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Vehicle To Vehicle Communication Using MQTT Protocol

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ABSTRACT

Various parameters used for communication between vehicles, such as Traffic Estimation, emergency, Li-fi Technology, Gas detection in CNG's are discussed. The benefits of utilizing MQTT protocol in V2V communication are its low power usage and small packet size. Further the challenges faced are discussed while using MQTT protocol in V2V communication, such as scalability and security. A brief conclusion on the use of MQTT protocol in V2V communication is Provided. It also helps using Li-fi technology between two vehicles. Vehicle communication is implemented using Blynk platform acting as a medium for data transfer and visualization. The system is developed to monitor various driver help parameters like accident detection, obstacle detection, fire detection. The Ultrasonic sensor is placed in the front part of the vehicle, if any two vehicles draw near to one another or there is any obstacle in front of one vehicle then an alert message is sent to the other vehicles up to 100m in 360 degrees wide through Blynk application. By using radio frequency we can enlarge the distance up to 1KM range which works as wireless communication between vehicles. The IR sensor is placed in the engine part for accident detection. Fire sensor is placed in the vehicle, it detects the heat through IR waves and gives alert message to that vehicle and passes this information to other vehicles. The application of Vehicle-to-Vehicle communication technology in providing information services, improving traffic efficiency, enhancing traffic safety, implementing supervision and control and other aspects will make millions of people enjoy more comfortable and convenient life style with better safety traffic service.

KEYWORDS: MQTT, Radio Frequency, Li-Fi Technology, Internet of Things

1. INTRODUCTION

Approximately 1.3 million people die every year due to road accidents, which comprises 10 percent of the cause of death on earth. In countries like India, China, USA, many developed nations and many developing nations where a large part of the population live in cities and use their own private vehicle to go to work, it creates a crowd on the road and it becomes difficult in these countries to manage traffic. Integration of smart devices in vehicles can help in managing traffic and reducing on road accidents, which can save the precious life of human beings. Once an MQTT broker service is available in a 5G network, V2X services can then be written to communicate via MQTT. Road infrastructure, like stop lights or stop signs, can be instrumented to publish information on an

MQTT topic. Vehicles that move into proximity of the infrastructure, can subscribe to these topics to receive the information. Similarly, cars can publish information on topics that other cars who are local can subscribe MQTT is a publish/subscribe protocol that allows for a decoupled architecture of the clients from each other and the central broker. MQTT clients publish information on specific message topics and other MQTT clients subscribe to message topics they want to receive. The MQTT broker is the central broker that coordinates the publishing and subscribing of the MQTT clients.

A. Internet of Things

The Internet of Things (IOT) is the network of physical objects or "things" embedded with electronics, software, sensors and network connectivity which enables these objects to collect and exchange data. IOT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct indication between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

B. LIFI Technology

Li-Fi, also known as "Light Fidelity" is a wireless optical networking technology, which uses light emitting diodes (LEDs) to transmit data. It is a bidirectional wireless system that transmits data via LED or infrared light. It was first unveiled in 2011 and unlike wi-fi which uses radio frequency, Li-Fi technology only needs a light source with a chip to transmit an internet signal through light waves. This is an extraordinary advance over today's wireless networks.

Fig 1: LIFI Technology

C. C.Radio Frequency

Radio frequency (RF) is a measurement representing the oscillation rate of electromagnetic radiation spectrum, or electromagnetic radio waves, from frequencies ranging from 300 gigahertz (GHz) to as low as 9 kilohertz (kHz). With the use of antennas and transmitters, an RF field be used for various types of wireless broadcasting and communications. Many types of wireless devices make use of RF fields. Cordless and cellphones, radio and television broadcast stations, Wi-Fi and Bluetooth, satellite communications systems and two-way radios all operate in the RF spectrum.

II. LITERATURE REVIEW

Mrs. Vaishali, D. Khairnar, Dr. S. N. Pradhan, Research Scholar Professor, Institute of Technology, Nirma University:

The project presents the specific application of wireless communication, Automotive Wireless Communication_ also called as Vehicle-to-Vehicle Communication. The paper first gives an introduction to the Automotive Wireless Communication. It explains the technology used for Automotive Wireless Communication along with the various automotive applications relying on wireless communication. Automotive Wireless Communication gives drivers a sixth sense to know what's going on around them to help avoid accidents and improve traffic flow. The paper also describes VANETS (vehicular ad hoc networks) and Real-world test network implementation.

