VISIBLE LIGHT COMMUNICATION IN INTELLIGENT TRANSPORTATION SYSTEM FOR I2V AND V2V MODE

Mamatha K R[1], Pavithra S[2]

[1]P G Scholar, Dhanalakshmi Srinivasan College of Engineering, Tamil Nadu, India
[2] Assistant Professor, Department of Electronics and Communication Engineering, Dhanalakshmi Srinivasan College of Engineering, Tamil Nadu, India.

Abstract - *A new mode of wireless communication technology, Visible Light Communication which uses LED light as transmitter and receiver use is photo-detector. Intelligent Transportation System using this VLC can help to develop traffic control which is eco friendly. In existing methods, cellular networks were used along with short range communication which is dedicated which works on radio frequency. As an alternative to this, a method of combining Wi-Fi along with Li-Fi is proposed in system which uses Intelligent Transportation. This combination is why because, total eradication of RF-based technology is not possible but the two technologies could be used complementarily to create more efficient, future and green proof access network. In this paper communication between vehicle to device and vice versa and inter-vehicles communication completely with Li-Fi is proposed*

Key Words: Vehicular communications, Visible Light Communication, Dedicated Short Range, Intelligent Transportation System, Radio Frequency

1. INTRODUCTION

Large development of automobile vehicles road traffic technologies in both urban and rural areas were under the atmospheric pollution traffic congestion, accidents, and poor traffic management. By 2020 [1, 2], road accidents will be the major cause of the death. Since road traffic volume increases day to day, accidents also increase proportionally. Advanced technologies are needed to reduce this issue which leads to unsafe for the public. There developed technologies to monitor and control vehicles thereby reducing congestion, traffic delay and accidents [3, 4].The Intelligent Transportation System is the technology which involves in developing the traffic management and thus providing safe journey for both road and vehicle users. ITS apply communication and information technologies to provide a solution to this congestion as well as other traffic control issues. ITS is an integrated application of technology using advanced methods using electronics, computers, and sensors. It is the voice of vehicles, improves fuel efficiency, and enables real traffic monitoring and evaluation. The important applications of ITS are road enforcement which is automatic, notification system for emergency vehicle , collision avoidance device, traffic light sequence with dynamic and variable speed limits . Network Technology which uses Vehicular Ad-hoc in ITS to improve its functioning. In VANET various vehicular communication modes used like Vehicle to Infrastructure, infrastructure to vehicle and between vehicles to reduce accidents and fatalities. Many advanced applications for road safety, passenger information, services and vehicle optimization were enabled by these modes of communications with existing capabilities. Two authorities which coordinate various parties to enable reliable and highly efficient technologies in future wireless networks were The European Union wireless communication and Mobile Enablers for Information Society [5, 6].These mode of communications collect traffic data, analyze and distribute it, in order to increment awareness, thus transportation system can be efficiently managed with efficiency and reduced traffic jams. These data which is assembled is used adjust the transportation system automatically based on different traffic scenario. Moreover system requires a large distribution of the diverse geographical area for intelligent vehicles and infrastructures, to gather more data and efficient distribution. But a major challenge for ITS is implementation cost maintenance as small as possible without affecting reliability [10].Referring on the above strategies various technologies used by ITS like floating cellular data , technologies which is computational, wireless communications , sensing technologies, inductive loop detection, , video vehicle detection. In wireless communication devices are connected by wireless networks and data transmission done through signals using mediums like a radio wave, microwave etc. Various domains were used for this communication mode like ad-hoc networks, sensor networks, mesh networks, cellular networks in different nature in terms of packet types and resources. Computational science provides platform i.e process control which is model-based and artificial intelligence [11] and development in architecture and software for real-time applications. There are four parts Quantitative, Operational Languages, tools for automotive running [12].an example of this technology is Advanced Driver for Assistance System [13].Transportation system which determines the transportation track speed on the Floating Car for Data (FCD), which determines the speed, travel direction, tie and localization data from phones which act as sensors [14].Sensing technologies is a technology with embedded sensor work. Wireless sensor networks having many numbers of sensor nodes representing efficiency over traditional sensor [15].Another technique is inductive loop detection using a magnet for electrical current induction in a wire. This is applied in vehicle detector.VSN240 vehicle sensor node is an example [17] by measuring earth's magnetic field.

