Communication between two or more on road vehicles using LoRa

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Abstract— **The Internet of Things (IoT) refers to the integration of computing devices that have technological characteristics to enable data transmission and reception. This system proves efficient in the simultaneous handling of multiple peripherals. The method is further amplified by using a low-power, wide area network device called LoRa. The proposed system is developed with the aid of a Global Positioning System, in addition to LoRa. The core objective is to have a reliable module of communication with such a long range, high signal power and a better cost economy compared to any other. Wireless data transmission between motor vehicles in real time aims at preventing accidents through the transfer of data by motor vehicles in transit related to their respective location and speed, the process referred to as Automotive Wireless Communication. The system aims to lower the number of mishaps taking place, thereby placing driver safety as paramount importance. The main benefit is that such communications occur automatically where a large amount of data is exchanged and used between various communication systems in a stable and intelligent way.**

Keywords—LoRa, Global Positioning System, Automotive Wireless Communications, driver safety.

I. INTRODUCTION

Adhoc Vehicle Networks (VANETs) provide less infrastructure, fast deployability and network access that can be configured by itself. This network is made up of vehicles linked by cellular networks and able to store and forward data to their peers. When we compare these VANETs with other Adhoc networks, they are particularly challenging in their environments due to the high mobility and numerous signal weakening, like buildings. In this model more realistic configuration is investigated for radio propagation models. This is a modeling framework for corrupted signal transmission without compromising robustness. This method uses node location and urban road maps information to choose between two parameter settings based on the position of vehicles interacting in line of sight or around the corner. Here we studied how the propagation of the signal differs in different settings especially between line-of - sight and around-the-corner contact. The impact of various empirical parameter settings on basic epidemic data dissemination protocol performance is assessed. Our goal is to understand the effect on application performance of more practical signal propagation models.

Intelligent transportation systems are used to reduce traffic congestion's negative effects. Traffic management system would be capability to track conditions and identify congestion in traffic. Sensor related solutions include loops, video processing, and image processing. The limitations come in the accuracy of measuring traffic conditions across large segments of the road. The solution came by putting ongoing information exchange between vehicles which includes location and speed information. It also characterizes the conditions of congestion, based on location, duration and intensity. The paper discusses and tests CoTEC (Co-operative Traffic Congestion Detection), a novel technique for effectively detecting congestion from road traffic using V2V communications.

The Iot creates network connection between different devices, and provides remote monitoring services. The purpose of information exchange between cooperative Intelligent Transport System (ITS) is to improve vehicle safety and driving efficiently by traffic or fuel. In critical and dangerous situations (e.g. traffic jam ahead or lane shift warning) the V2V contact can be used for specific warnings to the driver. State-of-the-art vehicles in tandem with an air bag system are fitted with three-point universal seat belts to reduce the risk of injury to passengers. Compared to standard passenger airbags, intelligent pre-crash systems can reduce loads by up to 20 per cent on average in special cases External airbags and synthetic pressure hoses filled with gas can improve additional absorption before the impending

collision. There was an idea to estimate optimal trigger points for the adoption of frontal restrain system for collision for exteroceptive sensor measurement. This method involves sharing vehicle condition-defining signals in case there is a very high risk of crashes. In this case, the potential collision opponent provides information such as kinematic measurements (e.g. speed, acceleration, yaw rate, etc.), Global Navigation Satellite System (GNSS) geographic position data, as well as crash-relevant parameters (e.g. mass, dimensions, rigidity). Then came the Intelligent Crash Prediction Idea, where we had methods for detecting and monitoring a possible collision vehicle and for predicting the extent of an imminent collision.

Vehicles regularly transmit broadcast beacons, also known as CAMs (Cooperative Awareness Messages), in cooperative V2V communication systems in order to announce their presence to neighboring nodes providing information about their speed and location. Many of the proposed techniques rely on regular exchange of specific packets (different from beacons or CAMs), which are not initially considered within cooperative standards and are transmitted to estimate road traffic conditions beyond the transmission range of each vehicle. With this strategy, vehicles infer information on road traffic density from the segments under assessment. IoT definition involves WSN and M2 M (Machine-to - Machine) communications networks. Connectivity, efficient energy management, stability, complexity and fast-paced development are the key problems emerging in developing IoT concepts.

There are numerous IoT applications such as Smart Power Grid, e-Learning, Smart City, Healthcare and Safety of the Environment. WSN field problems are the complexity of integrating large numbers of sensors and the coexistence of congested RF environment. LoRaWAN is made up of battery-powered devices which provide bidirectional communication. The LoRa network can be divided into the back-end and a front-end component using star network topology. The transfer rate for the LoRaWAN technology ranges from 0.3 kbps to 50 kbps. To optimize battery life span, the devices control their contact capacity and transfer rate. Classes are based on communication mechanisms employed such as Class A , Class B and Class C. The LPWAN (Low-Power Wide Area Network) proposes a compromise of lowering the data rate at the expense of longer communication range. For extremely low bandwidth there's a very wide contact gap. The technique for LoRa modulation is of type Chirp Spread Spectrum (CSS). If spreading factor increases, packet size will decrease resulting in higher channel power and longer communication distance.

