

Image Encoding & Decoding Using Base64 Technique and It's Wireless Transmission Using Li-Fi

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Abstract— Li-Fi is one of the advanced and fastest technology among other available data transmission technologies in the world of data communication. The high bandwidth and immunity to interference ability of Li-Fi makes it unique from other available wireless technologies. It could be used in areas where high data transfer is much required and other wireless technologies are restricted due to their hazardous signal radiations. It could be useful in variety of application including audio transmission, video transmission, text transmission and image transmission. Li-Fi communication is also called as the Visible Light Communication (VLC) since we make the use visible light for transmitting the data from transmitter to receiver. In this article a prototype is designed to transfer a 2D image using UART serial communication from one PC to another PC using VLC.

Keywords- Bandwidth, VLC, 2D, UART

I. INTRODUCTION

Due to high bandwidth and immunity to interference from electromagnetic waves spectrum, VLC is preferred over other available communication techniques. The experimental results shown in this article uses Visible Light Communication system, responsible to transfer a real time 2D image from one PC to other PC using Li-Fi technology. The basic idea is to send image as serial data using serial communication. To transmit the data, light emitting diodes are used at the transmitting end and photodiodes are used at the receiver end. LED carries the data in the form of 1's and 0's by switching on and off the light at faster rates. The microcontrollers are used at both the ends for controlling the overall data transmission process, and also it converts the data from ASCII to binary at transmitter side and from binary to ASCII at the receiver side by using Base64 encoding technique. Conversion is required to make data into a suitable file to be recognized by the PC software. In order to access the file and to transmit it serially user interface is developed using VB.Net. Thus the transmission of 2D image from one PC to other PC is carried out with the Li-Fi technology using LEDs and photodiodes, with the data rate of 9600 bits per second, over the distance of 1 meter successfully achieved using light as the transmission medium.

II. TECHNIQUES USED FOR IMAGE TRANSMISSION

Since Li-Fi makes use of visible light for sending data, it is required to modulate the data into a signal which can be transmitted over the medium [1]. These signals consist of light pulses. Following are the techniques used in this prototype for image transmission.

A. Pulse-width modulation (PWM)

PWM is a technique used to instruct a message into a pulsing signal. PWM is mainly used to encode information but its actual use is to permit the control of the power supplied to electrical devices, especially to inertial masses like motors. The drawback of PWM is, it supports low data rate up to 4.8 Kbps. The main advantage of PWM is that power loss in the case of switching devices is very low. When a switch is off there is practically no current supplied but when it is on and if power is being transferred to the load, there is almost no voltage drop across the switch. Hence the power loss in both the cases is close to zero. [2]

B. Base64

Base64 is a generic that encode binary data by treating it numerically and translating it into a base 64 representation. Base64 can be used in the cases when there is a need to encode binary data that needs be stored and transferred over media that are specifically designed to deal with textual data. This is to ensure that the data during transport remains intact without modification. Base64 encoding technique is commonly used in a number of applications including email via MIME, and storing complex data in XML.[3]

C. RS232

RS232 is Standard Communication can be defined as, an asynchronous serial communication method. The word serial communication means, that the information is transmitted one bit at a time and asynchronous says that the time slot for transmitting the information is not defined in advance. The process of data transfer can start at any given time and it is the task of the receiver to detect at what time a message starts and ends. In RS232 standard, the information is sent bit by bit on a physical transmission medium. The transmitted information needs to be broken up in data words. The length of a data word

can be varying. In RS232, the line voltage level may have two states. The on state is shown with mark whereas, the off state with space. No further line states are possible except these two. If the line is found idle, it is kept in the mark state. [4]

D. UART

UART is stands for Universal Asynchronous Receiver/Transmitter. The control operation of UART can be control by clock which runs multiple data. Initially the Start bit is high and when the start bit goes low, the UART starts its process. The stop bit is high after receiving the 8 bits [5]. The figure 1.1 shows the wave form of UART