An alternative to traditional loop detection system is Video Vehicle Detection (VVD) in which video image acquisition, video image processing appropriate cabling and vision processing were major function [18].Radio modem communications, for transferring data between the distances typically of range,10-40 mile using ultra high and frequency which is very high (VHF and UHF).Example of this type is fleet management, SCADA , telemetry application[19].A new technology invented in vehicular environments with infrastructures which is existing such as LED-arranged in traffic lights is called LED-based system using light communication. To eliminate 80% of the road crashes happening current and helps to foster automobile and telecommunication industries for a safer ground telecommunication industries for a smarter and transportation system [8],a vehicle to everything communications elevates the collaboration among vehicles, pedestrians and transport infrastructure. But the total eradication of Wi-Fi from the public is not possible because it becomes one of the major sources of communication. In this paper, a complete functioning of Li-Fi is proposed, in order to decrease over usage of radio spectrum and thus encouraging Visible Light Communication.

This paper organized as follows, 1.2 section presents brief review of literature work of the system, by specifying various technologies and their implications section 2 presents proposed completed light communication for intelligent transportation development. Section 2.1 presents system architecture and experimental scenario, section 2.2 presents relevant simulation result outlined in 2.3. Section 3 concludes the paper.

1.2. Literature Survey

IEEE 802.11p describe how communication takes place with an individual DSRC spectrum channel, which imposes a new section set of requirement on communication system by introducing operating mode of WAVE and IEEE 802.11 in BSS. Advantages of multichannel operations, advanced security and other applications on upper layer [20].A promising technology for vehicular communication for safety measures, evaluation of the performance impact of varying channel conditions done[22],impacts of energy efficient packet error rate, rate of collision and successful packet transmission with respect to throughput performance.

In [24] capable of tackling the severe interferences present in the open based road to developing wireless technology has properly chosen which is a complete DSRC system for Intelligent System using combined digital technology along with reception diversity like spread spectrum. This type of DSRC system is operational in its basic form with several mobile users over a distance of 500 meters and for more efficiency radio channel is categorized.

A new method in [24], which describes cloud-based computing in traffic managing system for metropolitan areas, thus increasing the performance, travelers safety, and to reduce consumption of energy. For routing geographical addressing and cloud-based service discovery mechanism used, and throughput improves by this method.

In paper[30] widely developed cellular network along with communications having device to device(D2D), is a promising technique to support reliable and efficient vehicular communications. Power allocation and Spectrum sharing concentrated on slowly varying information large-scale fading of channels. Across all V2I links uniform capacity performance is available and its major drawback is high mobility.

Vehicular networks like VANET which is one of the wireless networks used for vehicular communications on roads. This has more reliability but drawback is conventional routing is not possible. But in [29] overcome the demerit thus by determine reliable routes for this mechanism to find vehicle information from the source vehicle to destination, but for this latency is a problem which is low. In [31], describe about an idea of internet usage by visible light communication, which can give the way for communication to establish a smart wireless network grid, underwater communication grid with mobile services.

Standardization of GPS in cell phones and vehicles in traffic explained in [21].One of the major advantage is increased accuracy when compared to heavily relying on cell information, in triangulation method. Lack of precision in the position and speed measurements is major issue. Long range communication includes Worldwide operability for Access of Microwave s(WiMAX),3G,Global System Communication For Mobile were used for providing wireless access over long distance[27]In this WiMAX contain two types fixed and mobile, which cover 30 miles of range and 70Mbps data rate[28].

Another technology which explained in [25] that is about WAVE and this idea of using TDMA MAC to achieve real-time constraints and it efficiently delivers packets But using centralized way and perfectly avoiding a collision. Communication with Bluetooth is used by Group of Special Interests)for short-range communication, this technology used for calculating travelling time, license plate recognition systems and data collection by using 48bit Control address for Media Access [26].

