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A

PROJECT REPORT ON

Audio And Data Transmission Using LI-FI Technology

SUBMITTED TO THE SAVITRIBAI PHULE PUNE
UNIVERSITY, PUNE IN THE PARTIAL FULFILLMENT FOR
THE AWARD OF THE DEGREE OF

BACHELOR OF
ENGINEERING IN
ELECTRONICS AND TELECOMMUNICATION

BY

ROHIT SANJAY BOBADE	**72162922K**
YASHODEEP DNYANESHWAR DESHMUKH	**72162933E**
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UNDER THE GUIDANCE OF

MRS. NILIMA S. WARADE

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

BY ALL INDIA SHRI SHIVAJI MEMORIAL SOCIETY'S INSTITUTE OF INFORMATION TECHNOLOGY, PUNE -411001

ACADEMIC YEAR: 2022-23

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Department of Electronics and Telecommunication Engineering

Certificate

This certify that the Project Report entitled

Audio And Data Transmission Using LI-FI Technology

(SDG Number-GOAL 9: Industry, Innovation and Infrastructure)

Submitted by

Mr. Rohit Bobade (B190253025)
Mr. Yashodeep Deshmukh (B190253051)
Mr. Sarvesh Mali (B190253148)

is a record of bona-fide work carried out by them, in the partial fulfillment of the requirement for the award of Degree of Bachelor of Engineering in Electronics and Telecommunication Engineering at All India Shri Shivaji Memorial Societies' Institute of Information Technology, Pune under the Savitribai Phule Pune University, Pune. This work is completed during academic year 2022-23, under our guidance.

Mrs. Nilima S. Warade
Internal Guide
Department of E&TC

Dr. Mohini Sardey
Head of the Department
Department of E&TC

External Examiner

Dr. P. B. Mane
Principal
AISSMS IOIT, PUNE

DATE

Acowledgement

It is our great pleasure in expressing sincere and deep gratitude towards my guide **Mrs. Nilima S. Warade,** Professor Electronics & Telecommunication Engineering Department for her valuable guidance and constant support throughout this work and help to peruse additional studies in Safety and Maintenance by Implementing the Embedded System.

We take this opportunity to thank head of the department Dr. M.P. Sardey and project coordinator **Mrs. Archana Ubale** and all staff members of department of electronics & Telecommunication Engineering AISSMS IOIT, Pune. For cooperation provided by them in many ways. The motivation factor for this work was the inspiration given by our honorable principal **Dr. P.B. Mane.** Lastly, we are thankful to those who have directly or indirectly supported for our work.

Rohit Bobade Yashodeep Deshmukh Sarvesh Mali

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Department of Electronics and Telecommunication Engineering

Vision

To be one of the renowned Electronics & Telecommunication Engineering programs imparting quality education by promoting professionalism, values, and ethics leading to a progressive career in industry & academia globally.

Mission

- To boost employability/entrepreneurship/higher studies through value-added activities.
- To inculcate research attitude and professional ethics for addressing the needs of industry.

Program Educational Objectives

The Program Educational Objectives (PEOs) are as follows:

Graduates will

1. Engage in solving problems in the E&TC domain by developing products/offering services to cater to the needs of the society.
2. Work in diverse career fields of information and communication technology.
3. Develop new methodologies and technologies for solving real-life problem

Program Specific Outcomes

Graduates will be able

- Apply domain-specific knowledge to analyze, design and develop electronics and telecommunication systems/applications in the field of Embedded Systems, Very Large-Scale Integration (VLSI), Internet of Things (IoT), and Communication Technology.
- Select and apply software and hardware tools such as Electronic Design Automation (EDA) and Test/ Measurement equipment to solve engineering problems.

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Program Outcomes

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
[Engineering knowledge]

2. Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. [**Problem analysis]**

3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. [**Design/development of solutions]**

4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. [**Conduct investigations of complex problems]**

5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. [**Modern tool usage]**

6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. [**The engineer and society]**

7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. [**Environment and sustainability]**

8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. [**Ethics]**

9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. [**Individual and team work]**

10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. [**Communication]**

11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. [**Project management and finance]**

12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. [**Life-long learning]**

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 cameinto 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 visiblelight 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 radiofrequency 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. Proper alignment between the transmitter and receiver.

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CHAPTER 1

1. INTRODUCTION

As the demand for high-speed data in wireless communications increases dayby 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 arenot 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 quantizationbit. To accomplish this, we just need a microcontroller and a transceiver. By this we can theoretically achieve the speed of 10Gigabytes 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.

CHAPTER 2.

1. 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 asa 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.., 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.

CHAPTER 3.

AIM AND OBJECTIVES METHODOLOGY

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

3.1 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.

3.2 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, transmita digital 1, if it's OFF you transmit a digit 0.

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.

CHAPTER 4.

PROBLEM STATEMENT

The problem statement revolves around the need for faster, more secure, and interference-free data transmission. The objective is to develop a robust LiFi-based data transmission system that can achieve high-speed communication, ensure data security through line-of-sight transmission, and mitigate interference from crowded wireless environments.

The project will involve designing and implementing specialized LiFi transceiver modules, optimizing communication protocols, and integrating LiFi technology with exist networking infrastructure. The successful execution of this project will contribute to the advancement of wireless communication technology and open up new possibilities for applications in areas such as healthcare, defense, and enterprise networking.

CHAPTER 5.

BLOCK DIAGRAM AND EXPLAINATION

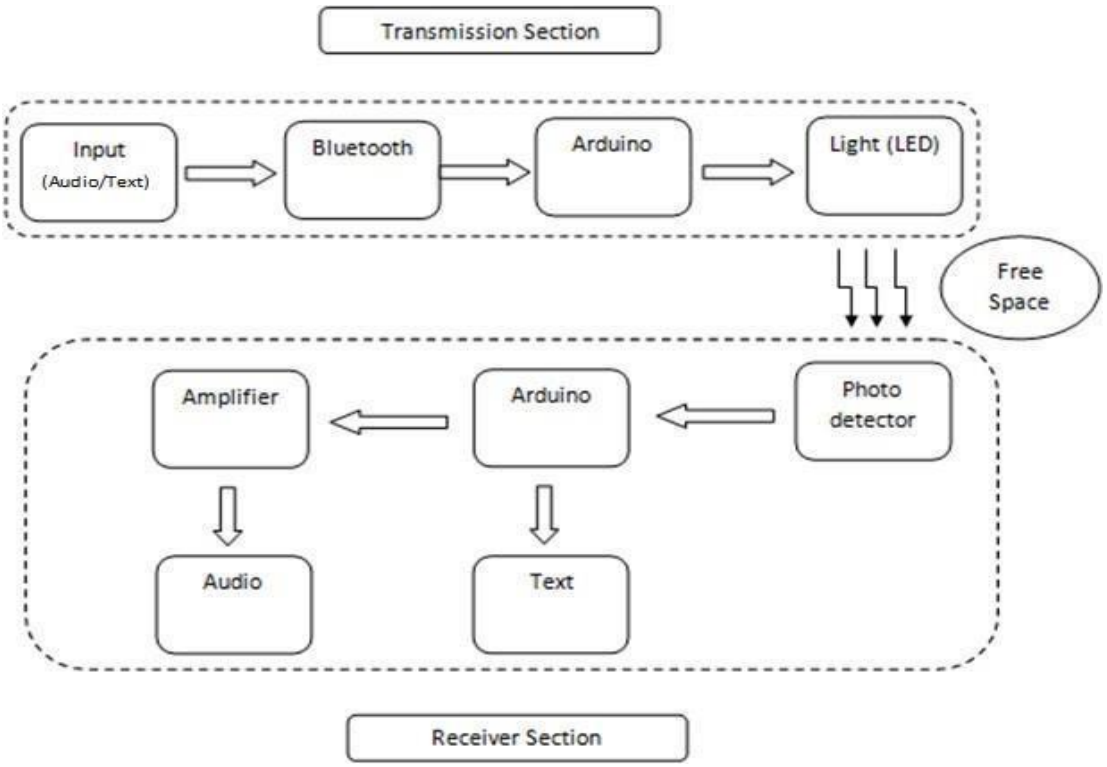


Fig No : 5.1 Block Diagram

EXPLANATION

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.

CHAPTER 6.

HARDWARE DESIGN

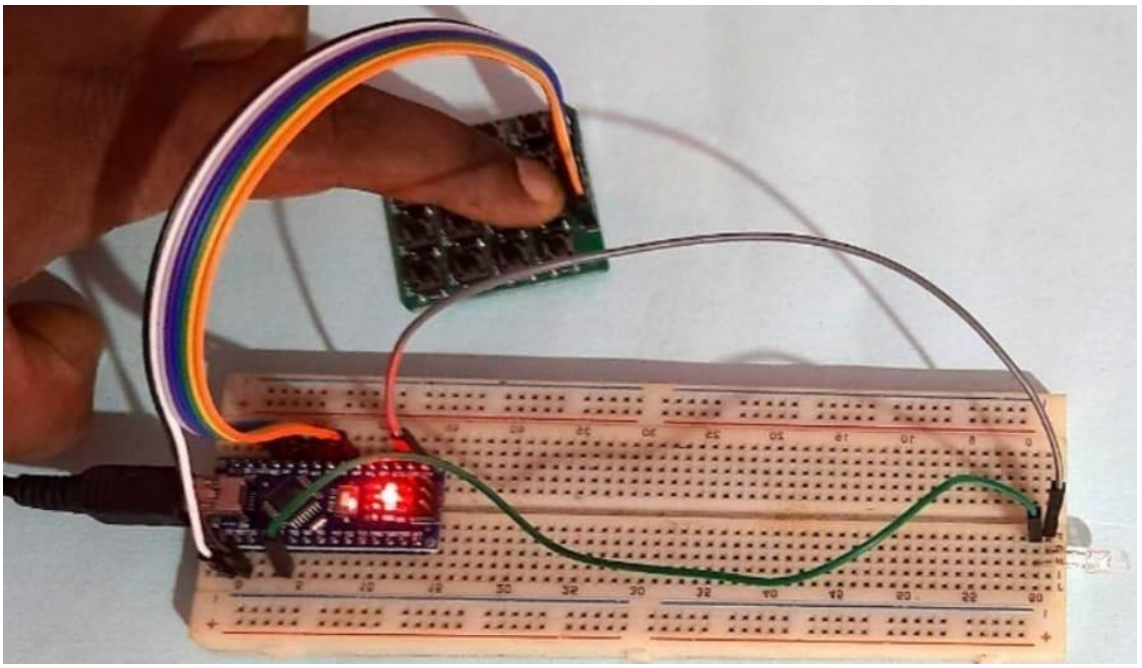


Fig No : 6.1 Transmission section

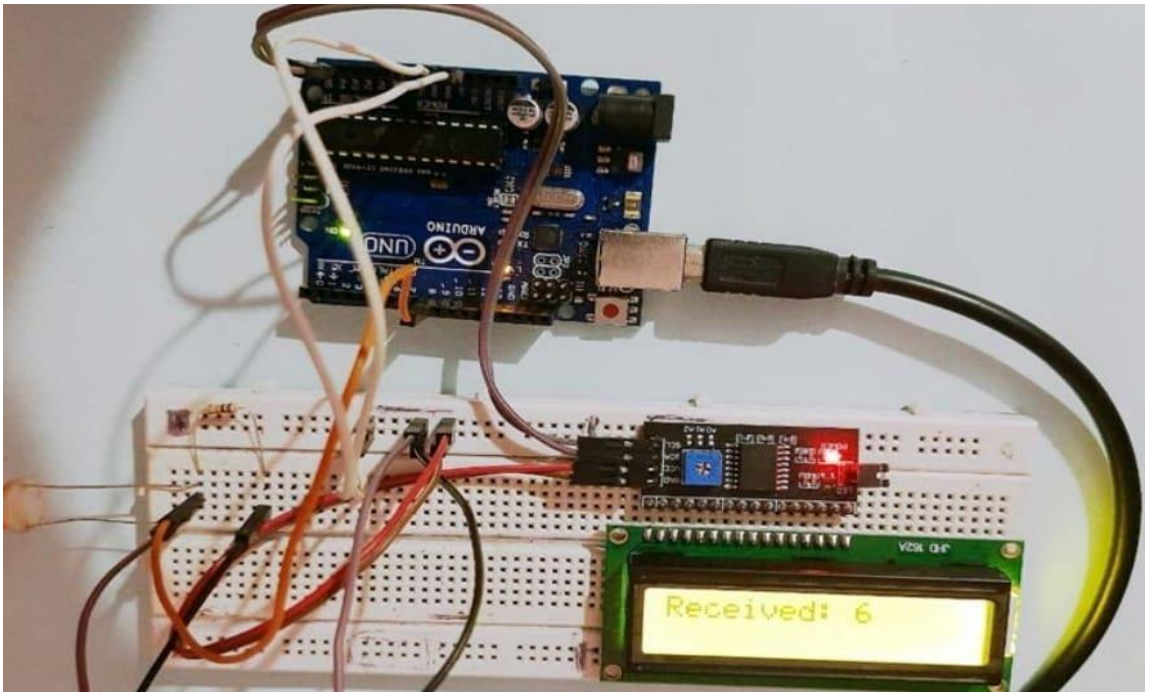


Fig No : 6.2 Receiving section

6.2 HARDWARE REQUIREMENT

1. Arduino UNO
2. Arduino NANO
3. I2C Interfacing Module
4. Photodiode
5. LED
6. 4*4 Keypad
7. 16*2 LCD Display
8. Speaker
9. Jumper Wires
10. 9V Battery
11. 5mm Audio Jack

