

Text Communication Using Li-Fi

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Abstract- Li-Fi stands for Light-Fidelity. The technology is very new and was proposed by the German physicist Harald Haas in 2011. Li-Fi provides transmission of data through illumination by sending data through an LED light bulb that varies in intensity faster than human eye can follow. while Li-Fi is ideal for high density wireless data coverage in confined areas where there are no obstacles. Li-Fi is a wireless optical networking technology that uses light emitting diodes (LEDs) for transmission of data. The term Li-Fi refers to visible light communication (VLC) technology that uses as medium to deliver high-speed communication in a manner similar to Wi-Fi. Li-Fi provides better bandwidth, efficiency, availability and security than Wi-Fi and has already achieved high speeds in the lab.

In this project , At the transmitter we use 4x4 hex keypad as input source , converts into binary bits by microcontroller and transmitted through LED . At the Receiver photo diode is used as detector and converts into electrical signal equivalent of binary bits by the Arduino (microcontroller) and displayed on the 16x2 LCD display .

Index Terms: Light Fidelity; LED; VLC; Wi-Fi; Bandwidth

I. INTRODUCTION

The focus of this project will be Visible Light Communications (VLC). We aim to design our own analog circuit to integrate with a arduino, and then sending some form of data using visible light LEDs from a transmitter, and decoding it with a receiver.

Information will be converted into bits through some coding scheme by a microcontroller and will be transmitted with blinking LEDs. The blinking of these LEDs will not be visible to the human eye as they are blinking at a high frequency. Photodiodes on the receiving side will detect the fluctuation of the LEDs from the transmitter and will send signals to a microcontroller which is integrated with a computer to determine the originally transmitted message. The transmitting system will be powered from a wall outlet whereas the receiving system will be powered by batteries and the computer or microcontroller combination.

II. LITERATURE SURVEY

The advent of Li-Fi technology has many improvements over the currently existing system Wi-Fi. People are already using Wi-Fi and have no problem with it, but it cannot remain the same as the always growing population leading to more Wi-Fi users. Li-Fi is a communication technology that can deliver a bidirectional, high speed, network and mobile speed communications using LED bulbs used to provide both illuminations as well as data transmission. It is considered to be self-controlled and invisible to the naked eye. [1][6]

Light Emitting Diodes(LEDs) switch On and Off faster than the human eye can detect since the operating speed of LEDs is less than 1 microsecond, thereby causing light to appear as continuously On. The modulation process is so rapid that humans cannot even notice it. [8] A light-sensitive photodetector will receive the signals at the destination and convert it back into original data. This method of transmitting data rapidly through light is technically referred to as Visible Light Communication (VLC) and the term Li-Fi has been inspired by Wi-Fi as it has the capacity to compete with Wi-Fi. [2]

The term 'Li-Fi' coined by Harald Has is a subset of Optical Wireless Communications (OWC) and could be used as a complement to R.F communications (Wi-Fi or cellular networks) or even a replacement in terms of broadcasting data. Both Li-Fi and Wi-Fi transmit data electromagnetically. Devices equipped with wireless network adapters will detect the wireless signals broadcasted by access points and tune it in range to process whereas Li-Fi will make use of fast flickering LED bulbs to transmit data in the form of light waves. It also accommodates a photodetector diode to receive the light signals and a signal processing element in order to convert that data into 'stream-able content'. [3]

Wi-Fi is generally used for wireless coverage within buildings, whereas Li-Fi is ideal for high-density wireless data coverage in confined areas.

These two technologies can be considered complimentary. The low-cost nature of LEDs and lighting units allows a lot of opportunities to make use of this medium. LiFi takes out the fiber from fiber optics as it sends data through light waves. Amplitude modulation is done in Li-Fi technology and thus, it is considered to be 80% more efficient compared to Wi-Fi. PCBs with power amplifier circuits are reused to transmit data up to a range of 10 meters. This makes Li-Fi fast and efficient for short-distance communication. [4]

Li-Fi will be using WWSN (Wireless Visual Sensor Networks) connected to each other and controlled by a user via a user interface from anywhere at any time through cloud computing. [5] By using these technologies, efficient transmission of data can be done via visible light communication. [6]

III. METHODOLOGY

Hardware Components

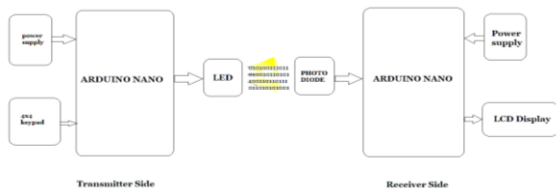


Fig 1. Block diagram of Li-Fi Text communication

List of the Components :

1. 4x4 Keypad
2. Arduino NANO - 2
3. Light Emitting Diode (LED)
4. Solar Panel
5. Liquid Crystall Display (LCD)

4X4 HEX KEYPAD

Typically one port pin is required to read a digital input into the controller. When there are a lot of digital inputs that have to be read, it is not feasible to allocate one pin for each of them. This is when a matrix keypad arrangement is used to reduce the pin count.

