

Transferring Data Using a Visible Light

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Abstract:- This project aims to demonstrate the availability and usability of a basic Li-Fi system that can be manufactured and utilised in daily life starting with the fundamental tools. We present a novel method of data transfer that combines sustainable energy harvesting with high-speed communication (using Li-Fi technology). This makes it suitable for a range of applications, such as secure data communication, Internet of Things (IoT) devices, and wireless sensor networks. A light communication system called Li-Fi uses modulating circuits and regular LED bulbs. We shall explain in this how light from an LED diode is utilised as a transmission medium for this purpose. Compared to Wi-Fi, it transfers data more quickly. In the experimental setup, modulated light signals are emitted by LEDs and detected by solar cells that have photodetectors installed. To recover the transmitted data, the receiving signal must be decoded. Light from the source is directed through a plane convex lens to minimise losses at the lowest levels. If the light source is precisely at the focal point, the light rays on the exit will extend nearly parallel and strike the solar cell with the least amount of loss. It also emphasises how this technology will be used in the future. Additionally, it showcases the technology that will enable data transfer at the speed of light in the future and make efficient use of the light spectrum to connect gadgets to the internet. ex. Organization v2v(vehicle-to-vehicle), Smart mirror, Indoor navigation in building and landscapes, Hospital and health care...etc.,

Keywords:- Solar Panels, Li-Fi, Wireless, LED, Security.

I. INTRODUCTION

In all associated areas, there is currently a significant increase in the demand for faster and more secure communications for smartphones, tablets, portable computers, and other devices. Due to the inability of outdated wireless technology to meet the intense need for fast and secure communication, Li-Fi (Light Fidelity) technology was developed. Visible light is used in Light Fidelity (Li-Fi), a high-speed distant communication technology. It is included in the optical wireless communications category. Variable-intensity Light Emitting Diode bulbs are used to transmit data. This mutation leads to digital communication. Gigabits

per second is the standard unit of measurement for data transmission.

Li-Fi refers to the use of light as a means of information transmission. Similar to Wi-Fi, but faster, high-speed communication technology lets you send and receive more data in less time. It makes use of the electromagnetic spectrum's visible light region, which runs from 380 to 780 nm. It has 10,000 times greater space bandwidth as a result. It is theoretically capable of speeds up to 224 Gbps.

➤ Existing Systems

These days, wireless communications play a significant role in communication. The primary method of delivering data wirelessly is through the use of radio waves, or electromagnetic waves. However, due to intrusion and the availability of confined spectrum, radio waves can only sustain a limited bandwidth. Data transmission via Visible Light Communication (VLC) is a solution to this. While Li-Fi is ideal for high-density wireless data coverage in a confined area and for reducing radio interference difficulties, Wi-Fi is concerned with wireless coverage within buildings. Li-Fi primarily employs LEDs to transfer multimedia data between two terminals.

II. PROPOSED METHODOLOGY

Li-Fi is a new data transmission method. By varying the light's intensity, Li-Fi data is delivered and subsequently detected by a photo detector. A photo detector serves as the receiver in VLC (Visible Light Communication) technology, which uses an LED light source as a transmitter. Electrical signals are transformed into optical signals in the transmitter and sent via LEDs. A photo detector is included in the receiver. The optical signals are transformed into electrical signals by the photo detector. By passing more information, this technology becomes more sophisticated and allows for faster data exchange.

The below flowchart describes the process how the data is transferred through the LED. The system consists of transmitter module and receiver module. The UART (Universal Asynchronous Receiver & Transmitter) is used transfer the data serially and the methodology as described below.

➤ *The Steps in the Methodology are as Follows:*

- To begin with, transfer the data from the PC. To do this, the data needs to be changed from electrical to optical signals.
- The data will be transformed into a binary value and sent via a Li-Fi transmitter that uses light to transfer data.
- The photo detector (Li-Fi receiver) receives light from the transmitter side.
- The binary values are transformed into electrical signals once more, and change the electrical signals from the optical ones. Therefore, the user can use PCs to view their results.
- By utilising technology for visible light communication.