II LITERATURE SURVEY

John S. Otto, Fabian E. Bustamente, and Randall A. Berry performed an early experimental study to determine the effect of practical radio transmission settings on the evaluation of Vehicular Ad-hoc networks. Signal propagation was found to continue to vary between Line-Of - Sight and Around-the-Corner communication. More accurate models were investigated to assess the effects of propagation later on.

Subsequently, Ramon Bauza, Javier Gozalvez and Joaquin Sanchez Soriano conducted a report on road traffic congestion focused on a cooperative vehicle for vehicle communication. These communications networks deliver new capacities for creating creative and sophisticated traffic control and management solutions. Therefore, this technique offered useful information in real time for road traffic managers, but one limiting factor was that a limited region was restricted. As well as physics involved in vehicle dynamics, it was determined that the reliability of these networks could be maintained by using the time history data present in the vehicle network.

A fundamental predecessor was initiated and completed to demonstrate cooperative vehicle localisation based on GPS fusion and inter-vehicle distance measurements. The position of each vehicle was determined by a GPS element which would transmit its respective vehicle's co-ordinates to a VANET cluster. Appropriate range sensors were used for distance calculation.

A study carried out in the field of IoT and LoRa by Alexandru Lavric and Valentin Popa provided remote monitoring and control services, and referred to M2 M communication. LoRa technology was evaluated in this model according to IoT requirements but only lacked in Gateway module that is needed for efficient transmission. Furthermore, the performance of the link reliability in cellular V2V communication has been improved.

Following this, Guang Yu Li, Quang Sun, Lila Boukhatem, Jimsong Wu and Jian Yang conducted a study on V2V Charging Navigation. That VANET-based communication paradigm, a semi-centralized charging navigation framework based on mobile edge computing (MEC). A specification should be implemented to improve the adaptive offloading calculation adjustment scheme. It was also determined that the theoretical structure for the platooning would increase the probability of failure, transmission, and mobility of vehicles. A sure probability of breaking is to be developed and more dynamic vehicles must be incorporated.

III PROPOSED METHODOLOGY

The proposed methodology provides an optimized safety procedure of passenger travel, with the help of an intelligent LoRa technology. The process can be segregated into the following steps:

1. Signal Transfer:

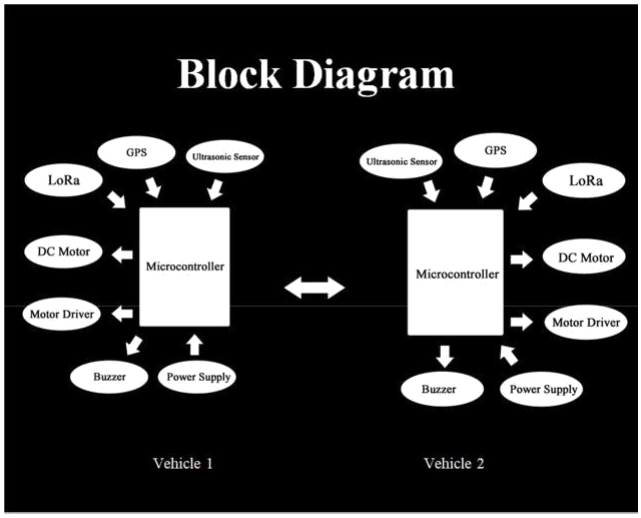
The ultrasonic sensor is responsible for the transmission and reception of signals from one vehicle to another. The sensor has a transmitting point that continuously transmits ultrasonic waves to the outer regions. The signal tends to disperse into air if the surrounding is said to be free or if there is no presence of any surrounding vehicle traffic. When there exists another medium, the ultrasonic signal bounces back from the other vehicle surface and gets reflected. The reflected signal now travels back to the reception unit present in the ultrasonic sensor.

2. Calculating Distance:

The time it takes for the signal to travel from its moment of transmission to its mount of reception aids in determining the distance between the user vehicle and that of the third party. The distance is calculated by keeping the speed of the ultrasonic waves in mind. The speed of the waves in a free medium is 340 m/s. The to-and-fro duration is factored in and the distance between the two commodities is calculated using the the speed, distance and time formula. The time is entered in a unit of seconds and the distance unit of meters. The speed is determined in meter per second which is appropriately converted to kilometer per hour. This measure is then used to work on the braking speed with which the vehicle has to slow down. Based on the unit of distance necessary safety protocols are to be implemented.

3. Implementation of Safety Protocols:

Once the speed and distance is determined, the appropriate safety measure set of instructions is to be executed. For this, the same set of measured are passed on to the third party vehicle with the same setup using LoRa. Due to the efficiency and long range of LoRa networks, the signals are transmitted quickly to the other commodity and safety measures are employed effectively. The presence of a GPS helps in determining the position of the vehicle, which is further used I determining the distance to break upon.