6.3 SOFTWARE USED

1. Arduino IDE
2. Tinkercad

6.4 CIRCUIT DIAGRAM

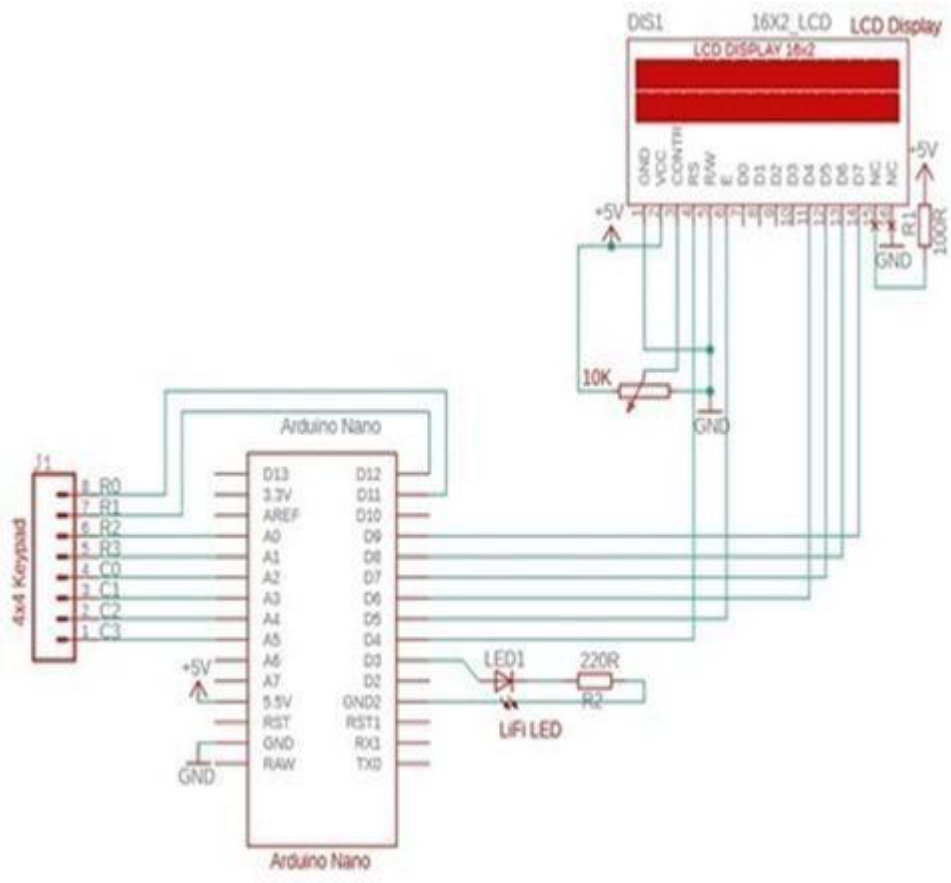


Fig No : 6.3 Circuit Diagrams

6.5 Component Details

1. Arduino UNO

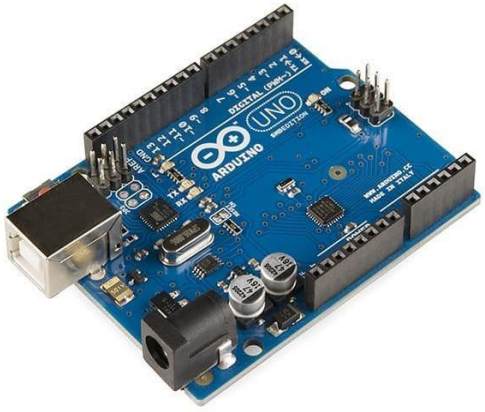


Fig No : 6.4

Arduino Uno can be used to connect and interface with light sensors, such as photodiodes or phototransistors, which detect the light signals emitted by the Li-Fi transmitter. The Arduino can read the sensor data and process it to extract the transmitted information. Arduino Uno can be used to control the LED or other light sources used in the LiFi transmitter. It can generate the necessary signals to modulate the light source with the data to be transmitted. Arduino Uno's GPIO pins can be used to drive the LED or control additional circuitry for better modulation techniques.

Arduino Uno can be used for signal processing tasks in a Li-Fi system. You can program the Arduino to process the received light signals, extract the encoded data, and perform any necessary error correction or decoding algorithms.

Arduino Uno has built-in UART (Universal Asynchronous Receiver-Transmitter) capabilities, which can be used to establish serial communication with other devices. In a Li-Fi system, you can use Arduino Uno to transmit the received data to a computer or another Arduino for further processing or data.

2. Arduino NANO

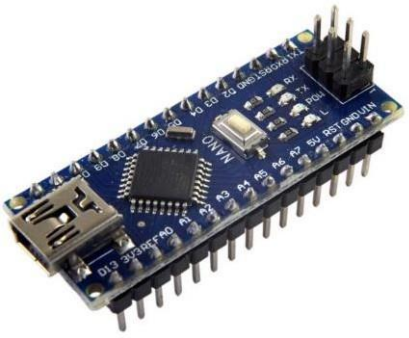


Fig No : 6.6

Arduino Nano -

Arduino Nano's small size and lightweight nature make it suitable for projects where space is limited. In LiFi applications, where the transmitter and receiver circuits need to be integrated into small devices or prototypes, Arduino Nano can provide the necessary control and processing capabilities without occupying much space.

Arduino Nano can interface with various sensors and actuators used in LiFi-based projects. It can connect to light sensors, motion sensors, or other environmental sensors to collect data about the surrounding conditions. Arduino Nano can also control actuators such as LEDs, motors, or relays, allowing for dynamic responses based on the LiFi signals received.

Arduino Nano can be used to control the LiFi transmitter and receiver circuits. It can generate the modulation signals for the LED or light source used in the transmitter, and process the received light signals in the receiver circuit. Arduino Nano's GPIO pins can drive the necessary circuitry for modulation and demodulation of the LiFi signals.

3. I2C Interfacing Module

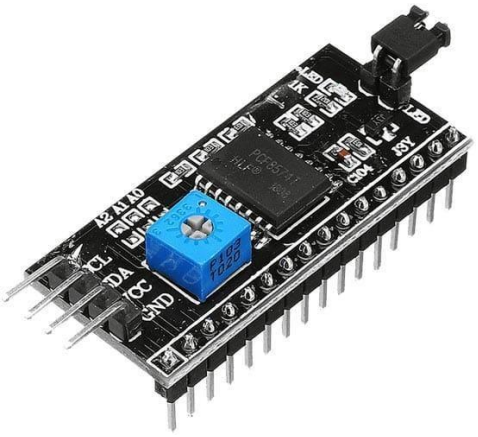


Fig No : 6.7

The I2C module can be used to control the light transmitter in a LiFi system. This module can receive commands or data from a microcontroller or another controlling device through the I2C bus. The commands can specify the intensity, modulation, or other parameters of the light emitted by the transmitter. In a LiFi system, the I2C module can be used to interface with the light receiver. The received data from the light receiver, which may include the encoded information from the transmitted light, can be passed through the I2C bus to a microcontroller or processing unit for further decoding and processing.

LiFi systems can incorporate various sensors to enhance functionality or enable additional features. For example, ambient light sensors or proximity sensors can be connected to the I2C bus through the I2C module. This allows the system to adjust the LiFi transmission parameters based on ambient light conditions or trigger certain actions when an object is detected in proximity to the receiver.

4. Photodiode

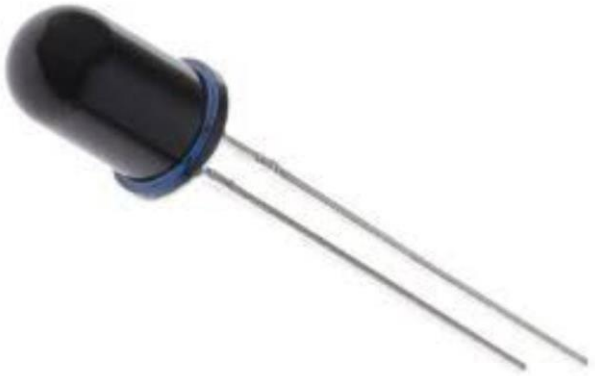


Fig No : 6.8

The photo detector is responsible for capturing the modulated light signals transmitted by the LiFi transmitter. It acts as the light receiver and detects the variations in the light intensity or frequency caused by the encoded data. Once the photo detector receives the modulated light signals, it converts them into electrical signals. This conversion process involves transforming the light energy into an equivalent electrical current or voltage, which can then be processed by other components in the system.

The electrical signals obtained from the photo detector are typically passed through signal processing stages to extract the encoded data from the received light signals. This can involve demodulation, filtering, and other digital signal processing techniques to recover the transmitted information accurately.

5. LED

Fig No : 6.9

LEDs are used as the light source in Li-Fi systems. These LEDs emit light in the visible spectrum, typically in the range of 400 to 800 nanometers. The LEDs can be modulated rapidly to encode data in the form of binary signals. By turning the LEDs on and off at very high speeds, they can transmit data in the form of light pulses. The LED light pulses are modulated to carry digital data. The modulation techniques commonly used in Li-Fi systems include intensity modulation, where the LEDs are dimmed or rightened to represent binary 1s and 0s, and frequency modulation, where the frequency of light is varied to encode data.

Overall, LEDs play a crucial role in Li-Fi technology by providing the means to transmit data wirelessly using visible light. This technology offers advantages such as high data rates, low interference, and the ability to work in areas where radio frequency-based wireless technologies might be restricted or not suitable, such as in hospitals or aircraft cabins.

6.4*4 Keybord

Fig No : 6.10

4x4 keyboard is a type of input device commonly used in electronic systems to provide user interaction and input. It consists of a grid of 16 keys arranged in a 4x4 matrix, allowing users to input alphanumeric characters, symbols, or perform specific functions. In the context of a Li-Fi-based project, a 4x4 keyboard can be used as a user interface to control or interact with the Li-Fi system. For example, it can be used to input commands, select options, or enter data related to the Li-Fi transmission and reception.

The 4x4 keyboard can be used to enter configuration parameters or settings for the Li-Fi system, such as network credentials, transmission modes, encryption keys, or other operational parameters.

7. 16*2 LCD

Fig No : 6.11

A 16x2 display, often referred to as a 16x2 LCD (Liquid Crystal Display), can be used in a Li-Fi based project as an output device to provide visual feedback or information to the user. Here's how a 16x2 display can be used in a Li-Fi project:

Status and Information Display: The 16x2 display can be used to show important information about the Li-Fi system, such as connection status, data transfer rates, network settings, or any other relevant system information. It allows users to have a visual representation of the Li-Fi system's current state.

8. Speaker

Fig No : 6.12

A speaker can be used as an output device to reproduce sound. For example, if you have a LiFi-based wireless audio system, the data encoded in the light signals can be audio information that is transmitted to a receiver device. The receiver can then decode the data and play it back through a speaker, allowing you to hear the sound.

8. 5mm Audio Jack

Fig No : 6.13

It's important to note that the use of the 5 mm jack in a LiFi-based project depends on the specific application and requirements of the project. The 5 mm jack's primary purpose is for audio connectivity, and its usage in a LiFi project would typically be for integrating audio output capabilities alongside LiFi data transmission.

9. Arduino IDE

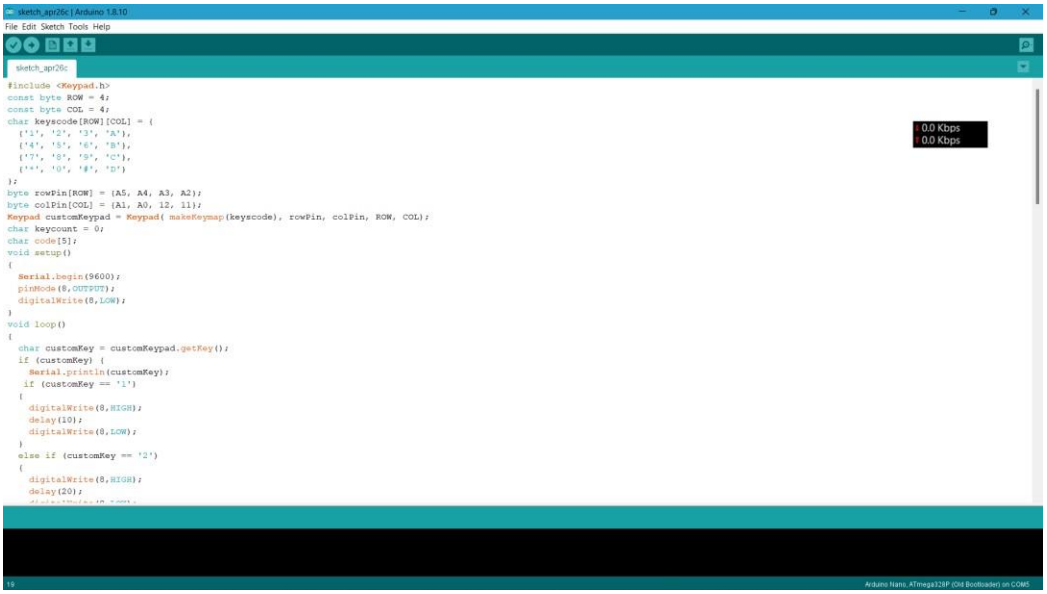


Fig No : 6.14

When it comes to Li-Fi (Light Fidelity) based projects, the Arduino IDE can be utilized to program Arduino boards that are interfaced with Li-Fi modules or components. Li-Fi is a wireless communication technology that uses light waves to transmit data. It utilizes light-emitting diodes (LEDs) to transmit data and photodiodes to receive data. You can write the code for your Li-Fi project using the Arduino programming language (based on C/C++) within the Arduino IDE. The IDE provides a text editor with syntax highlighting and various code editing features to facilitate coding.

