



Article

Intelligent Road Management System for Autonomous, Non-Autonomous, and VIP Vehicles

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Abstract: Currently, autonomous vehicles, non-autonomous vehicles, and VIP (emergency) autonomous cars are using intelligent road management techniques to interact with one another and enhance the effectiveness of the traffic system. All sorts of vehicles are managed and under control using the intersection management unit approach. This study focuses on transportation networks where VIP cars are a major disruption, accounting for 40% of accidents and 80% of delays. Intelligent Mobility (IM) is a strategy promoted in this study that proposes setting up intelligent channels for all vehicle communication. As part of its function, the IM unit keeps tabs on how often each junction is used so that it may notify drivers on traffic conditions and ease their workload. The suggested layout may drastically cut average wait times at crossings, as shown in SUMO simulations. The entrance of a VIP car should disrupt all traffic, but the IM (intersection management) unit effectively manages all traffic by employing preemptive scheduling and non-preemptive scheduling techniques for all types of vehicles. We are employing Nishtar roads, the M4 motorway, Mexico, and Washington roads in our scenario. In comparison to all other routes, the simulation results demonstrate that the Washington road route is better able to manage all vehicle kinds. Washington's traffic delays for 50 cars of all sorts are 4.02 s for autonomous vehicles, 3.62 s for VIP autonomous vehicles, and 4.33 s for non-autonomous vehicles.

Keywords: autonomous vehicles; non-autonomous vehicle; VIP vehicle; preemptive scheduling; non-preemptive scheduling



Citation: Naeem, A.B.; Senapati, B.; Islam Sudman, M.S.; Bashir, K.; Ahmed, A.E.M. Intelligent Road Management System for Autonomous, Non-Autonomous, and VIP Vehicles. *World Electr. Veh. J.* **2023**, *14*, 238. <https://doi.org/10.3390/wevj14090238>

Academic Editor: Grzegorz Sierpiński

Received: 6 July 2023

Revised: 21 August 2023

Accepted: 25 August 2023

Published: 1 September 2023



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1. Introduction

In the modern era, autonomous and non-autonomous vehicles are converting and implementing intelligent road management methods to interact with other vehicles to increase traffic system efficiency. Intersection management units are a system for dealing with and regulating all types of traffic [1]. The computer system design of our commercial autonomous cars is presented in this study, together with thorough performance, energy, and cost assessments. This article has two goals based on our commercial deployment experience. First, we identify design restrictions specific to autonomous cars that may alter how we approach current architectural difficulties. Second, we identify novel architectural and system concerns that may have received less attention in the past but are crucial to autonomous cars [2]. This document shows the computer system architecture of our commercial autonomous cars and offers in-depth cost, energy, and performance studies.

This study aims to accomplish two things by using our commercial deployment expertise. To potentially alter the way we approach current architectural challenges, we first outline design restrictions specific to autonomous cars. Second, we uncover fresh issues with architecture and systems that have maybe not received as much attention in the past but are crucial for autonomous cars [3].

The transport management system consists of the few critical components. Routes, transportation, building, and hiring are all aided by a city's road network, making roads a critical component of every prosperous metropolis. They are also very important in helping to alleviate poverty. The upkeep of roads and other urban infrastructure, such as sidewalks, is now under scrutiny by academics and local officials. The number of years a road has served its intended purpose may be used to estimate its remaining pavement life cycle. The condition of local roads is essential to citizens' daily life; hence, it is important that this topic receive sufficient attention in educational curricula [4].

Soft computing approaches are used in the design and implementation of intelligent evacuation algorithms for crowd control management. The paper discusses evacuation navigation routes, options for evacuation, and video and non-video-based features of crowd surveillance and disaster prediction. Deep reinforcement learning (DRL) is used to learn complex rules in high-dimensional settings, while autonomous vehicle (AV)-based Intelligent Transportation Systems (ITS) offer a great playing ground for policy-driven DR [5].

This research focuses on all types of autos in the transportation system, where VIP vehicles join the road and disrupt the whole system. Accidents are a common occurrence in the road system. Junctions account for 40% of all traffic accidents and more than 80% of all road delays. This reduces traffic congestion, reduces the number of cars on the road, and improves road safety. There are various methods for managing junctions, each with its own set of features, restrictions, benefits, and downsides. In the recent age, most of the VIP vehicles makers are from developed nations like the USA, China, Korea, Germany, Italy and the UK, and they have been using quantum computing for industrial manufacturing as zero factory concepts where the VIP vehicles have a better managed inventory; PMA and OEM characteristics are managed in the upcoming quantum computing capabilities.

