An Energy Efficient Fast and Furious Visible Light Communication

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Abstract— An emerging technology Li-Fi, or light fidelity is a bidirectional and fully networked wireless communications medium which uses light from light-emitting diodes (LEDs) and provides transmission of data through illumination by sending data through a LED light bulb that varies in intensity faster than the human eye can follow. It can provide connectivity within a very large area with more security and with higher data rates and high speed than data that can be transmitted through Traffic management is a major concern for cities around the world. The conventional traffic problem has been cast as a mismatch situation between supply and demand. India is known for its insensitive and callous motorists who deny passage to emergency vehicles like ambulances, fire-engine and police control room vans. An Intelligent Traffic Management System aims at managing traffic effectively during emergencies through the use of cutting-edge communication and processing technologies and appropriate intelligent system algorithms. In the present state-of-the-art, a wireless communication is a promising technology that offers a solution for the design and development of a good deal of traffic control system applications. A number of traffic management schemes have been implemented to prioritize emergency vehicles. Most of this research is associated with intelligent traffic control system design for providing clearance for emergency vehicles. Fuzzy control approaches have been adapted to monitor real-time traffic and handle the crowded traffic flow. It uses visible light communication or infra-red and near ultraviolet spectrum which works by switching bulbs on and off within nanoseconds. Technologies like RFID, ZigBee, and Global System for Mobile communication (GSM) can be used for designing an intelligent traffic control system. By using Li-Fi technology highly reliable vehicle to vehicle communication is possible by transmitting and receiving data through LED head-lights and tail-lights. In this paper we propose a system that uses Li-Fi enabled LED head-light, tail-light and traffic signal light that can be used for traffic management and road safety by using vehicle to vehicle data transmission. In response, we propose a new formulation of the traffic management problem and outline focus areas while solving them for cities in developed and emerging geographies. Our system has presented an approach to schedule emergency vehicles in traffic. The aim of designing this system is to reduce road accidents and managing traffic more accurately and mostly directing the emergency vehicles an easier path.

Index Terms—Emergency vehicles, LEDs, Light Fidelity (Li-Fi), traffic management, visible light communication

1 INTRODUCTION

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II. Wi-Fi is the main wireless communication medium which uses radio waves to provide wireless high-speed internet and is used in all the areas such as offices, schools, homes, colleges, Universities etc.

III. ABOUT LI-FI: The objective of LI-FI is transfer data through visible light. Since the bandwidth of visible light is 10,000 times more than Radio waves, more data can be transferred through light at short period of time. Visible light communication (VLC) eliminates the risk of some disease caused by the Radio waves due to long period exposure. This protocol can be adapted where Radio waves are restricted, such as airplanes, hospitals, and in some research facilities. Researchers reached bit rate of 224 GB/s which is 100s of times faster than our average WI-FI connection at home or office.

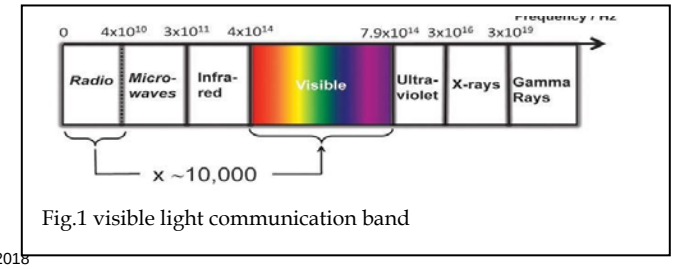

Fig.1 visible light communication band

IV. Li-Fi is a wireless optical networking technology that uses light-emitting diodes (LEDs) for data transmission. It is designed to use LED light bulbs similar to those currently in use in many energy conscious homes and offices. However, Li-Fi bulbs are outfitted with a chip that modulates the light imperceptibly for optical data transmission. Li-Fi data is transmitted by the LED bulbs and received by photoreceptors. Visible light communications (VLC) signals work by switching bulbs on and off incredibly quickly

– too quickly to be noticed by the human eye. Although Li-Fi but would have to be kept on to transmit data, the bulbs could be dimmed to the point that they were not visible to humans and yet still functional. VLC technology was exhibited in 2012 using Li-Fi. By August 2013, data rates of over 1.6 GB/s were demonstrated over a single color LED. In September 2013, a press release said that Li-Fi, or VLC systems in general, do not require line-of-sight conditions.