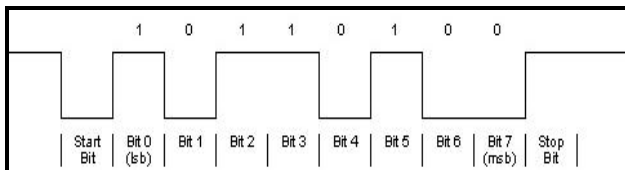


Figure 1.1: UART waveform

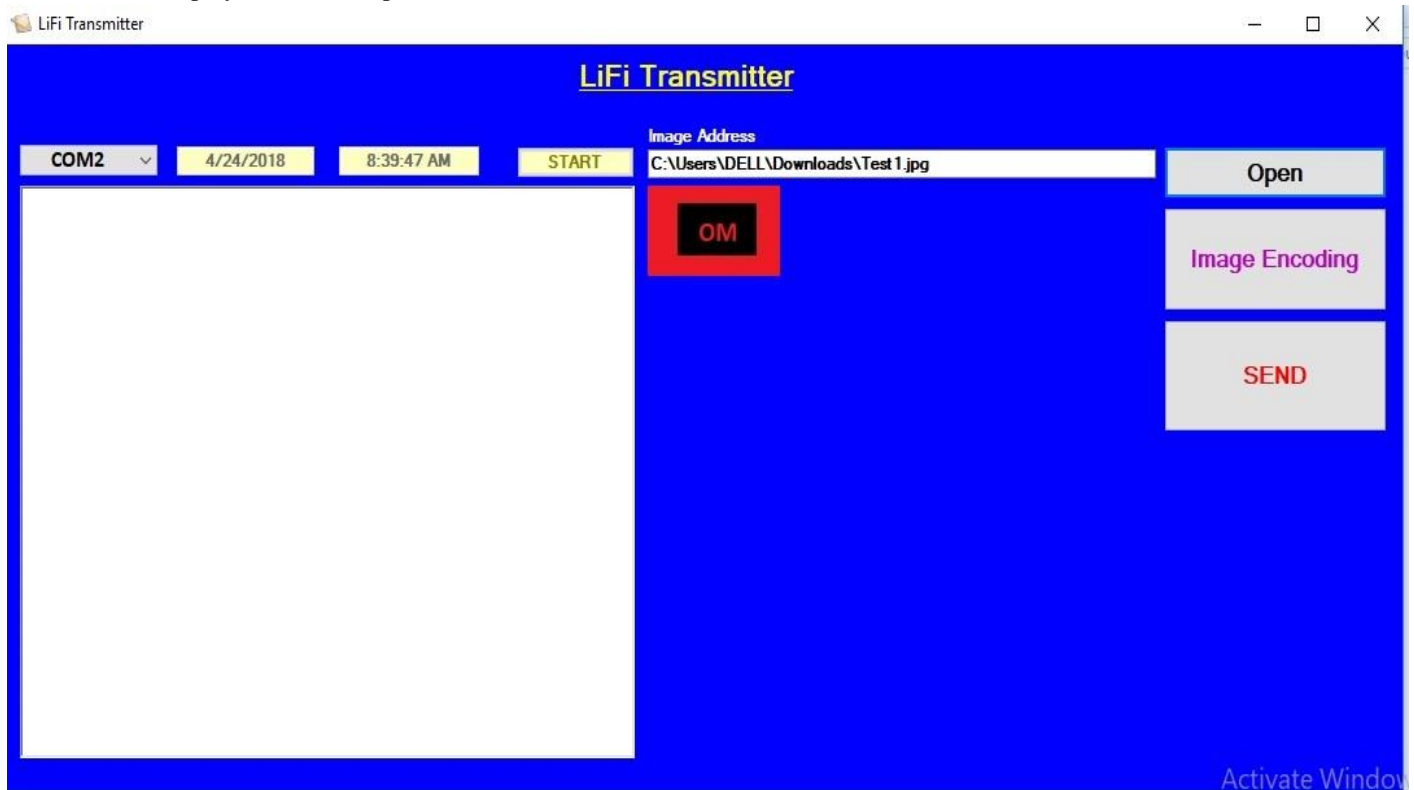
III. SYSTEM DESIGN AND IMPLEMENTATION

The system consists of:

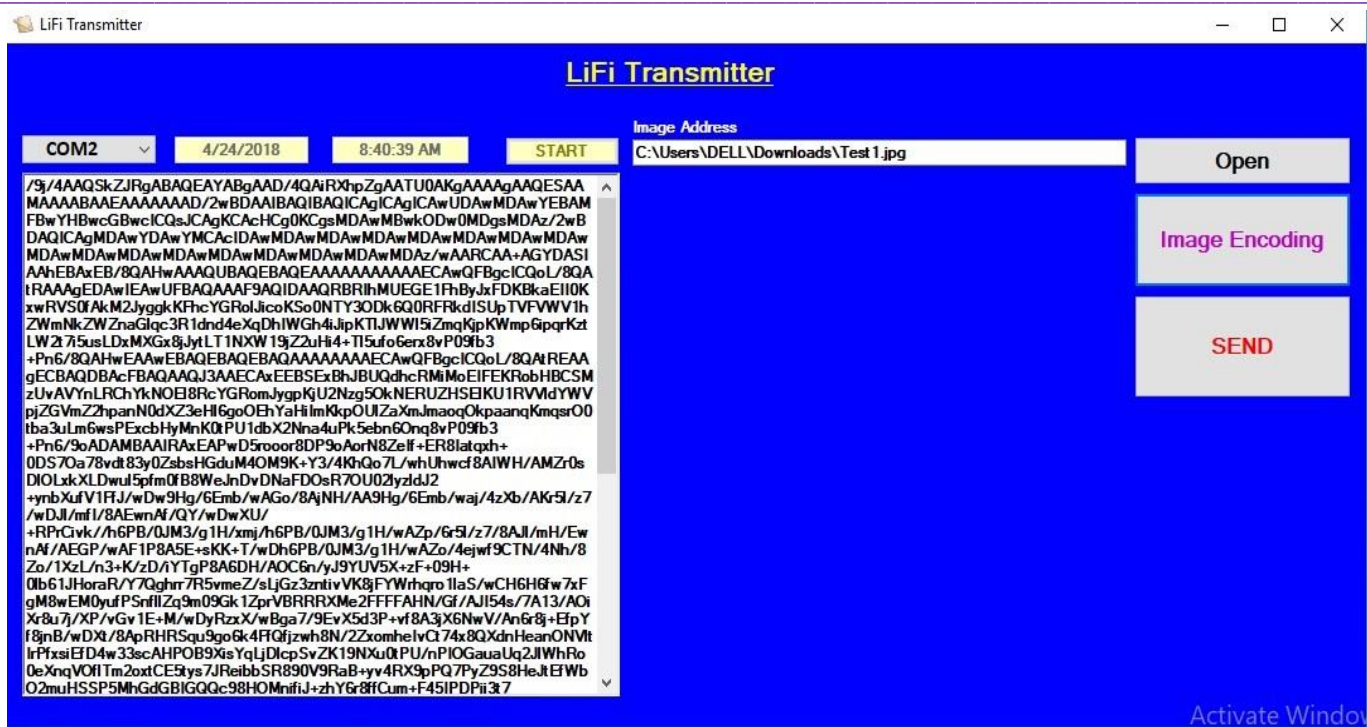
- The Data Reading module,
- Data interpretation module and the
- Data display (GUI) are implemented in software.

Here, the user interface is developed using VB.Net programming for Transmitter and Receiver PC. The transmitter side performs the task of image selection, image encoding and image sending. Following are the steps which need to be performed for successful transmission of image between transmitter and receiver.

- The image which is already available in the PC is selected by the user and the COM port activation is done as shown in screenshot 1.1.
- Click on Image Encoding button, it will start the operation of encoding the image into base64 encoding format.
- After encoding the image, click on Send button as shown in screenshot 1.2. And the process of sending an encoded image from transmitter side is done by the software.
- At the receiver end, the image is received in encoded form.
- The COM port selection is made at receiver section as shown in screenshot in 1.3.
- Click on Image Decoding button provided in UI and user will get final 2D image as shown in screenshot 1.4.



