Intelligent Accident Rescue System

Vishant Kumar, Sandesh Tyagi, Sakshi Garg, and Deepti Mehrotra

Abstract Vehicles on roads are increasing day by at a very fast pace. This increase in vehicles has also increased the number of road accidents. Every year, an average of 150,000 people die due to accidents in India. Therefore, it is necessary to evaluate such scenarios where first aid and rescue can be provided at the accident site or the breakdown site at the earliest. In this paper, we have proposed a solution for situations where rescue is needed. We have taken the scenario of school buses as nowadays school buses get late in reaching school due to traffic jams, road accidents, etc. A network of school buses has been created in which if the drivers or the passengers get to know about the traffic jams ahead on the road, then the driver can take another path and reach on time or in case of bus breakdown, the driver or the passengers can send the signal to the other nearby bus drivers for rescue. This has been established using the OMNet++ tool using the SIoV concept. The results obtained are promising with a fully deployed functional network that is capable of providing help to the victim node at the earliest.

Keywords V2V · SIoV · Intelligent rescue system · RSU · OBU

1 Introduction

As the world is changing day by day, people are focusing more and more on Internet of Things (IoT). Today, we see everything is getting smarter. We see smart homes, smart cities [1], and many smart devices which make things easier and smarter. Vehicles are also getting smarter day by day with the help of Internet of Vehicles (IoV) [2]. IoV vehicles are equipped with sensors and other technologies which help connect with other vehicles to transfer or receive data. We see many accidents occurring on roads due to a lack of concentration of drivers; the cars get off the roads and crash. If a vehicle has an early warning system, these types of crashes can be avoided. There

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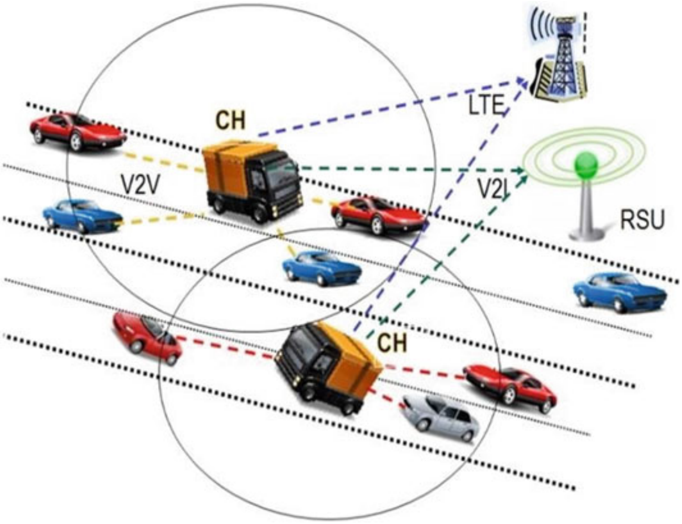


Fig. 1 SIoV

could be a situation in which one vehicle is stuck in traffic. In such cases with the assistance of V2V communication, the vehicle which is stuck in traffic can inform other vehicles to go for a different route as in Fig. 1.

From IoV, SIoV [1] came into the picture. In SIoV [3], the vehicles that are having common interests are socially connected with each other. In SIoV, vehicles connected with each other share information of common interest like vacant parking places, weather conditions, traffic information, etc. An instance of SIoV [4] considers a scenario where an ambulance carrying a patient is moving towards a hospital. Now while moving, it connects with other ambulances to know the traffic condition on the way to the hospital so if traffic is there the ambulance gets notified earlier and then it can change the route. SIoV does not just socialize or connect vehicles, it also connects the driver or passengers. Sensors are also attached to the vehicles which show information about the vehicles like whether the vehicle is working fine or not to the driver or the passengers. Our major contributions to this study are as follows: first, to provide a system which can effectively rescue an accidental vehicle. Second, a system which is multipurpose or can be used in many domains like ambulance, defence, school buses management, etc., and last, to get real-time traffic information and inform other connected vehicles.

The paper is further organized as Sect. 2 which is the literature review, and Sect. 3 is the methodology applied in the paper. Section 4 is the data analysis and results, and Sect. 5 is the conclusion.

