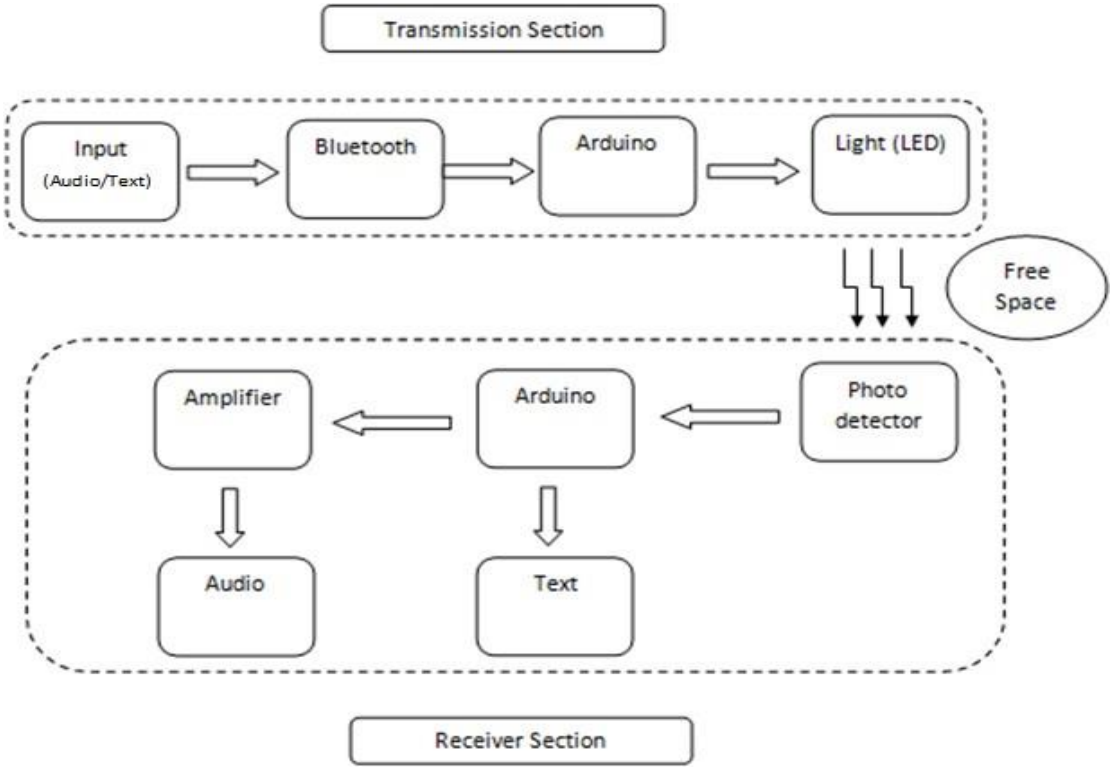


Fig No.1 – Block Diagram

Input: The input is given in the form of text via 4*4 Keyboard and here Bluetooth have been used to transfer data by compiling and uploading to Arduino.

Bluetooth: The Connection Between Input (audio/text) And Arduino Is Takes Place By Bluetooth. Because of Bluetooth There Is Wireless Connection (no cables are used)

Arduino: . The data transmitted to Arduino Uno is in the form of Alphanumeric value. The alphanumeric value is converted to a binary value. The binary values from Arduino being sent to the LED.

LED : The main purpose of the LED here is to transmit the received values from Arduino to the photodiode. The LED's transmit data by flickering.

Photo Detector: Further, in the receiver section, the photodetector receives the flickers in the form of Binary data .

Amplifier : to amplify the weak signals which is received by photo detector.

Receiver Arduino: then again it is sent to the Arduino on the receiver section for conversion. Here the binary data is converted to ASCII value. At last in the receiver side has a dictionary in form of codes which converts the ASCII value again to alphanumeric character.

Speaker(Audio output) : The audio output we can get on speaker. The purpose of speaker is to convert the electrical signal into sound signal.

LCD(Text output) : For text output we can use 16*2 LCD. The purpose of 16*2 LCD is to display alphanumerical values.