Fig No : 6.15

CHAPTER 7.

BILL OF MATERIAL

SR.N0	COMPONANT NAME	QUANTITY	UNIT COST (Rs.)	TOTAL COST
1	Arduino UNO	1	750	750
2	Arduino NANO	1	425	425
3	I2C Interfacing module	1	225	225
4	Photodiode	1	30	30
5	LED	1	20	20
6	4*4 Keybord	1	152	152
7	16*2 LCD display	1	256	256
8	Speaker	1	265	265
9	Jumper wires	16	4	64
10	9V Battery	1	30	30
11	5mm Audio Jack	1	25	25
12	Solar pannal	1	120	120
13	Resister	2	5	10
14	Dot Matrix PCB	2	90	180
			TOTAL AMOUNT	**2,552**

CHAPTER 8.

RESUILT

The project on data transfer using LiFi (Light Fidelity) aims to revolutionize wireless communication by utilizing light waves to transmit data. LiFi is a cutting-edge technology that employs light-emitting diodes (LEDs) to transmit data at high speeds, providing an alternative to traditional radio frequency-based wireless communication systems.

By harnessing visible light, LiFi offers several advantages over conventional wireless technologies. Firstly, LiFi can provide significantly faster data transfer rates, reaching speeds of up to several gigabits per second. This makes it ideal for applications that require high-bandwidth communication, such as video streaming, online gaming, and large file transfers. Moreover, LiFi offers enhanced security as light signals do not pass through walls, ensuring that the data transmission remains confined within a specific area. This characteristic makes LiFi particularly suitable for environments where privacy and data security are crucial, such as medical facilities, defense installations, and corporate offices.

Another key benefit of LiFi is its immunity to electromagnetic interference, which can be a significant issue in crowded wireless environments. Since LiFi operates using light waves, it can coexist with existing radio frequency-based wireless systems without interference, resulting in improved network reliability and performance.

The project will involve developing specialized LiFi transceiver modules, optimizing the communication protocols, and integrating LiFi technology with existing networking infrastructure. Through this research, the project aims to demonstrate the feasibility and potential of LiFi as a viable wireless communication solution, paving the way for its widespread adoption in various industries and everyday applications.

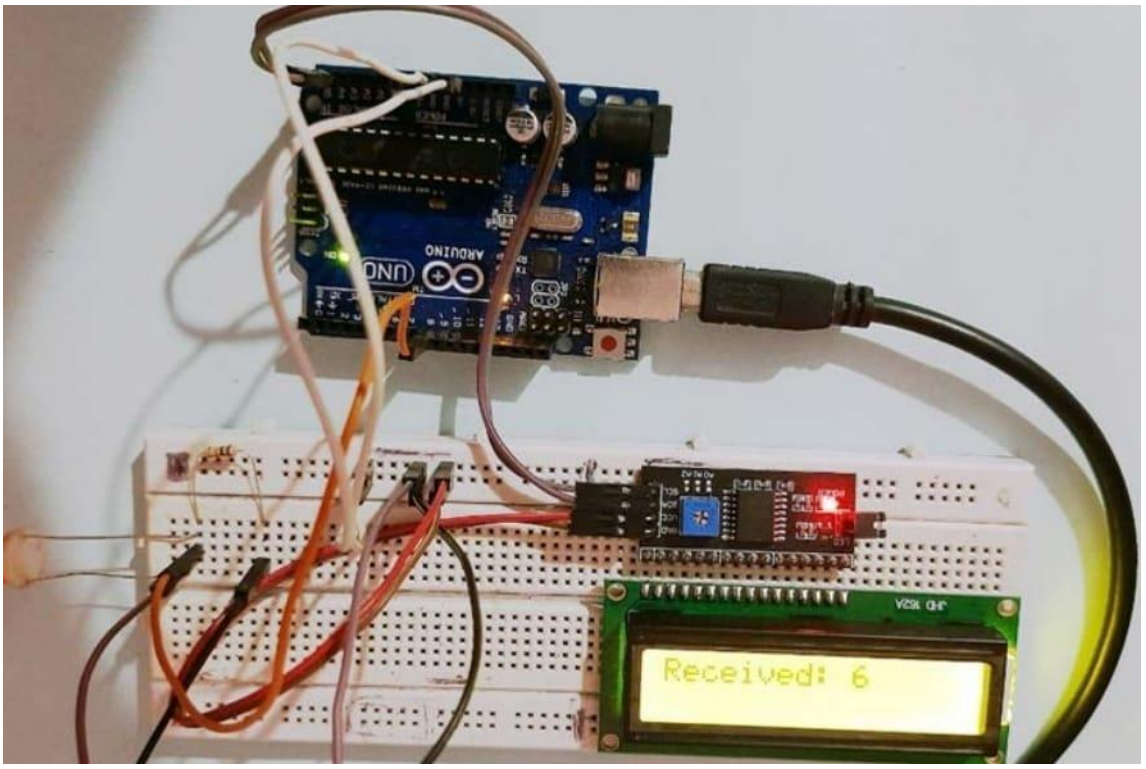


Fig No : .1 Transmission section

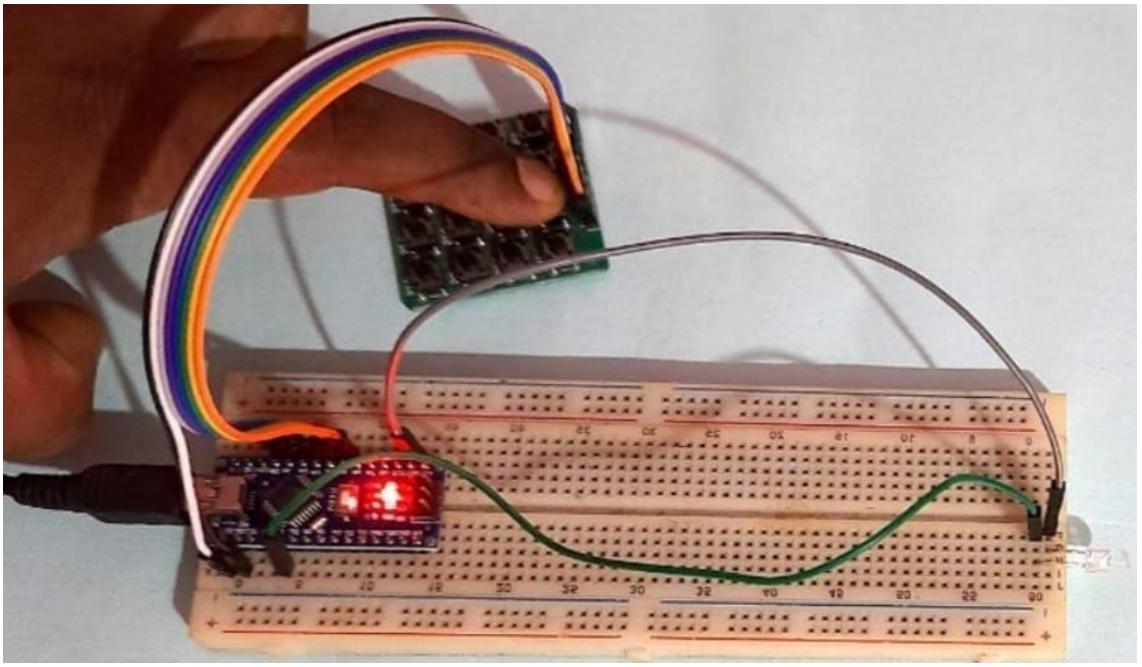
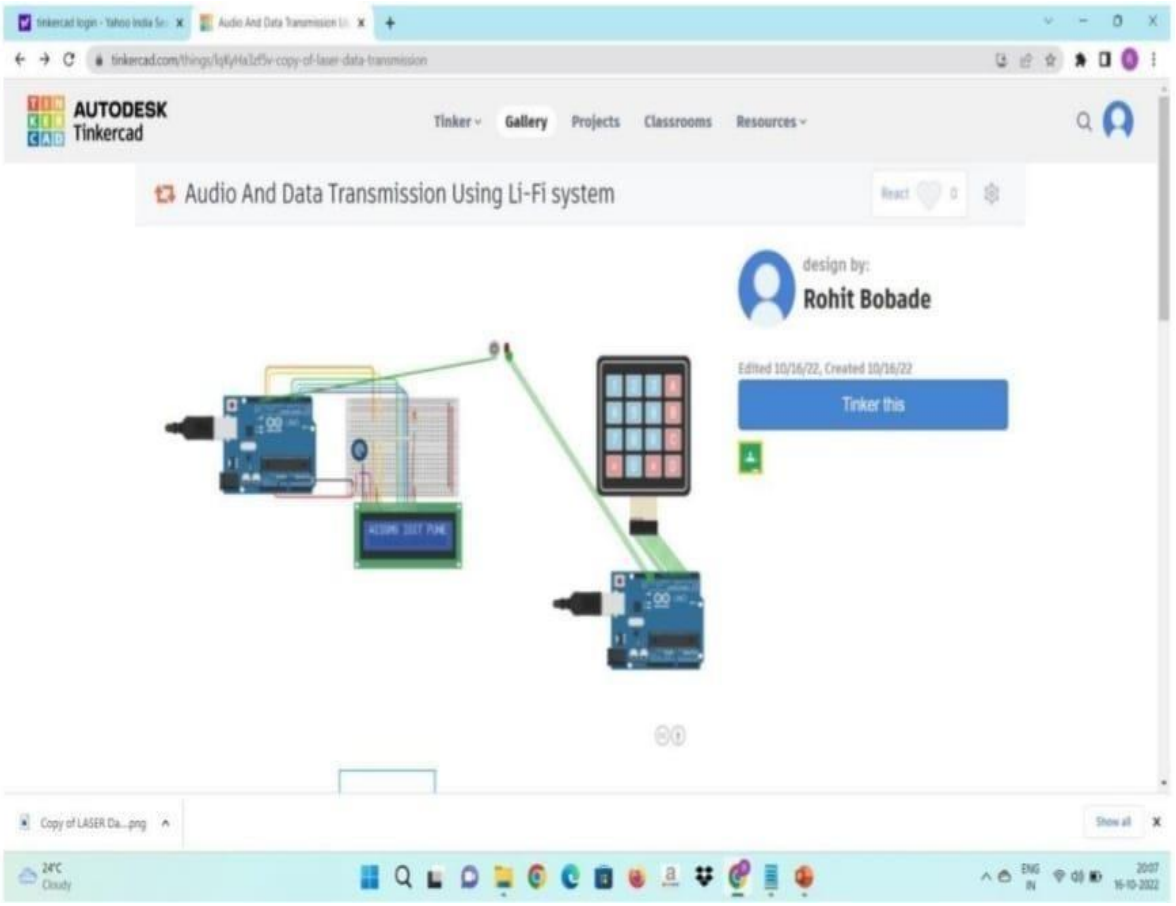


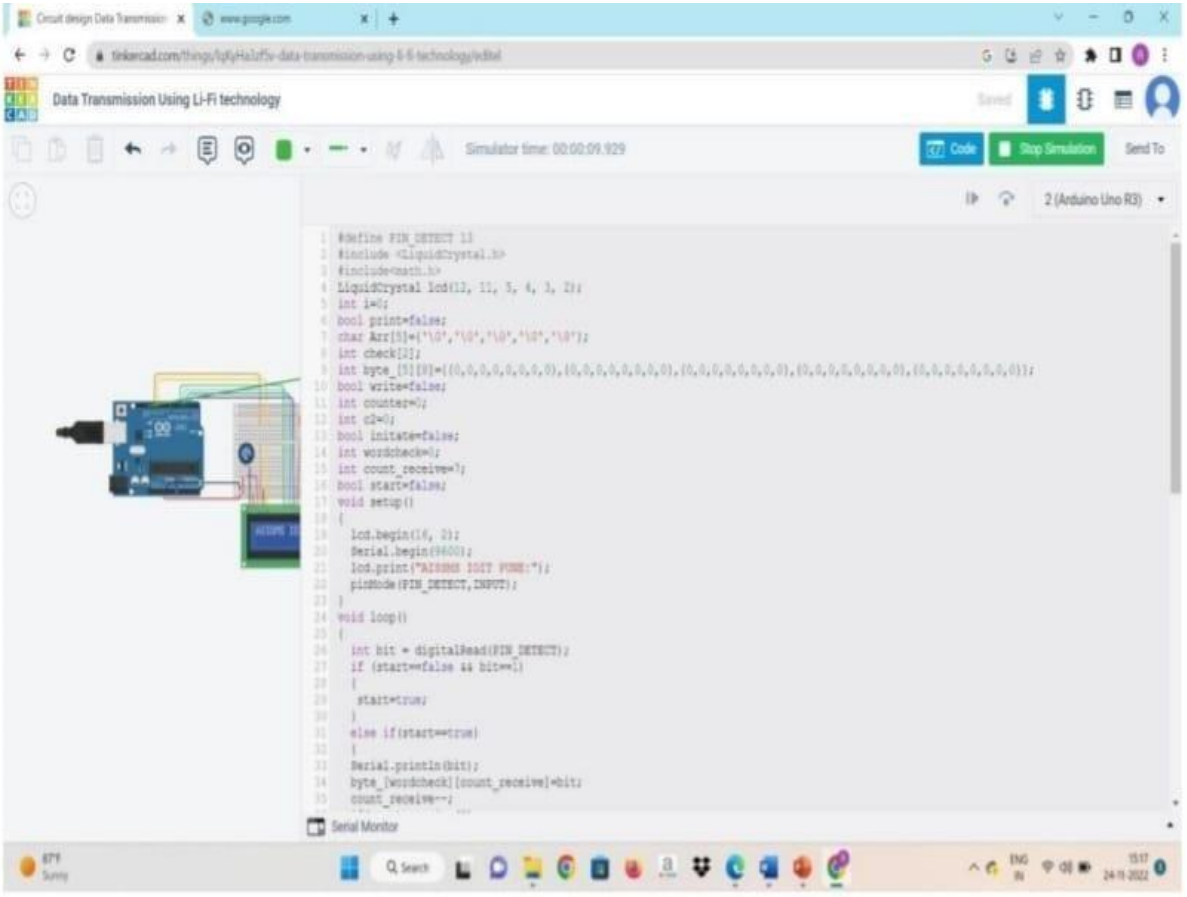
Fig No : 8.2 Receiving section

CHAPTER 9.

