

Implementation of VLC Transceiver for Audio and Video Signal using LI-FI Technology

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Abstract: In a trendy world of wireless technology, we are using many numbers of devices to access the internet. Most of these devices use wireless communication. In electromagnetic spectrum due to lack of radio spectrum, we cannot use it for longer time. It will be led to network complexity, shortage of bandwidth and an increased risk of interference of radio frequencies. This conflict occur in Wi-fi in order to overcome this we are going to Li-fi technology. Li-Fi is a new way of wireless communication that uses light waves to transmit data instead of radio waves. Light-emitting diodes are used to transmit the data in visible light spectrum. Li-fi uses visible light communication and it has a promising future. On comparing with Wi-fi it has low latency, high efficiency, accessible spectrum, and high data can be achieved. It is highly secured so the data cannot be hacked. This paper aims at designing Li-fi transceiver for audio and video signal transmission with large increase in transmission distance and improvement of channel capacity.

Keywords: Li-Fi, li-fitransceiver, Visible light communication.

I. Introduction

Li-Fi known as light fidelity was introduced first time by Prof. Harald Haas on July 2011 at TED Global Talk. Li-Fi is based on Visual Light Communication (VLC) that using light emitting diodes (LEDs) to fully networked wireless system. Li-Fi enables the electronic device to connect to the internet with no wire. In order to make a communication link between a node, a Li-Fi will need a transceiver to transmit and receive the data. This transceiver will have a modulation technique to make the LED enable to carry the data using the light. The emergence of Li-Fi is to overcome the shortage of current technology. We all know that right now Wi-Fi is the most used technology to connect many devices to the internet. As this comes, the use of an internet device has been increased. Wi-Fi is reduced due to the limitation of radio frequency resources. [According to Li-Fi, Wi-Fi has the difference related to congestion, density, security, safety, and speed. The more Wi-Fi enabled device exists, the congestion may occur. In the technology of Wi-Fi, we can't add more routers if the user is increased, while we can add the light in Li-Fi. Efficiency and safety of the internet are the dominating issues right now. The performance of Li-Fi is claimed that better than the performance of Wi-Fi. The rated speed of Li-Fi is 1000 times faster than Wi-Fi. For the safety of the internet, Li-Fi is more secure than the Wi-Fi based on the spread of the signal. Li-Fi has a light characteristic that light cannot go through the wall. Based on those two technologies, in a simple conclusion is Li-Fi has more secure communication rather than the Wi-Fi. The susceptibility exists if there is leakage in the wall while having an indoor communication With Li-Fi, we can connect to the internet simply by being within a range of an LED beam, or we could conceivably transmit data using our car headlights. The ramifications of this are huge, especially with the internet of things in full swing and the much-mooted spectrum crunch expected to bite increasingly hard in the coming years. LI-FI is a new technology which uses visible light for communication instead of radio waves. LI-FI uses Visible Light Communication (VLC). Visible light communication is a data communications medium which uses visible light between 400 and 800 THz (780–375 nm). VLC is a subset of optical wireless communications technologies. It refers to 5G Visible Light Communication systems using Light Emitting Diodes as a medium to high-speed communication in a similar manner as WI-FI [6]. It can help to conserve a large amount of electricity by transmitting data through light bulbs and other such lighting equipment. It can be used in aircraft without causing any kind of interference. LI-FI uses light as a carrier as opposed to the traditional use of radio waves as in WI-FI and this means that it cannot penetrate walls, which the radio waves are able to. It is typically implemented using white LED bulbs at the downlink transmitter [1]. By varying the current through the LED at a very high speed, we can vary the output at very high speeds. This is the principle of the LI-FI. The working of the LI-FI is itself very simple—if the LED is ON, the signal transmitted is a digital 1 whereas if it is OFF, the signal transmitted is a digital 0. By varying the rate at which the LEDs flicker, we can encode various data and transmit it. Li-fi has overcome existing technologies, Li-Fi technology consists of LED as the media transmission and photodetector as a receiver of transmitted data, Lamp driver is needed to make LED working

properly, while amplification and processing are responsible to manage the signal that comes from a photodetector.