Y. Wei, J. Chen and S. Hwang:

For vehicle-to-vehicle (V2V) communication, such issues as continuity and reliability still have to be solved. Specifically, it is necessary to consider a more scalable physical layer due to the high-speed mobility of vehicles and the complex channel environment. Adaptive transmission has been adapted in channel-dependent scheduling. However, it has been neglected with regards to the physical topology changes in the vehicle network. In this paper, we propose a physical

topology-triggered adaptive transmission scheme which adjusts the data rate between vehicles according to the number of connectable vehicles nearby. Also, we investigate the performance of the proposed method using computer simulations and compare it with the conventional methods. The numerical results show that the proposed method can provide more continuous and reliable data transmission for V2V communications.

PROPOSED SYSTEM

The Proposed system of V2V Communication modelled by using some hardware components which are generally sensors used and Radio Frequency Transmitter and receiver. MQTT Protocol is Message Queuing Telemetry Transport which is used to communicate and interface all the sensors within and outside the vehicle, outside the vehicle is that communication between other vehicles. RF Transmitter and Receiver plays a major role in deployment of V2V Communication.

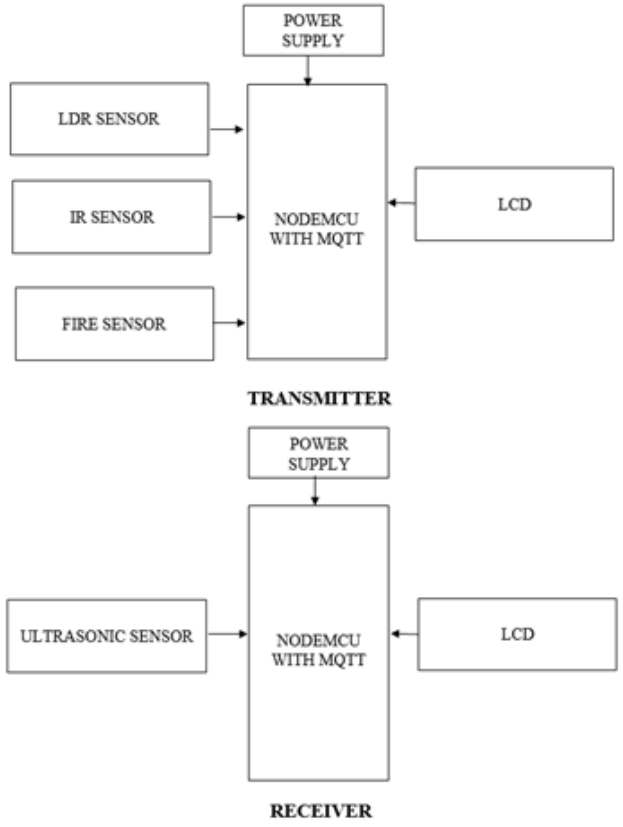


Fig 2: Block Diagram

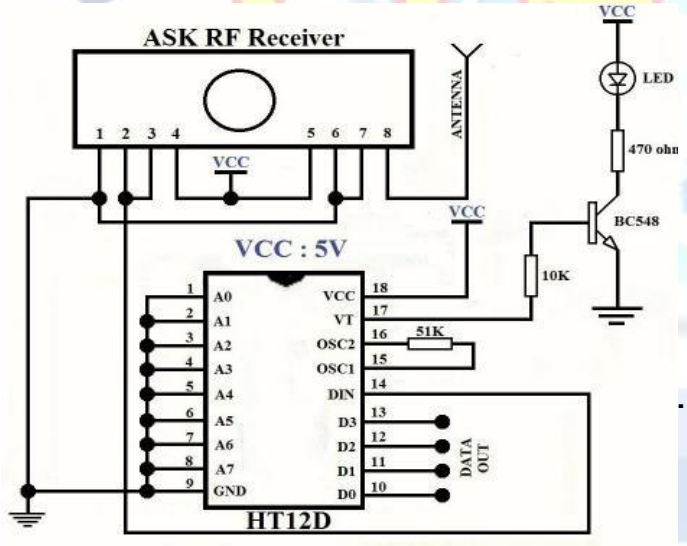
Radio frequency(RF) is measurement representing the oscillation rate electromagnetic radiation spectrum, or electromagnetic radio waves, from frequencies ranging from 300 gigahertz (GHz) to as low as 9 kilohertz (kHz) the use of antennas and transmitters, an RF field can be used for various types wireless broadcasting and communications. Many types of wireless devices make use of RF fields. Cordless and cellphones, radio and television broadcast stations, Wi-Fi and Bluetooth, satellite communications systems and two-way radios all operate in the RF spectrum. In addition, other appliances outside of communications, including microwave ovens and garage door openers, operate at radio frequencies. Some wireless devices, like TV remote controls, computer keyboards and computer mice, operate at IR frequencies, which have shorter electromagnetic wavelengths. Many types of wireless devices make use of RF fields. Cordless and cellphones, radio and television broadcast stations, Wi-Fi and Bluetooth, satellite communications systems and two-way radios all operate in the RF spectrum. In addition, other appliances outside of communications, including microwave ovens and garage door openers, operate at radio frequencies. Some wireless devices, like TV remote controls, computer keyboards and computer mice, operate at IR frequencies, which have shorter electromagnetic wavelengths.