Autonomous and non-autonomous vehicles, as seen in the road and transport management systems, can be supported by "quantum computing for industrial management" and the "quantum communication theory" in today's age of technology and quantum computing. Work with quantum computers continues to advance at major automakers including Mercedes, Audi, and the Volkswagen Group. Adopting the quantum computer, they have developed a traffic management system that will replace forecasting for urban traffic volumes, transport demand, and travel times with precise calculations. This is a first for the transportation management and road management systems for the autonomous vehicles. To cut down on customer wait times, public transit agencies, taxi services, and other transport management service providers may more effectively deploy their fleets. Conventional supercomputers cannot compete with the speed at which quantum computers can handle problems like traffic planning. Quantum computers may be the sole option for solving some problems. Automakers believe that there is significant opportunity in using this cutting-edge computer technology to create innovative internal applications and commercial models [5,6].

This paper's contributions are mentioned below.

We advocate for an IM approach that establishes intelligent channels for all types of vehicles and their communication. The IM unit monitors who is currently utilizing the junction. When a vehicle is within the communication range of an IM unit, it may receive traffic updates, allowing it to avoid approaching a junction before it is safe to do so. The strain on the IM unit is considerably decreased since all of the demanding computing tasks are conducted on the vehicle side. Simulations utilizing SUMO (Simulation of Urban Mobility), the results of which reveal the commonly used scheduling technique, show

that the proposed design may significantly minimize the average wait time caused by the intersection.

This work is organized as follows: Section 2 contains the literature review. Section 3 describes the methodology of the study. In this section, first, we explain the problem formulation of the paper, then explain vehicle flow using the SUMO process and junction management system with network routes, and lastly explain the traffic management plan with collision process. Section 4 discusses the results and explains the performance of all vehicles. Section 5 finally describes the conclusion and future work.

2. Literature Review

Conditional automation (TOR) allows human drivers to delegate driving dynamic tasks (DDT) to automated driving systems (ADS) and only be ready to regain control in emergencies. This paper reviews existing research on TOR and conditional automation, highlighting concerns and providing conceptual foundations for effective ideas and reports on real-world cases [6]. It also compiles standards and guidelines for autonomous driving, discusses techniques and limitations, and provides conclusions. In Singapore, the DART system addresses the capacity gap between existing Mass Rapid Transit (MRT) and bus systems by integrating fully autonomous vehicle modules into a high-tech, environmentally friendly, and effective system architecture [7]. The authors consider various elements, such as bicycles, pedestrians, public transit indications, shared space, bike lanes, public transit networks, segmentation of modes of transportation, reduced trip time and distance, policy changes, and technological innovation [8]. The paper proposes an innovative traffic management system to reduce difficult junction and behind-intersection traffic congestion, considering new trends and issues like automated delivery services, urban flying cars, and autonomous automobiles [9]. A framework for message broadcasting, intelligent traffic signal control (STSC), and adaptive traffic signal control (ATSC) is proposed for various transportation applications in smart cities [10]. A new traffic signal design is created specifically for the E.V.S.P scenario, allowing motorists passing through the intersection of the direction of the emergency assistance vehicle (EAV) [11]. V2X correspondences (ITS) are a novel paradigm for intelligent transportation systems with AI-targeted artificial neural networks being assessed for reducing or eliminating traffic volume when non-autonomous vehicles participate in mixed traffic flow circumstances in South Africa [12]. This research aims to demonstrate framework flexibility and accommodate multiple moving machine components using simple linkages. Autonomous vehicles are popular due to their safety and efficiency, but unresolved safety issues remain unresolved. Joint analysis of these vehicles' security and safety is lacking [13].