II. VLC System Design

The VLC system consists of two parts: the transmitter and the receiver. The block diagram of the system is shown in Fig.1. The VLC system mainly consisted of PC, MCU, amplifier module, a filter module, LED driver, transmitting circuit and receiving circuit. We can analyze the communication process of the VLC system as follow:

Firstly, the PC acts as a source to produce data, it transmits the data to PIC microcontroller through UART cable which is programmed which modulates the data. The signal is transmitted through a visible channel and received by photodiodes. After amplification and modulation process it transmits the data and it is received at the receiver side.

2.1 Transmitter Section:

The transmitter section consists of a Li-Fi transmitting module, PIC microcontroller, MIC, voice playback module.

2.1.1 LI-FI Transmitter:

In the process, a voice is used as the input signal. This signal is converted to an electrical signal through a microphone. The transmitted data will be digitized when the digital signal drives the LED LED, turning led ON for ones and OFF for zeros. Likewise, the video has been transmitted through UART cable which is ported in the PC by connecting to the respective port. Hence, the transmission data rate has to be so high that it eliminates the flicker as a constant light source to the human eye. LED turning led ON for ones and OFF for zeros. Block diagram of li-fi transmitter is shown in Fig.1.

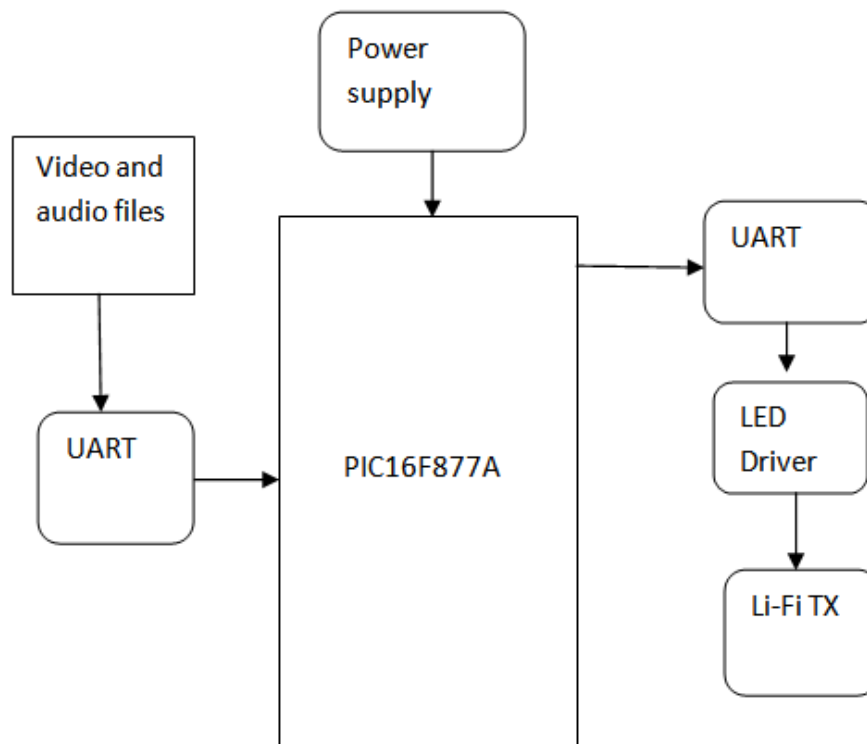


Fig.1: Block Diagram of li-fi transmitter

2.1.2 Voice Playback Module:

WTV-SR is provided with an mp3 mode, Key control one by one, parallel interface, one-line serial interface, three-line serial interface. Therefore, WTV-SR module is suited for many occasions. It can be changed different control modes by setting I/O, which on the bottom of WTV-SR. It gives a Flexible power supply by either supply module or supply solution, so it is an effective recording solution. The recorded voice can be uploaded to the system. It also supports download voice from PC and plays recorded voice with high quality.It

can record up to 252 segment voice and recording time up to 1600 seconds. It supports audio recording at 10 KHz or 14 KHz sample rate.

2.1.3 Microphone:

In a voice communication process, voice is used as an input signal. This signal is converted to an electrical signal. Then the signal is transmitted to the receiver.

2.2 Receiver Section:

The receiver section consists of a Li-Fi receiving module, PIC microcontroller, an amplifier, speaker and audio amplifier.