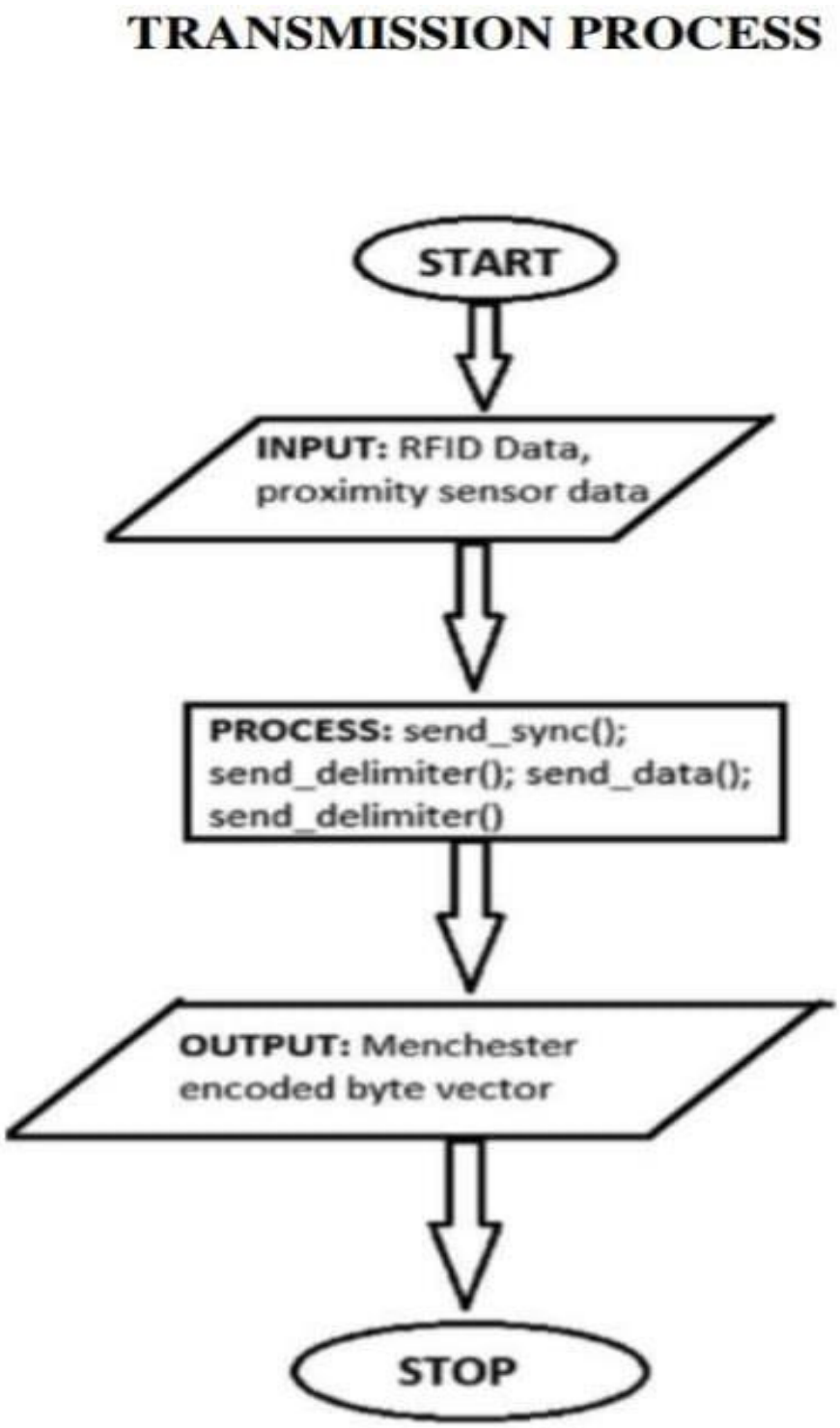
SOFTWARE DESIGN

9.1 Software Simulation

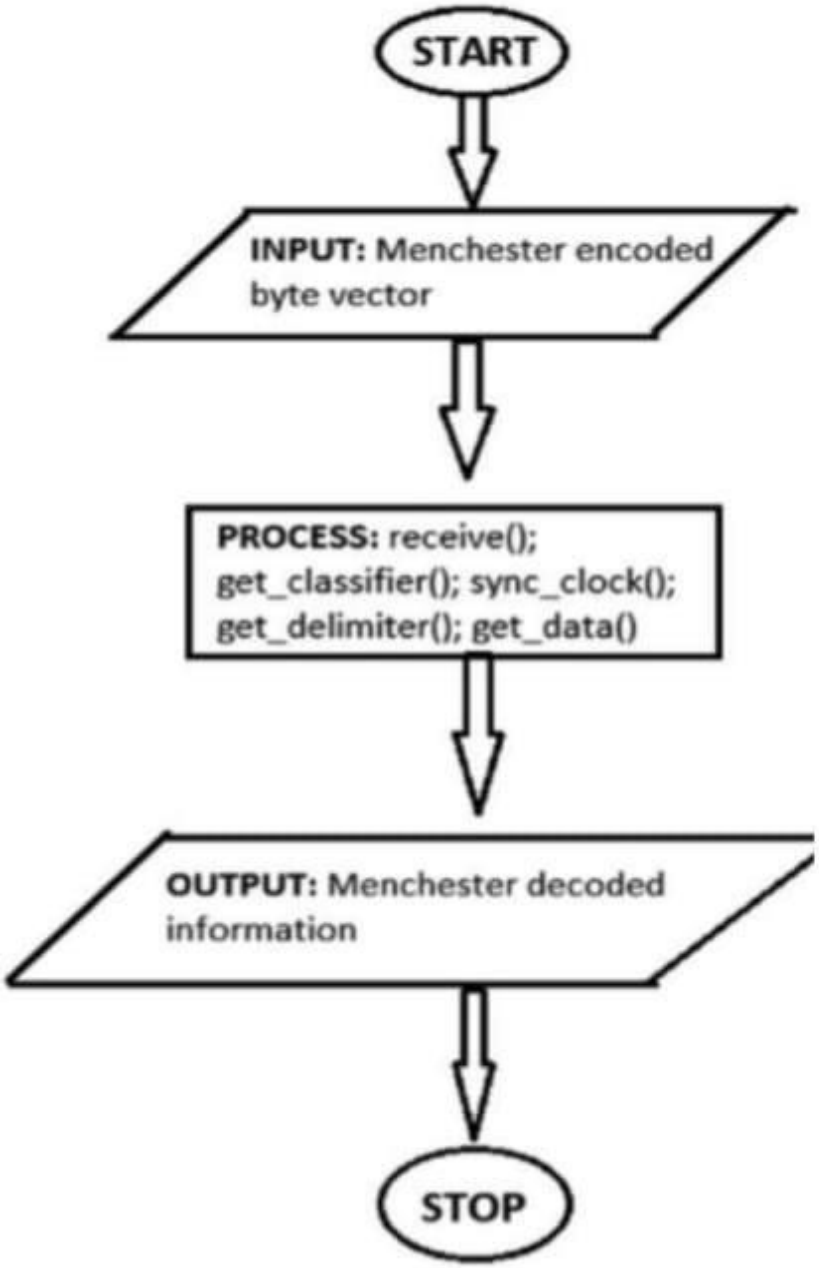



Data Transmission Using Li-Fi technology
Code
Stop Simulation
Send To
2 (Arduino Uno R3)
Serial Monitor

9.2 Flowchart



RECEPTION PROCESS



CHAPTER 10.

ADVANTAGES DISADVANTAGES AND APPLICATIONS

10.1 ADVANTAGES

1. High-Speed Data Transfer: Li-Fi technology has the potential to transmit data at extremely high speeds, ranging from several gigabits per second (Gbps) to potentially terabits per second (Tbps). This allows for faster transfer of large amounts of data compared to traditional Wi-Fi.

2. Increased Bandwidth: Unlike traditional Wi-Fi, which operates in the crowded radio frequency spectrum, Li-Fi uses the visible light spectrum, which has a much larger bandwidth available for data transmission. This increased bandwidth can accommodate more devices and data-intensive applications without congestion.

3. Enhanced Security: Li-Fi technology offers improved security compared to Wi-Fi. Since light signals do not pass through walls, the potential for eavesdropping or unauthorized access to the network is significantly reduced. This makes Li-Fi a more secure option for data transmission.

4. Reduced Interference: Since Li-Fi operates in the visible light spectrum, it is not affected by electromagnetic interference from devices such as microwaves or cordless phones. This reduces the chances of signal interference, leading to more reliable and stable data transmission.

5. Low Power Consumption: Li-Fi uses LED bulbs for data transmission, which are energy-efficient and consume less power compared to traditional Wi-Fi routers. This can result in energy savings and reduced operational costs.

10.2 DISADVANTAGES

1. Line-of-Sight Requirement: One of the significant limitations of Li-Fi is that it requires a direct line-of-sight between the light source and the receiving device. Obstacles such as walls or physical barriers can obstruct the light signal, causing interruptions in data transmission.

2. Limited Range: Li-Fi has a relatively limited range compared to Wi-Fi. The range of Li-Fi is typically within a room or a specific area where the light source is located. This can restrict its application to certain environments and may require more infrastructure for wider coverage.
3. Susceptibility to Lighting Conditions: Li-Fi relies on visible light to transmit data, which means it is affected by lighting conditions. Changes in ambient light levels or direct sunlight can interfere with the transmission and impact the reliability and speed of data transfer.

4. Compatibility Challenges: Since Li-Fi is a relatively new technology, compatibility can be a challenge. Devices need to be equipped with Li-Fi receivers or compatible transceiver chips to support data transmission via Li-Fi. This may require additional hardware upgrades or adaptations in existing devices.

10.3 APPLICATIONS

1. High-Speed Internet Access: Li-Fi can be used to provide high-speed internet access in areas where traditional Wi-Fi may not be feasible or faces limitations. It can be deployed in offices, homes, hospitals, or educational institutions to offer faster internet connectivity.

2. Indoor Localization and Navigation: Li-Fi technology can be utilized for precise indoor positioning and navigation systems. By installing Li-Fi transmitters in specific locations, the light signals can be used to determine the position of devices accurately, enabling applications such as indoor wayfinding or asset tracking.

3. Smart Lighting Systems: Li-Fi can be integrated into smart lighting systems to provide dual functionality. The LED bulbs used for illumination can also serve as data transmitters, enabling data communication while providing lighting in homes, offices, or public spaces.

4. Secure Data Transfer: Li-Fi's inherent security features make it suitable for applications requiring secure data transfer, such as military communications, healthcare, or financial institutions where data privacy and protection are crucial.

5. Internet of Things (IoT) Connectivity: Li-Fi can support the growing network of IoT devices by providing reliable and high-speed connectivity. It can facilitate communication between IoT devices within a localized area, enabling smart homes, smart cities, or industrial IoT applications.

CHAPTER 11.

CONCLUSION AND FUTURE SCOPE

CONCLUSION

In conclusion, the project on data transmission using Li-Fi technology offers several advantages and has promising applications. Li-Fi technology provides high-speed data transfer, increased bandwidth, enhanced security, reduced interference, and low power consumption. These advantages make it a viable alternative to traditional Wi-Fi for various applications.

However, Li-Fi technology also has its limitations. It requires a line-of-sight connection and has a limited range compared to Wi-Fi. It is susceptible to lighting conditions and compatibility challenges. These factors need to be considered when implementing Li-Fi solutions. Despite these limitations, the applications of Li-Fi technology are diverse and impactful. It can revolutionize high-speed internet access, enable precise indoor localization, contribute to smart lighting systems, ensure secure data transfer, facilitate IoT connectivity, and even find applications in underwater communication.

As Li-Fi technology continues to evolve, addressing its limitations and improving compatibility, it has the potential to transform the way we transmit data. Its high-speed capabilities, security features, and energy efficiency make it a promising option for future data communication systems. With further research and development, Li-Fi technology could open up new possibilities for faster, more reliable, and secure data transmission in various sectors.

FUTURE SCOPE

1. Improved Range and Coverage: Research and development efforts can focus on expanding the range and coverage of Li-Fi technology. Overcoming the line-of-sight limitation and developing advanced techniques to extend the reach of Li-Fi signals will make it more practical for larger areas and outdoor environments.

2. Integration with 5G Networks: Li-Fi can be integrated with 5G networks to enhance data transmission capabilities. Combining Li-Fi's high-speed and low-latency characteristics with the wide coverage and mobility of 5G networks can lead to even faster and more

3. Standardization and Interoperability: Establishing industry standards and ensuring interoperability between Li-Fi devices and existing communication systems will be essential for widespread adoption. Efforts to develop common protocols and frameworks will enable seamless integration of Li-Fi technology into various applications and devices.

4. Miniaturization and Integration in Devices: Advancements in miniaturization and integration of Li-Fi components into various devices such as smartphones, tablets, and IoT devices will make Li-Fi more accessible and convenient for everyday use.

CHAPTER 12.

