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Li-Fi Technology: Future Direction for Vehicle Communication

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Abstract

Nowadays, travelling is one of the major concerns in everyone's life. Mostly travelling can be preferred in early morning to avoid traffic congestions. Due to climatic condition, most of the cities literally covered with mist and fog may lead to accidents. In order to overcome this natural climatic condition and make accident free prone through Li-Fi innovative technology. Light Fidelity (Li-Fi) uses visible light for communication even faster than human eye. This paper explains the Li-Fi methodology and its benefits over Wi-fi. It is most powerful technology which helps to identify the vehicles mainly in mist and fog presence. Accidents are totally avoided based on emerging visible light communication technology. LED headlights are installed in cars which can enable vehicle to vehicle communications in order to avoid accidents. LED bulbs also installed in streetlights and traffic lights it not only avoids accidents but also control traffics and gives information to direct the roads.

Keywords: Li-Fi, Light fidelity, fog, mist, accident, LED technology

INTRODUCTION

Day to day mobile technologies has been grown widely. Wireless communication evolved in the past two decades which leads to technological development. Widely used technology nowadays is Wi-Fi whereas in smart phones, laptops and systems. It uses the radio frequency for communication. If the number of users in the frequency is increased then the radio frequency is affected by vanishing the signal or poor signal.

Major four issues are raised by using radio waves in Wifi technology. The first one is demand of capacity. These radio waves are limited in the electromagnetic spectrum range from around20 kHz to 300 GHz. It was not suitable for wireless communication due to expensive. Second problem is efficiency, millions of base stations use mass of energy creates big problem. Availability is another concern widely used in places like homes, work places, publics, hospitals, and aircrafts etc. Major dropping issue is security, while data transmission it may penetrates through walls, third party can easily hack the data [1].

Invention of new technology "Light Fidelity (Li-Fi)" overcomes the drawback of Wi-Fi. Harald Hass an IEEE Senior Member and a Professor of Mobile Communication had developed a visible light communication in 2011 and introduced via TED Global talk. Audience dubbed him as "Father of Li-Fi."

The capacity of Li-Fi is 10,000 times more than Wi-Fi. Data can be passed through illumination light capacity also addressed. Where ever light is available, data transfer also possible and this potential source can be used for high speed data transmission. On security concern, as light rays can't penetrate through walls so possibly avoid the third party hack [2].

Wi-Fi Disadvantages

The speed of Wi-Fi is 150 mbs to the standards of IEEE 802.11n, whereas Li-Fi technology passes 1 to 3.5 Gbps. As it uses Visible Light Communication (VLC) as the mode of transmission, its speed is like the speed of light [3] [4]. As [3], the Wi-Fi Technology uses the radio spectrum which is fully utilized. The Li-Fi technology uses the visible light rays which is 60 GHz spectrum. As radio waves do penetrate through walls it is interference or misused by hackers. Li-Fi can't even travel through walls, major hacking happens are avoided [3].

Advantages of Li –Fi

As said by Harald Hass, there are number of advantages by using Li-Fi. In Li-fi, Visible Light Communications (VLC) signals work by turning LED light ON and OFF state which hits within nanoseconds. The glittering of the light is not identified by the naked eye. Li-Fi is capable of transferring the data even the LED bulbs are dimmed, data transmission is possible. Data transfer speed is higher while compared other internet based applications. It provides data security, during data transmission it covers only low region and can't pass through walls, this gives a reason to protect data from intruders. It mainly works on optical spectrum, no need to bother about radio spectrum as well as it doesn't produce harmful radiations like radio spectrum. It is highly power consumption and device operates on low power. Finally, it is easy to fit on devices [4,5].

Applications

Hospital

Li-Fi technology can be applicable in hospitals to monitor the patient's health like blood pressure, sugar level, heartbeat without using any harmful radiations. Sensors collects the data, transfer to microcontroller for processing then forward processed data to display unit.

Underwater

Underwater communication is challenging in wireless networks. Radio spectrum not that efficient because of absorption loss. Li-Fi device works well on underwater communication.

Aircrafts

Wi-Fi is not allowed in the aircrafts due to distractions of navigation system. To avoid this, Li-Fi can be used as an alternative of Wi-fi for transferring the data with high speed using lights in the aircraft.

Street Light

Li-Fi technology holds photodetector to receive signals then it converted into streamed content. Street light can act as hotspot for Li-Fi. Headlight in the car replaced as LED lights which can communicate with traffic signals. This helps to control the traffic in turn avoids occurrence of accidents.

Education

Wi-fi Technology is cost effective those used in education system. For high speed data transmission, will enable new technology Li-Fi which is more economical than Wi-fi technology.

