IoT Based Smart Transport Management and Vehicle-to-Vehicle Communication System

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IoT Based Smart Transport Management and Vehicle to Vehicle Communication System

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Abstract. Vehicle to Vehicle (V2V) communication is an advance application and thrust area of research. In the current research the authors highlighted the technologies which are used in V2V communication systems. Advantage of such technology is that it helps to detect live location and tolling. It plays an important role if there are huge amount of traffic. In the current research we can get more information about Lifi, RFID, VANET and LORAWAN Technology. Lifi is known as VLC communication system which uses visible light for high data transmission and reception. RFID technology helps an emergency vehicle to reach destination quickly by avoiding any kind of traffic. LORAWAN is a large-scale network technology with a long range and VANET with low power that lets you obtain accurate traffic information on each route. It saves time. The comparison between the different technologies are reviewed in order to get the optimized technology as per the applications.

Keywords: Internet of Things (IoT), vehicle to vehicle (V2V) communication, Li-fi, RFID Tag.

1. Introduction

IoT is one of the most significant, dynamic and groundbreaking research contributions of the 21st century [1]. IoT has brought a drastic change in the lifestyle of every individual through its vast range of applications. The best part in the current development is the storage of data in cloud. The use of IoT based application is implemented in almost all the fields. Transport management system has several limitations and is constrained by existing technologies. Advance tools like LiFi, RFID, LORAWAN and VANET are discussed in the current research. Currently, the use of IoT with LiFi Technology is implemented and executed in Transport management system using V2V communication system. Authors described the effectively the use of Lifi in V2V Communication [2]. This technology uses several Input and Output devises. The use of Lifi created the easiness in the data transmission and storage capacity. The hardware and software components, Lifi Communicator system, etc. needed for Lifi technology are discussed below.

1.1 Hardware Component needed for Lifi Technology

Following are the conventional hardware components used in the execution of Lifi Technology:

- **Sensor -** Sensor is useful to find out the speed and distance of vehicle
- **LED Light (Transmitter)**- White LED will be used for data transmission from vehicle 1 to vehicle 2.
- **Photodiode** - Photodiode will be used for data detection
- **Wi-Fi Module** - For this system we require efficient communication using the internet.

1.2 Software Used for Lifi Technologys

Following are some of the software which are very useful in the development and execution of Lifi Technology:

- **Arduino IDE -** Arduino is used to install Arduino UNO board. Program written using Arduino software are called sketches**.**
- **Telegram App -** Telegram App is used to directly send the accident location to the hospitals and police station.

1.3 Lifi Communicator Systems

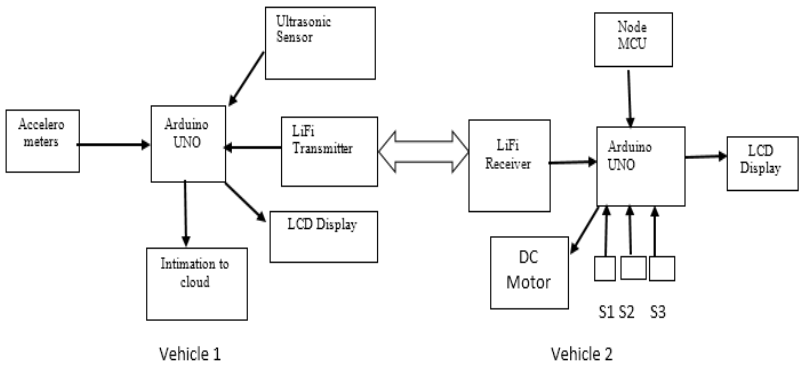

Fig. 1. Systematic block diagram for Lifi communication.