ACKNOWLEDGEMENT

Acknowledgement

It is my great pleasure in expressing sincere and deep gratitude towards my guide **Mrs. Nilima S. Warade** Assistant Professor Electronics & Telecommunication Engineering Department for her valuable guidance and constant support throughout this work and help to peruse additional studies in communication and data basics and TINKARCAD. We take this opportunity to thank Head of the Department **Dr. M. P. Sardey** and Project coordinator **Mrs. Archana Ubale** and all staff members of department of Electronics &Telecommunication Engineering AISSMS IOIT, Pune, for cooperation provided by them in many ways. The motivation factor for this work was the inspiration given by our honorable principal **Dr. P. B. Mane.**

Lastly I am thankful to those who have directly or indirectly supported for our work.

CHAPTER 13.

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APPENDIX 1

DETAILS OF COMPETITION/AWARD/SPONSORSHIP

AISSMS
INSTITUTE OF INFORMATION TECHNOLOGY
ADDING VALUE TO ENGINEERING
An Autonomous Institute Affiliated to Savitribai Phule Pune University
Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra
Accredited by NAAC with 'A+' Grade
DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINNERING
Academic Year 2022-23

Project Group No.	**Application Of Project**	**Sponsored Project Company Name**	**Paper Publication Details Journal Name ,Volume And Issue Date**	**Project Exhibition/ Participation Place/National/ International**
D21	Smart Homes	N/A	IEEE Internet Of Things Journal (Under Review)	1. Hackathon Event PVPVIT Sangli. 2. AISSMS IOIT Project Competition. 3. AISSMS IOIT Project Poster Competition.

APPENDIX 2

ABSTRACT

AISSMS
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Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra
Accredited by NAAC with 'A+' Grade
Department of Electronics and Telecommunication Engineering

Audio And Data Transmission Using LI-FI Technology

(GOAL NO -9: Industry, Innovation and Infrastructure)

Division-BE(D)	**Group Number- D21**

1. **Rohit Sanjay Bobade (Roll Number-160)**
2. **Yashodeep D. Deshmukh (Roll Number-164)**
3. **Sarvesh Sanjay Mali (Roll Number-177)**

Name of Internal Guide – Mrs. NILIMA S. WARADE

Problem Statement - 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. 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.

Project Domain: Industry, Innovation and Infrastructure.

Objectives - 1. To Transfer Audio 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.

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

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

Project photo including Group members and guide during Presentation (Geo Tag Photo).

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 cameinto the aid. Light fidelity (Li-Fi).

Project Mapping with Program Outcomes (1 – Slight, 2- Moderate, 3- Substantial)

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

Participation in Competition: Give the Competition Details
1.Participation Hackathon Event.

Awards: Hackathon Event Certification.

APPENDIX 3

PROJECT EVALUATION

AISSMS
INSTITUTE OF INFORMATION TECHNOLOGY

Department of Electronics and Telecommunication Engineering
Academic Year 2022-23

Project Title:		**Guide:**	
Project Domain:		**Group No:**	

Roll No.	Name	Email ID	Mobile No.	Sign

Project Phase 1

Presentation 1 Evaluation

Criteria	Student's	Student1	Student2	Student3	Student4
	Name				
↓	Sign				
Literature Review	(4 Marks)				
Formulation of Aim and Objectives	(4 Marks)				
Timely Submission	(2 Marks)				
Total Marks					

TW Submission Checklist

Synopsis (Three different topics)	
Log Book	
Project Phase 1 Report with Plagiarism Report (2 Copies)	
Project Title Mapping with POs and PSOs	
Presentation PPT	
Sponsorship Letter (If any)	

Presentation 2 Evaluation

Criteria	Student's	Student1	Student2	Student3	Student4
	Name				
↓	Sign				
System Design	(4 Marks)				
Simulation using Modern Computer Aided Tools	(4 Marks)				
Timely Submission	(2 Marks)				
Total Marks					

Guide Sign	
HOD Sign	
Evaluator/ External Examiner Sign	

S

AISSMS INSTITUTE OF INFORMATION TECHNOLOGY

Department of Electronics and Telecommunication Engineering
Academic Year 2022-23

Project Phase 2

Presentation 3 Evaluation

Criteria ↓	Student's Name	Student1	Student2	Student3	Student4
	Sign				
System Implementation	(4 Marks)				
Working Model	(4 Marks)				
Timely Submission	(2 Marks)				
Total Marks					

Final Project Submission Checklist

Project Abstract	
Plagiarism report (Project Report and Paper)	
Published paper in UGC/WoS/Scopus care journal with DOI	
Two signed copies of report with CD	
Participation Certificate (Project or Paper Presentation Competition)	
Project Hardware	
Project group photo with Guide (Soft and hardcopy)	

Presentation 4 Evaluation

Criteria ↓	Student's Name	Student1	Student2	Student3	Student4
	Sign				
Working Model with Enclosure	(3 Marks)				
Effective Presentation	(3 Marks)				
Project Report	(3 Marks)				
Timely Submission	(1 Marks)				
Total Marks					

Guide Sign	
HOD Sign	
Evaluator / External Examiner Sign	

Paper publication/IPR Details:

Paper Title:		Journal/Conference Name:	
Authors:			
DOI/IPR No.			

APPENDIX 4

SELF EVALUATION OF PROJECT BY STUDENTS

AISSMS
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Department of Electronics and Telecommunication Engineering

BE Project/ Academic Year 2022-23

Self-Evaluation Sheet

Project Title: **Audio And Data Transmission Using LI-FI Technology**

Group Number: **D21**

Name of Students:
1. **Rohit Sanjay Bobade**
2. **Yashodeep Dnyaneshwar Deshmukh**
3. **Sarvesh Sanjay Mali**

Literature Survey	Design	Implementation	Test Result	Attendance on the Project day	Working according to plan activity	Maintaining Log Book	Research Paper	Participation in Project/Poster Competition	Award/ Prize if any
(5)	(20)	(20)	(5)	(10)	(5)	(5)	(5)	(5)	(5)
5	18	18	4	10	4	5	5	5	5

Observation and Comments of Guide:

The Have successfully Built the project achieving all the planned objectives.it has been Observed that the project work is completed fulfilling most of the criteria's in the evaluation rubrics With excellent results.

Student Name **Sign**
1. **Rohit Sanjay Bobade**
2. **Yashodeep Dnyaneshwar Deshmukh**
3. **Sarvesh Sanjay Mali**

Guide Name **Sign**

Mrs. Nilima Satish Warade

NOTE: The Evaluation will be verified by Project Evaluation Committee

AISSMS
INSTITUTE OF INFORMATION TECHNOLOGY
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Department of Electronics and Telecommunication Engineering

BE Project/ Academic Year 2022-23

Critical Thinking Questionnaire

Group Number:	**D21**
Project Title:	**Audio And Data Transmission Using LIFI Technology.**
Date:	**28/04/2023**

1.Who benefits from the project?

- The project benefits anyone who needs to transmit data or audio wirelessly, especially in areas where traditional radio frequency (RF) technology is not feasible or safe to use.

2. Who is this project harmful to?

- The project is not harmful to anyone.

3. What are the strengths and weaknesses of the project?

- The strengths of the project include high-speed data transmission, low latency, and reduced interference compared to RF technology. The weaknesses may include limited range and the need for a clear line of sight between the transmitter and receiver.

4. Where would we see this project in real world?

- This project can be implemented in various settings such as hospitals, airplanes, underwater environments, and industrial facilities where traditional RF technology may interfere with sensitive equipment or pose a safety risk.

5. When would this project benefit our society?

- This project would benefit our society in situations where reliable and secure wireless communication is essential, such as emergency response situations, medical procedures, and military operations.

6. Why is this project a problem/challenge?

- This project may be a challenge due to the need for specialized hardware and infrastructure, and the lack of standardization for lifi technology.

7. How does this project benefit us/others?

- This project benefits us by providing a safer and more reliable alternative to traditional RF technology for wireless communication. It also benefits others by improving communication in critical situations and reducing the risk of interference with sensitive equipment.

APPENDIX 5

CERTIFICATES


BRAIN IT ON
PVP PVPIT
TWIST THE BRAINS ! CHEST THE IDEAS !
CERTIFICATE
OF PARTICIPATION
Thanks for Making this event ON
Yashodeep Deshmukh
For Your
PARTICIPATION
in IoT and Embadded System
domain of Hackathon event
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Organised by PVIPIT, Sangli
@ 17 Mar
Department of Computer Science & Engineering
Ishan Nadaf
President
Prof D.D. Dhokate
Staff Co-ordinator
Dr. B.S. Patil
HOD of CSE Department
Dr. D.V. Ghewade
Principal
Padmabhooshan Vasantraodada Patil Institute of Technology, Sangli
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Club Cybernauts
Presents
(Computer Science Students' Association

Dr. VPSSM's

Padmabhooshan Vasantraodada Patil Institute of Technology, Budhgaon

Club Cybernauts

BRAIN it ON

CERTIFICATE

OF APPRECIATION

2023

PROUDLY PRESENTED TO

Mr./Ms. *Yashodeep Dnyaneshwar Deshmukh*

from *All India Shri Shivaji Memorial Society College Of Engineering*

for qualifying in domain *IoT and Embedded System*

in National level event "**Brain-it-On 1.0**" with demonstration innovative concepts and presenting abilities, held on 17th March, 2023.

Mr. Ishan Nadaf	Mrs. D. D. Dhokte	Prof. Mr. B . S. Patil	Dr. D. V. Ghewade
President	Staff co-ordinator	HOD of CSE Department	Principal

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PARTICIPATION
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APPENDIX 6

RESEARCH PAPER

Audio And Data Transmission Using LI-FI Technology

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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.**

Keywords— Optical wireless communication (OWC), VLC, LED, Li-Fi, Solar panel, Arduino, Bluetooth, radio frequency, high speed data.

I. 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.

I. METHODOLOGY

[1] The main goal of this project is 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 [2]. If the LED is on, we transmit a digital 1, if it's off you transmit a 0. The LED canbe switched on and off very quickly, which gives nice opportunities for transmitting data. Hence all that is requiredis 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 thephoto 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.

II. LITERATURE REVIEW

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.[1]

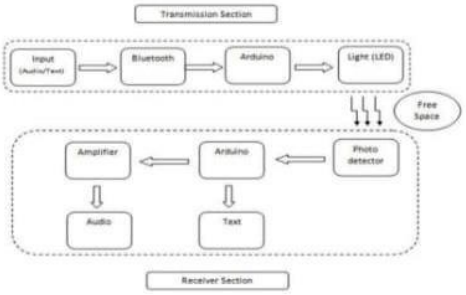
As the demand for high-speed data in wireless communications increases day by day with the significant increase of the number of users, Radio Frequency (RF) spectrum become one of the scantest resources in the world. RF technologies have limitations of the regulated spectrum, spectrum congestion, expensive 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 12 AISSMS IOIT PUNE wireless communication technology which utilizes light emitted from Light emitting diode bulb for simultaneous transmission of text and audio sign.[2]

Continuous improvements in wireless communication systems, ex 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. 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 datatransmission 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.[3]

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.[4]

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).[5]

III. BLOACK DIAGRAM



A. Explanation of Block Diagram

The mode of communication discussed in this paper is through visual light. VLC based system uses wavelength ranges between 380nm to 750 nm that means 430 THz to 790 THz frequency for communication. As it supports larger bandwidth so it overcomes bandwidth limitation of RF communication and it works when both transmitter and receiver are in the line of sight. VLC based system can not be intercepted by any other from another room and as information is transmitted through light so it is not affected because of electromagnetic radiations. So can be said that VLC provides secured communication than RF-based systems. The block schematic of the transmission isdepicted in Fig. 1. The input is given in the form of text through 4*4 Keyboard and the data is transmitted through BT to Arduino Uno. The BT HC-05 is easy to use Serial Port Protocol (SPP) module. The data is transferred by compiling and uploading to Arduino. This way tangle-free connection is being got. The data transmitted to Arduino Uno is further transmitted to the photodiode through the LED. The transmitting data is in the form of binary and the LED blinks too fast to be seen by naked eyes. Further, in thereceiver 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 the conversion of data into ASCII value. At last, the receiver side has a dictionary in form of codes. The dictionary converts the ASCII value to the alphanumeric character where the alphanumeric characters are displayed on the 16*2 LCD.

Component specification

A. 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.

B. 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).

C. 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.

D. 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.

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

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

G. 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.

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

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

IV. SOFTWARE DESIGN

A. Circuit Simulation Result of the system:

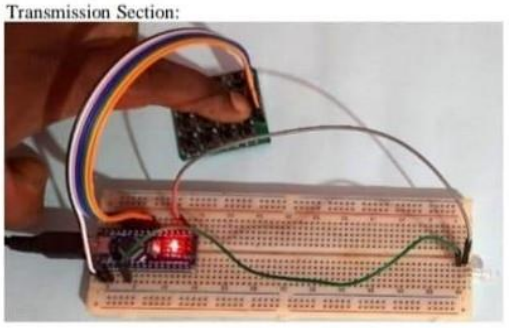
B. SIMULATION RESULT OF THE SYSTEM :

V. SOFTWARE DESIGN

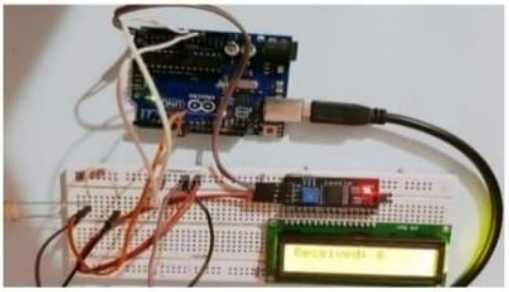
The simulation is expected to demonstrate the feasibility of using Li-Fi technology for audio and data transmission, and to provide insight into the key factors that affect the performance of the system. The simulation may also be used to optimize the system design and to compare the performance of Li-Fi with other wireless communication technologies.

