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TEXT, VOICE AND IMAGE TRANSMISSION USING VISIBLE LIGHT COMMUNICATION

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Abstract— *Over the years, the overdependence on Wireless Fidelity (Wi-Fi) for data transmission necessitated the need for an alternate and more reliable means of communication, hence, Light Fidelity (Li-Fi). It involves the use of Light Emitting Diode to transmit data by blinking (i.e. switching them On and Off) at a speed not noticeable to the eye. This paper proposed the development of the Li-Fi system using off the shelf electronic components. The proposed system utilizes an embedded system with dual-core Advanced Virtual RISC (AVR) microcontroller (ATmega16L) interfaced to input/output circuits comprising of the Light Emitting Diode (LED), LM358N Operational Amplifier and a photodiode. Also, by developing a user (Receiver PC) interface using Embedded C programming, the sample data (text, voice and image) transferred was monitored and the speed, efficiency, security and capacity of the system was examined and discovered to be top notch. This would make the system an indispensable means of communication in the nearest future. This data transmission system is different from those in existence because expensive components were not in the design, invariably reducing the overall cost of the implementation.*

1. INTRODUCTION

Light Fidelity (Li-Fi) is a high speed, wireless communication using visible light. It falls under the category of optical wireless communications. Data transmission takes place through Light Emitting Diode (LED) bulbs whose intensity varies. Based on this variation, communication occurs digitally. This technology has vast applications where the use of Wi-Fi is limited or banned. It also takes out the adverse health effects of using electromagnetic waves. Unless light is seen, data can't be hacked and so data transmission is secure. Data transmission is typically in terms of Gigabytes per second [1]. The use of light as a means to transmit data has been coined Li-Fi. The high-speed communication technology is similar to Wi-Fi but is faster, allowing you to send and receive more data in less time. By swapping incandescent bulbs with LEDs - which have electronic properties - Li-Fi could bring Internet access to more areas and could revolutionize the telecommunications industry. The speed of data transmission is about 10 Mbps, though it is aimed to improve up to 100 Mbps by 2022 [2]. Recently, wireless technology has bloomed to a great extent such that wireless technology requires a large amount of data to transmit every day. Nowadays, wireless communications have become important in the communication process. The main means of transmitting wireless data is by using electromagnetic waves i.e. radio waves. However, radio waves can support less bandwidth because of compact spectrum availability and intrusion. The solution to this is data transmission using Visible Light Communication (VLC). Wi-Fi deals with wireless coverage within premises, whereas Li-Fi is perfect for high compactness wireless data coverage in a defined area and for mitigating radio interference issues. Li-Fi basically focuses on transmitting multimedia data between two terminals using LEDs.

2. EXISTING SYSTEMS

In today world communication between the devices is much common. These devices are using radio waves for short range wireless transmissions. Wi-fi and Bluetooth are currently the two prominent short range wireless technologies. The radio wave spectrum has certain key limitations which includes bandwidth consumption, efficiency, availability and security.

DISADVANTAGES:

[1] In radio wave spectrum data transmission security is very less. [2]Lot of data cannot be transferred simultaneously. [3]Health issues. [4]Bandwidth usage is limited.

3. PROPOSED SYSTEM

Li-fi is a new technique of data transmission. LIFI data is transmitted by modulating the intensity of the light, which is then received by a photo detector. VLC(Visible Light Communication) technology consists of a light source as a transmitter and photo detector as receiver. In transmitter the electrical signals are converted into optic signals and transmitted through LED. The receiver contains photo detector. The photo detector converts the

optic signal into electrical signal. This method is made sophisticated by using more than one led at a given time. By this way more information can be passed and hence a faster data communication is possible.

ADVANTAGES:

- More security and vulnerable to unauthorized access.
- Availability of data is increased.
- Less power is required.
- Provides faster communication.
- Less harmful to humans.

4. METHODOLOGY

Step2: Data must be converted from electrical to optical signals in order to transmit.