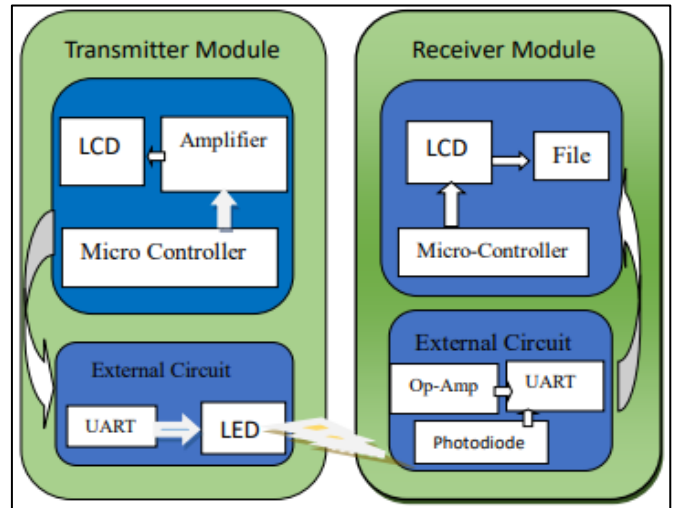


Fig 1 Flow Chart of Li-Fi System

III. SYSTEM DESIGN AND WORKING OF TRANSMITTER BOARD

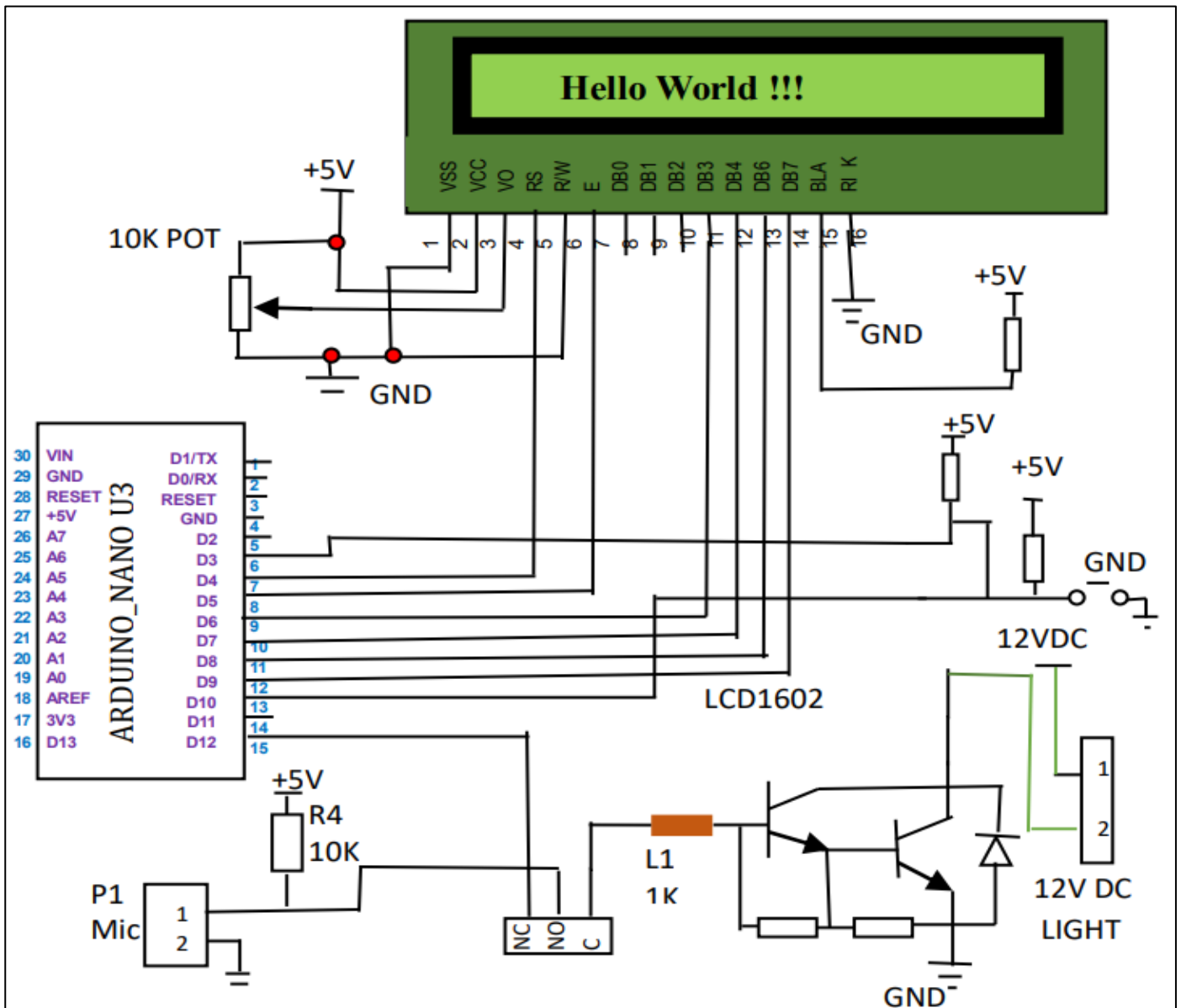


Fig 2 Transmitter Circuit

Alphanumeric data can be sent via the keyboard. You can also use the spacebar, backspace, delete, and enter commands. Uppercase alphabets and special characters (!,@,#,\$,%,&,*,(,)) can also be communicated if the caps lock key is activated. A key's ASCII code is transmitted straight to the microcontroller when it is pressed on the keyboard. The data is sent to the transistor pair by the microcontroller, which translates the ASCII code into binary. When a PNP transistor operates in the off state, it reads zero in the binary code; when an NPN transistor operates in the on state, it reads one. After then, the binary pulse made up of ones and zeros is sent to the LED torch by this transistor pair. The blinking of led light is so fast that it cannot be detected by a human eye.

IV. SYSTEM DESIGN AND WORKING OF RECEIVER CIRCUIT⁶⁴

Within the receiver section, a PNP transistor (IC BC 5578) is linked to a photodiode. The circuit is powered by a 9-volt battery that is connected to it. The voltage regulator IC 7805 is utilized to reduce the 9-volt DC supply to a 5-volt DC supply, which is necessary for the microcontroller AT89S52 to function. The clock frequency of the microcontroller is provided by a crystal oscillator operating at 11.0592 MHz, which is linked to two 27 pf paper capacitors for frequency stabilization. In order to offer the reset function, a 10uf capacitor is additionally attached to the microcontroller. The manual reset feature is provided by a button switch. The 16x2 LCD and microcontroller are interfaced so that the data sent by the transmitter may be seen.