V. Project Module

Transmission Section:



Receiving Section:



V. REFERENCES

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[2] Sabita Mali, Department of EIE, ITER Siksha 'O' Anusandhan (Deemed to be University) Khandagiri Square Bhubaneswar-751030, Odisha, India "Design and Implementation of Text and Audio Signal Transmission using Visible Light Communication." -978-1-7281-5464- 0/20/$31.00 ©2020 IEEE

[3] ShabanaParveen M1, Siddarthan K2,Vignesh T3, Ajay Krishnaa A R4 Data transmission using Li-Fi technology www.jetir.org (ISSN-2349-5162)©2019 JETIR.

[4] G Madhuri, K Anjali and R Sakthi Prabha Department of Electronics and Communication Engineering, Sathyabama Institute of Science & Technology, Chennai, India "Transmission of data, audio and text signal using Li- fi. technology " IOP Conf. Series: Materials Science and Engineering 872 (2020) 012010 IOP Publishing doi:10.1088/1757-899X/872/1/012010.

[5] Rosilah Hassan Faculty of Information Science & Technology . Universiti Kebangsaan Malaysia 43600UKM,

Bangi, Selangor, "MALAYSIA Visibile Light Communication Technology For Data Transmission

[6] Umesh Pant E&CE "Department National Institute of Technology," Hamirpur, Himachal Pradesh Analog/Digital Data Transmission using Li-Fi 978-1- 7281- 6575-2/20/$31.00 ©2020 IEEE

TABLE I. DISTANCE OF AUDIO TRANSMISSION

Sl. No.	Distance(in cm)	Audio Received (in %) (Without O uter Interference)
1	>5	100
2	10	100
3	20	90
4	25	70
5	30	50
6	<35	40

TABLE II. DISTANCE OF TEXT TRANSMISSION

Sl. No.	Distance(in cm)	Text Received (in %) (Without O uter Interference)
1	>5	100
2	10	100
3	20	75
4	25	40
5	30	40
6	<35	35

APPENDIX 7

PLAGIARISM REPORT

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SA	**ICIS2021_paper_29.pdf** Document ICIS2021_paper_29.pdf (D110789775)	2

Entire Document

1 AISSMS IOIT PUNE
A PROJECT STAGE-1 REPORT ON Audio And Data Transmission Using LI-FI Technology
SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE IN THE PARTIAL FULFILLMENT FOR THE AWARD OF THE DEGREE OF BACHELOR OF ENGINEERING IN ELECTRONICS AND TELECOMMUNICATION
BY
UNDER THE GUIDANCE OF MS. NILIMA S. WARADE ACADEMIC YEAR: 2022-23
ROHIT SANJAY BOBADE 72162922K YASHODEEP D. DESHMUKH 72162933E SARVESH SANJAY MALI 72162967K
2 AISSMS IOIT PUNE CERTIFICATE "Audio And Data Transmission Using LI-FI Technology" Submitted by Mr. ROHIT SANJAY BOBADE (72162922K) Mr. YASHODEEP DNYANESHWAR DESHMUKH (72162933E) Mr. SARVESH SANJAY MALI (72162967K)
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.
MS. NILIMA S. WARADE Dr. M. P. Sardey Internal Guide Head of Department Department of E&TC Engg. Department of E&TC Engg. Dr. P. B. Mane
External Examiner Principal Date : AISSMS
Institute of
Information Technology, Pune. .
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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
4 AISSMS IOIT PUNE 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.

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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.

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Hence the future applications of the Li-Fi can be predicted and extended to different platforms and various walks of human life. 5

AISSMS IOIT PUNE
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and Objective 4 Methodology 5 Specification of
the system 6
Block Diagram
of the system and
it's explanation 7 Components Used 8
Software Design 9 Expected Results 10 References 11 Appendix
6
AISSMS IOIT
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the inspiration
given by our honorable principal Dr. P. B. Mane. Lastly I am thankful to those who have directly or indirectly supported for our work. Sign Sign
Sign
Rohit S. Bobade Yashodeep D. Deshmukh Sarvesh S. Mali
7 AISSMS IOIT PUNE LIST OF FIGURES FIGURE NO TITLE PAGE NO Fig.1 Block Diagram Fig.2 Flow Chart Fig.3 Simulation Result
8 AISSMS IOIT PUNE
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
9 AISSMS IOIT PUNE 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.

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Li-Fi could offer safe, abundant connectivity for all areas of

the

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locations. This can save money as compared to the currently implemented solutions. Also, the pressure on a power plant could be lessened 10

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AISSMS IOIT PUNE 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.

11 AISSMS IOIT PUNE 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

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refers
to visible

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light communication that uses light as a medium to deliver high speed data which is much greater than that of

Wi Fi. Li Fi

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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

13 AISSMS IOIT PUNE 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.

14 AISSMS IOIT PUNE 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.

15 AISSMS IOIT PUNE 4.

BLOCK DIAGRAM OF THE SYSTEM AND ITS EXPLANATION Fig No.1 – Block Diagram

Input: The

input is given in the

Ouriginal by Turnitin

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.
16 AISSMS IOIT PUNE 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.
17 AISSMS IOIT PUNE 5. SYSTEM DESIGN TRANSMISSION PROCESS RECEPTION PROCESS Fig No.2 – Flow Chart
18 AISSMS IOIT PUNE 6. SOFTWARE DESIGN Fig No.1 – Simulation Result Link-
https://www.tinkercad.com/things/lqKyHa3zf5v
19 AISSMS IOIT PUNE 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.
20 AISSMS IOIT PUNE 8.REFERENCES (IEEE Format) [1] Satya Jaswanth, Badri Computer Science and Engineering Indian Institute of Technology, Ropar satyajaswanth.badri@gmail.com "Audio and Video Transmission Using Visible Light Transmission" ANTS 1570-566372 ©2019 IEEE [2] Sabita Mali, Department of EIE, ITER Siksha 'O' Anusandhan (Deemed to be University) Khandagiri Square Bhubaneswar-751030, Odisha, India "Design and Implementation of Text and Audio Signal Transmission using Visible Light Communication." -978-1-7281-5464-0/20/$31.00 ©2020 IEEE [3] ShabanaParveen M1, Siddarthan K2,Vignesh T3, Ajay Krishnaa A R4 Data transmission using Li-Fi technology www.jetir.org (ISSN-2349-5162)©2019 JETIR. [4] G Madhuri, K Anjali and R Sakthi Prabha Department of Electronics and Communication Engineering, Sathyabama Institute of Science & Technology, Chennai, India "Transmission of data, audio and text signal using Li-fi. technology " IOP Conf. Series: Materials Science and Engineering 872 (2020) 012010 IOP Publishing doi:10.1088/1757-899X/872/1/012010. [5] Rosilah Hassan Faculty of Information Science & Technology . Universiti Kebangsaan Malaysia 43600 UKM, Bangi, Selangor, "MALAYSIAVisibile
Light Communication Technology For Data Transmission Using Li-Fi" 978-1-7281-5467-1/20/$31.00 ©2020 IEEE [6] Umesh Pant E&CE "Department National Institute of Technology," Hamirpur, Himachal Pradesh Analog/Digital Data Transmission using Li-Fi 978-1- 7281-6575-2/20/$31.00 ©2020 IEEE
21 AISSMS IOIT PUNE
APPENDIX A1 Bill of material. A2 Important Datasheets, Application notes A3 Project participation certificates.

Hit and source - focused comparison, Side by Side

Submitted text	As student entered the text in the submitted document.
Matching text	As the text appears in the source.

1/6	**SUBMITTED TEXT**	22 WORDS	**100%**	**MATCHING TEXT**	22 WORDS

This concept promises to solve issues such as the shortage of radio frequency bandwidth and boot out the disadvantages of Wi-Fi.

SA Lifi paper.doc (D38126805)

Ouriginal
by Turnitin

2/6	SUBMITTED TEXT	111 WORDS	100%	MATCHING TEXT	111 WORDS

Hence the future applications of the Li-Fi can be predicted and extended to different platforms and various walks of human life. 5

Hence the future applications of the Li-Fi can be predicted and extended to different platforms and various walks of human life.

W https://www.ijert.org/li-fi-the-revolutionary-wi-fi

3/6	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

Li-Fi could offer safe, abundant connectivity for all areas of

SA Lifi paper.doc (D38126805)

4/6	SUBMITTED TEXT	96 WORDS	93%	MATCHING TEXT	96 WORDS

locations. This can save money as compared to the currently implemented solutions. Also, the pressure on a power plant could be lessened 10

SA Lifi paper.doc (D38126805)

5/6	SUBMITTED TEXT	21 WORDS	92%	MATCHING TEXT	21 WORDS

light communication that uses light as a medium to deliver high speed data which is much greater than that of

SA ICIS2021_paper_29.pdf (D110789775)

6/6	SUBMITTED TEXT	107 WORDS	72%	MATCHING TEXT	107 WORDS

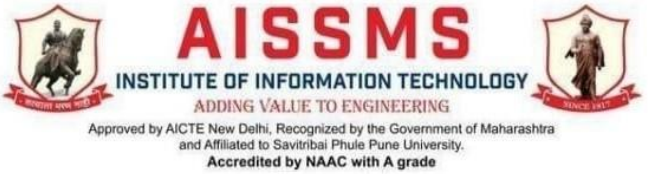
data is transmitted in several bit streams and the receiver side consisting an IR detector decodes the message. The transmission happens in the form of binary data where 0 means LED in OFF state and 1 means that the LED is in the ON state. Transmitter and receiver sections contain Arduino which is programmed 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 •

SA ICIS2021_paper_29.pdf (D110789775)

APPENDIX 8

CO-PO-PSO MAPPING

4. CO-PO-PSO MAPPING



DEPARTMENT E&TC ENGINEERING

Project Title Mapping with PO-PSO-MAPPINNG:

Project Mapping with Program Outcomes (1 – Slight, 2- Moderate, 3- Substantial)													
PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	3	3	3	3	3	2	3	3	3	2	3	3

Justification:

PO1: The knowledge we had gained up to now was used to solve multiple problems like hardware software interfacing, making them work the way it's needed.

3/3

PO2: We had reviewed many papers and reports and found out the problems they were facing and overcame them with our knowledge. We were able to analyze those complex problems, so that further improvements could be made.

3/3

PO3: The design of our project was very complex at first. But after some research, we were able to make it simple for users while keeping environmental and safety considerations in check.

3/3

PO4: We saw faculty having to make time for marking correct attendance of every student which is tedious and very time consuming so after talking to them we got to know about various ideas to solve this particular problem.

3/3

PO5: Before creating our prototype, first we made a terminal-based prototype and focused on developing the functionality first so that to know its capacity we predict all the things that could go wrong and its bugs finding.

3/3

PO6: Our project helps bring technology which is easy to use and environment friendly thus, helping society to reduce paper usage and save time from tedious task of managing attendance.

3/3

PO7: Our project is directly contributing in reducing the usage of the paper in everyday life which will highly impact on the environment in a good way to reduce paper usage.

3/3

PO8: We as engineering students have responsibility to make use of the knowledge we gained to help provide better and easy solutions to ensure security.

2/3

PO9: While working on our project, tasks were divided equally to reach members and together we were able to develop a prototype. Each member has to understand other member's weakness and strengths to help them accordingly and give their best outcome.

3/3

PO10 Before developing our prototype, we had communicated with our college faculty members to help gain more information on how to proceed with our prototype and make it better. We took this guidance and developed the prototype.

3/3

PO11 Along with development of our prototype, project management was very crucial. We had to use our resources and energy very effectively to get the best result while being economical.

3/3

PO12 This project has made us realize that technology keeps on advancing and we have to keep on updating knowledge about the technologies. Engineering has taught us that learning is a lifelong process. every day we get to learn something new and thus help use this knowledge to make the world the greatest place to live.

2/3

PSO1 In our project, we have applied the knowledge we learnt about microcontrollers, development boards, sensors, RTC, file management, network, Python programming language, operating systems, etc.

3/3

PSO2 We made a terminal-based system which will require to put data manually so to test and make the hardware interface accurately, later we focused on the GUI part to make it user friendly and lot of testing and debugging for better experience.

3/3

Project Outcome:

_____
_____
_____

Declaration: Project is self-sponsored/sponsored by_____

APPENDIX 9

BILL OF MATERIAL

SR.N0	COMPONANT NAME	QUANTITY	UNIT COST (Rs.)	TOTAL COST
1	Arduino UNO	1	750	750
2	Arduino NANO	1	425	425
3	I2C Interfacing module	1	225	225
4	Photodiode	1	30	30
5	LED	1	20	20
6	4*4 Keybord	1	152	152
7	16*2 LCD display	1	256	256
8	Speaker	1	265	265
9	Jumper wires	16	4	64
10	9V Battery	1	30	30
11	5mm Audio Jack	1	25	25
12	Solar pannal	1	120	120
13	Resister	2	5	10
14	Dot Matrix PCB	2	90	180
			TOTAL AMOUNT	**2,552**

APPENDIX 10

DATASHEETS

Handson Technology

User Guide

I2C Serial Interface 1602 LCD Module

This is I2C interface 16x2 LCD display module, a high-quality 2 line 16 character LCD module with on-board contrast control adjustment, backlight and I2C communication interface. For Arduino beginners, no more cumbersome and complex LCD driver circuit connection. The real significance advantages of this I2C Serial LCD module will simplify the circuit connection, save some I/O pins on Arduino board, simplified firmware development with widely available Arduino library.

