Abstract: This paper presents initial designs and results of a small-scale prototype of a vehicle to vehicle communication system using light fidelity (Li-Fi) technology, a new technology that was developed in the last few years, which still needs more investigations on its sustainability for outdoor vehicular networks. Vehicle to vehicle communication is the most effective solution that has been used in order to reduce vehicles accidents. In this proposed system, we are going to propose unknown area travel guiding using LIFI (Light Fidelity). Here VLC transmitter in street light section and VLC receiver in bike section. Data transfers starts only at the time of transmitter and receiver within the range. Whenever the bike reaches near the street light the corresponding street information will be transfer to the bike’s receiver side. Both numerical and voice simulations using Proteus package and experimental results are also presented.

Key words: Li-Fi (Light Fidelity), VLC (Visual Light Communication), LED (Light Emitting Diode)

1. Introduction

Li-Fi is a Optical Wireless Communication (OWC) similar to Wi-Fi that allows data to be sent at high speeds using LED lights and without the usage of cables[1-5]. If it is a wired communication then a separate connection is needed to implement each node communication whereas in wireless there will be more collision since the channel will be used by more nodes. To avoid this collision here Visual light communication(VLC) is used to transfer data. Li-fi technology uses visible rays which is a part of the electromagnetic spectrum that is not greatly utilized so far[6-9]. Li-Fi is now part of visible light communications (VLC) PAN IEEE 802.15.7 standard. Lifii is typically implemented using LED bulbs at the downlink Transmitter[10-14]

Visual Light Communication Concept

The proposed use of Visual Light Communication (VLC) that is Li-Fi technology in this paper comprises mainly light-emitting diode (LED) bulbs as means of connectivity by sending data through light spectrum as an optical wireless medium for signal propagation. In fact, the usage of LED eliminates the need of complex wireless networks and protocols. Several case studies mimicking the vehicle to vehicle communication are explored in this work. Incandescence lights quickly break down when switched on and off frequently. These are thus not recommended as VLC transmitters. More promising alternatives are fluorescent lights and LEDs[15-19].

Figure 1. Electromagnetic spectrum.
The effect of phosphor in phosphor-based white LEDs on VLC and illumination control with high-frequency dimming is experienced. The PWM dimming linearity is experimentally verified with lumen measurement. VLC with illumination control is demonstrated at a distance of 1 m by using an APD as an optical receiver[27-30].

2. Proposed Transmitter Section
This paper is to propose unknown area travel guiding using LIFI (Light Fidelity). Here VLC transmitter is embedded in street light section and VLC receiver in bike section. Data transfers starts only at the time of transmitter and receiver within the range. Whenever the bike reaches near the street light the corresponding street information will be transfer to the bike’s receiver side.

The transmitter section consists of an input data that you wish to transmit, a timer circuit that is used to provide the required time intervals between each bit. These bits i.e. 1’s and 0’s are transmitted in the form of flashes of the LED bulb. Power supply is used to provide the supply voltage to the microcontroller or 5V CMOS devices. The ULN2003 have series input resistors for operation directly from 6 V to 15 VCMOS or PMOS logic outputs. The ULN 2003 is the standard Darlington arrays. Level shifter is used to convert one voltage into another voltage. Diodes are used to convert AC into DC these are used as half wave rectifier or full wave rectifier. Diodes of number IN4001, IN4002, IN4003, IN4004, IN4005, IN4006 and IN4007 have maximum reverse bias voltage capacity of 50V and maximum forward current capacity of 1 Amp. Resistors can be integrated into hybrid and printed circuits, as well as integrated circuits.

A resistor is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current. Capacitor is a passive electronic component consists of a pair of conductors and voltage potential difference exists between the conductors, an electric field is present in the dielectric. The work done in establishing the electric field, and hence the amount of energy stored, is given by

\[ W = \int_{q_{m}}^{Q} V dq = \int_{q_{m}}^{Q} \frac{q}{C} dq = \frac{1}{2} \frac{Q^2}{C} = \frac{1}{2} CV^2 = \frac{1}{2} qV. \]

The flashes of the bulb are received by the photodiode. The photodiode then converts the light energy into electrical signals. Next these electrical signals are amplified and the output is presented.

3. Receiver Block
The receiver consists of an optical element to collect and concentrate the radiation onto the receiver photo detector; photodiode convert visible light into an electrical signal biased the photodiode operates in the photoconductive mode generating a current proportional to the collected light. This current is of a small value and a preamplifier is used to convert it into a voltage. This preamplifier should have low distortion and a large GBW.

![Figure 2. Receiver block diagram](image)

The resulting voltage is then applied to a low-pass filter to remove any high frequency noise. The resulting voltage signal is then further amplified in the final voltage amplifier stage. Amplifying and filtering stages, which helps reduce the DC noise component of the captured signal as well as low-frequency components. The final voltage signal should correspond to the received light pulses which are then decoded in the final decoder block, thus extracting the digital data. This final block performs the inverse function of the emitter’s encoder block, but it can also be implemented with a microprocessor embedded c.

In this project keil software is used. Integrated make facility for assembling, compiling, and linking your embedded applications, True integrated source-level Debugger with high-speed CPU and peripheral simulator, μVision3 integrates all tools including the C compiler, macro assembler, linker/locator, and HEX file generator.

![Figure 3. Compilation flowchart](image)
4. Conclusion And Future Scope

A dual-purpose offline LED driver providing both illumination and data transfer. LED driver is realized by using a constant current. The circuit module is designed at the preliminary stage that reads numeric data and special characters * , # possible but it can be enhanced in this paper to make audio communication possible and also to read alpha-numeric data. LIFI is expected to be ten times cheaper than Wi-Fi. The light waves cannot penetrate walls which makes a much shorter range, though more secure from hacking, relative to Wi-Fi. While the US Federal Communications Commission has warned of a potential spectrum crisis because Wi-Fi is close to full capacity, LIFI has almost no limitations on capacity. The visible light spectrum is 10,000 times larger than the entire radiofrequency spectrum. Our research deals with designing a simple and low cost data communication system using LED. If this technology can be put into practical use, every streetlight can be used to transmit wireless data and we can proceed safest drive even in un time. LIFI has the cleaner, greener, safer and brighter future. The concept of LIFI is currently attracting a great deal of interest because it may offer a genuine and very efficient alternative to radio-based wireless. This may solve issues such as the shortage of radio-frequency bandwidth and also allow internet where traditional radio based wireless isn’t allowed such as aircraft or hospitals. The future work is to enable video communication using camera VLC. The possibilities are numerous and can be explored further.

References

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