V. The light waves cannot penetrate walls which makes a much shorter range, though more secure from hacking, relative to Wi-Fi. Direct line of sight isn't necessary for Li-Fi to transmit signal and light reflected off of the walls can achieve 70 Mbps. Wi-Fi and Li-Fi transmit data over the electromagnetic spectrum, but whereas Wi-Fi utilizes radio waves, Li-Fi uses visible light. While the US Federal Communications Commission has warned of a potential spectrum crisis because Wi-Fi is close to full capacity, Li-Fi has almost no limitations on capacity. The visible light spectrum is 10,000 times larger than the entire radio frequency spectrum. Researchers have reached data rates of over 10 GBPS li-Fi is expected to be ten times cheaper than Wi-Fi. Short range, low reliability and high installation costs are the potential drawback. By Communication through visible light, Li-Fi technology has the possibility to change how we access the Internet, stream videos, receive emails and much more. Security would not be an issue as data can't be accessed in the absence of light. As a result, it can be used in high security military areas where RF communication is prone to eavesdropping.

How Li-Fi Works?

Li-Fi is typically implemented using white LED light bulbs at the downlink transmitter. These devices are normally used for illumination only by applying a constant current. However, by fast and subtle variations of the current, the optical output can be made to vary at extremely high speeds. This very property of optical current is used in Li-Fi setup. Fig 3. shows that Vehicles could communicate with one another via front and back lights to increase road safety. Also street lights and traffic signals could also provide information about current road situations.

2 WORKING

Traffic management is a major concern for cities around the world. The conventional traffic problem has been cast as a mismatch situation between supply and demand. We argue that this formulation is incomplete in that it admits solutions that ignore the impact on citizens all together, and hence unsustainable in the long run. In response, we propose a new formulation of the traffic management problem and outline focus areas while solving them for cities in developed and emerging geographies.

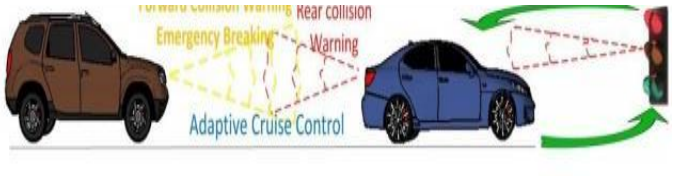

Fig 2. Vehicles communicating one anoother via front and back lights

Our proposed system presents the architecture of the urban traffic management system.

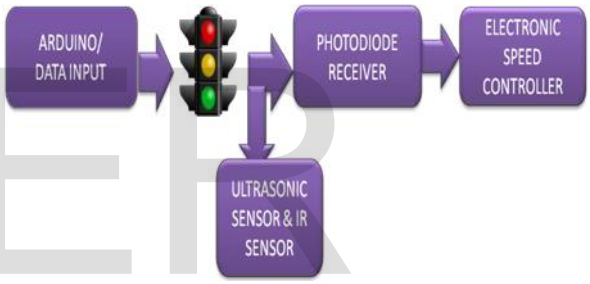

Fig 3. Traffic management system using Lifi

When the signal turns ON the vehicle starts moving in their own direction as soon as the system detects the ambulance, a stop command is sent through transmitter that is LED and the receiver which is in the line of site of signal receives the command. This received command stops the vehicle from crossing the signal. The vehicle which crossed the signal is allowed to move. Now the ambulance is allowed to pass through the opposite way which is free to cross the signal as shown in the figure.

The VLC receiver is a crucial component of the VLC system. Its design determines the overall system performances. Concerning the VLC sensors, they use sensing elements which can be either camera systems or photo detectors. The usage of embedded cameras was considered based on the fact that new generation vehicles are already equipped with cameras used for pedestrians and traffic lane detection. However, the automotive industry considers the usage of low-cost cameras like the ones used in smart phones. This system can be considered to be most convenient system in accordance to our day to days issues .when any ambulance is

detected by the transmitting circuit the microcontroller present will modulate the red light present in traffic signal in such a way that its intensity variation will transmit a data that will it change movement of the vehicle receiving this signal.

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4 CONCLUSION

Our system has presented an approach to schedule emergency vehicles in traffic. Li-fi technology has a massive use in traffic management and in establishing safe movements of vehicles on the road. To implement it commercially each and every vehicle has to include a led-based traffic head-light, tail-light and arduino microcontroller. Hence any recklessness of the drivers will not be enter tained. So it is high time we implement this fabulous technology to step forward to a digital world.

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