SKU: DSP-1182

Brief Data:

- Compatible with Arduino Board or other controller board with I2C bus.
- Display Type: Negative white on Blue backlight.
- I2C Address:0x38-0x3F (0x3F default)
- Supply voltage: 5V
- Interface: I2C to 4bits LCD data and control lines.
- Contrast Adjustment: built-in Potentiometer.
- Backlight Control: Firmware or jumper wire.
- Board Size: 80x36 mm.

Setting Up:

Hitachi's HD44780 based character LCD are very cheap and widely available, and is an essential part for any project that displays information. Using the LCD piggy-back board, desired data can be displayed on the LCD through the I2C bus. In principle, such backpacks are built around PCF8574 (from NXP) which is a general purpose bidirectional 8 bit I/O port expander that uses the I2C protocol. The PCF8574 is a silicon CMOS circuit provides general purpose remote I/O expansion (an 8-bit quasi-bidirectional) for most microcontroller families via the two-line bidirectional bus (I2C-bus). Note that most piggy-back modules are centered around PCF8574T (SO16 package of PCF8574 in DIP16 package) with a default slave address of 0x27. If your piggy-back board holds a PCF8574AT chip, then the default slave address will change to 0x3F. In short, if the piggy-back board is based on PCF8574T and the address connections (A0-A1-A2) are not bridged with solder it will have the slave address 0x27.

Address selection pads in the I2C-to-LCD piggy-back board.

Table 5. PCF8574A address map

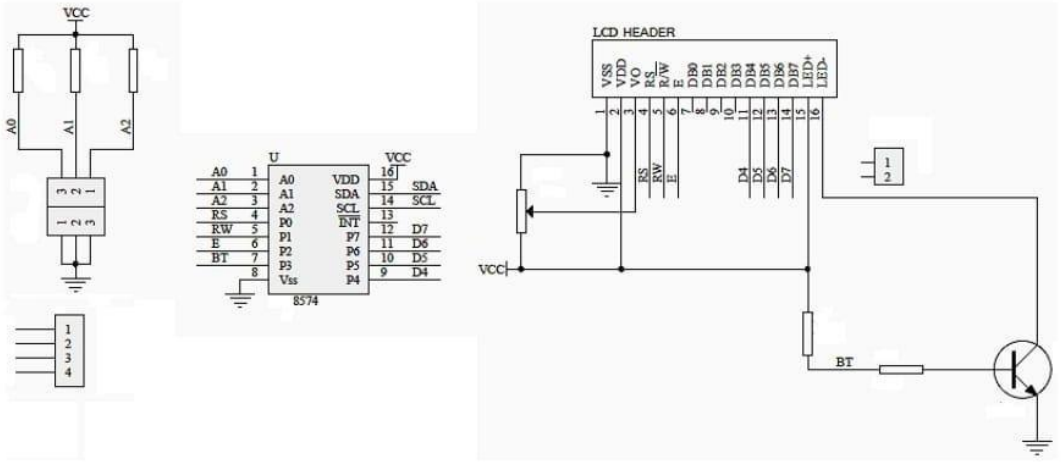
Pin connectivity			Address of PCF8574A								Address byte value		7-bit hexadecimal address without R/W
A2	A1	A0	A6	A5	A4	A3	A2	A1	A0	R/W	Write	Read	
V_{SS}	V_{SS}	V_{SS}	0	1	1	1	0	0	0	-	70h	71h	38h
V_{SS}	V_{SS}	V_{DD}	0	1	1	1	0	0	1	-	72h	73h	39h
V_{SS}	V_{DD}	V_{SS}	0	1	1	1	0	1	0	-	74h	75h	3Ah
V_{SS}	V_{DD}	V_{DD}	0	1	1	1	0	1	1	-	76h	77h	3Bh
V_{DD}	V_{SS}	V_{SS}	0	1	1	1	1	0	0	-	78h	79h	3Ch
V_{DD}	V_{SS}	V_{DD}	0	1	1	1	1	0	1	-	7Ah	7Bh	3Dh
V_{DD}	V_{DD}	V_{SS}	0	1	1	1	1	1	0	-	7Ch	7Dh	3Eh
V_{DD}	V_{DD}	V_{DD}	0	1	1	1	1	1	1	-	7Eh	7Fh	3Fh

Address Setting of PCD8574A (extract from PCF8574A data specs).

Note: When the pad A0~A2 is open, the pin is pull up to VDD. When the pin is solder shorted, it is pull down to VSS.

The default setting of this module is A0~A2 all open, so is pull up to VDD. The address is 3Fh in this case.

Reference circuit diagram of an Arduino-compatible LCD backpack is shown below. What follows next is information on how to use one of these inexpensive backpacks to interface with a microcontroller in ways it was exactly intended.



Reference circuit diagram of the I2C-to-LCD piggy-back board.

I2C LCD Display.

At first you need to solder the I2C-to-LCD piggy-back board to the 16-pins LCD module. Ensure that the I2C-to-LCD piggy-back board pins are straight and fit in the LCD module, then solder in the first pin while keeping the I2C-to-LCD piggy-back board in the same plane with the LCD module. Once you have finished the soldering work, get four jumper wires and connect the LCD module to your Arduino as per the instruction given below.

LCD display to Arduino wiring.

Arduino Setup

For this experiment it is necessary to download and install the "Arduino I2C LCD" library. First of all, rename the existing "LiquidCrystal" library folder in your Arduino libraries folder as a backup, and proceed to the rest of the process.

https://bitbucket.org/fmalpartida/new-liquidcrystal/downloads

Next, copy-paste this example sketch Listing-1 for the experiment into the blank code window, verify, and then upload.

Arduino Sketch Listing-1:

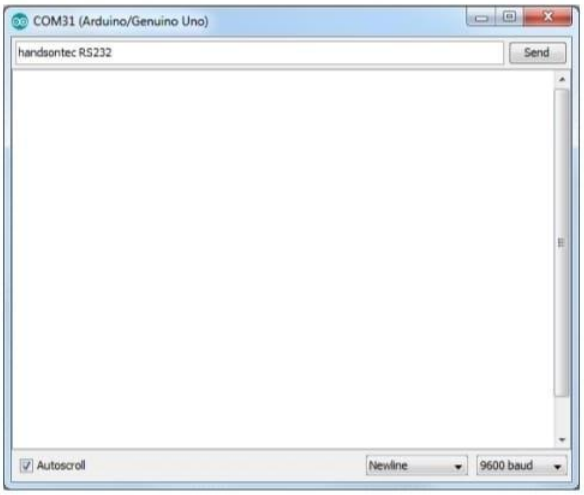
```
/*============================================================================
//  Author      : Handson Technology
//  Project     : I2C to LCD with Arduino Uno
//  Description : LCD with I2C Interface.
//  LiquidCrystal Library - I2C Serial to LCD
//  Source-Code : I2C_LCD.ino
//============================================================================
*/

/*-----( Import needed libraries )-----*/
#include <Wire.h> // Comes with Arduino IDE
// Get the LCD I2C Library here:
// https://bitbucket.org/fmalpartida/new-liquidcrystal/downloads
// Move any other LCD libraries to another folder or delete them
// See Library "Docs" folder for possible commands etc.

#include <LiquidCrystal_I2C.h>
/*-----( Declare Constants )-----*/
// set the LCD address to 0x3F for PCF8574AT with A0,A1,A0 address line open, default
setting.
// Set the pins on the I2C chip used for LCD connections:
//                    (addr, en,rw,rs,d4,d5,d6,d7,bl,blpol)
LiquidCrystal_I2C lcd(0x3F, 2, 1, 0, 4, 5, 6, 7, 3, POSITIVE);  // Set the LCD I2C
address

/*-----( Declare Variables )-----*/


void setup()   /*----( SETUP: RUNS ONCE )----*/
{
  Serial.begin(9600);  // Used to type in characters

  lcd.begin(20,4);         // initialize the lcd for 20 chars 4 lines, turn on
backlight

// ------- Quick 3 blinks of backlight  -------------
  for(int i = 0; i< 3; i++)
  {
    lcd.backlight();
    delay(250);
    lcd.noBacklight();
    delay(250);
  }
  lcd.backlight(); // finish with backlight on

//-------- Write characters on the display ------------------
  // NOTE: Cursor Position: Lines and Characters start at 0
  lcd.setCursor(3,0); //Start at character 4 on line 0
  lcd.print("Hello, world!");
  delay(1000);
  lcd.setCursor(2,1);
  lcd.print("From Handsontec  ");
```

```
  delay(1000);
  lcd.setCursor(0,2);
  lcd.print("20 by 4 Line Display");
  lcd.setCursor(0,3);
  delay(2000);
  lcd.print(" www.handsontec.com ");
  delay(8000);
  // Wait and then tell user they can start the Serial Monitor and type in characters
to
  // Display. (Set Serial Monitor option to "No Line Ending")
  lcd.setCursor(0,0); //Start at character 0 on line 0
  lcd.print("Start Serial Monitor");
  lcd.setCursor(0,1);
  lcd.print("Type char to display");


}/*--(end setup )---*/


void loop()   /*----( LOOP: RUNS CONSTANTLY )----*/
{
  {
    // when characters arrive over the serial port...
    if (Serial.available()) {
      // wait a bit for the entire message to arrive
      delay(100);
      // clear the screen
      lcd.clear();
      // read all the available characters
      while (Serial.available() > 0) {
        // display each character to the LCD
        lcd.write(Serial.read());
      }
    }
  }

}/* --(end main loop )-- */


/* ( THE END ) */
```

If you are 100% sure that everything is okay, but you don't see any characters on the display, try to adjust the contrast control pot of the backpack and set it a position where the characters are bright and the background does not have dirty boxes behind the characters. Following is a partial view of author's experiment with the above described code with 20x4 display module. Since the display used by the author is a very clear bright "black on yellow" type, it is very difficult to get a good catch due to polarization effects.

This sketch will also display character send from serial Monitor:

In Arduino IDE, go to "Tools" > "Serial Monitor". Set the correct baud rate at 9600. Type the character on the top empty space and hit "SEND".



The string of character will be displayed on the LCD module.

Resources:

- Handson Technology
- Complete Guide to Arduino LCD Interfacing (PDF)

Features

- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 131 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 20 MIPS Throughput at 20 MHz
  - On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory Segments
  - 4/8/16/32K Bytes of In-System Self-Programmable Flash progam memory (ATmega48PA/88PA/168PA/328P)
  - 256/512/512/1K Bytes EEPROM (ATmega48PA/88PA/168PA/328P)
  - 512/1K/1K/2K Bytes Internal SRAM (ATmega48PA/88PA/168PA/328P)
  - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
  - Data retention: 20 years at 85°C/100 years at 25°C(1)
  - Optional Boot Code Section with Independent Lock Bits
    - In-System Programming by On-chip Boot Program
    - True Read-While-Write Operation
  - Programming Lock for Software Security
- Peripheral Features
  - Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
  - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Six PWM Channels
  - 8-channel 10-bit ADC in TQFP and QFN/MLF package
    - Temperature Measurement
  - 6-channel 10-bit ADC in PDIP Package
    - Temperature Measurement
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Byte-oriented 2-wire Serial Interface (Philips I²C compatible)
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby
- I/O and Packages
  - 23 Programmable I/O Lines
  - 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
- Operating Voltage:
  - 1.8 - 5.5V for ATmega48PA/88PA/168PA/328P
- Temperature Range:
  - -40°C to 85°C
- Speed Grade:
  - 0 - 20 MHz @ 1.8 - 5.5V
- Low Power Consumption at 1 MHz, 1.8V, 25°C for ATmega48PA/88PA/168PA/328P:
  - Active Mode: 0.2 mA
  - Power-down Mode: 0.1 µA
  - Power-save Mode: 0.75 µA (Including 32 kHz RTC)

8-bit AVR® Microcontroller with 4/8/16/32K Bytes In-System Programmable Flash

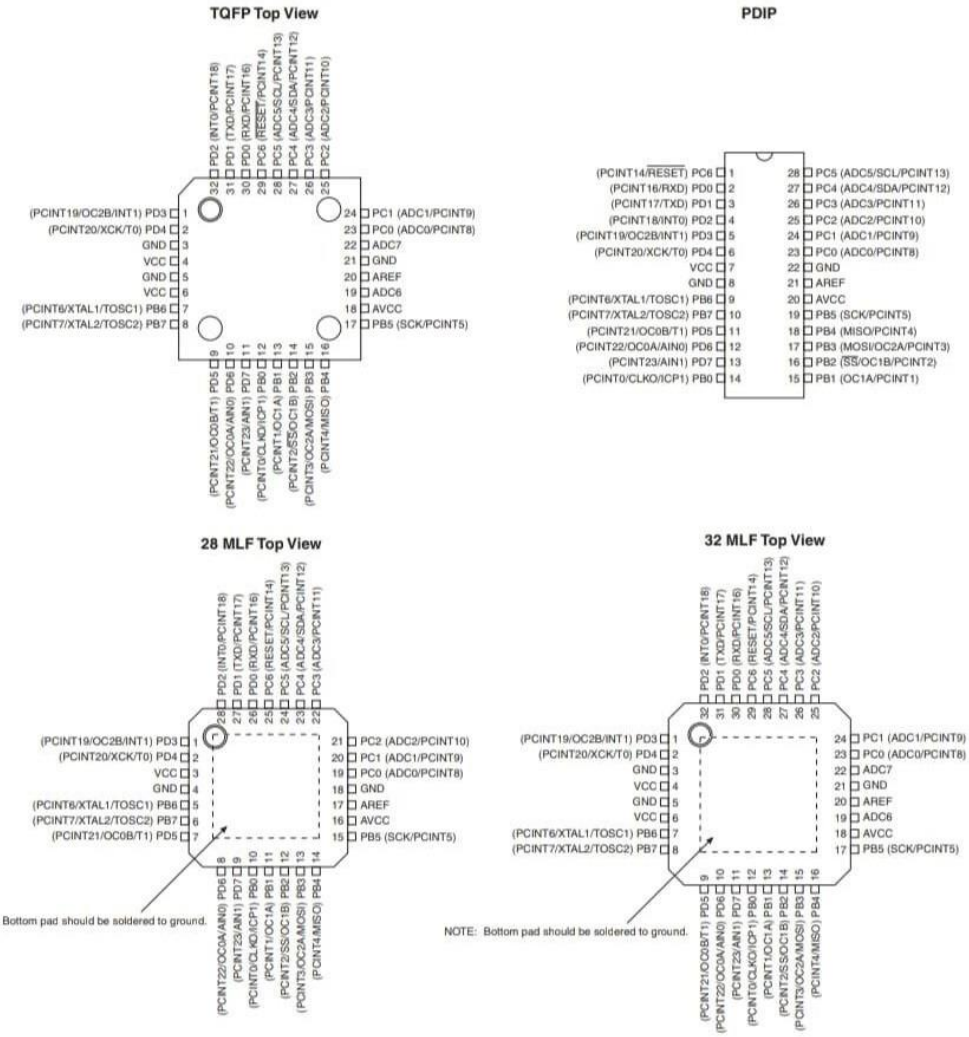
ATmega48PA
ATmega88PA
ATmega168PA
ATmega328P

Summary

Rev. 8161CS–AVR–05/09

1. Pin Configurations

Figure 1-1. Pinout ATmega48PA/88PA/168PA/328P



1.1 Pin Descriptions

1.1.1 VCC

Digital supply voltage.

