INTEGRATED VLC WITH WI-FI FOR SMARTWAY TRANSPORTATION SYSTEM: A SURVEY

MAMATHA K R[1], VINOTHINI.K[2]

[1]*Assistant Professor, Department of Electronics and Communication Engineering, Dhaanish Ahmed Institute of Technology, Coimbatore, Tamil Nadu, India*
[2]*Assistant Professor, Department of Electronics and Communication Engineering, Dhaanish Ahmed Institute of Technology, Coimbatore, Tamil Nadu, India*

Abstract - *Communication based on visible spectrum is a new mode of wireless communication technology using visible spectra by typical transmitters and receivers. This technology in developing Intelligent Transportation is a cost-reduction method. Currently Radio Frequency (RF)-based technology is used for road safety applications and ripping out this method entirely by replacing it with VLC is not particularly feasible, so that the idea is retrofitting system that currently uses to work with combining both RF and VLC technology. Here paper presents the specific technologies of wireless methodology for the Intelligent Transportation, which helps to decrease the occurrence of traffic accidents, optimize the traffic flow and improve the safe of devices and roadside users. Application based on communication of vehicles, and vehicle to infrastructure has emerged the best solutions to improve traffic safetness. This are have, visible light communication with big potential for simple design for functional efficiency and large area distribution along with usage of Wi-Fi. The intention of this survey on a wide field, Intelligent Transportation Systems functioning with Wi-Fi and Li-Fi is discussed with its wide applications, technologies, and usage in different areas*.

Key Words: **Visible Light Communication, Wi-Fi, Intelligent Transportation System, Application, Road safety**

1. INTRODUCTION

Heavy increase of traffic on roads in metropolitan towns and cities of the various countries are experiencing greenhouse emissions, traffic congestion and accidents leading to poor quality of life. Recent studies forecast that road accidents will become the major reason of death in the world by 2020[1, 2].With the increased volume of road traffic, important factor is to introduce advanced intelligent road traffic information system which can monitor and control vehicle movements to minimize congestions, journey time and accidents [3][4]. Modes of communications, like Vehicle-Vehicle, Vehicle-Infrastructure (V2I) and reverse of V2I mode investigated to reduce accidents and fatalities. Using of these modes of communication with present vehicle-sensing technique has a big potential which enabling many applications for safety on road in advance, passenger information, services of manufacturer, and optimization in vehicle traffic. The committee by European Union for mobile communication to Twenty-Twenty (20-20) Information Society, among other consortia and standardization bodies, are both coordinating efforts of various parties to enable highly reliable and efficient vehicular communications in coming wireless communication networks.[5],[6].

The ITS [7] considers using cooperative technologies to decrease the accidents number and of associated fatalities. The aim is to increment the efficiency of the transportation system and thereby reduce the CO2 emissions. ITS add value to the transportation system by providing access in real-time to relevant traffic information. By use of I2V /V2I and V2V communications continuously collect traffic data, analyze it and distribute it, in order to increase the vehicle awareness. Moreover, this information enables an active management of the transportation device, increasing efficiency and reducing traffic jams. The assembled data is used to automatically adjust the transportation system to different traffic situations. Therefore, a different aspect of the ITS is the widespread distribution. However, based to ensure its effectiveness, the system requires a large arial distribution of the intelligent vehicles and of the intelligent infrastructures, enabling it to gather more data and to efficiently distribute it. Withal, a major challenge for the ITS is to maintain the implementation cost as low as possible, but without affecting its reliability regarding the road transport system, the growth in vehicles in large cities, congestion, the consequent growth of fuel and pollution consumption, directly impact the health of the population. Another effect is the increase in accidents, which provide feedback to previous effects [10].

Summarization of technical methods involved in intelligent Transport method: Intelligent Transportation System integrates current and growing communication technologies. Due to development of many technologies, the transportation system in wireless communications, wireless networks connect the devices; transmit the data through signals through medium for communication between various devices.

To improve transportation conditions, safety, and services, like microwave and radio wave, for sharing transferring the data among nodes. This communication mode has various sub categories for domains such as,

cellular networks ,sensor networks, , mesh networks and a different types of ad-hoc networks but different in case like types of packet, infrastructure and resources.