Before they may be used extensively, autonomous vehicle manufacturers must overcome a significant moral quandary: ethical algorithmic performance [14]. Similar to other inevitable catastrophes, fundamental dynamic situations in which at least two or more lives are at risk are offered to autonomous vehicles. Moral conundrums occur in certain situations, such as whether to give one's life to save further fatalities [15]. People's lives are categorized using algorithms based on predetermined standards. This approach uses deletion, insertion, and other operations to prioritize between nodes with various properties. BST is treated as a crucial queue and is placed in a priority queue. In this calculation, the likelihood of survival is also referred to as the probability of endurance. Customers and automakers may now create moral decisions based on their values by introducing an adaptable and unstable algorithm [16].

Because of the increased need for mobility, the transport infrastructure has experienced significant changes. Inefficiencies result in large time losses, a decrease in pedestrian and vehicular safety, high levels of pollution, and a decrease in quality of life. The purpose of this essay is to provide cutting-edge capabilities for training automobiles as well as controlling traffic and safety jointly [17]. This will be accomplished by designing the proposed functionality, which will include, at a high level, (1) sensor networks made up of nearby vehicles exchanging traffic-related information throughout the transportation

infrastructure. The objective of the three basic sections listed above is to offer drivers and the transportation system as whole instructions that are useful for controlling context. [18]. The sensors put on roadway surfaces by MTM's traffic innovations were used to filter and manage the daily passing traffic at the traffic counter [19]. The phrase ITS refers to a group of technologies that may improve transportation system management, public transit, and individual travel choices [20]. ITS includes modern automated technologies that seek to improve the convenience, efficacy, and safety of surface transportation. Even though it is not one of the primary goals of ITS, reducing energy usage has been proven to be beneficial in some cases. This paper reviews and summarizes the primary energy benefits of a variety of ITS systems. Models, pilot studies, field testing, and large-scale deployment have all validated these benefits [21]. The Intelligent Transport System (ITS) is becoming more and more crucial and necessary for a nation as a result of the quickening pace of current economic and technological growth [22]. The reality is that depending only on the growth and building of transport infrastructure does not fundamentally resolve the current transport issues and sometimes makes them worse. Therefore, every nation is currently researching ITS technology to address traffic issues [23].

The amount of ITS and research fields development, however, varies owing to the diverse money investment conditions, current technical merit, and various traffic difficulties for each nation. To create an integration model, this study combines the ITS technologies and focuses on comparing and analyzing worldwide ITS research. We see the traffic issue as a worldwide issue as well as a problem for certain nations. The communication of technology should be improved, and ITS methods should be updated and improved [24]. Transportation systems in modern civilization face substantial issues, such as traffic congestion. Technology for communication and information is becoming more important in modern transportation networks. Automakers are developing in-vehicle sensors for use in several applications, including recreation, traffic management, and safety [25]. Government agencies have put in place roadside infrastructure, such as cameras and sensors, to collect weather and traffic data. It is feasible to develop intelligent and smart transportation systems by seamlessly integrating automobiles and sensing equipment and using their detecting and communication capabilities [26]. We discuss how sensor technology may be linked to the transportation network to establish a sustainable ITS in addition to how several sensors put in different ITS components can aid with safety, congestion control, and entertainment applications. Finally, we discuss some of the difficulties that must be addressed to create a collaborative and fully effective ITS system [27].

3. Material and Method

This section contains the methodology of the study.

3.1. Intersection Environment

Junctions come in a variety of shapes and sizes. We want to concentrate on the often-seen four-way junction, also known as a crossroad, as shown in an intersection environment in Figure 1. However, the recommended method may easily be applied to several junctions with various layouts. An average intersection has twelve incoming lanes. The ID for each lane is numbered clockwise from the top and is unique. Since each lane only travels in one direction, this crossing is straightforward.

The following presumptions were established to provide a consistent environment in which the result may be repeated before developing the IM technique. We should thus be informed of the present traffic condition. Assume that the following statements about our circumstances are always accurate.

1. Vehicles operating on lanes must travel in the lane's direction since all passing and lane-changing have already occurred.
2. All vehicles—VIP, autonomous, and non-autonomous—may go at a fixed pace in a certain lane.

3. It seems that VIP cars and other traffic components, such as pedestrians, are not taken into consideration.
4. All vehicles will automatically communicate with the IM unit whenever they enter the communication range. In other words, there is no information packet loss, communication time latency, or unwanted information insertion. Thus, $T_l = T_c = P(loss) = 0$ where T_l is lag time, T_c is communication time, and $P(loss)$ is packet loss information.
5. All of the time and speed predictions given by AV and OV are accurate. Further AV and OV decisions are based on these calculations.
6. Normal automobiles use the onboard unit (OBU) to obtain information from the IM unit.
7. The IM unit supports and controls all VIP vehicles as they enter routes.

