

DESIGN AND IMPLEMENTATION OF A VEHICLE TO VEHICLE COMMUNICATION SYSTEM USING Li-Fi TECHNOLOGY

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Abstract - Traffic safety applications using vehicle-to-vehicle (V2V) communication is an emerging and promising area within the ITS environment. Many of these applications require real-time communication with high reliability. Li-Fi is a wireless communication system in which light is used as a carrier signal instead of traditional radio frequency as in Wi-Fi. Li-Fi is a technology that uses light emitting diodes to transmit data wirelessly. Li-Fi is a form of Visible Light Communication (VLC). VLC uses rapid pulses of light to transmit information wirelessly that cannot be detected by the human eye. This paper is determined to enhance the quality of Intelligent Transportation System (ITS) with the help of Visible light communication technology using a Li-Fi transmitter and receiver kit. The V2V communication system consisting of the Li-Fi transmitters placed on a leading vehicle and the Li-Fi receiver is placed on a following vehicle. The received data can be used for further development in vehicle control and to avoid collisions by controlling the speed of the vehicle.

Key Words: vehicle-to-vehicle, Li-Fi , wireless , vehicle , control, speed

1. INTRODUCTION

HARALD HASS, who is considered to be the father of Li-fi from university of Edinburgh, UK says that the heart of this technology lies in the intensity and the potential of the light emitting diodes. The major reason which lead the modern man through this invention is that the confinement of Wi-Fi to comparatively small distance. As there are more and more devices coming up day-by-day the signals are being clogged up due to heavy traffic, there arised a need for an error free transmission technology. And the solution to this problem was the Li-fi technology.

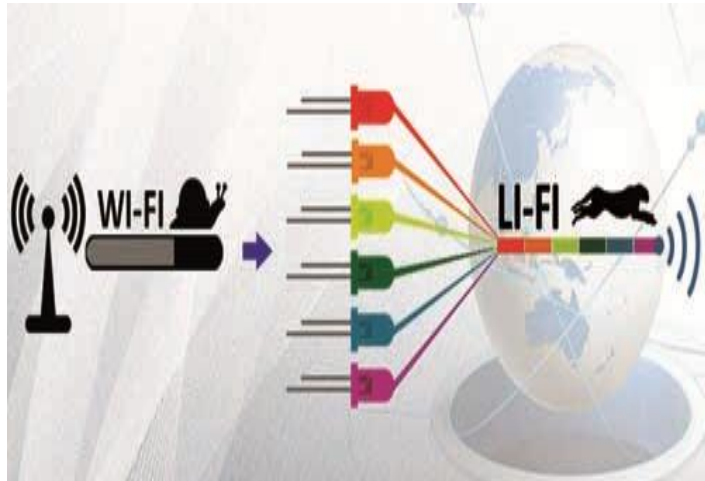
Over the past few years there has been a rapid growth in the utilization of the RF region of the electromagnetic spectrum. This is because of the huge growth in the number of mobile phones subscriptions in recent times. This has been causing a rapid reduction in free spectrum for future devices. Light fidelity (Li-Fi) operates in the visible light spectrum of the electromagnetic spectrum i.e. it uses visible light as a medium of transmission rather than the traditional radio waves. Although Li-Fi can be used to off-load data from existing Wi-Fi networks, implementations may be used to provide capacity for the greater downlink demand such that existing wireless or wired network infrastructure may be used in a complementary fashion.

2. EXISTING METHOD

Li-fi basically known as "light fidelity" is an outcome of twenty first century. The basic ideology behind this technology is that the data can be transmitted through LED light whose intensity varies even faster than the human eye. As the transmission of the data takes place through the light emitting diodes (LED"s) the amount is comparatively small .In modern times, it is called as the optimized version of WI-FI .The advantageous thing is the wireless communication which decreases the cost enormously.

