DATA TRANFER USING VISIBLE LIGHT COMMUNICATION

Research focus: Using Light Fidelity (Li-Fi) for transfer of data.

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Abstract:

Principle Of Visible Light Communication:

Visible Light Communication (VLC) is one of the most advanced technologies that is gaining attention now days. Basically, in VLC light act as a transporting medium for transfer of any type of data with great speed. As the Electromagnetic Spectrum for the radio waves is getting overloaded due to the sudden increase in the demand of smartphones users around the globe, VLC is the key to open the window for us to get into future technology with a high speed of data transfer.

What is Li-Fi:

Li-Fi stands for Light Fidelity. It is based on the principles VLC [Visible Light Communication]. Which majorly compromises of Data transmitters and Data receivers. The transmitter basically transmits the information or data in form of light to the photodiode or receiver which processes it and convert it to the desired electronic signal.

History:

The term Li-Fi was coined by Prof. Harald Hass, Professor of Mobile Communications at University of Edinburgh at his famous TED Global Talk on “Wireless data from every Light” in 2011.

Network Architecture:

The basic architecture of Li-Fi constitutes of 4 main components: (1) data generation and collection (2) communication technology (3) data management and processing and (4) data interpretation.

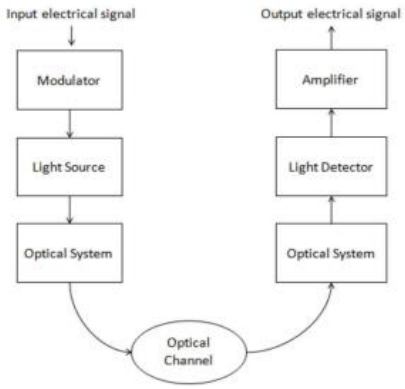


Figure 1: Block Diagram of VLC system

Hardware and Software Requirements:

Transmitter Block: In transmitter, Atmega328P microcontroller is used as system processor for pre-processing and modulation of data to be transmitted over downlink. The data to be transmitted may contain Image, Text, sound etc. Further conversion to the digital domain and data modulation/encoding is performed in controller. LED driver circuit is designed to convert the modulated data into optical signal to transmit through the optical channel.

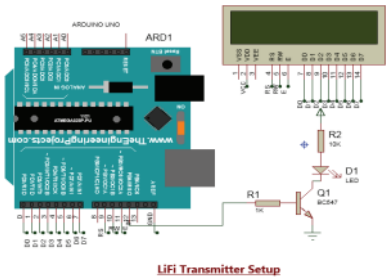


Figure 3: LiFi Transmitter block

Optical Channel: In the present work we have chosen a theoretical model for o by Barry for analytical studies (8). net given 4.2.2 Receiver Block: At receiver end, Photodiode is used as transducer, which

converts the light modulations into electrical impulses, which can be processed in system processor. Transistor based amplifier circuitry is designed to enhance the signal strength. Atmega328P microcontroller is used in the work as system processor for demodulation and processing of encoded data bits.

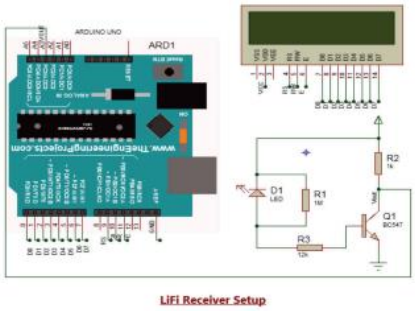


Figure 4: LiFi Receiver Block

Software block: In software block, the modulation and demodulation of data bits are performed. In this work, we have implemented Manchester coding (9) at the transmitter for encoding data bits and OOK modulation technique by continuous switching of LEDs. The encoding algorithm is implemented using C++ on Arduino IDE.

Working:

Li-Fi makes use of visible light through overhead lighting for the transmission of data. This is possible through the use of a Visible Light Communications (VLC) system for data transmission. A VLC system has two qualifying components:

1. At least one device containing a photodiode in order to receive light signals; and
2. A light source equipped with a signal processing unit for the transmission of signals.