2. SYSTEM DESCRIPTION

Wireless-Fidelity technology is for local area networking which is wireless with IEEE 802.11e standard devices. Devices connect to internet via WLAN and Access Point. Wi-Fi based devices were using RF spectrum which is commonly used in device having Intelligent Transportation. But the major problem is RF is a licensed spectrum. Light-Fidelity technology is a part of Visible Light spectrum Communication, which use visible spectrum for working medium. Introducing this VLC in ITS will be an eco-friendly method, but currently used technology cannot be easily replaced. Here safety information contained messages

transmitted between vehicles by estimating the braking information, acceleration information, and distance between vehicles, sleepiness of driver and also information about alcoholic consumption of driver to the traffic control system usage of Wi-Fi technology. Traffic signal message was transmitted to vehicles using Light-Fidelity technology. Thereby reducing the usage of Frequency of Radio and Wireless-Fidelity access points serve large coverage area along with limited bandwidth, and thus susceptible to traffic overload This issue gets more magnified with an more number of users due to the medium access inefficiency control in Wireless-Fidelity systems. Using Light-Fidelity can manage this issue by providing extra capacity.

2.1 System Architecture and Experimental Scenario

For simulation process Proteus is used which is a fully methodological functional, programming language by procedural. This incorporates many functions from C, C++ and assembly, , comprehensibility of scripts of Proteus, Powerful string manipulation, availability of advanced logical data structure arrays, queues, sets. AVL trees. Proteus is a high-performance simulator for MMD multiprocessors, which is fast, accurate and exile. Each module that provides different combinations of performance and accuracy. Proteus provides repeatability and monitoring and debugging on real multiprocessors. Simulation has a role at levels of analysis and design of multiprocessors systems from design to runtime systems for algorithm and application. This software give a analytical result for the system model for both infrastructure to vehicles and between vehicles.

MP LAB IDE is the program using software that used on PC to make applications based on microchip microcontrollers. To write correct code Programmer Editor used with choice of tools with language. This option aware of constructs of compiler programming and assembler and automatically to check to ensure it is correct. Project Manager in application in tools enables to arrange various files, library files, and processor description with header files and. source files

Visible Light Communication has many different applications thus used in important traffic information broadcasting in V2V and I2V mode. In [7] analyzing for VLC for transportation system by usage of image sensor with 2-Dimensional traffic lights based LED well matched for broadcast in I2V mode of communication. The emitted light from traffic signal modulated and this modulated light is detected by receiver which is fixed on head light of vehicle which contain photo detector which provide safety information to driver regarding traffic.VLC transmitter used here is transducer using an electro-optical that transmit message using visible light spectrum over wireless medium. At receiver side same type transducer is use which receives the information, which is in modulated form is converted into electrical signal that can be processed by demodulator decoder. Here both Wi-Fi and lifi modem for transmitter is fixed on traffic light and respective receiver on vehicles. But in vehicles contain both of transmitter and receiver that is head light of vehicle act as receiver for the message signal coming from the transmitter which is fixed in existing traffic light. In case of infrastructure to vehicle communication traffic light is transmitter and headlight of vehicle which is under Field Of View of the receiver. Whereas for vehicle to vehicle communication tail light of one vehicle act as a transmitter and head light of vehicle behind the first one act as receiver.

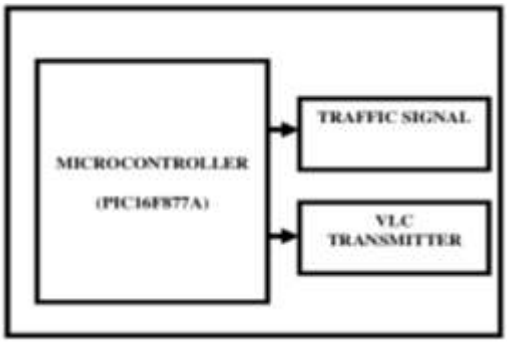

Fig-1: Transmitter block diagram for Infrastructure

The block diagram in figure fig.1 given here describe for transmitter in traffic light shown in figure. Functionality of each block described next. Microcontroller read data from control station. Information is transmitted to the traffic signal and VLC transmitter which is inserted in traffic signal. Thus information is passed as signal to vehicles. Here the system is categorized to two parts section A describes about Light Fidelity communication and section B describes about wireless communication. Section A is for traffic light and vehicles and B for vehicular communications. Figure fig.2 above shows the receiver section for infrastructure to vehicle here a VLC receiver used to receive information from VLC transmitter. A power supply is needed in both transmitter and receiver, but different amount of power needed for each component.

