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Vehicle to Vehicle Communication and Traffic Signal Controlling for Emergency Vehicles using Li-Fi

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Abstract - *Light Fidelity (Li-Fi) is a form of bi-directional Visible Light Communication (VLC) in which light is modulated at speeds greater than a human eye can follow. Li-Fi can be used to implement Vehicle to Vehicle (V2V) communication as it has many advantages over other communication protocols. One of the main advantages of Li-Fi is that it provides connectivity within a very large area with more security and higher data rates. Emergency vehicles such as Ambulances, Firefighting trucks, Police vehicles etc. can propagate faster through traffic-dense roads using Li-Fi based V2V communication system. In this paper, a V2V communication system is proposed in which the headlight and tail light of a vehicle are made as Li-Fi transmitter and Li-Fi receiver respectively. The proposed system was designed, implemented and tested for its operation.*

Key Words: *Li-Fi, V2V, VLC, Traffic management*

1. INTRODUCTION

In India, many lives have been lost as emergency vehicles like ambulance or firefighting vehicles were not able to reach their destination on time due to heavy traffic. An efficient and feasible traffic management as well as V2V communication system can be implemented using Li-Fi. In this paper, a Li-Fi based emergency vehicle detection and traffic clearance system has been implemented.

To make secure wireless communication between vehicles there is no other way than Li-Fi. Li-Fi does not have any adverse effect on human body and also we can have a separate communication channel which is solely independent and not congested like radio waves.

VLC is an emerging communication platform which uses visible light in the frequency range of 400 to 800 THz. Li-Fi is a VLC protocol, which is like the Wi-Fi protocol in every layer except the physical layer. The concept of Li-Fi was introduced by Dr. Harald Haas during his speech at TED Global 2011. He considered LED bulbs as the principle source of light because older sources such as incandescent and fluorescent light bulbs have proved themselves to be inefficient in terms of luminosity and energy consumption when compared to LEDs. Their intensity can be modulated at very high speeds. This property is exploited in Li-Fi technology. Li-Fi also enables transmission of thousands of data streams in parallel at high speeds. A photodiode is used as the receiving element in this technology. Both these devices are cheap to acquire, which makes Li-Fi an economically viable solution to all the problems offered by radio wave communication.

2. PROJECT CONCEPT AND WORKING

The concept of this system which is used to provide clearance to any emergency vehicle when it struck in traffic jam. Here we clear the path of the emergency vehicle hence it can reach the destination in time. Emergency vehicle stuck in a heavy traffic condition it will send an information to the next vehicle through light medium from headlight to indicator of next vehicle. The information received by the next vehicle and it transmit to the another vehicle next to it. The process will continue till the information reaches to the first vehicle and then further information will be transfer to the traffic signal system through a road stud. The traffic signal light will turn on from red to green. The LIFI based trans receiver will be adopted to each vehicle for transmit the information. This project helps to reach the emergency vehicle in minimum time. We can also use this system the entire system is based on LIFI system which is a booming technology.

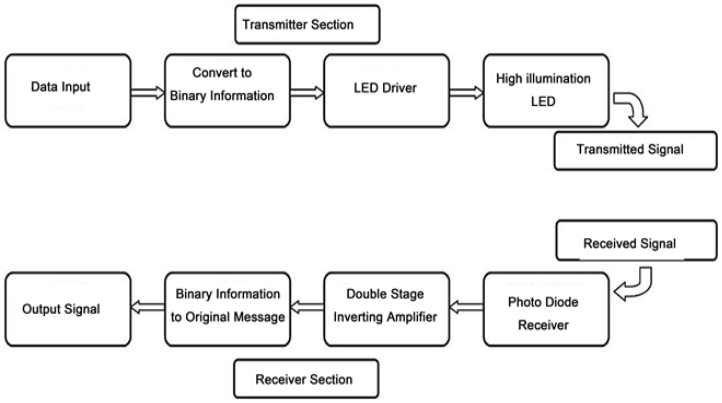

Fig -1: Block diagram of Li-Fi

Li-Fi communication can be done through several modulation techniques. We have used ON-OFF keying modulation technique and Morse encoding and decoding technique. Morse code as an on-off series is happening so fast, that it is invisible to human eye. LI-FI uses white LED bulbs at the downlink transmitter. Normally, a constant current is applied across the LEDs to use them. But by varying the current very fast, the optical output can be made to vary at very high speeds. This is property used in a LI-FI setup. If the LED is ON, we transmit a digital 1 and if it is OFF, we transmit a digital 0. We can easily transmit data by

switching the LEDs ON and OFF very rapidly. Now, by varying the rate at which the LEDs flicker, we can encode the desired data and thus transmit the data very easily.