5. SYSTEM DESIGN

TRANSMISSION PROCESS **RECEPTION PROCESS**

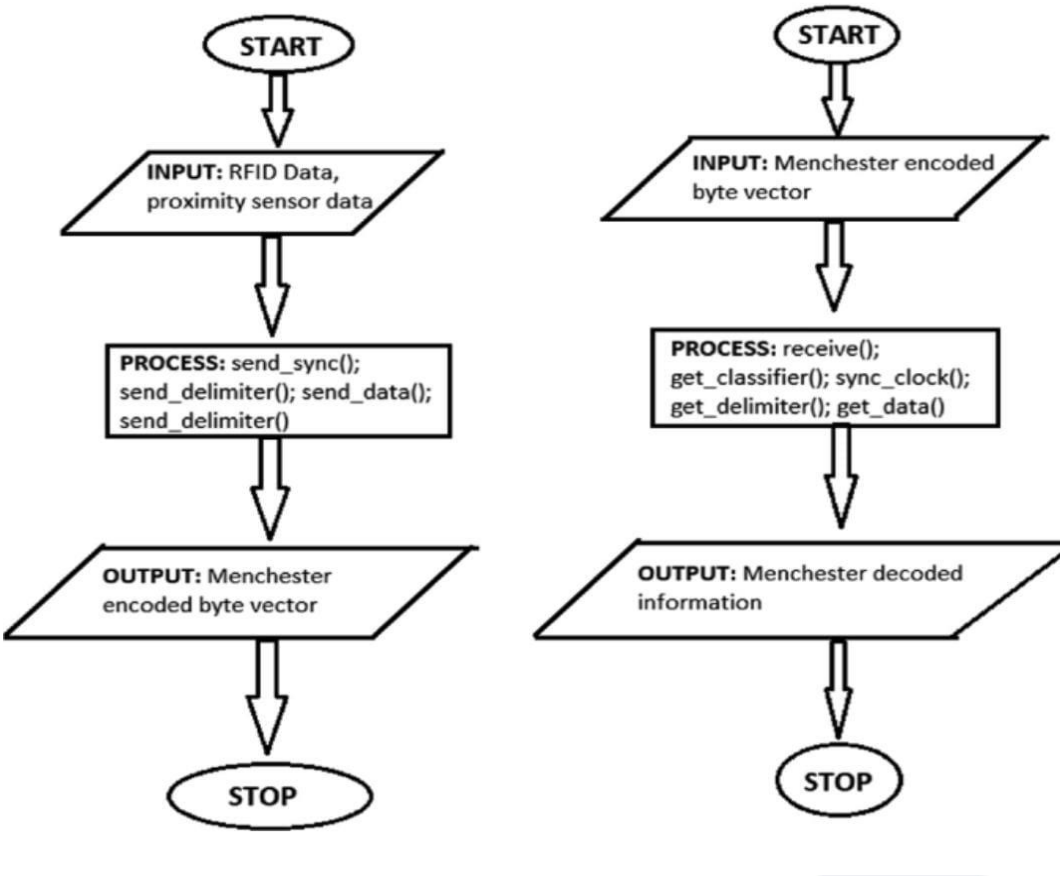


Fig No.2 – Flow Chart

6. SOFTWARE DESIGN

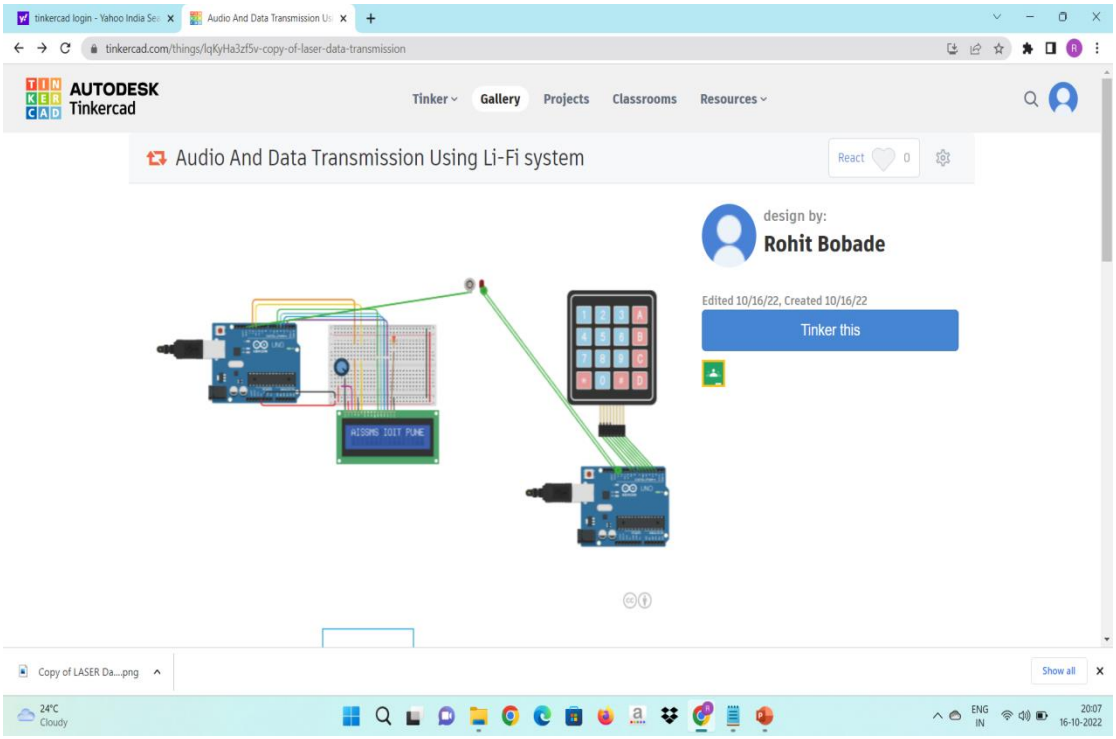
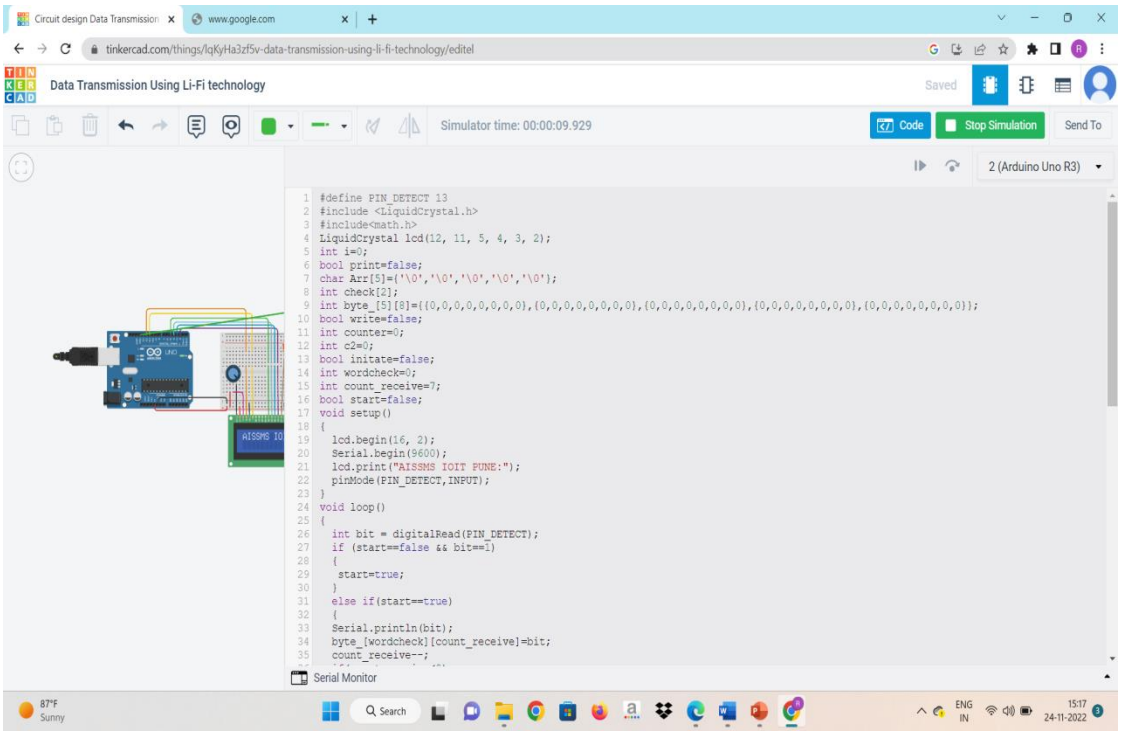


Fig No.1 – Simulation Result

Link- https://www.tinkercad.com/things/lqKyHa3zf5v



7. EXPECTED RESULTS

In this project, proposed, explained and demonstrated a real- time text and audio broadcast prototype by using LED and solar panel and examine the transmission of both text and audio signals using visible light communication. It is observed that transmission of text with the distances up to 0.5m and transmission of audio with distances up to 1.5m can be achieved. The VLC technology will be more explored in near future as demand for high-speed communication increases with application to transportation and home network.

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APPENDIX

A1	Bill of material.
A2	Important Datasheets, Application notes
A3	Project participation certificates.