Computational in science used in ITS by providing a development in architecture, platform and software for application which is real-time. The platform means including process control that is model-based and artificial intelligence [11].This is making up of four parts, Quantitative, Operational Languages, tools for automotive running [12].Advanced Driver Assistance System solves safety problem in transportation is an example of this technology [13].Floating Car Data (FCD) in transportation system determines the transportation speed on the track. FCD works to determine the speed, travel direction, tie and localization data from mobile phones where mobile phones act as sensors. Networks like CDMA, GPRS, UMTS, and GSM are used by floating data/cellular data works. Data being collected through position of vehicles at constant time intervals [14]

Sensing technologies is an unprecedented technology in which embedded sensor work. Wireless sensor networks have a large number of sensor node represent a significant efficiency over traditional sensor [15] end to end delay and synchronization are critical for this type of systems [16].Inductive loop detection is a detection system using the magnet to induce an electrical current in a wire. Its application in vehicle detector, vehicle passage for communication and reception of signals.VSN240 vehicle sensor node is one example of this, for measuring earth's magnetic field [17].

Vehicle Video Detection is alternative for traditional loop detection system. Video image acquisition, video image processing appropriate cabling and vision processing are major functions. Advantages of this system are less cost for data collection, better analysis, and accuracy [18].

In radio modem communications, data transferring between locations, mostly the distance of devices from 10 to 40 mile range, using both frequency types that is Ultra High Frequency and Very High Frequency. Fleet management, automated meter reading, telemetry applications, SCADA applications use this technology. Information broadcast on congestion and emergencies via FM radio band, along with the weather changing [19].

LED-based VLC system is a new technology that used in environments of vehicular using already used infrastructures such as traffic lights that based on LED. Vehicle to anything communications elevates the collaboration among transport infrastructure, pedestrians, and vehicles, which help to eliminate 80% of the current road crashes and helps to improve telecommunication and automobile industries for a safe telecommunication industries for a talented and better safety of ground transportation system[8].

The rest part of this literature survey is elaborated as follows. Section II states the overall literature survey of the system, specifying various technologies used and then section III contains a discussion about the common issues, In, [25] mainly based on the study of the basic of technologies with WAVE and in this idea of using TDMA MAC to achieve real-time constraints and it efficiently deliver solutions, section IV gives the conclusion for this survey and proposes several future research directions that could be addressed.

2. LITERATURE SURVEY

2.1 Short range communications

According to Williams [9], the term Intelligent Transport Systems is used to describe complex systems in which vehicles, passengers, drivers, operators, managers, and environment interact, providing with guidance and movement experience with making road systems safer and better drainage capacity. This is possible due to the information the integration with information technology and communication systems, applied to the field of transport

IEEE 802.11p describe method of communication takes place over each channel of the spectrum of DSRC, which produce a set of new requirement on communication system by introducing 802.11p for WAVE BSS and operating mode. Advantages of, security and multichannel operations for other upper layer applications [20]

Traffic safety system classified as a system which real-time which means that the data traffic sent on the wireless channel has a deadline. An important component is MAC protocol. To meet the deadline two MAC methods have been evaluated i .e having a bound on the line access request from channel to channel access. Unpredictable behavior is the main drawback is ITS [21].

A specific technology for communication for vehicular mode for safety measures, therefore performance evaluation of the varying impact of channel conditions done [22], impacts of efficient energy packet error rate, the rate of collision, and successful packet transmission related to throughput performance.

In [23] surveys combined working of cellular networking and DSRC solutions for better communications. This will describes each technological limitations and DSRC-cellular architecture which is hybrid. The main challenges is network selection issues were vertical handover.

The technology which is wireless chosen properly which has severe interferences in complete DSRC system to open road to develop a for ITS application using digital technology combined as spread spectrum along having reception with diversity [24] .The DSRC system is thus operational in its basic form supporting several mobile users

over an 18 and 500 meters distance more. For efficiency in design, the radio channel is categorized as Packets. But it shows some drawbacks like on using the centralized way and perfectly avoiding a collision.

Special Interests Group started bluetooth communication technology for communication which short-range. This technology used in ITS for capturing travel time, license plate recognition systems and for data collection, the protocol used by this technology broadcast a 48B MAC address[26].