The VLC light source can be in the form of a fluorescent bulb or a light emitting diode (LED). LED light bulbs are the most optimum VLC light source, however, since a robust Li-Fi system requires extremely high rates of light output. Fluorescent bulbs emit light in a much wider band of wavelengths, which makes it a relatively less efficient light source than LED. LED, on the other hand, is a light source that emits light in a very narrow band of wavelengths, making it a more efficient light source.

LED is also a semiconductor, which implies that it can amplify light intensity and switch rapidly. This is an important quality to look for in a VLC light source because Li-Fi relies on the constant stream of photons emitted as visible light for the transfer of data. When the current applied to the light source is varied slowly, the light source dims up and down, which makes it unsuitable as a source of light, not for the Li-Fi system, but as a device for household illumination. To strike a balance between VLC light source and household illumination, this current as well as the optical output is modulated at extremely high speeds, making it detectable by the photodiode device and converted back into electrical current, but unperceivable by the human eye. Once these signals are received and demodulated, they can now be converted into a continuous stream of binary data that contain videos, images, audio, text, or applications that are readily-consumable on any internet-enabled device. Because Li-Fi technology is still in its relative infancy, there is still much room for growing innovation. One proposed innovation to the existing technology includes creating a bidirectional communication system like conventional broadband and Wi-Fi. This can be done by interchanging visible light and infrared light from a photodetector, allowing connected mobile devices to send back data to the light source for an uplink. Another proposed innovation is the re-engineering

of the multi-coloured RGB LEDs to send and receive data on a wider range of signals than the single-coloured phosphor-coated white LEDs.

Role in Sustainable Development:

The main source of global climate change is CO2 emissions. It is generally accepted that the world needs to rapidly curb CO2 emissions to prevent the worst impacts of climate change (Hansen et al., 2013). To overcome this burring issue the whole world is focused on sustainable development, which focused on developing renewable electricity sources such as wind and solar power; systems for join in renewable power into the grid; hybrid and electric vehicles; and energy-efficient lights, motors, appliances, and heating and cooling system to control the impact of CO2 emissions and archived the goal of sustainable development (Peng, Liu & Jiang, 2012). Outdoor energy consumption by lighting is often high due to the long operating hours and high wattage necessary for traffic visibility and public safety. Research reveals that street lighting consumption is 60% of total electricity consumption by a municipality (Shahzad et al., 2018). To achieve a long-standing sustainable and cost-effective outdoor lighting system, such lighting systems can be replaced by Li-Fi lighting technology.

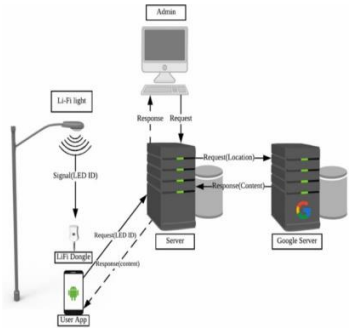
Li-Fi has a low consumption of electricity and it can be integrated into the technology of energy-saving LED lighting, it plays a vital role in sustainability (Montoya et al., 2017). While LED lightbulbs are more expensive than standard lightbulbs, using LED lighting has a positive impact on the energy saving. The Li-Fi uses the visible light spectrum in place of the radio spectrum to transfer data wirelessly *via* the illumination of LED lamps. The key benefit of this technology is to give wireless connections with high data rates.

The Li-Fi positively impacts sustainability, environment, and cost-effectiveness. While the speed of Li-Fi is possibly going to be the true demand for most users, it is amazing that this developing technology of Li-Fi does not harm the environment because it utilizes LED lights. Some of the key impacts of Li-Fi (Manral & Singh, 2016):

1.The longer period of life: Li-Fi LED lights to last up to six times longer than most lights installed in the outdoor area. This eliminates the need for periodic substitutions.

2.Fewer lights needed: With LED lighting, fewer lights are needed for light delivery to be of high quality (Maksimovic, 2018).

3.Sustainability: Lower expense and better value:. The process of Li-Fi technology would save costs, as it will do without electrical equipment such as routers, modems, signal repeaters, wave amplifiers, and antennas in homes and, above all, workplaces (MacKay, 2008). These appliances, which are already connected to the energy grid 24/7, will avoid using electricity and replacing the purpose of the electricity grid with an LED bulb, which is still on during operating hours in most situations, so it would not be an added expense.



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