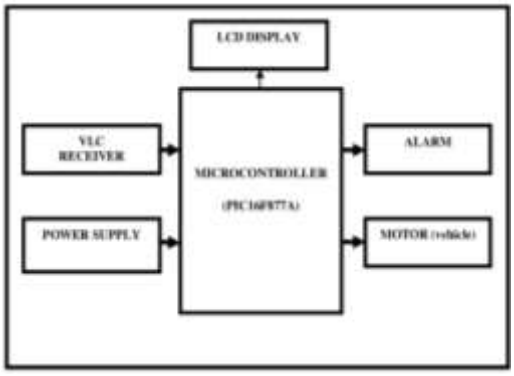

Fig-2: Receiver block for vehicle in case of infrastructure mode

Microcontroller output is connected to LCD display, shows traffic signal information, Alarm which indicates any

unauthorized movements, and motor of vehicle will stop if rules not followed.

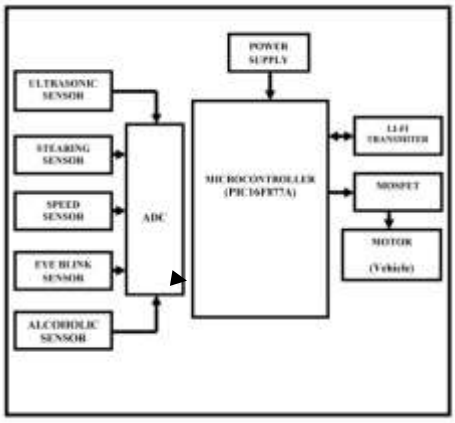

Fig-3: Block diagram for vehicle to vehicle communication

In Figure fig 3 shows block diagram for transceiver for vehicular communications.MCU and MOSFET utilize a wall output with 120V AC output. Data source (i.e sensor) reads the speed, acceleration and particular distance between vehicles. The signal contained data will be processed by microcontroller. New processed data will then be transmitted to the LED driver and this will make the current constant to protect LED. Then, data will transmit bye the LED light as carrier. Upon data transmission wirelessly through light, the photodiode will detect transmitted light in form of current. Figure 4 shows circuit diagram for Infrastructure to Vehicle communication.

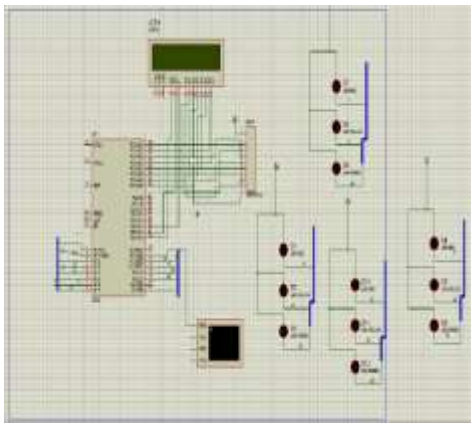

Fig-4: Circuit for infrastructure mode

This circuit explains the infrastructure connection which help the driver of vehicle to get information about the traffic signal for four path.Each will indicate which path is busy and based on this the driver get message.This method of transferig themessage is done using Visible Light spectrum.

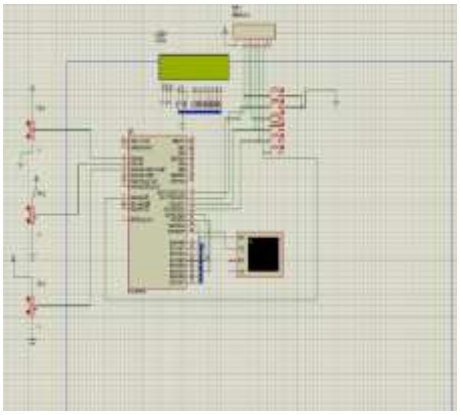

Fig-5: Circuit for vehicle mode.