3.1 RF Transmitter

The Transmitter module consists of three pins namely vcc, Din and ground. The vcc pin has a wide range input voltage from 3V to 12V. The transmitter consumes a minimum current of 9mA and can go as high as 40mA during transmission. The center pin is the data pin to transmit the signal. This signal modulated using the ASK and then sent on air at a frequency of 433MHz. HT12E is an encoder IC that converts the 4-bit parallel data from the 4 data pins into serial data in order to transmit over RF link using transmitter.

3.2 RF Receiver

RF receiver module has four pins namely Vcc, Dout, Linear out and Ground as shown above. The Vcc pin should be powered with a regulated 5V supply. The operating current of this module is less than 5.5mA. The pins Dout and Linear out is shorted together to receive the 433Mhz signal from air. This signal is then demodulated to get the data and sent out through the data pin. HT12D is a decoder IC that converts the serial data received by the RF Receiver into 4-bit parallel data and drives the output accordingly. The RF modules can also function without the need of Encoder and Decoder modules. Simply power on both the modules with the corresponding voltage mentioned above but, there is a big drawback in this method. You can have only one button on the sender side and one output on the receiver side, so to have more inputs and outputs, the encoder and decoder modules are required.



3.4 Flowchart for V2V Communication

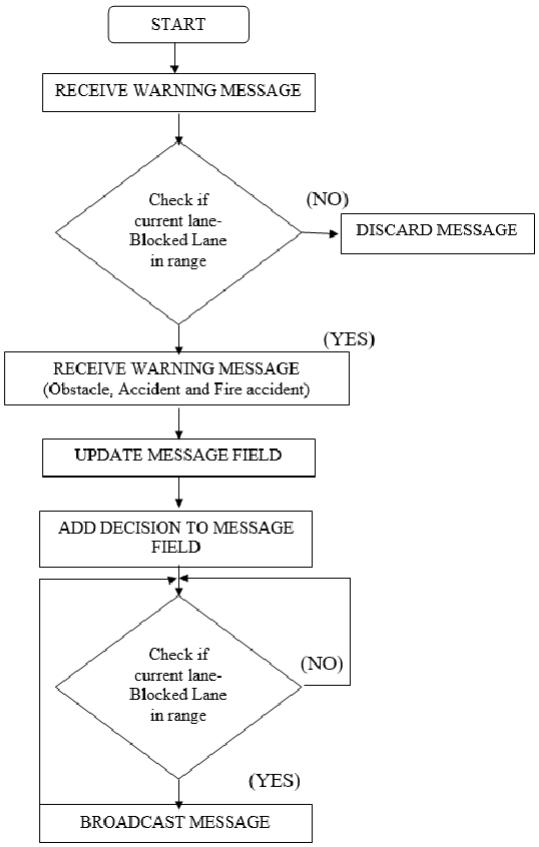


Fig 5: Flowchart

Proposed Flowchart describes the interaction between the vehicles and the communication is passed via cloud and the LCD which is displayed onthe screen when there is obstacle which is sensed by the ultrasonic sensors and gas leakage or fire accidents are sensed by fire sensor and accidents between vehicles is detected by the IR sensor.

MQTT PROTOCOL

Implementation of MQTT Protocol

The best way to enable V2X on top of a 5G network is with a modern protocol well suited for these use cases – MQTT. The automotive industry has embraced MQTT as the messaging standard for connected cars using MQTT for V2X services is a natural extension. MQTT is a publish/subscribe protocol that allows for a decoupled architecture of the clients from each other and the central broker. MQTT clients publish information on specific message topics and other MQTT clients subscribe to message topics they want to receive. The MQTT broker is the central broker that coordinates the publishing and subscribing of the MQTT clients.

