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Design of Vehicle To Vehicle Data Transmission Application Using Li-Fi Technology

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Abstract: *Vehicle to vehicle data transmission, we present initial designs and results of a small-scale prototype using light fidelity (Li-Fi) technology, a new technology that was developed in the last few years, which still needs more systematic inquiry on its sustainability for outdoor vehicular networks. Vehicle to vehicle communication is the most effective solution we have used in order to reduce vehicle's accidents. The propose use of Li-Fi technology 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 light emitting diode (LED) eliminates the need of complex wireless networks and protocols. The design system is aim to ensure a highly-reliable communication between a commercial LED-based transaction light and a receiver mount on a vehicle.*

Keywords: *light emitting diode, photodiode, vehicle to vehicle communication, visible light communication.*

I. Introduction

Li-Fi is an important and popular technology in the communication system. Li Fiis nothing but the Light fidelity communication systems. It is the very fast and inexpensive wireless communication systems and is the optical version of the Wi-Fi. The technology works by adapting light emitting diode (LED's) to send digital type of information, invisible to the naked eye. In this, we present initial designs and results of a small-scale prototype of a vehicle to vehicle communication system using light fidelity (Li-Fi) technology. The Intelligent Transportation System (ITS) is a particular area where VLC seems very useful. Either in vehicle-to-vehicle (V2V) or in infrastructure-to-vehicle (I2V) communication, VLC convinced an important segment of both the academia and industry that it is the appropriate wireless communication technique. Several wireless communications technologies have been proposed and investigated for ITS data exchange: 802.11 (Wi-Fi), Bluetooth, VLC. Even though in terms of communication range, RF based solutions clearly outperform VLC systems, in high traffic density, the increased number of nodes will cause mutual interferences. This will lead to increased latencies, unacceptable for a reliable safety system. The work about I2V communication using VLC is mostly focused on the communication between trafficlights and vehicles. This is due to the thing that thehigh power of the traffic light enable longer communication distances. Vehicle to vehicle communication is the most effective solution that has been used inorder to reduce vehicles accidents. The proposed use of Li-Fi technology comprises mainly light-emitting diode (LED) bulbs as means of connection of sending data through LED spectrum as an optical wireless medium for signal propagation.

II. System Design

2.1 System Architecture

Fig 1 is divided into three parts, i) sender ii) Receiver iii) according touser input. sender will send the message to micro controller which convert normal message to ASCII then this ASCII message is given to NPN switching circuit which is used to boost the signal. then this signal is given to PNP switching module which revert the message which was inverted in NPN switching circuit. then this reverted message is given to syska LED which transfer ASCII message into LED spectrum. Now at receiver side photo transistor will receiver message obtained by LED. Then photo transistor pass message to impedance matching circuit which sensing data in proper format. This signal is given to TTL to USB circuit which convert ASCII message into normal message.

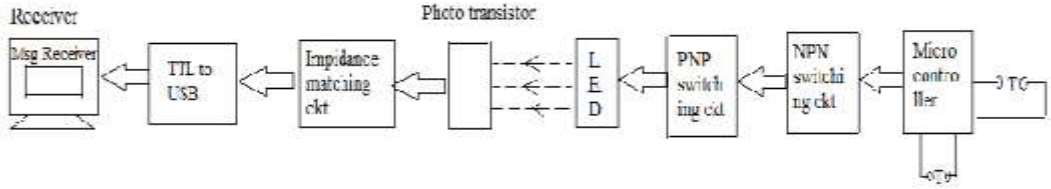

Fig 1: Block Diagram of vehicle to Vehicle Communication Using Li-Fi.

The functionality of the building blocks of the system is described next. The data sourcee.g. (speed sensor) reads the speed of the vehicle. The speed data from the sensor is peak to peak AC voltage so it will be converted to DC voltage to be readable by the microcontroller. Then the data will be processed by microcontroller (e.g. to compare between the current and previous speed). New processed data will then be transmitted to the LED driver. LED driver will make the current constant to protect LED. Then, data will transmit by the LED light.

2.2 Algorithm

- Sender

1. Start
2. Transfer message to micro controller i.e E=mc2
3. Micro controller send msg to NPN switching cktIc = Ie – Ib
4. NPN ckt send msg to PNP cktIc = Ie + Ib
5. PNP ckt send msg to LED(syska)

- Receiver

1. LED send msg to photo transistor.
2. Active mode $|Vcc| \geq |R\ L\ |x\ |I\ c\ |$
3. switch mode $|Vcc| \leq |R\ L\ |x\ |I\ c\ |$
4. Phototransistor send msg to impedance matching.

   $Z\ s = Z * L$
5. Impedance matching send msg to TTL to USB convertor.
6. TTL to USB convert msg into normal form E=mc 2
7. Stop.