2.2 Long range communications

Long range communication includes microwave access for WiMAX, Mobile Communication for Global System , 3G meant for providing long distance wireless access over [27].WiMAX comprises two set of address: 802.16-2004(IEEE 802.16d) for WiMAX fixed and 802.16-2005(IEEE 802.16e) for mobile WiMAX. The range is 30 miles and 70Mbp data rate [28].

Network technology that is ad hoc networks for vehicle is one of the wireless networks for communication among vehicles running on roads. On highways, VANET has more reliability. One of the drawbacks of VANET is conventional routing not suitable. But in this paper [29] determines reliable routes with a renewed mechanism is invented with the vehicle information from the vehicle source to destination vehicle. Demerit for this paper is low latency

In [30] widely developed technique in cellular network, deals with the communications between device-device, provide a solution to support reliable and efficient vehicular communications. This paper explain power allocation and spectrum sharing concentrated on slowly large-scale varying wireless channels with fading information . Uniform capacity performance is available across all links between vehicle and infrastructure. High mobility is a major drawback.

Zigbee [32] technique used ITS is new method with low cost, wireless PAN standard, low power with device designed to reach the needs of various sensors and other devices.

In [33] deals with the standardization of GPS in cell phones and vehicles in traffic. Advantage of this is increased accuracy when compared with heavily relying on cell information, mainly in triangulation and trilateration method. Its demerit is precision lack in the position and speed measurements.

In [34] presents the design of area information system(GIS) based on web service technology, to support ITS applications with spatial data and processing related to geo-processing like detect addresses which is duplicate, planning routes ,display maps, etc. without intermixing GIS instruments.

A new method described in [35], cloud computing based traffic control system for metropolitan areas, to increase the operational performance, the safety of travelers and to decrement energy consumption. For routing geographical area addressing and service based with cloud discovery mechanism used. Traffic throughput improves by this method using the dynamic route.

In [36], communications based on LTE which is device-device (D2D) developed to a new method for wireless communications along short-range in beyond and advanced 4G networks. For this CVN solution is used with architecture which is fully integrated for LTE-based communications for vehicular environment in ITS. To support CVN, NS3 extensions implemented.

Wi-Fi is technology that become a predominant method by accessing the internet wirelessly, in [37] describes use of Wi-Fi indirect device to device communication. In this performance-energy through experimentation novel trade-off of the NoA defined power with Wi-Fi having direct saving protocol.

In [38], presents cellular networks using LTE and Wi-Fi direct with a supporting protocol for communications between devices. In this supported with minor modifications over LTE network to the standard procedures without any change in infrastructure. The reasonable transmission rates is an advantage by this method and end delay is major issue using this method.

In [39], gives an idea of using internet by visible light communication. A wireless network using VLC is new technology that can create the path for a communication to establish a smart wireless network grid, underwater communication grid along with mobile services

In [40], a method of the communication on road to vehicle with visible light mechanism and system using the high-speed camera as a receiver and traffic light using LED as the transmitter, which is found by the subtraction of the frames arranged in consecutive pattern.

Visible light communication promises large-scale acceptability due to capability for provide localized, light base cells using unlicensed spectrum [41].LED has become common in automotive lightning because of its long service, low cost, vibration resistance and better performance, so used for V2V communication [42].

3. COMMON ISSUES AND SOLUTIONS

From the survey, some of the common shortcomings were observed and pointing out the solution as follows.

Data rate: in every technique main objective is to give awareness to public or vehicles or authorities about the problems in the fast method, so designing a system with high data rate is required here.

Spectrum: most of the intelligent transportation works on RF medium, which is band limited, a new eco-friendly technology suggested.

Complex infrastructure: Another issue is, the design of the system, which will be difficult in outdoor conditions and for vehicles to carry huge onboard units. For this simple design with small size or an existing infrastructure is suggested.

4. CONCLUSION

The Intelligent Transportation technology combine many technologies and provide the perfect solution to reduce and avoid problems caused by road traffic to both human and properties, causing public issues. This literature survey summarizes the field of an intelligent transportation system which covers many technologies, offering benefits like improved safety, efficiency, mobility and accessibility for areas like arterial, data collection, environmental issues, and traveler information. Some common limitations are data rate and system design. Traditional technologies failed to compact it all, to overcome these limitations combined Wi-Fi and Li-Fi technology is proposed. This paper enables for future research to understand overview for new technologies for transportation system, which may be needed for further study.

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