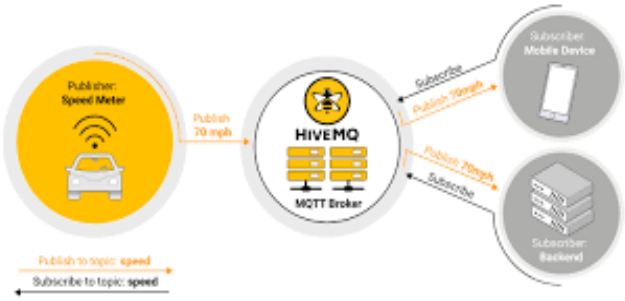


Fig 6: MQTT Protocol

Guaranteed delivery of a message with MQTT Quality of Service Levels of at most once (QoS0), at least once (QoS1), and exactly once (QoS2). For safety critical use cases, guaranteed message delivery is essential to the overall reliability of the implementation. The ability to process and analyze the large number of messages that flow through a V2X system. MQTT 5 shared subscriptions allow for the parallel processing of the MQTT messages to work on multiple messages of the same topic, while maintaining low latency.

Need of LIFI in V2V Communication

The implementation of light-fidelity (Li-Fi) in vehicular communications could be a low-cost, high-data-rate, and efficient-bandwidth usage solution. the average throughput in a road intersection equipped with a traffic light that operates as a server, which is assumed to have Li-Fi communication links with the front lights of the vehicles waiting for the green light. We further assume that the front vehicle (the car next to the traffic light) is able to communicate to the car immediately behind it by using its own tail lights and the front lights of such vehicle, and so on and so forth. LiFi can be used in communication between vehicles using their headlights and this can be used to reduce accidents occurring on the roads. In vehicles, such a communication can help cars communicate their speeds and other parameters and hence prevent accidents and decrease traffic. Li-Fi is transmission of data through light by using fibre optics and sending data through a LED that varies in intensity. Faster than the human eye can follow. Integrated chips inside LED will do the processing and amplification of data. The light intensity can be manipulated to send data by very small changes in the results. The technology transfers Thousands of data simultaneously in higher speed with the help of special modulation and demodulation technique. Li-Fi technology is high intensity brightness LED,,s. Light emitting diodes can be made to switch on and off faster since operating speed of LED,,s is even less than one μs, than the human eye can detect, causing the light source to be appear continuously. This on-off activity cannot be seen with the naked eyes of the human and that enables a kind of data transmission using codes. Switching on and LED is a logic 1switch off is a logic 0 the data can be encoded from the light wave and the exact information can be achieved. This Li-Fi uses light for data communications medium using visible light waves as optical carrier for data transmission and illumination. Li-Fi is one of the very efficient version of Wi-Fi, which is based on visible light communication (VLC).

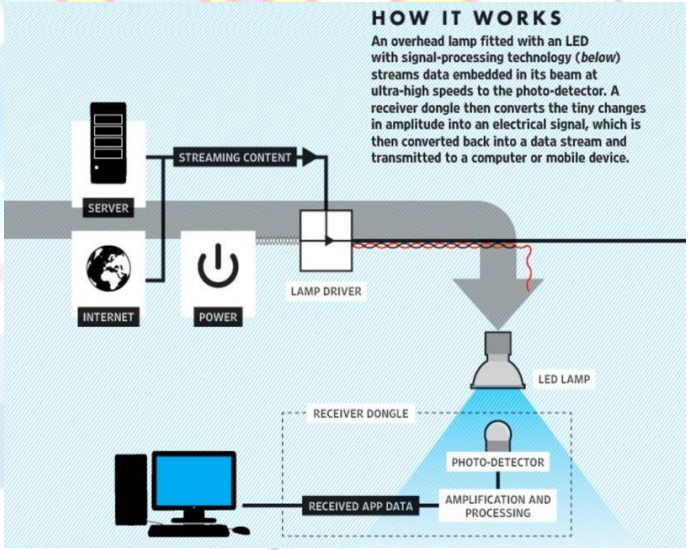


Fig 7: Working of LIFI Technology

Building of V2V architecture using MQTT Protocol

Major telcos that have deployed 5G networks are supporting application services by offering AWS Wavelength in the 5G data centers. AWS Wavelength allows a limited set of existing cloud

native services to operate in the 5G data centers, including an MQTT broker like Hive MQ.