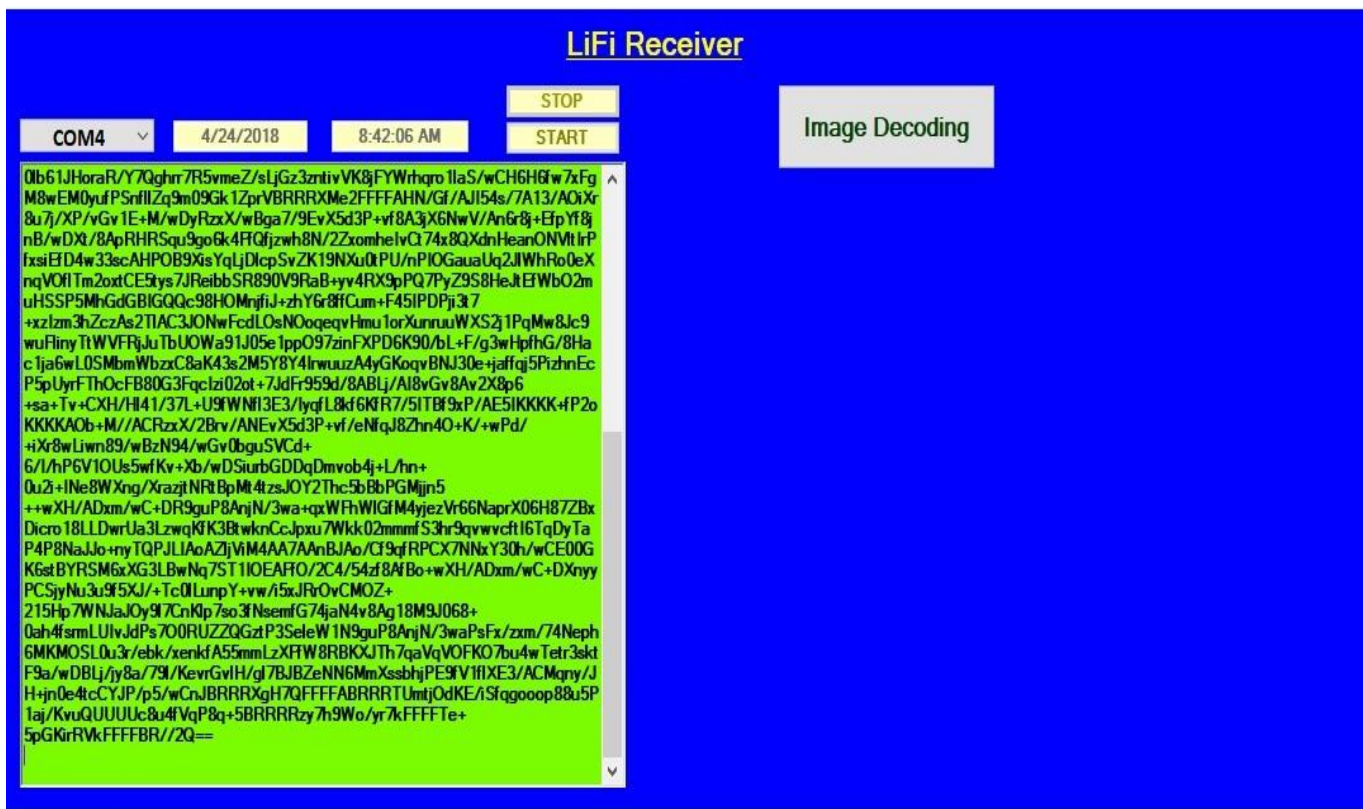
Screenshot 1.1: Image selection and COM port activation.