1.1.2 GND

Ground.

1.1.3 Port B (PB7:0) XTAL1/XTAL2/TOSC1/TOSC2

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier.

If the Internal Calibrated RC Oscillator is used as chip clock source, PB7..6 is used as TOSC2..1 input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

The various special features of Port B are elaborated in "Alternate Functions of Port B" on page 76 and "System Clock and Clock Options" on page 26.

1.1.4 Port C (PC5:0)

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC5..0 output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

1.1.5 PC6/$\overline{\text{RESET}}$

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C.

If the RSTDISBL Fuse is unprogrammed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. The minimum pulse length is given in Table 28-3 on page 308. Shorter pulses are not guaranteed to generate a Reset.

The various special features of Port C are elaborated in "Alternate Functions of Port C" on page 79.

1.1.6 Port D (PD7:0)

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

The various special features of Port D are elaborated in "Alternate Functions of Port D" on page 82.

1.1.7 AV_{CC}

AV_{CC} is the supply voltage pin for the A/D Converter, PC3:0, and ADC7:6. It should be externally connected to V_{CC}, even if the ADC is not used. If the ADC is used, it should be connected to V_{CC} through a low-pass filter. Note that PC6..4 use digital supply voltage, V_{CC}.

1.1.8 AREF

AREF is the analog reference pin for the A/D Converter.

1.1.9 ADC7:6 (TQFP and QFN/MLF Package Only)

In the TQFP and QFN/MLF package, ADC7:6 serve as analog inputs to the A/D converter. These pins are powered from the analog supply and serve as 10-bit ADC channels.

PARALLAX

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4x4 Matrix Membrane Keypad (#27899)

This 16-button keypad provides a useful human interface component for microcontroller projects. Convenient adhesive backing provides a simple way to mount the keypad in a variety of applications.

Features

- Ultra-thin design
- Adhesive backing
- Excellent price/performance ratio
- Easy interface to any microcontroller
- Example programs provided for the BASIC Stamp 2 and Propeller P8X32A microcontrollers

Key Specifications

- Maximum Rating: 24 VDC, 30 mA
- Interface: 8-pin access to 4x4 matrix
- Operating temperature: 32 to 122 °F (0 to 50°C)
- Dimensions:
  Keypad, 2.7 x 3.0 in (6.9 x 7.6 cm)
  Cable: 0.78 x 3.5 in (2.0 x 8.8 cm)

Application Ideas

- Security systems
- Menu selection
- Data entry for embedded systems

How it Works

Matrix keypads use a combination of four rows and four columns to provide button states to the host device, typically a microcontroller. Underneath each key is a pushbutton, with one end connected to one row, and the other end connected to one column. These connections are shown in Figure 1.

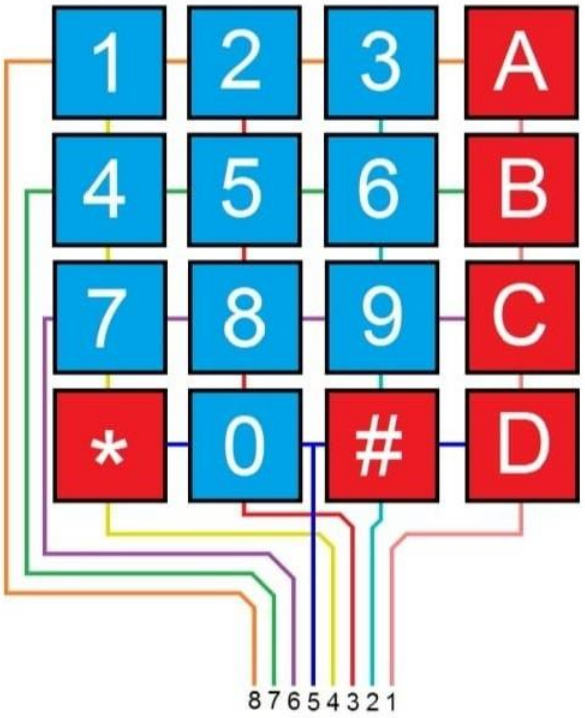


Figure 1: Matrix Keypad Connections

In order for the microcontroller to determine which button is pressed, it first needs to pull each of the four columns (pins 1-4) either low or high one at a time, and then poll the states of the four rows (pins 5-8). Depending on the states of the columns, the microcontroller can tell which button is pressed.

For example, say your program pulls all four columns low and then pulls the first row high. It then reads the input states of each column, and reads pin 1 high. This means that a contact has been made between column 4 and row 1, so button 'A' has been pressed.

Connection Diagrams

Figure 2

For use with the BASIC Stamp example program listed below.

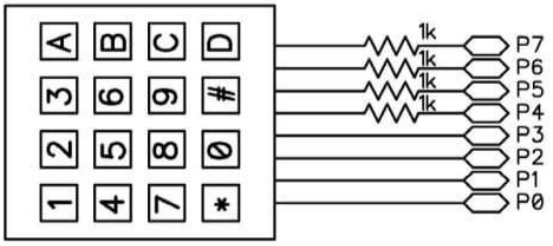
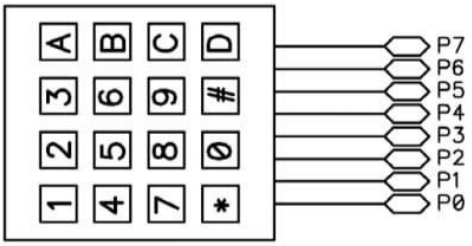


Figure 3

For use with the Propeller P8X32A example program listed below.



BASIC Stamp® Example Code

The example code below displays the button states of the 4x4 Matrix Membrane Keypad. It uses the Debug Terminal, which is built into the BASIC Stamp Editor software. The software is a free download from www.parallax.com/basicstampsoftware.

```
' 4x4MatrixKeypad_Demo.bs2
' Display buttons pressed on the 4x4 Matrix Membrane Keypad
' Author: Parallax HK Engineering

' {$STAMP BS2}
' {$PBASIC 2.5}

row         VAR  Nib                     ' Variable space for row counting
column      VAR  Nib                     ' Variable space for column counting
keypad      VAR  Word                    ' Variable space to store keypad output
keypadOld   VAR  Word                    ' Variable space to store old keypad output
temp        VAR  Nib                     ' Variable space for polling column states

DEBUG CLS                                ' Clear Debug Terminal
GOSUB Update                             ' Display keypad graphic

DO
  GOSUB ReadKeypad                       ' Read keypad button states
  DEBUG HOME, BIN16 keypad, CR, CR,      ' Display 16-bit keypad value
              BIN4 keypad >> 12,CR,      ' Display 1st row 4-bit keypad value
              BIN4 keypad >> 8, CR,      ' Display 2nd row 4-bit keypad value
              BIN4 keypad >> 4, CR,      ' Display 3rd row 4-bit keypad value
              BIN4 keypad                ' Display 4th row 4-bit keypad value
```

```
  IF keypad <> keypadOld THEN               ' If different button is pressed,
    GOSUB Update                            ' update the keypad graphic to clear
  ENDIF                                     ' old display

  IF keypad THEN                            ' Display button pressed in graphic
    GOSUB display
  ENDIF

  keypadOld = keypad                        ' Store keypad value in variable keypadOld
LOOP

' -----[ Subroutine - ReadKeypad ]-------------------------------------------------
' Read keypad button states
ReadKeypad:
  keypad = 0
  OUTL   = %00000000                        ' Initialize IO
  DIRL   = %00000000

  FOR row = 0 TO 3
    DIRB = %1111                            ' Set columns (P7-P4) as outputs
    OUTB = %0000                            ' Pull columns low (act as pull down)
    OUTA = 1 << row                         ' Set rows high one by one
    DIRA = 1 << row

    temp = 0                                ' Reset temp variable to 0
    FOR column = 0 TO 3
      INPUT (column + 4)                    ' Set columns as inputs
      temp = temp | (INB & (1 << column))   ' Poll column state and store in temp
    NEXT

    keypad = keypad << 4 | (Temp REV 4)     ' Store keypad value
  NEXT
RETURN

' -----[ Subroutine - Update ]-----------------------------------------------------
' Graphical depiction of keypad
Update:
  DEBUG CRSRXY,0,7,
    "+---+---+---+---+",CR,
    "|   |   |   |   |",CR,
    "+---+---+---+---+",CR,
    "|   |   |   |   |",CR,
    "+---+---+---+---+",CR,
    "|   |   |   |   |",CR,
    "+---+---+---+---+",CR,
    "|   |   |   |   |",CR,
    "+---+---+---+---+"
RETURN

' -----[ Subroutine - Display ]---------------------------------------------------
' Display button pressed in keypad graphic
Display:
  IF KeyPad.BIT15 THEN  DEBUG CRSRXY, 02,08,"1"
  IF Keypad.BIT14 THEN  DEBUG CRSRXY, 06,08,"2"
  IF KeyPad.BIT13 THEN  DEBUG CRSRXY, 10,08,"3"
  IF Keypad.BIT12 THEN  DEBUG CRSRXY, 14,08,"A"
  IF KeyPad.BIT11 THEN  DEBUG CRSRXY, 02,10,"4"
  IF Keypad.BIT10 THEN  DEBUG CRSRXY, 06,10,"5"
  IF KeyPad.BIT9  THEN  DEBUG CRSRXY, 10,10,"6"
  IF Keypad.BIT8  THEN  DEBUG CRSRXY, 14,10,"B"
  IF KeyPad.BIT7  THEN  DEBUG CRSRXY, 02,12,"7"
  IF Keypad.BIT6  THEN  DEBUG CRSRXY, 06,12,"8"
  IF KeyPad.BIT5  THEN  DEBUG CRSRXY, 10,12,"9"
```

```
  IF Keypad.BIT4  THEN  DEBUG CRSRXY, 14,12,"C"
  IF KeyPad.BIT3  THEN  DEBUG CRSRXY, 02,14,"*"
  IF Keypad.BIT2  THEN  DEBUG CRSRXY, 06,14,"0"
  IF KeyPad.BIT1  THEN  DEBUG CRSRXY, 10,14,"#"
  IF Keypad.BIT0  THEN  DEBUG CRSRXY, 14,14,"D"
RETURN
```

Propeller™ P8X32A Example Code

The example code below displays the button states of the 4x4 Matrix Membrane Keypad, and is a modified version of the 4x4 Keypad Reader DEMO object by Beau Schwabe.

Note: This application uses the 4x4 Keypad Reader.spin object. It also uses the Parallax Serial Terminal to display the device output. Both objects and the Parallax Serial Terminal itself are included with the with the Propeller Tool v1.2.7 or higher, which is available from the Downloads link at www.parallax.com/Propeller.

```
{{ 4x4 Keypad Reader PST.spin
Returns the entire 4x4 keypad matrix into a single WORD variable indicating which buttons are
pressed. }}

CON

  _clkmode = xtal1 + pll16x
  _xinfreq = 5_000_000

OBJ
  text : "Parallax Serial Terminal"
  KP   : "4x4 Keypad Reader"

VAR
  word  keypad

PUB start
  'start term
  text.start(115200)
  text.str(string(13,"4x4 Keypad Demo..."))
  text.position(1, 7)
  text.str(string(13,"RAW keypad value 'word'"))

  text.position(1, 13)
  text.str(string(13,"Note: Try pressing multiple keys"))

  repeat
    keypad := KP.ReadKeyPad     '<-- One line command to read the 4x4 keypad
    text.position(5, 2)
    text.bin(keypad>>0, 4)      'Display 1st ROW
    text.position(5,3)
    text.bin(keypad>>4, 4)      'Display 2nd ROW
    text.position(5, 4)
    text.bin(keypad>>8, 4)      'Display 3rd ROW
    text.position(5, 5)
    text.bin(keypad>>12, 4)     'Display 4th ROW
    text.position(5, 9)
    text.bin(keypad, 16)        'Display RAW keypad value
```

Revision History

v1.0: original document
v1.1: Updated Figure 1 on page 2
v1.2: Updated Figure 1 on page 2 (again); updated BS2 comments