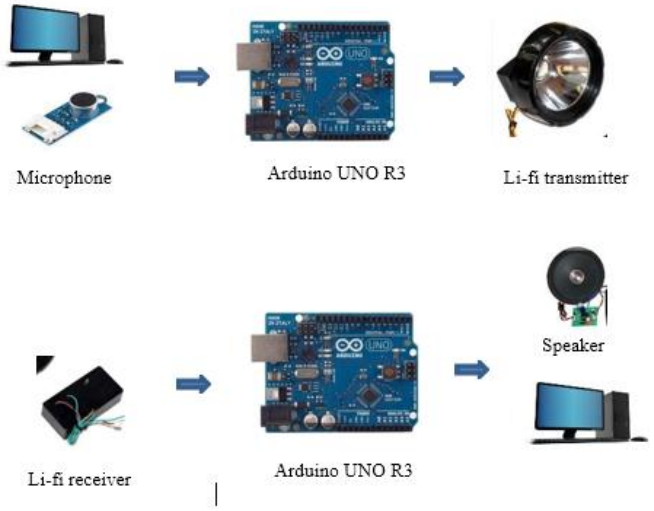
Step3**:** The data will be converted as a binary values and the data will be transmitted through light using li-fi transmitter.

Step4: The light from the transmitter side is received by the photo detector (li-fi receiver).

Step5*:* Again the binary values is converted into optical signals. And convert the optical signals to electrical signals. So the user can view their results using PC's

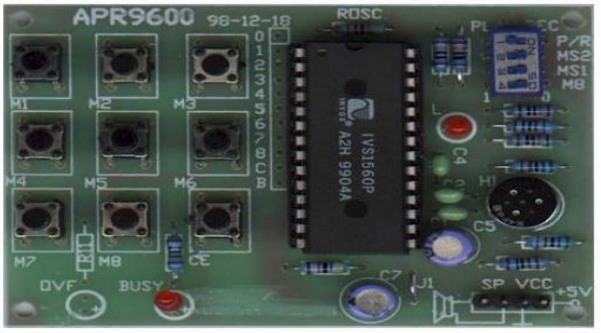
Step6: By using visible light communication technology. No data loss occurs. The data can be transferred safe and sec

5. ARCHITECTURE DIAGRAM



A. Voice playback board

Voice Recorder module is a type of module built in recording and audio playback. It allows to record sound from a microphone, the line-in jack, or music played by another player in WMA or WAV formats. They are small handheld devices used primarily for recording voice memos, dictation, lectures, or conferences for later playback.

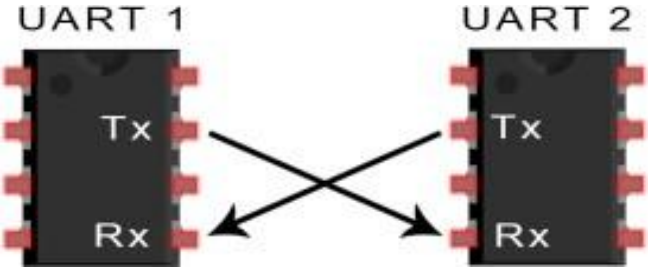


B. Interfacing PC

Personal laptop is used in our project to send the data transmission and display the data at receiver end. Pc and Arduino r3 will communicate throw the UART(Universal Asynchronous Receiver Transmitter) communication. Putty software is used to transfer the data.

C. Uart communication

In UART communication, two UARTs communicate directly with each other. The transmitting UART converts parallel data from a controlling device like a CPU into serial form, transmits it in serial to the receiving UART, which then converts the serial data back into parallel data for the receiving device. Only two wires are needed to transmit data between two UARTs. Data flows from the Tx pin of the transmitting UART to the Rx pin of the receiving UART:



UARTs transmit data asynchronously, which means there is no clock signal to synchronize the output of bits from the transmitting UART to the sampling of bits by the receiving UART. Instead of a clock signal, the transmitting UART adds start and stop bits to the data packet being transferred. These bits define the

beginning and end of the data packet so the receiving UART knows when to start reading the bits. When the receiving UART detects a start bit, it starts to read the incoming bits at a specific frequency known as the baud rate. Baud rate is a measure of the speed of data transfer, expressed in bits per second (bps). Both UARTs must operate at about the same baud rate. The baud rate between the transmitting and receiving UARTs can only differ by about 10% before the timing of bits gets too far off.