The system requires a transmitter and a receiver in each vehicle in both rear and front sides of the vehicle. Thus more scenarios will be applicable. For the time being, only two scenarios will be studied in this paper:

A. First Scenario

As shown in Fig 2 when vehicle 1 is braking, the speed meter in the vehicle will be sensing that the current speed is lower than the previous speed. Thus, a message will be sent through the transmitter which is placed in the rear lights to vehicle 2. The message will be received by vehicle 2 using the photodiode which is placed at the front of vehicle 2. A notice of (Slow DOWN) will be displayed in vehicle 2 using an LCD.

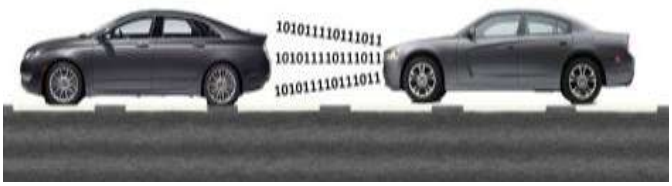

Fig 2: First scenario of vehicle to vehicle communication using Li-Fi.

B. Second Scenario

As shown in Fig 3 when vehicle 1 is in T- junction, it will keep sending its speed-information to vehicle 2 using the LED at the headlights. The speed-information will be received by the photodiode in vehicle 2 and compared to vehicle 2 speeds. If vehicle 2 is about to cross the junction while vehicle 1 is moving with a high speed, the driver will be alerted to check the other vehicle which is around in the area.

Fig 3: Second scenario of vehicle to vehicle communication using Li-Fi.

III. Proposed System

The propose plan of action for our project is to initiate on optical wireless communication model that gives high data rates (in the order of MHz) and transmission distances ofup to 1m. This model should effectively be able to transmit data from one device to anotherusing LEDs, there by initiate a Li-Fi network in a localized environment.

The transmit section consists of the data input which is then fed into a switching control system. Based on the data, the switching control generates a stream of 1s and 0sthereby encoding the data in binary. The output of this control is given to the array of LEDswhich turn OFF and ON at extremely high speeds. This ON-OFF modulation of the LEDlight transmits the data. LED is the choice for light source since it consumes very less powerwhen compare to fluorescent lamp or a light bulb. It consumes about one-tenth the powerwhen compare to conventional methods of lighting. Also, the lifetime of a typical LED bulbis several tens of thousands of hours. LEDs are also fast switching with good visibility. Thus,LEDs are ideal for use as the downlink transmitter. For the uplink transmitters, Infrared(IR) can be chosen to be the uplink transmitter for user convenience. This avoids fitting anLED light source on or next to the mobile devices.

The receive section consists of a photo diode, e.g. silicon photo detector or a Infrared germanium cylindrical detector. The photo detector extract the incoming received signal based on the sequence of 1s and 0s. The demodulated signal is then sent to a filter to destroy unwanted noise. This filter signal is then amplify using signal amplification mechanism. The filter and amplify signal is then given to an output device such as an LCDdisplay or a speaker.The input signal is thus remotely transmiter and receiver. Thus, a Li-Finetwork is established.

IV. Conclusion

The concept of Li-Fi will introduce along with existing techniques and classical trends used for vehicle to vehicle communications. In this project aims to propose a cost effective solution to reduce accidents in Oman, the design guidelines. The hardware aspects regarding the development of a VLC communication system consisting of a commercial LED-based traffic light and a vehicle will mount receiver. We will present the approach we follow, some of the difficulties we encounter and explain the choices we have made. Throughout the implementation process, we also efforts on keeping the implementation cost as low as possible.Due to unavailability of all system components, sending data through Li-Fi small-scale prototype.

V. Future Scope

The future of LI-FI is GI-FI. GI-FI or *gigabit wireless* refers to wireless communication at a data rate of more than one billion bits (gigabit) per second. In 2008 researchers at the University of Melbourne demonstrated a transceiver integrated on a single integrated circuit (chip) that operated at 60 GHz on the CMOS process. It will allow wireless transfer of audio and video data at up to 5 gigabits per second, ten times the current maximum wireless transfer rate, at one-tenth the cost. Researchers chose the 57–64 GHz unlicensed frequency band since the millimeter-wave range of the spectrum allowed high component on-chip integration as well as the integration of very small high gain arrays. The available 7 GHz of spectrum results in very high data rates, up to 5 gigabits per second to users within an indoor environment, usually within a range of 10 meters. Some press reports called this "Gi-Fi". It was developed by Melbourne University-based laboratories of NICTA (National ICT Australia Limited), Australia‘s Information and Communications Technology Research Centre of Excellence.

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