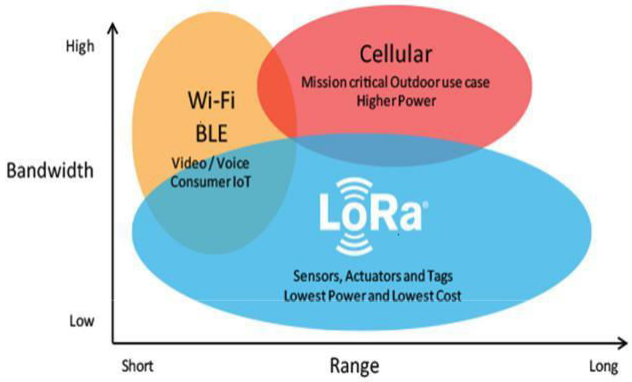


IV CONCLUSION

The proposed project proves to be a one stop solution for enhancing security and safety of the driver, in vehicle to vehicle communication. It can be used to administer and govern the flight of vehicles on the road. The vast expanse of traffic requires the need to enforce safety protocols. As this has been a difficult task to execute, we propose the use of inter-vehicular communication to help procure and secure consumers and passengers. Based on a survey, accidents are caused on a large scale due to human error as opposed to mechanical failure. Thereby, to prevent this, we utilize the LoRa and GPS and communicate and determine the position of the vehicle. The process is followed by implementing appropriate safety protocols tooth vehicles on both sides so as minimize the effect of protocols being established. The algorithm involved has been devised based involving various factors namely escape velocity and centrifugal force for circular paths. The proposed project proves that LoRa serves to be an efficient and effective means of communication as compared to Bluetooth and other wireless connectivity devices. The broadband range is appropriate and the bandwidth helps connect signals in a specific range. The speed of transmission is also improved so that the reaction time of the driver is also taken into consideration. The system works under LoRa technology as a result of which it proves to have a variety of benefits such as long range, low power and low-cost value. It enables encrypted signals thereby preventing any mix up. All these features make the LoRa Wide Area Network a better choice for the Internet of Things compared to the other wireless networks. Hence, this proves to be a secure, affordable and apt method to avoid the mishaps on the road.

V RESULT

Similar to Bluetooth and other wireless networking tools, we showed the transmission and receiver stimulation results, the new project shows that LoRa acts as an efficient and reliable means of communication. The broadband range is suitable, and the bandwidth helps to connect signals within a given range. The transmission speed is also increased, so that the driver's response time is not taken into account. The final result has been updated graphically in fig 4.3 and it is concluded that LoRa is more reliable medium compared to other mediums like Wi-Fi and Bluetooth.



V APPLICATIONS

- Connected vehicle grid.
- Smart traffic system.
- Accident prediction and avoidance system

VI FUTURE SCOPE

- The ecosystem supporting LoRa includes a comprehensive collection of network operators, hardware manufacturers, software designers, service providers, universities, and industry associations that play a key role in creating and enabling devices, networks and applications.
- The ecosystem is continuously growing — and continues to grow at an impressive rate in conjunction with widespread adoption of LoRa Technology

VII REFERENCES

1. John S. Otto, Fabien E. Bustamente, and Randall A. Berry, "The Impact of Radio Propagation on Inter-vehicle Wireless Communication" 2009 IEEE International Conference on Automatic Control and Intelligent Systems (I2CACIS), Selangor, Malaysia, 2009, pp. 324-330.

2. Ramon Bauza, Javier Gozalvez and Joaquin Sanchez Soriano, "Road Traffic Congestion Detection through Cooperative Vehicle-to-Vehicle Communications" in IEEE Access, vol. 7, pp. 133602-133614, 2010.

3. Vineetha Paruchuriv " Inter-vehicular Communications: Security and Reliability Issues" 2011 2nd International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I- SMAC)I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), 2011 2nd International Conference on, Palladam, India, 2011, pp. 27-29.

4. Mohsen Rohani, Denis Gingras and Vincent Vigneron " Cooperative Vehicle Localization based on fusion of GPS and Inter-vehicle Distance Measurements ," 2013 IEEE International Conference , St. Petersburg, 2013, pp. 10-13.

5. Jose´ Javier Anaya, Pierre Merdrignac, Oyunchimeg Shagdar, Fawzi Nashashibi and Jose´ E. Naranjo "Vehicle to Pedestrian Communications for Protection of Vulnerable Road Users' in 2017 IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM), Veltech Dr.RR & Dr.SR University, Chennai, T.N., India. 2 - 4 August 2017. pp.184-189.

6. S. A. Ghadage and N. A. Doshi, "Advantages in Crash Severity Prediction using Vehicle to Vehicle Communication," 2015 International Conference on Intelligent

7. Alexandru Lavric, Valentin Popa, "Internet of Things and LoRa Low-Power Wide - Area Networks," 2012 26th International Conference on Advanced Information Networking and Applications Workshops, Fukuoka, 2017, pp. 973-976.