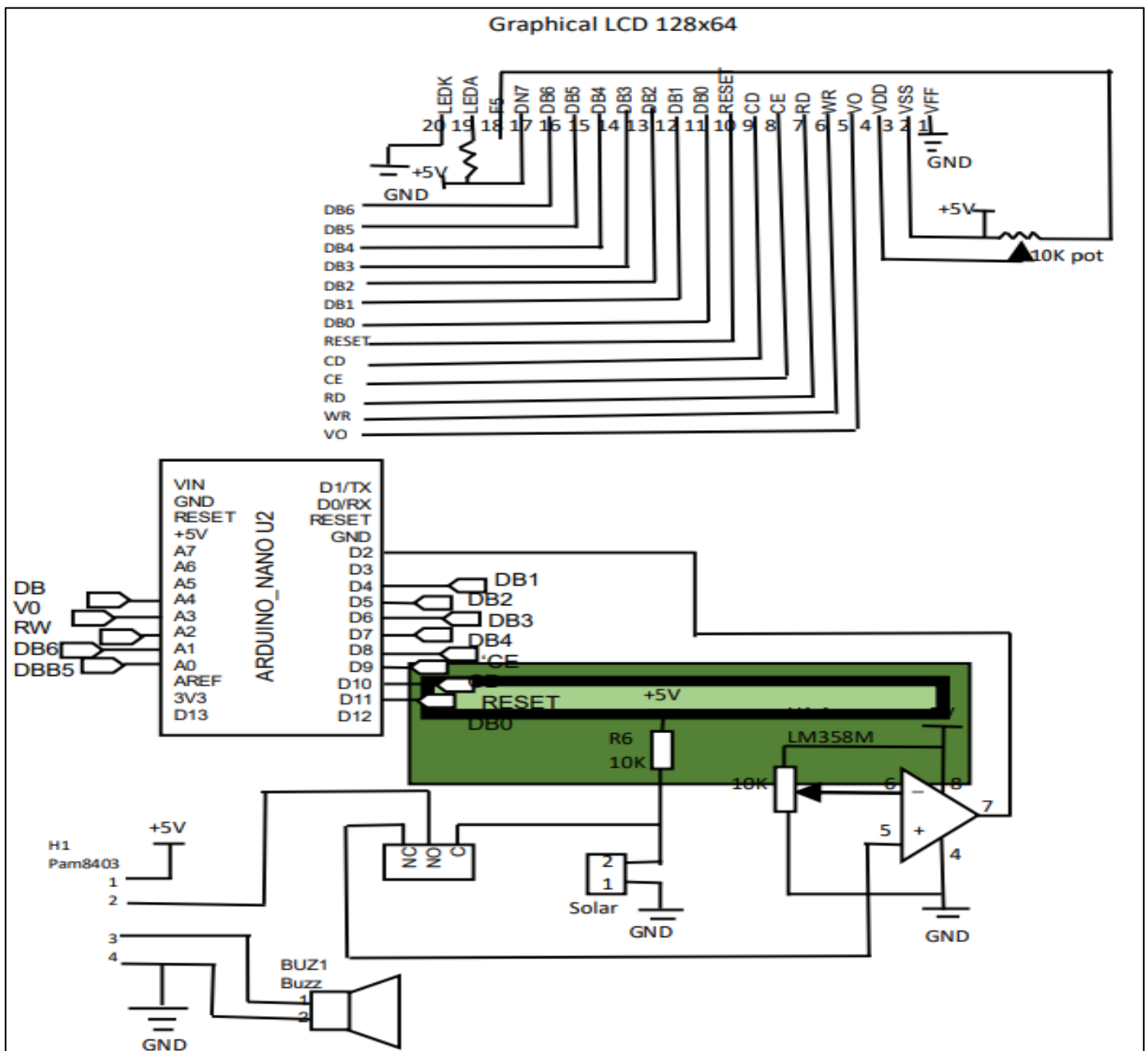


Fig 3 Receiver Circuit

The LED's light is directed towards the receiver. When the led flickers, the photodiode notices it and sends a sequence of ones and zeros to the transistor. When the PNP transistor detects a zero, it is in the on state; when it detects a one, it is in the off state. The microcontroller reads the

transistor's on and off states and converts the binary code that is created as a result of on and off into an ASCII code. This ASCII code is subsequently transmitted by the microcontroller to the 16x2 LCD for display, which is directly interfaced with microcontroller.

V. OBSERVATIONS

There are the observations that the hardware setup is made through the table are shown below. We describe about the parameters and observations for hardware set and placement of transmitter and receiver.

Table 1 Observations

PARAMETERS	OBSERVATION
The maximum height at which a torch can be maintained to facilitate Li-Fi transmission.	Minimum height: 7 cm Maximum height: 75 cm
Minimal light allowance	Minimal allowance every LED light that has a microcontroller operating attached to it transmits data.
Range of temperatures	0 - 70 Degree Celsius

VI. OVERALL SYSTEM DESIGN



Fig 4 System Model

The figure that illustrates how an LED light source is used to communicate with both the transmitter and reception circuits. This circuit uses visible light communication to enable the transmission of both audio, image and numerical data. The numeric matrix keypad's output is shown on the LCD. A speaker provides the output when audio is sent via a microphone. An image also shown on the LCD.

The coolterm software is use to transfer the image and numerical data through the LED. It converts the text file into ASCII Code. The whole transmission part is performed through this software.