3. FLOW DIAGRAM

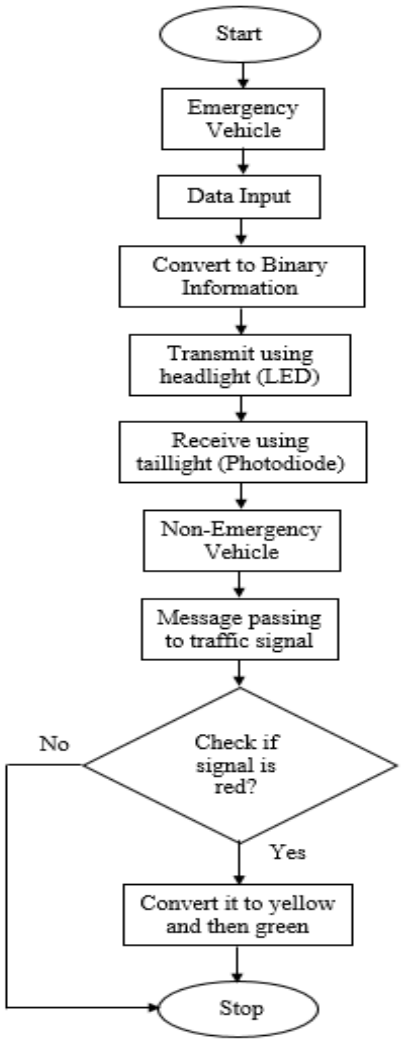

Fig -2: Flow diagram of Li-Fi based V2V communication and traffic control system

4. HARDWARE REQUIREMENTS

4.1 Arduino Microcontroller

Arduino is a small microcontroller board with a USB plug to connect to your computer and a number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc. They can either be powered through the USB connection from the computer or from a 9 V battery. Arduino can be controlled by the computer or programmed to work independently.

4.2 Li-Fi Transmitter

The task of transmitter is to convert digital data into visible light. An LED was a suitable component because of its relatively linear relation between current and light intensity. The general idea is to modulate the light intensity of the LED i.e.; the intensity of the light corresponds to the symbol transmitted.

Fig -3: Transmitter module at headlight of the vehicle

4.3 Li- Fi Receiver

The receiver converts the incoming light into current using a photodiode. The photodiode is a semiconductor converting light into an electrical current. So for better results we are using photodiode as a li fi receiver.

Fig -4: Receiver module at tail-light of the vehicle

4.4 Decoded Message

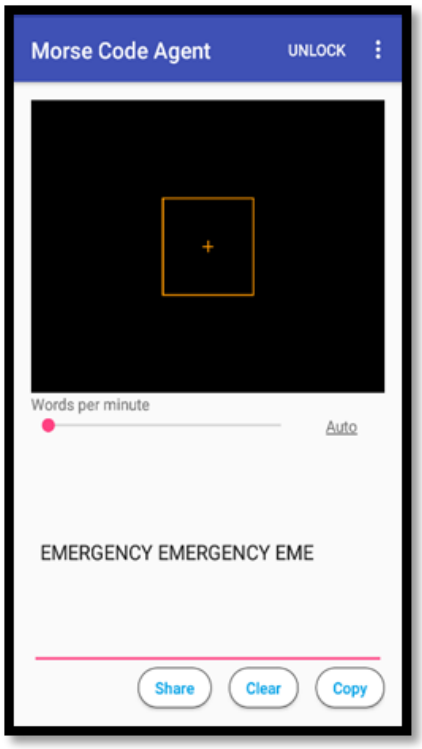

Fig -5: Sample text message decoded using app

5. WHOLE SYSTEM

Fig -6: Whole module of V2V communication using Li-Fi

6. CONCLUSION

Using the Li-Fi communication infrastructure various other data can also be sent from one vehicle to another. Traffic density based automatic traffic signal control can be implemented. Highway toll collection, accident notification and other important traffic related parameters can also be implemented using the same model. If this system is implemented in the real world, many lives can be saved as the emergency vehicles would wait for very less time in traffic jams.

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