LiFi is the use of the visible light portion of the electromagnetic spectrum to transmit information at very high speeds. This is in contrast to established forms of wireless communication such as Wi-Fi which use traditional radio frequency (RF) signals to transmit data.It has been designed in such a way that it overcomes the disadvantages that occurs during the usage of Wi-Fi. In general terms, Li-fi works even under water thereby causing a great benefit to the military operations. The physics envisions that this technology would make a great difference between the assumption and the proof in this case .The demonstration took place using two Casio smart phones. The data was made to exchange between the phones using light. Even though the distance was nominal, it is sure that there would be a rapid

increase in the distance of transmission. As there is a limited amount of Radio based wireless spectrum available, a number of companies formed a consortium called Li-fi consortium in order to promote high speed optical wireless systems. The members of this consortium believe that a speed of 10 Gbps can be achieved in no time.



3. PROPOSED METHOD:

Li-Fi system consists of mainly two parts, the transmitter and the receiver. The transmitter part modulates the input signal with the required time period and transmits the data in the form of 1's and 0's using a LED bulb. These 1's and 0's are nothing but the flashes of the bulb. The receiver part catches these flashes using a photodiode and amplifies the signal and presents the output.

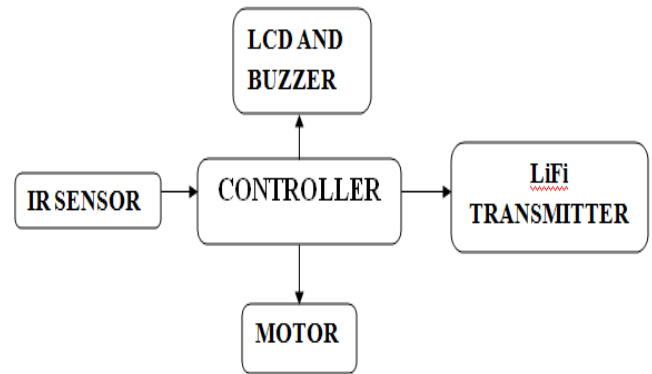
Light emitting diodes can be switched on and off very much faster than the human eye allowing the light source to appear continuously. The data transmission is done through binary codes which involve switching on LED can be done by logic 1 and switch off using logic 0. The encoding of information in light can therefore be identified by varying the rate at which the LED's flicker on and off to give strings of 0's and 1's. Visible light communication is this method of using rapid pulses of light to transmit information wirelessly.

Li-Fi TRANSMITTER

LED's can be switched on and off very quick. For transmitting data this way all that we require is LED's and controller that code data into LED's. Parallel data transmission can be done by using array of LED's or by using red, green, blue LED's to alter light frequency with the frequency of different data channel. Advancements and enhancements in this field generate a speed of 10 gbps. But amazingly fast data rates and lowering band widths are not the only reasons that enhance this technology. LiFi usually is based on light and so it can be probably implemented in aircrafts and hospitals that are prone to interference from radio waves. Unlike Wi-Fi Li-Fi can work even under-water

which makes it more advantageous for military operations. Radio waves are replaced by light waves in data transmission called Li-Fi.

BLOCK DIAGRAM FOR TRANSMITTER SECTION



3.1 IR DISTANCE SENSOR

In the infrared sensor, a narrow band infrared beam is transmitted from the LED. When the beam strikes an object it is reflected back towards the sensor and into a focusing lens. The focusing lens directs the reflected beam onto the PSD. The incident angle of the reflected beam is determined by the distance from the sensor to the reflecting object; the farther away the reflecting object is, the slighter the angle. As a consequence of the narrow band of propagation, there is a minimum distance away from the LED the reflecting object needs to be in order for the beam to reflect upon the focusing lens. Furthermore, as the reflecting object moves farther and farther away, the change in angle at which the reflected beam decreases; i.e. sensitivity decreases.

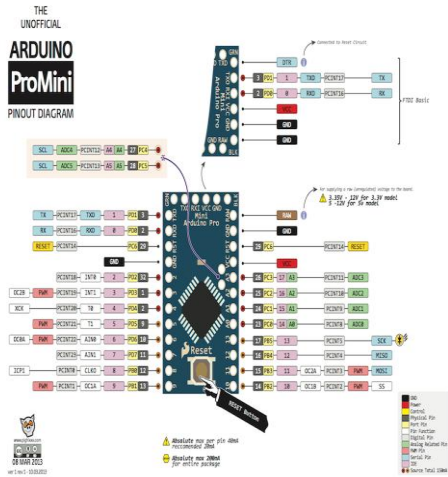
3.2 LCD DISPLAY:

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. This display is used to display the information about the detected object. The LCD display are built-in in the controller kit.