2.2.1 LI-FI Receiver:

The receiver module consists of photo detector .When the light falls in, it detect the data that is transmitted via light. This detected data will be given to an amplifier which will amplify the detected signal and give it to microcontroller. The microcontroller will extract the data from the received signal. This digital data will be converted to analog using digital to analog converter. The analog signal (i.e. audio) will be amplified by the amplifier. Based on intensity of light, the microcontroller detects the error and the error controlled audio signal is received at the speaker. For video signal it must be connected to the port of PC. The video signal is received when it reach the exact baud rate .After reaching the baud rate the video can be played. It will be transmitted at a high rate. Block diagram of li-fi receiver is shown in Fig.2.

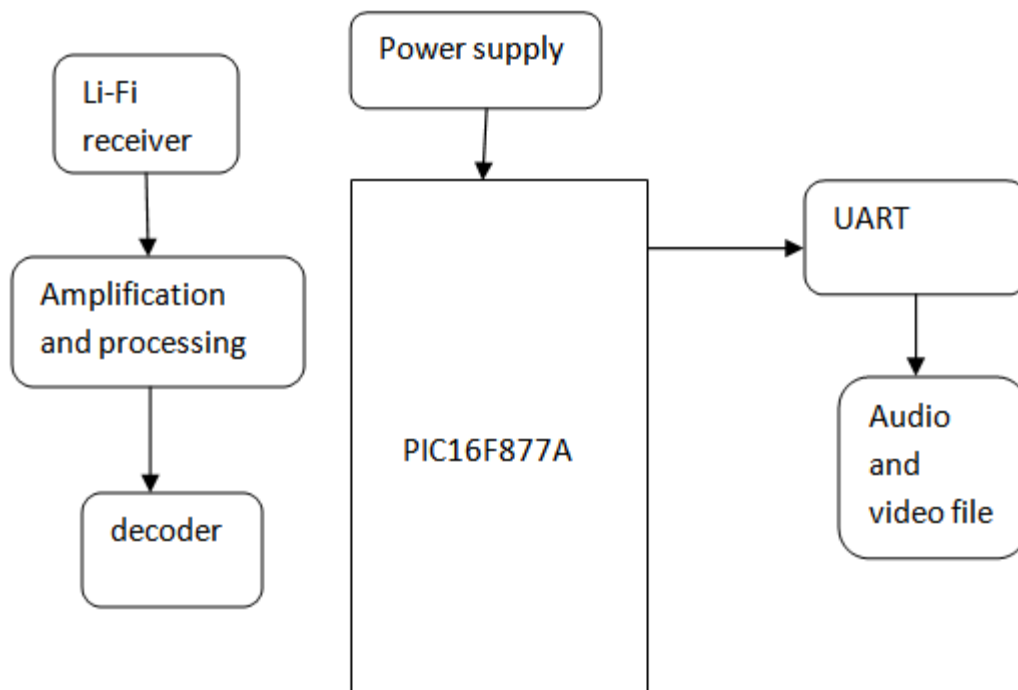


Fig.2: Block Diagram of li-fi receiver

2.2.2 PIC Micro Controller:

The PIC16F877A is a CMOS flash-based 8-bit microcontroller, operating at a frequency of 20 MHz. It has 40 pins. Its main function is to control the voice recorder. It serially sends the recorded audio file from the voice recorder to the transmitting module. For that, it uses UART which helps the microcontroller to send the data serially. In the receiver section the PIC takes the audio from the receiving module and transmits to the amplifier.

2. 2.3 SPEAKER:

In this project, we use Speaker which converts Electrical or Analog signals to the audible form to reach the Receptor. It converts the sound signal with the help of Electromagnets present in the Speaker. Hence the Receptor Receive the input has been transmitted from the transmitter.

2.2.4 Audio Amplifier:

Audio amplifier can amplify sound that is given from a Microphone. This circuit can also be used in many applications like portable music players, intercoms, radio amplifiers, TV sound systems, Ultrasonic drivers etc. It can also be used as a sound sensor for microcontrollers. It is inexpensive, low power.

III. Conclusion:

In this, we proposed a real-time high- quality audio and video signal transmission using LED. Transmitting distance is about 10-15m can be achieved. Thus this technology uses light to transmit the data. There will be available of light everywhere so there will be great scope for LiFi. As Li-Fi technology becomes popular, it will lead to a cleaner, greener, safer communications and have a bright future and environment. As Li-Fi provides secured, low cost, easy data transmission and provides reliable communication, It can be used in industrial, medical, military applications. VLC system will become one of the most promising technologies for the future generation in optical wireless communication.

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