D. LI-FI

At present, the day to day activities use lot of LED based lights for illumination, which can also be used for communication because of the advantages like fast switching, high power efficiency and safe to human vision. Hence, this project presents about ecofriendly data communication through visible light which consists of the white LEDs that transmit audio signals to the receiver. The receiver circuit consists of solar panel connected with the amplifier and speakers to recover back the amplified version of original input signal. Here we are using a new technology of wireless communication "LI-FI". Therefore, we proposed a connection protection mechanism that cooperates with wireless network and visible light communication to achieve reliability and performance in industrial communication network. In this project we are transmitting text / sensor data / audio through LIFI

ADVANTAGES:

- transfer rates of up to 3 Gbit/s
- no radiation exposure
- no interference with radio systems
- data transmission with commercially available high- power LED lamps
- combination of lighting and data communication
- cost-effective retrofitting possible
- parallel operation of several VLC systems possible
- optically opaque surfaces make data protection easy
- transmission standard IEEE 802.15.7

E. Need of LIFI:

Li-Fi enabling the system using fully networked wireless communication and could provide a connection that's 100 times faster than Wi-Fi

It can reach speeds up to 3Gpbs by using DMT modulation the signal of Li-Fi cannot go through the wall.

While the signal of WiFi can go through the wall, it can cause the vulnerabilities in data loss and data leakage

F. Arduino uno

The **Arduino Uno** is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc.[2][3] The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[1] The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.[4] It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

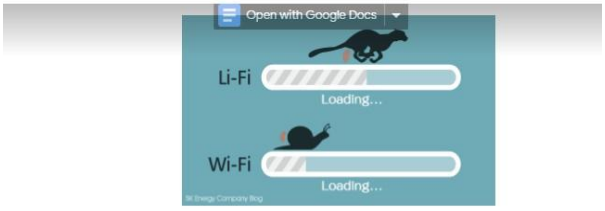
G. Interfacing li-fi device

Light Fidelity is a high speed wireless communicating device which uses visible light as a medium. LIFI set up comprises a transceiver unit. Data is given to the LIFI transmitter section by using LED from which the data is transmitted and gets received in a LIFI receiver. The voice data is received and gets amplified by an audio amplifier and the output is given to the speaker.

H. Li-fi receiver

Photo diode will be used as an li-fi receiver , it will receive the signals and the binary values will be converted in to digital signals and the output is displayed in PC using UART

communication.



COMPARISON OF TECHNOLOGIES USED FOR CONNECTING TO THE END USER

Technology	Connection	Security	Reach	Impact	Cost	Bandwidth Expansion
Wi-Fi	Wireless-EMF	Good	Excellent	unknown	Good	Limited
Hardwired	Cables	Excellent	Fair	None	Good	Limited
Li-Fi	Wireless-Light	Excellent	Excellent	None	Low	Exceptional

6. Hardware Required

- Arduino uno r3 microcontroller
- Sound Recorder
- VLC transmitter/receiver
- Amplifier
- Speaker
- Pc

7. Software Required

Software: Arduino ide
Programming language: embedded c

8. Conclusions

Although this technology is still in its infancy, with further studies and development its far-reaching applications will only get better. VLC technology is all about using LED light bulbs meant for illumination to also send data simultaneously. It is best suited as an alternative for data transfer where radio transmission networks are not desired or possible. In future, we will be able to transmit an image, audio and even a high-definition video using LED light bulbs.

Features such as high bandwidth, non-interference with radio waves (in electromagnetic-sensitive areas) and non- hazardous to health has made VLC an attractive technique for future communication. Li-Fi is 100 times faster than analogous Wi-Fi, which uses RF for communication.

The optical wireless communication system is a good replacement for the regular communication system. VLC is a rapidly growing segment in the field of communication.

The purpose of Li-Fi technology is to provide a high-speed data communication using visible light spectrum. Now Li-Fi is on-going of research, it has a potential advantage that can make a supplement RF communication and can be used to improve wireless network performance. Although Li- Fi has a good performance in the transfer rate, Li-Fi is not good enough when deploy in an outdoor in sunlight or other condition. Li-Fi will probably not completely replace Wi-Fi, these two technologies can be used together to achieve more efficient and secure network.

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