Lifi Communication system as shown in Fig. 1 consists of accelerometer, Arduino Uno, cloud intimating device, ultrasonic sensors, LiFi transmitter and receiver, LCD display, Node MCU, DC motor, etc. Some important points that need to be considered while using Lifi for transport management system includes:

a. Activation of sensors and actuators is necessary to enable vehicle to vehicle communication between 2 vehicles.
b. The Sensor reads the received data, interprets it and then transmit it in the suitable form to another vehicle under communication.
c. The complete Data is processed by Microcontroller.
d. The update and real time modification is done using cloud based technology.

1.4 Limitation of Li Fi Technology

When it comes to technological advancements, there are several limitations associated with the technology. Following are some of the limitations of LiFi Technology which can be treated as further area of research in the field of V2V communication.

a. Lifi works on limited light range (suitable under visible light only).
b. Interference in LiFi occurs in Sunlight.
c. The major drawback in LiFi fidelity is that it shows poor performance in dark.

For fulfilling the limitation of Lifi we have to use RFID ((Radio Frequency Identification Tag) Tags for vehicle to vehicle communication. It is also an important cloud based tool.

2 RFID (Radio Frequency Identification Tag) Technology

RFID Tag is used for transmitting and receiving information via an antenna and a microchip. It is also called integrated circuit (IC). RFID Tag is used for Live tracking, tolling and real time vehicle tracking application. Many researchers have effectively highlighted the design and working of RFID Tag to track data in V2V communication application [3]. They are small in size, lightweight and can potentially last a lifetime.

2.1 Working of RFID Tag

According to this system all vehicles have radio frequency identification tags placed on them. RFID reader reads tag from vehicle and turn green. It is basically used to count no of vehicles passed through signal [4]. When emergency vehicle passes on the road. It will convert Red.

2.2 Limitations of RFID Tags

There are several limitations of RFID Tags as compared to other labels. Though it has wide range of applications but RFID tags needs lots more improvement in terms of security. Some of the limitations are mentioned below:

- RFID tags are not suitable for no reasons including protection and technical problems compared to other marks.
- RFID Tags are not possible for readers to differentiate. Almost everyone can read details.

2.3 Vehicle to Everything Communication (V2X Communication)

IoT based vehicle to everything communication is another good technology which is very helpful in vehicle navigation, vehicle transportation management and vehicle security management. The insights for this are mentioned below [5].

a) **Communication Type Insights -** V2I and V2V plays an important role if there are huge amount of traffic.
b) **Connectivity Type Insights** - Such systems are being installed in cars.
c) **Vehicle Type Insights** - Scope of Vehicle to everything technology is increasing day by day.

For connecting to the cloud we can use LORAWAN. With the help of LORAWAN we can easily identify the parking area in which the vehicle is parked.

3 LORAWAN Technology

LORAWAN, a long range, low-power wide area networking technology enables several advance services which are not possible through other network based technologies [6]. LORAWAN provides best battery life and it is very economical is a Wide area network. It's cost is too less. It's battery life is too good.

3.1 Implementation of Proposed Framework

LORAWAN implementation requires a specific set of framework for implementation [7].

V2V Communication - Beacon is used for scanning nearby devices. In this, the first 8 bit consists of manufacturer code, the next 20 bits has the vehicle information, the next 2 bits has the information about type of vehicle and the last 2 bits shows the emergency situation.

UUID - Universally Unique Identifier (UUID). We can divide it into 5 groups.

3.2 Proposed Framework

Lights are used for scanning surrounding vehicles. For instance, if one vehicle journeys steadily and the second vehicle travels at high speed. With the help of a beacon an alert message will be passed to second vehicle. Hence collision is avoided and the vehicle can pass easily without any interference.
V2I communication - With the help of V2I communication we can collect information from the cloud.
V2V communication - Here transmission is possible between nearby vehicles. It had some major problems like Bluetooth low energy consume less power.

Limitations of LORAWAN
LORAWAN has several limitations such as we can only send small packets through LORAWAN. For large packets it is not suitable. LORAWAN is not suitable if you want to control light in your house.

4. Vehicular Adhoc Network (VANET) Technology

VANET is a developing technology now a day [8]. It helps an emergency vehicle to select best routes with no traffic for reaching the destination easily. System also generates a warning message if an emergency vehicle meets an accident.