Therefore, the number of pins that are required to interface a given number of inputs decreases with increase in the order of thematrix.



Fig 3.4x4 Matric Keypad.

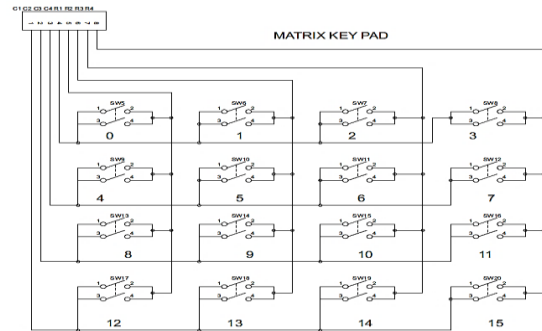


Fig 4. Circuit diagram 4x4 keypad

From the circuit you can see that when one of the 16 buttons are pressed, a pair of pins are connected together. We will use this feature to detect the button that was pressed in the following sections.

ARDUINO NANO

Arduino is an open source platform based on Hardware and Software. Arduino Boards are able to reads inputs. Arduino has been used in thousands of different project and applications. The Arduino Software is easy-to-use for beginners, yet flexible enough for advance users. Its runs on Mac, Windows and Linux.

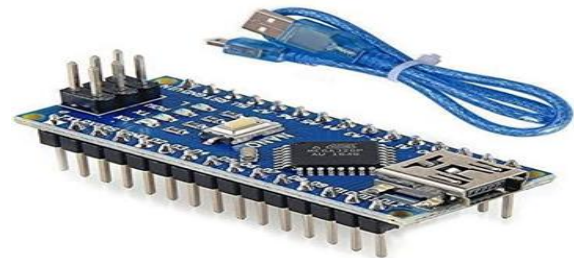


Fig 5.Arduinonanoand USB cable

Arduino Nano Pinout contains 14 digital pins, 8 analog Pins, 2 Reset Pins & 6 Power Pins. Each of these Digital & Analog Pins are assigned with multiple functions but their main function is to be configured as input or output. They are acted as input pins when they are interfaced with sensors, but if you are driving some load then use them as output.

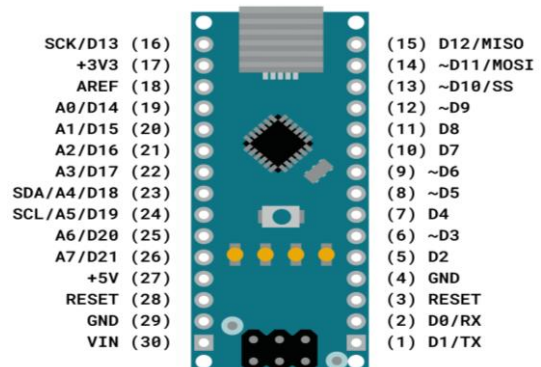


Fig 6.Arduinonano pin configuration

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor.

Light Emitting Diode (LED)

A Light Emitting Diode (LED) is a small device that emits light whenever electrical current passes through it. Different colors of LED can be used for the transmission of data.

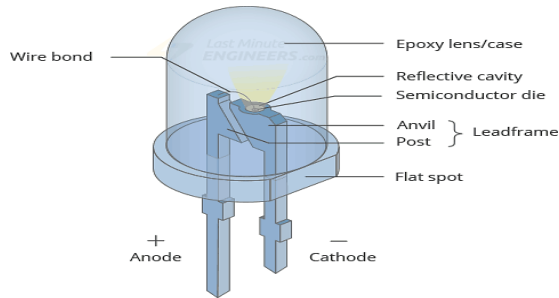


Fig 8.LED structure

LED as Light Source The most important requirement for a light source in order to serve communication purposes is the ability to be switched on and off repeatedly in very short intervals of time. Due to their ability to be switched on and off rapidly, LEDs are suitable light sources for Li-Fi. LEDs offer many benefits over fluorescent lamps and incandescent lamps such as higher efficiency, environment-friendly, flexibility of design, longer useful lifetimes and improved spectrum performance.

SOLAR PANEL

Photovoltaic solar panels absorb sunlight as a source of energy to generate direct current electricity. A photovoltaic (PV) module is a packaged, connected assembly of photovoltaic solar cells available in different voltages and wattages. Photovoltaic modules constitute the photovoltaic cells or arrays, this Photovoltaic cells generates and supplies milli-volts to few volts depend upon the Light fall on it and Voltage rating of the solar panel.



Fig 9. Solar panel

A solar panel is so sensitive that it can catch small intensity change and correspondingly there is a change in the voltages at the output of the solar panel. So, when the light of LED falls on the panel, voltages will vary according to the intensity of light. Then voltages of solar panels are fed into an amplifier which amplifies the signal and giving the output to arduinonano as a input signal.