2 Literature Review

SIoV is a new technology and the recent work done in this field was explored to identify the gap. It is given in Table 1.

Table 1 SIoV overview

S. No	Author	Application	Tools and Protocol used	Differences	Year
1.	Atzor et al. [5]	This paper tells us about the implementation of social internet of vehicles using cloud and virtualization techniques	Utilizes Intelligent Transportation System Station engineering (ITS SA) using Bluetooth 802.11p and Wi-Fi	It is different from our paper in a way that it does not make use of any simulator such as SUMO or NS3. It primarily focuses on implementing Social Internet of Vehicles using cloud and virtualization techniques	2018
2.	Abbas et al. [6]	Gives another street-mindful steering plan for Internet of vehicles by computing the assessed way ter	Used SUMO and NS3 simulator with IARAR protocol	This is different from our paper in a way that it emphasizes factors affecting the Internet of Vehicles (IoV) but we have focused on energy consumption. It also makes use of the IARAR protocol but in our paper, we have used TCP/IP and UDP protocol	2019
3.	Zia et al. [7]	This paper gives a specialist-based model of a suggested framework with cutting-edge SIOV	Uses the NetLogo which is created in an agent-based environment	It basically focuses more on an agent-based model. It does not even talk about the security of the model. Here, we discussed more of the security issues and the ways in which one can tackle them to prevent any piece of information from being exploited	2019

(continued)

Table 1 (continued)

S. No	Author	Application	Tools and Protocol used	Differences	Year
4.	Zang et al. [8]	MDTCS data transmission algorithm was given in this paper which is based on single-to-noise ratio	Uses MDTCS algorithm and the ISing model	This paper is different from our paper in a way as it focuses more on the data transmission. It highlights the challenges to guarantee the steadiness of information transmission because of quick organization geography changes, high information transmission deferrals and a few different reasons	2020
5.	Vershinin and Zhan [9]	The following paper mentions the security consciousness of the vehicle-to-vehicle dedicated short-range communication	Uses the MATLAB tool for simulation and works on RSA algorithm	This paper does talk about the security issues in vehicle-to-vehicle to communication but in our paper, we have attempted to involve better recreation programming for fostering the security execution of the DSRC	2020
6.	Arooj et al. [10]	In this review, they proposed the cross space, incorporated and examined the key elements to address different related viewpoints to diminish the intricacy among heterogeneous information sources	Makes use of OMNeT++ and the SUMO tool	This paper focuses more on the Internet of Vehicles, but we have focused more on SIOV, a subdomain of IOV	2020

3 Methodology

It is studied that there are very few studies that have discussed SIoV concerning emergency situations. Since no system is available which can provide rescue in emergency situations, our basic idea is to develop an artificial environment to test such situations and develop a system using SIoV which can provide emergency support and can be useful in many domains like Defence, Ambulance, and school buses. To develop an artificial environment, we have used SUMO and OMNet++ and we have analysed data collected from OMNet++. Also, Python script has been used to filter the data and generate graphs for further data analysis. Fig. 2 also gives a flow of the methodology.