4.1 Working of VANET

VANET can be used in simple cases as illustrated in Fig. 2 and Fig. 3. In Fig. 2, an emergencies vehicle is initially at rest in the parking lot of the hospital. Following this the vehicle allocated a destination of urgency with two separate roads. Emergency vehicles should select the best route in order to reach their destination fast [9].

Fig. 2. Case 1: Traffic management system testing [8].

driver can know more about best route by sending a message 'route status'. The optimized and less traffic route can be identified. When the message will be sent, GSM will send information to the hospital informing about best route which is more preferable. Vehicle now travel the best route. The use of this technology enables the driver to provide the fastest, safe and least traffic route which saves life, money and time of the complete process [10].

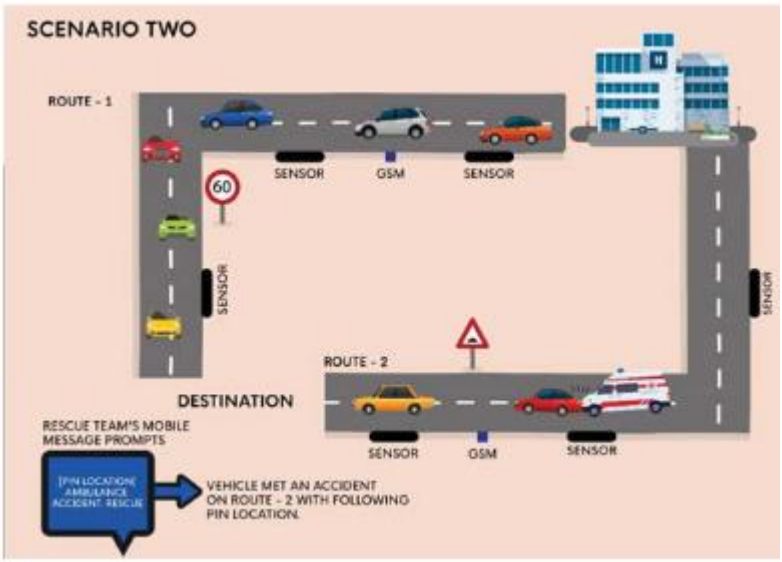

Fig. 3. Case 2: Traffic management system testing [8].

Fig. 3, highlights the scenario 2 for traffic management system testing where different sensors and GSM module is installed in the vehicle under communication to rescue the uneven happening through mobile messaging. This is even advance concept then simply IoT. In case if an emergency vehicle meets an accident, a message with location will be automatically send to the relevant rescue authorities [11].

4.2 Emergency application for V2V communication

In an emergency application for vehicular network, warning messages included auto collisions, street traffic and so on and then large number of duplicate packets congest networks [12], [13]. The V2V communication works under ultra-low latency of data and information sharing among users [14], [15]. Several corporate and business issues can be easily rectified using the advance industry 4.0 based technology. Reduction in response timings can be systematically analyzed in V2V communications.

4.3 Vehicle to Infrastructure communication

It is a combination of V2V and V2X, vehicle to infrastructure communication is the communication from accident vehicle to base station. The message is for emergency situation which forward it to the nearby rescue center. The architecture also works in security management along with the traffic management system.

5. Conclusion

The current manuscript reviewed on the applications of IoT in vehicle to vehicle communication system. Different technologies like LiFi Technology, RFID Tag, VANET and LORAWAN Technology are highlighted along with its limitations and applications in vehicle to vehicle communication system. Also the limitations of all the systems are highlighted in the research. The amalgamation of different IoT based tools can finally summarize the utility based on the application, specification and the nature of use. The further scope of research is being tried to identify from the limitations in existing technology and infrastructure. Also the use of V2V communication using advance Industry 4.0 tools can reduce the efforts, time requirements and money in different monitoring and security applications. Data capturing and modification is optimized using these technologies.

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