Working Structure of Li-Fi

Li-Fi consists of LED based transmitter. It is made up of semiconductor light source, modulated by a microchip. The photodetector is connected to the computer or any other internet enabled device displays the decoded signals. Light from the bulb can be modulated at high speed. The modulation of the light cant seen by the human eye. Digital bits of 0's and 1's are transmitted at very high speed. When the light is ON, send digital 1 and light is OFF send digital bit 0. The photodiode receives the light rays and displays the decoded signal [6].

Li-Fi used in vehicles

The two devices act as sender and receiver for data communication. Sender send the signal or message to the microcontroller. Microcontroller converts it into ASCII message which is amplified by the NPN transistor. NPN is used to boost the signal. After boosting it is reverted by PNP switching module. Then it is given to the LED which transfers the ASCII message into the LED Spectrum [7,8].

At the receiver side the photodiode receives the message from LED. It is then to the circuit. It matches the sensing signal and does the proper work [9,10]. Various devices and its functions used for vehicle communication are

Work of Microcontroller

It is a type of semiconductor which embeds thousands or millions of tiny resistors, capacitors and transistors. It can function as an amplifier, oscillator, timer, counter, computer memory. Mainly it is used to control other devices and machines [11].

Work of Speed Sensor

A wheel speed sensor or vehicle speed sensor (VSS) is a type of tachometer. It is a sender device used for reading the speed of a vehicle's wheel rotation. It usually consists of a toothed ring and pickup [12].

Temperature sensor

It works on measuring the temperature that's being given off by the thermostat and/or the coolant itself. From there, your vehicle's computer will use this temperature information to either continue operating or adjust certain engine functions, always working to keep the engine temperature at an ideal level [13].

IR Transmitter

It is an electronic remote device mainly consists of this IR transmitter and receiver. A remote control patterns a flash of invisible light which is turned into an instruction and is received by the receiver module. The IR signal is modulated during transmission. Fig.1 and 2 shows the block diagram of transmitter and receiver [14].

An Ultrasonic Sensor

It is a device used to measure the distance to an object by their sound waves. It measures the distance of sending device sound wave at the specific frequency and it receives the same sound wave to start back. It is mainly used for parking the vehicle.

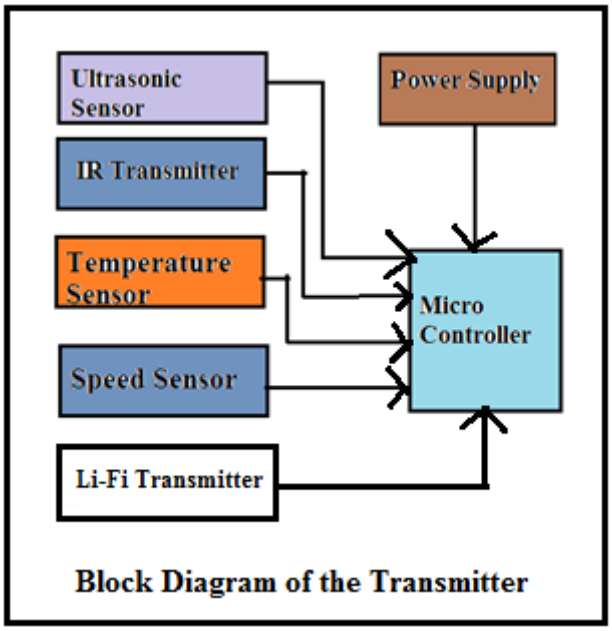

Fig.1. Block diagram of the Transmitter

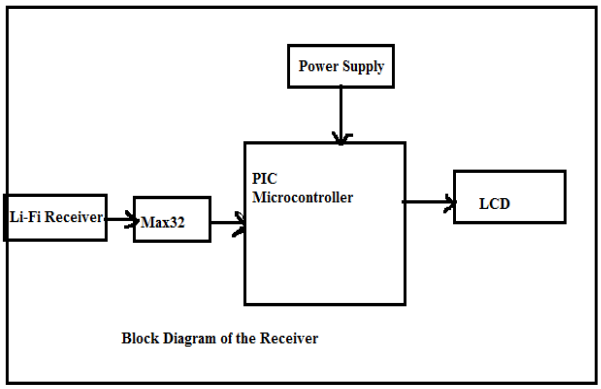

Fig.2. Block diagram of the receiver

In the fogged climate the LED lights used to transmit the information from one vehicle to the other vehicle mainly to indicate the presence of other vehicle. The vehicle at the back receives the information by LED light receiver which sends the message to the microcontroller of the receiving vehicle then it alerts the presence of vehicles through display screen. Due to this alert, vehicles crash will be reduced [15,16].

Conclusion

This paper elaboratively explains the Li-Fi methodology and its benefits over Wi-fi. Visual Light Communication helps to transfer information between the vehicles mainly in mist and fog presence to avoid accidents. LED headlights are installed in cars to enable vehicle to vehicle communications in order to avoid accidents. LED bulbs also installed in streetlights and traffic lights it not only avoids accidents but also control traffics and gives information to direct the roads.

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