3.3 ARDUINO PROMINI

Arduino promini is a microcontroller board based on ATMEGA 328. It has 14 digital input and output pins. In that it has 8 analog input pins, 6 PWM (Pulse width modulation) output pins. It is programmed with USB serial adapter or RS232 to TTL serial adapter. It is smaller than Arduino UNO and more practical for building home projects. It comes with the minimum of components (no

onboard USB or PIN headers).It has two versions,one operates at 5V and 16MHz and other operates at 3.3V and 8MHz.



3.4 INTERFACING

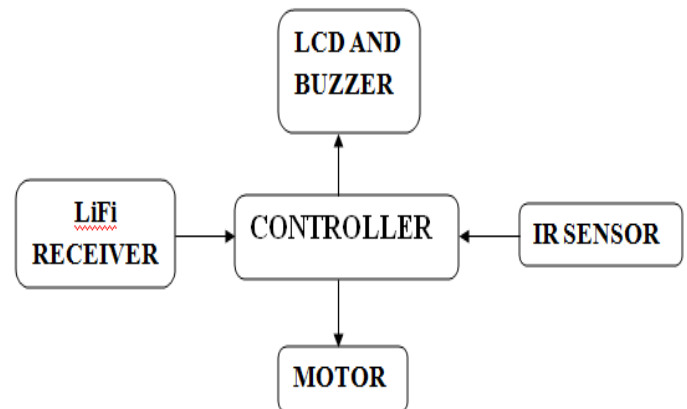
The arduino promini is operating at 5V and 16MHz frequency.The pins 12, 11, 5, 4, 3, 2 are used for interfacing LCD .Either pin 6 or 9 or 10 can be used for interfacing motor (for speed control).Pin1 for interfacing Li-Fi transmitter.Pin 0 for interfacing Li-Fi receiver.

3.5 Li-Fi TRANSMITTER

Receives the information from the controller and it modulates the data to light signal and transmits to the receiver section. The transmitter part modulates the input signal with the required time period and transmits the data in the form of 1"s and 0"s using a LED bulb. These 1"s and 0"s are nothing but the flashes of the bulb. Power supply DC +12V and Data UART(universal asynchronous receiver transmitter). input (TTL) are the input specification for the transmitter section.



3.7 Li-Fi RECEIVER



Receives the modulated information from the transmitter section and demodulates the signal in order to recover the original data. . The receiver part catches these flashes using a photodiode and amplifies the signal and presents the output.



4. WORKING PRINCIPLE

In the infrared sensor, a narrow band infrared beam is transmitted from the LED. When the beam strikes an object it is reflected back towards the sensor. IR distance sensor sense the information about the detected object and transfers to the controller.Controller used here is Arduino promini which is a microcontroller board based on ATMEGA 328 .It has 14 digital input and output pins.In that it has 8 analog input pins,6 PWM(Pulse width modulation) output pins.LCD display which is interfaced to controller pins(12,11,5,4,3,2) gives the information and it is displayed in LCD.Simultaneously the motor speed is reduced by the controller.In case of emergency situation or any break failure the buzzer sound is produced.These informations are transmitted to the Li-Fi transmitter. Receives the information from the controller and it modulates the data to light signal and transmits to the receiver section. The transmitter part modulates the input signal with the required time period and transmits the data in the form of

1"s and 0"s using a LED bulb. These 1"s and 0"s are nothing but the flashes of the bulb. In the receiver section, it receives the modulated information from the transmitter section and demodulates the signal in order to recover the original data. The receiver part catches these flashes using a photodiode and amplifies the signal and transmits to the controller so that the speed of the following vehicle can be reduced which will be indicated in the LCD display present in the receiver section.

5. CONCLUSION

We have presented a VLC system consisting of an Li-Fi transmitter and receiver that is targeted at V2V applications, and introduced its characteristics and capabilities. In traffic signals, Li-Fi can be used which will communicate with the LED lights of the cars and accident numbers can be decreased. Li-Fi is ideal for high density coverage in a confined region. It is believed that the technology can yield a speed more than 10 Gbps. It is the fastest and cheapest wireless communication systems which is suitable for long distance communication. Li-Fi will make all lives more technology driven in the near future.

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