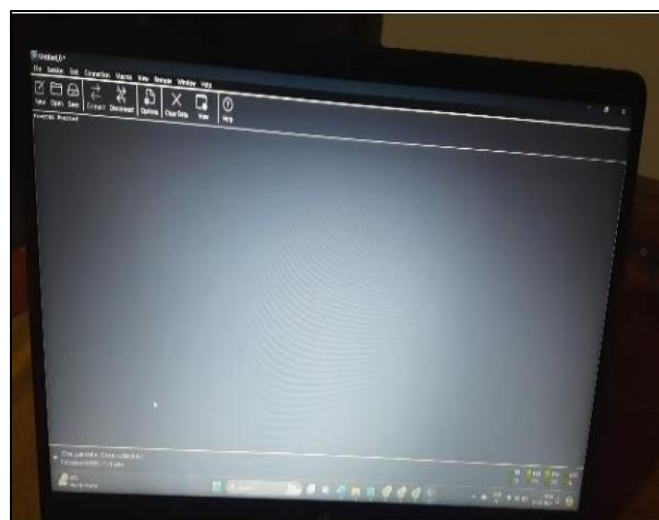


Fig 5 Coolterm Software

VII. DISCUSSIONS

We have worked with Li-Fi communication, which employs light wavelengths instead of conventional radio waves. With a signal-producing microchip inside, the LED generates rates that are significantly faster than our typical internet connection speed.

VIII. RESULTS

This experiment shed light on a future technological development: LED-based data transfer. A basic 8052 microcontroller was used in this experiment to communicate alphanumeric data, which allowed for efficient data transmission and reception. We also came to the conclusion that any LED light can be used for data transmission and receiving if it has a microcontroller operating system installed. Furthermore, if the light is visible, the transmitter and receiver's ability to communicate will not be impacted by changes in intensity. However, data transfer is not possible when there is an obstruction between the light source and the photodiode.

Thus, continual communication requires unhindered light. Since data theft won't be a concern, this technology can be safer and more secure than Wi-Fi even though it cannot be utilised to communicate over solid objects or opaque buildings. The figure-4 shows the data that received by the transmitter and transferred data is show on the LCD on receiver side and the text transfer by using coolterm software to covert the text to ASCII again ASCII covert into binary form through the micro-controller.



Fig 5 Text Transmission

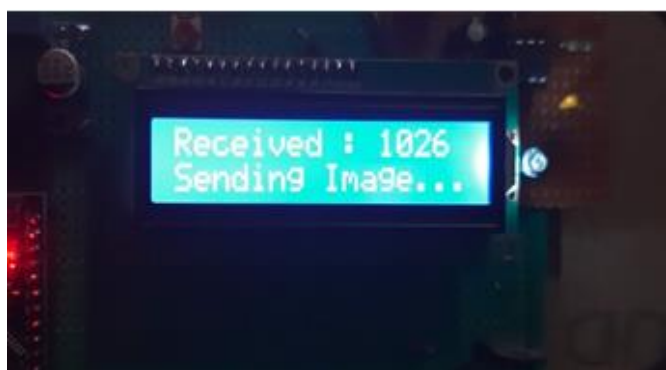


Fig 6 Image Transmission

The figure shows the image transmission, same as text the received data from PC shown on LCD at transmitter side. The transferred image displayed on receiver side LCD.

IX. CONCLUSION

The aim of the project is to design an affordable, basic data communication system that can communicate numerical data and assist with audio communication. It will do this by utilising LEDs, DTMF transmitters and receivers, LCDs, and ATMEGA-8 microcontroller units. The project module can be further improved to read alpha-numeric data and enable video communication via a camera or other digital device. Currently, it is designed to read numeric data and special characters *, #, and to facilitate audio conversation.

There are several possible results that can be looked into more. If this invention proves useful, each lightbulb can be used as a kind of wireless hotspot to transfer data, leading the way to a future that is safer, greener, cleaner, and more brilliant. Li-Fi is currently the subject of a great deal of curiosity, in part because it could provide a real and practical substitute for radio-based wireless technology. The increasing number of people using wireless internet along with their many devices is congealing wireless transmissions, which makes it harder and harder to demand a dependable, fast signal. This could shed light on problems like the slow radio-frequency transfer speed and provide internet access in places where traditional radio-based wireless is prohibited, such hospitals and aeroplanes. The fact that it can only function in coordinate line of sight is one of its drawbacks, though.

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