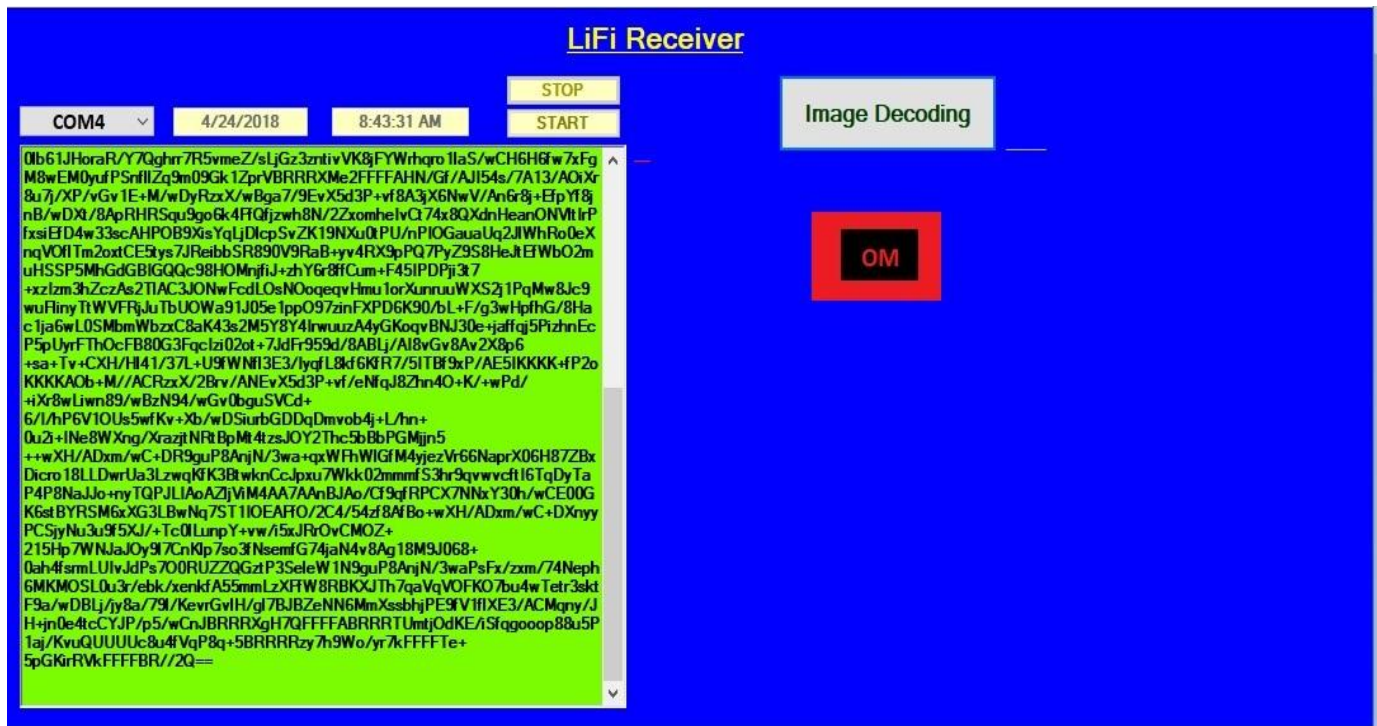
Screenshot 1.2: Encoding the Image into base64 and its transmission

At the transmitter side, the image is converted into byte format so that it can be sent to the transmitter circuit. Encoding can also be performed on this data. In this case Base64 encoding technique is performed; it converts binary

data to non-ASCII character data. Finally, this data is sent to the Transmitter circuit that transmits this data in the form of light.



Screenshot 1.3: Receiving Encoded image



Screenshot 1.4: Final Decoded image

At the receiver's side, the Receiver circuit captures the light signals, converts then into bit sequence and sends this byte of data to the software. The software then converts this byte data to the original format as sent by the sender (e.g., text format). Since Base64 encoding was performed at transmitter end, the software at receiver end will decode the non-ASCII character data back to binary data. The received image is then displayed on the receiver's device as output.

IV. OBSERVATIONS

The experimental setup was tested successfully and 2D image was sent from one pc to another pc using Li-Fi technology. The observations are discussed below:

- The maximum distance between transmitter and receiver is 1 meter to achieve successful transmission.
- Line of sight is always required for successful transmission between transmitter and receiver.
- Using high capacity LED's, transmission distance between transmitter and receiver can be increased.

V. LIMITATIONS

- Line of sight is the primary requirement in order to achieve successful data transmission.
- The interference between the transmitter and receiver will causes the data loss, for example striking of objects.
- Use of photo diode may cause interruptions due to the presence of other light sources.

VI. CONCLUSIONS

The possibilities are numerous and can be further explored. If this technology can be put into practical use, every bulb can be used something like a Wi-Fi hotspot to transmit wireless data and we will proceed toward the cleaner, greener, safer and brighter future [6]. In comparison to traditional radio-based wireless communication system the concept of Li-Fi is new and currently attracting a great deal of interest because it may offer very efficient and genuine [7]. With a growing demand of wireless internet connection, the airwaves are becoming increasingly clogged, making it more difficult to get a reliable, high-speed data signal. Li-Fi technology may solve problems such as the shortage of radio-frequency bandwidth and it can also allow internet where radio based wireless communication system isn't allowed such as in aircraft or in hospitals. One of the limitations however is that it only work in direct line of sight. [8]

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ABBREVIATIONS

VLC: Visible Light Communication
ASCII: American Standard Code for Information Interchange
PWM: Pulse Width Modulation
UART: Universal Asynchronous Receiver Transmitter
XML: eXtensible Markup Language
MIME: Multipurpose Internet Mail Extensions
Email: Electronic Mail
RS232: Recommended Standard 232
2D: 2 Dimensional
COM Port: Communicatopn Port
PC: Personal Computer