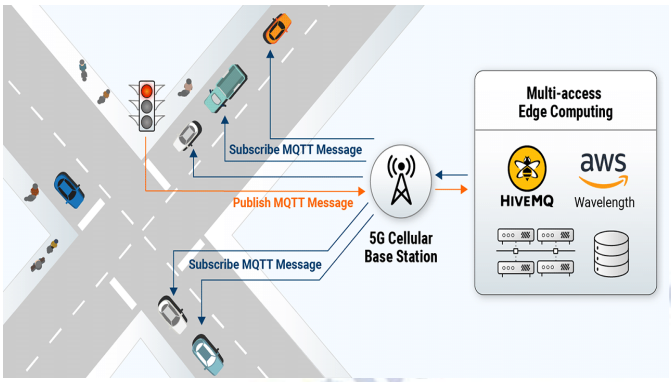


Fig 8: V2V using MQTT

Once an MQTT broker service is available in a 5G network, V2X services can then be written to communicate via MQTT. Road infrastructure, like stop lights or stop signs, can be instrumented to publish information on an MQTT topic. Vehicles that move into proximity of the infrastructure, can subscribe to these topics to receive the information. Similarly, cars can publish information on topics that other cars who are local can subscribe to. The advantage of an MQTT-based system is that all the MQTT clients are decoupled from each other so the system can organically grow and contract as the vehicles move around. Low-latency at the application messaging level is paramount for a successful V2X service. Hive MQ has been working with industry partners as they prepare for V2X use cases for 5G rollouts. In some of these collaborations Hive MQ has demonstrated a message latency of 10ms round trip from the MQTT client publishing a MQTT message to Hive MQ, MQTT broker running in a MEC to the subscribing MQTT client receiving the message. LIFI technology is main advantage used in this project because here the LIFI acts as a loop concept to the project as IOT and RF both acts interface between two vehicles when LIFI is implemented it can interface with other or third vehicle too by using ultrasonic sensor implemented in this project as this sensor detects the sound waves of the before vehicles as they can detect the sound and get displayed on the LCD.

RESULTS

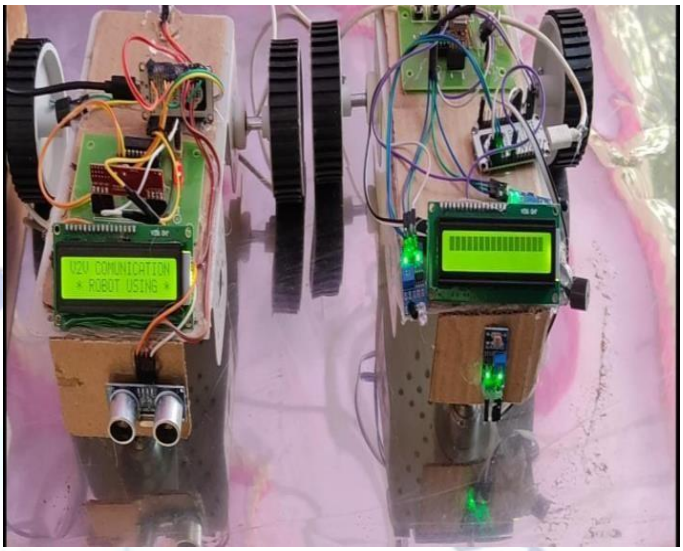


Fig 9: Vehicle to Vehicle Communication using MQTT Protocol

II. CONCLUSION AND FUTURE SCOPE

Conclusion

Vehicle to Vehicle communication can be a real game changer, because of its importance on our daily lives, it is a major challenge but it will be resolved with time. It includes a lot of points of interest to declare and develop, starting from the protocol design to obtain a standard communication model, then to go through the performance evaluation to have stable KPIs. After that to explore the implementation phase for commercial usage with zero percent failure, and finally to discover the integration mechanisms to release a full automated ITS solution ready to use for the real life. Vehicle to Vehicle communication real life implementation till now requires RSUs in order to have accurate results and full safety for the society, but due to lack of resources in some of the developing countries most of them don't have well established infrastructure and on the other side, the accidents and loss of lives are increasing exponentially year by year. The developing countries require to increase their investments, and this depends on providing full automated Intelligent Transportation System, ITS including V2V communication in order have daily traffic flow without bottlenecks. vehicle-to-vehicle communication protocol for cooperative collision

warning. Emerging wireless technologies for vehicle-to-vehicle communications are promising to dramatically reduce the number of fatal roadway accidents by providing early warnings.

Future Scope

New rules and regulations will be applied to ensure the implementation of the V2V technology as a mandatory requirement which will contribute positively in enhancing the traffic management and the number of accidents. Also, the National Highway Traffic Safety Administration anticipates that providing a full integrated ITS solution will decrease the accidents rate up to 81 percent. Whenever V2V is standard, V2I and the aftermarket will grow opportunistically based on funding, market forces. V2V communication gets involved in dedicated short range communication (DSRC) which is major and inbuilt process which is coming as an existence in many of the places all over the world where v2v and different communications such as V2I, V2P such communications gets developed and it will helpful to all the society which can be a major advantage for upcoming years.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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