LCD (Liquid Crystal Display)



Fig 10. Pin Diagram of LCD

Liquid Crystal Display is very helpful in providing user interface as well as for debugging purpose. The liquid crystal display screen works on the principle of blocking light rather than emitting light. LCDs require a backlight as they do not emit light them. We always use devices which are made up of LCD's displays which are replacing the use of cathode ray tube.

CIRCUIT DIAGRAM&WORKING

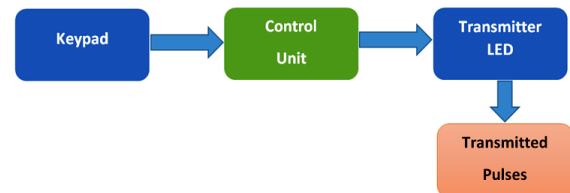


Fig 12.block diagram of transmitter

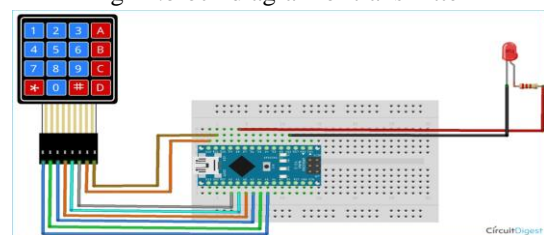


Fig 13.schematic diagram of Li-Fi Transmitter

As shown in the figure above, in the transmitter part of Li-Fi communication, the keypad is used as input here. That means we'll be selecting the text to be transmitted using the keypad. Then the information is processed by the control unit which is nothing but Arduino in our case. Arduino converts the information into binary pulses which can be fed to an LED source for transmission. Then these data are fed to LED light which sends the visible light pulses to the receiver side.



Fig 14. Block diagram of Receiver

In the receiver section, the LDR sensor receives the visible light pulses from the transmitter side and converts it into interpretable electrical pulses, which is fed to the Arduino (Control unit). Arduino receives this pulse and converts it into actual data and displays it on a 16x2 LCD display.

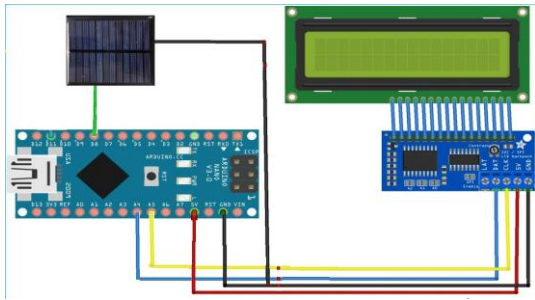


Fig 15. Schematic diagram Li-Fi Receiver

CONCLUSION & RESULT

We have presented reports on the upcoming technology Li-Fi i.e. Light Fidelity - A Visible Light Communication. Initially the speed at which the data is send on small scale is good enough but the large scale implementation of the same is much more promising. Where security impedes to be a big issue in any system, the Li-Fi system proves out to be far better than any other data sending process.

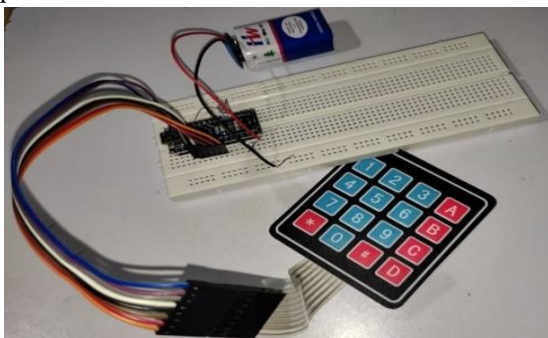


Fig 16. Transmitter side of Li-Fi

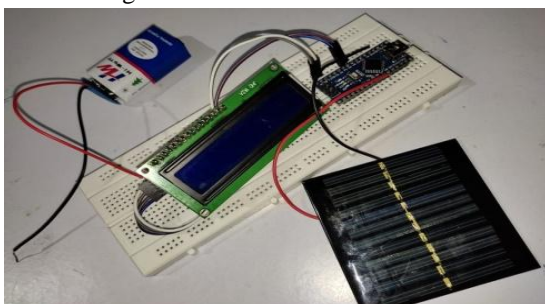


Fig 17. Receiver end of Li-Fi

ADVANTAGES

- Can be used UNDERWATER without Radio Interference because salt conducts electricity.
- Transmission can be blocked by walls , So there is less risk for data leaking
- Can be safely used on planes because it does not interfaces radio equipments

DISADVANTAGES

- Reliability and network coverage are the major issues to be considered. Interference from external light sources like sunlight, normal bulbs; and opaque materials in the path of transmission will cause interruption in the communication.

APPLICTIONS

- GigaSpeed Technology.
- Underwater Explorations and Communications
- Used for modern medical instruments
- Indoor Wireless Communication

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