2.2 Simulation Result

This section describes performance of V2I and V2V simulation results from experimental description from section IV. Through computer simulation the results of the performance analyzed. This model was run with i) traffic information between traffic signal and vehicles ii) safety messages between near vehicles. The output is visualized on virtual terminal. Figure fig. 4 shows the messages about traffic to vehicles. This helps the drivers to know about which path is busy and which path is open. This is done using visible light.

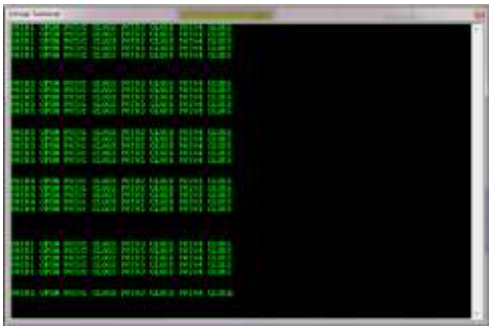

Fig-6: Simulation result for normal traffic condition

Figure fig. 6 will show the output of V2V communication, which shows the normal condition. Figure fig. 7 shows change in acceleration, when there is a change in direction of driving this information is assed to the vehicles behind.

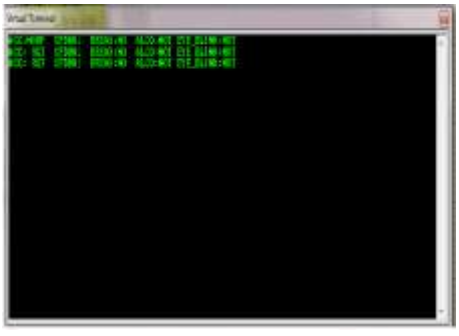

Fig-7: Simulation result for change in acceleration

Figure fig. 8 results the simulation result for the change in speed of vehicle A

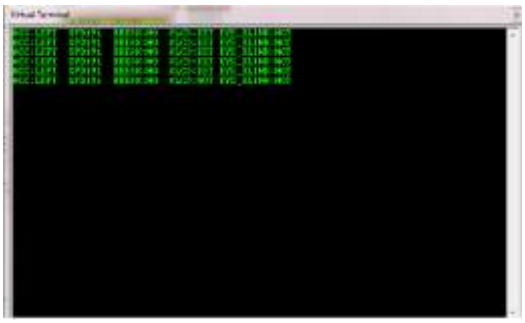

Fig-8: Simulation result for change in speed

3.3 Implementation Result

In this traffic light to vehicle communication when the traffic controller system is switched ON then the information about which path is open is given to the controller and controller send this information to the VLC transmitter and this transmit details to vehicles using LED light.

Fig-9: experimental setup for transmitter for I2V mode

For vehicle to vehicle communication sensors connected gives information to Digital using Convertor to get digital values. Controller stores this value and transfer to LiFi transmitter and via this information send to LiFi receiver. The buzzer is switched on when consumption of alcohol or eyes are closed being detected by eye blink sensor. And other information will display on LCD display.

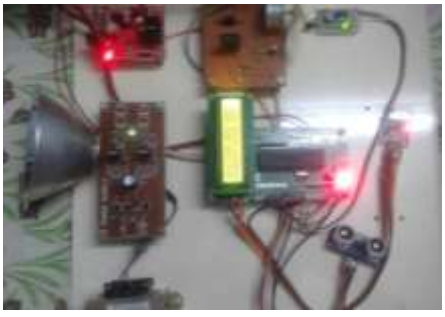

Fig-10: experimental setup for transmitter for V2V mode

Both scene contain receiver section consist of photodiode like photo detector using silicon or a infrared detector. The photo detector collects the information based on sequence of 0s and 1s.The demodulated signal sent to filter to destroy ripples and noise. This is then amplified using signal amplification mechanism. This output is given to output device.

Fig- 11: experimental setup for receiver for I2V and V2V

3. CONCLUSIONS

In this work, LiFi concept had been introduced with existing trends of transportation system for infrastructure to vehicle communication by using traffic lights with LED arranged in array format. The proposed system has a solution with cost effective to reduce accidents. The details and design guidelines of system were explained along with concept illustrated by sending data using LiFi prototype

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