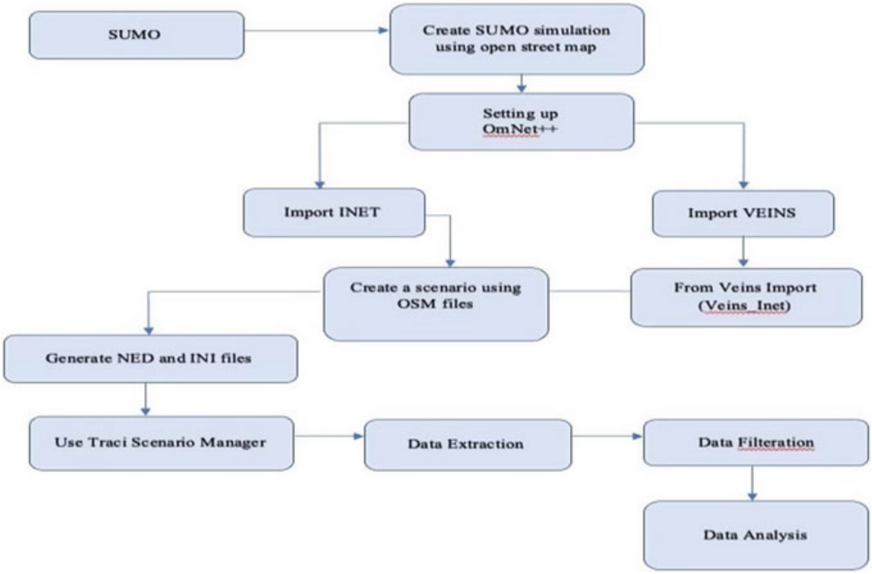


Fig. 2 Flowchart for this work

3.1 Sumo Simulation Details

For making connectivity between school buses and vehicles, Simulation of Urban Mobility (SUMO) is used. SUMO permits displaying of intermodal traffic frameworks including street vehicles, public vehicles, and people on foot. In this, we have created a real-time traffic scenario. For the network scenario, we have to use SUMO open street map (OSM) feature to create a real-time network scenario of Noida Sec 125 near Amity University Noida.

Setting up OMNet++: We imported the SUMO OSM file in OMNet++ to display a real-life situation. For making a V2V interface simulation and for a better picture of the network, Veins is used which is an open-source network simulation framework for running vehicular-based projects which can offer unrestricted extensibility. OMNeT++, an extensible modular and compound-based C++ simulation library and framework for building network simulators, supports a variety of frameworks such as INET and Veins for vehicle-to-vehicle communication (V2V). It supports TCP/UDP protocol.

3.2 Data Extraction

Below here, it can be seen that in OMNeT++ simulation, the map that we've fetched from SUMO is working perfectly fine and vehicles are moving on roads. The portion

Table 2 Dataset parameters

Parameters	Definition
Total distance	The total distance refers to the actual distance between the origin and destination locations of the substance
Total CO_2 emission	Total CO_2 emission is basically the data of total CO_2 emitted by vehicles. Stop time: stop time is the time at which the vehicle stopped. Start time: start time is basically the time the vehicles have started moving
Total lost packet	The total distance refers to the actual distance between the origin and destination locations of the substance
SNIR lost packets	Total CO_2 emission is basically the data of total CO_2 emitted by vehicles. Stop time: stop time is the time at which the vehicle stopped. Start time: start time is basically the time the vehicles have started moving

below the map shows the data like which vehicle is moving in which lane, etc. Time is also previously set for vehicles moving on the road. As we can see in the data shown below the map, the vehicles move every 124 ms.

Datasets. The dataset below shows us the following details as explained in Table 2.

The formula for the same is given below

$$\text{SNIR} = \text{Signal Power}/(\text{Noise} + \text{Interference power}) \tag{1}$$

3.3 Data Filtration

Data filtration is done to remove the multiple fields and any null values in the dataset that weren't necessary for the study like CO_2 emissions, etc. For this, a Python script is created to filter out the data and a code is written and implemented based on Python inbuilt libraries to create various graphs using Python script.

4 Data Analysis and Results

Data analysis is used to extract meaningful information from data and make decisions based on that knowledge. Analysing our past or future and making judgments based on it is what this is all about. After the deployment of the network over the simulation tool, we could establish a socially connected network where in case of an accident the nearby accessible active nodes can provide aid. So, during simulation we observed that nodes 68 and 70 had an accident. So, they reached out for help to other nodes in the network. We can see from the simulation that an accident took place between node 70 and node 67. Now if we see below that, node 70 is sending a signal to all other nodes that are there within seconds. Similarly, if two accidents occur then the nodes are capable to send a signal to other nodes or vehicles simultaneously.

After doing the analysis of nodes, we've created a graph which shows the SNIR packet loss for different nodes for node 70 and node 68 as in Figs. 3 and 4, respectively. The broadcast messages for node 68 and node 70 are shown in Figs. 5 and 6, respectively. These figures show a graph for node 68 and node 70 SNIR lost packet for different datasets like 130 nodes, 145 nodes, 160 nodes, 180 nodes, and 200 nodes.

Broadcast devices are simple messages from other apps or the system itself. These signals are referred to as events or intents on occasion. For example, applications can send out broadcasts to inform other apps that data has been downloaded to the device and is ready for them to use; the broadcast receiver will intercept this communication and take the required action.

Fig. 3 Node 70 SNIR packet loss

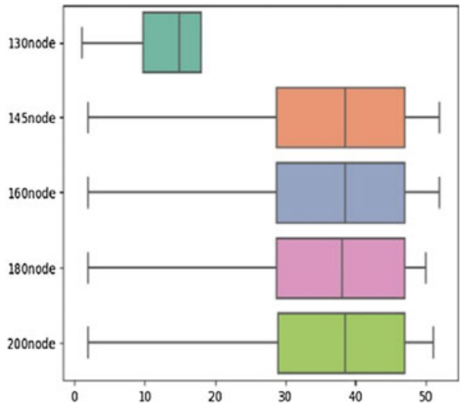
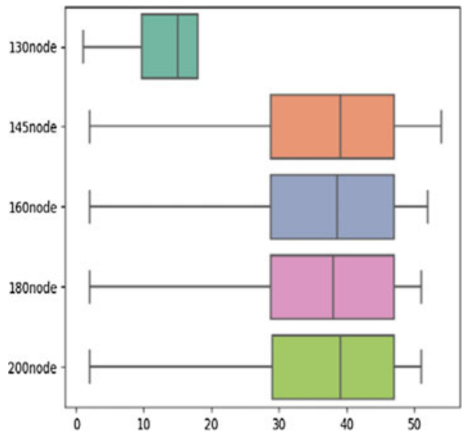


Fig. 4 Node 68 SNIR packet loss



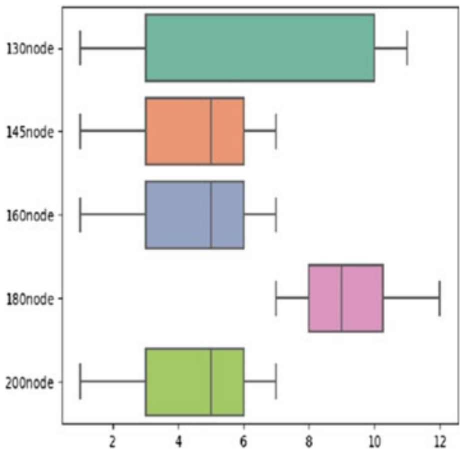


Fig. 5 Node 68 broadcast receiver

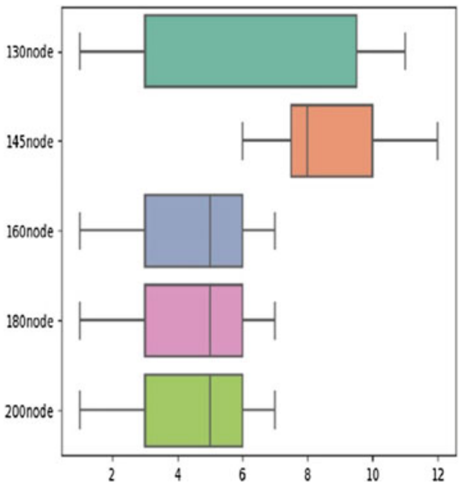


Fig. 6 Node70 broadcast receiver

The aim was to build a simulation to manage the connectivity between school buses in OMNet++. In the simulation, we could see that the vehicles are moving on roads and are perfectly visible with the time set at 113 ms.

5 Conclusion

In this study, a simulation has been developed by using OMNeT++, Veins, and INET. In this work, we varied the number of vehicles and did 5 simulations as 130, 145, 160, 180, and 200 vehicles or nodes to create connections and make them communicate with each other. As shown above, when the first node meets with an accident, it sends a packet named accident first to the radio manager and then sends it to the nearby other two nodes. In the paper, there is a brief explanation of the concepts used to achieve our goal. In the paper, we were able to gather datasets for 4 different node network for better results. Those numbers are 130, 145, 160, 180, and 200. In this paper, we showed communication between the vehicles. This is very helpful and if used in the real world, it could solve many problems like the problem of a school bus when stuck somewhere or it could be very helpful in emergency vehicles. The solution is not just helpful for school buses but is also helpful for emergency vehicles. We see many deaths in ambulances that take place daily in India because of not reaching on time, so with this, the vehicles could reach on time and lives can be saved.

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