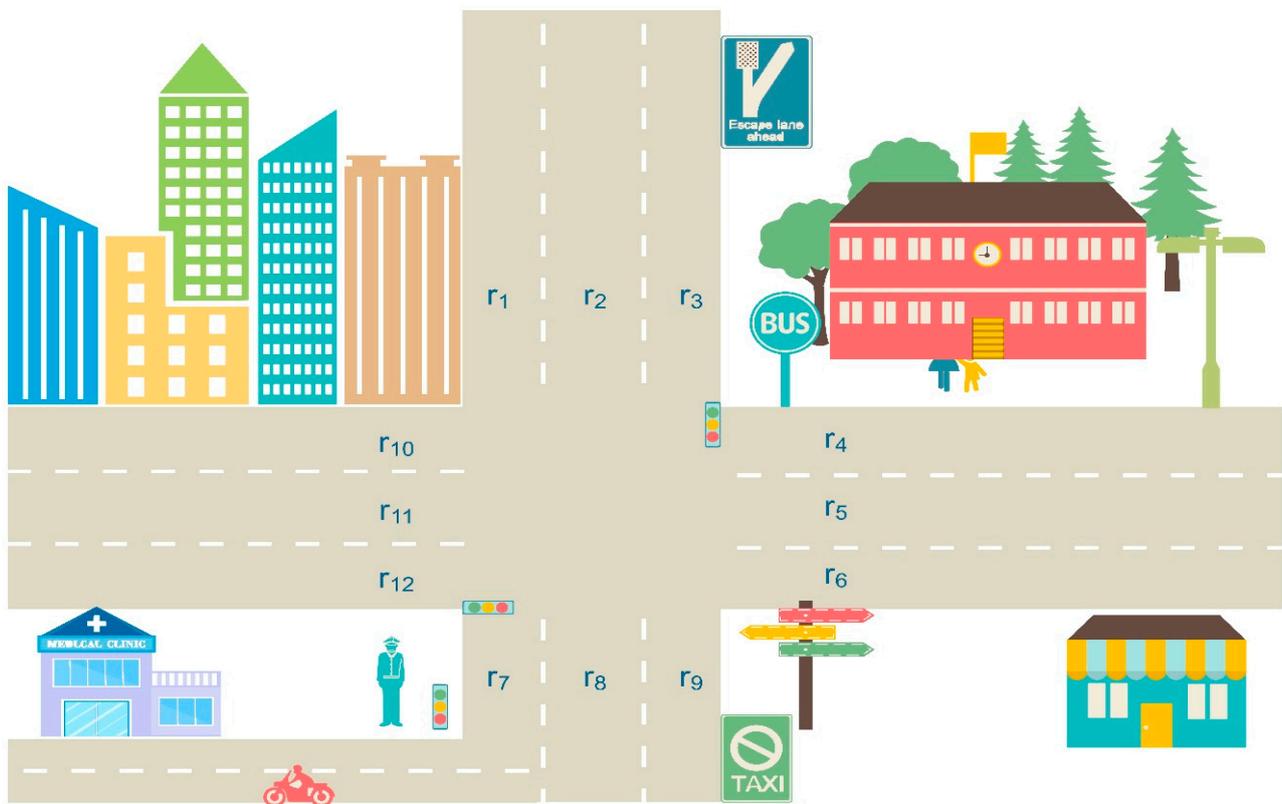


Figure 1. Intersection environment.

3.2. Algorithm Control Strategy

Figure 2 is shown as a flow diagram for the AV/OV process utilizing AIMS.

As a tactic for avoiding disagreements at intersections, the default setup will be given to all information within IM listings at first. Preemptive and non-preemptive scheduling approaches are used in IM unit work. As a result, it gives basic vehicle data for all cars as well as IDs such as Vid and Rid. When a vehicle enters the communication range of the IM unit, which may be hundreds of meters distant, basic vehicle information such as its Vid and Rid are relayed to the device. If there are no potential conflicts, the collision warning system will transmit a NULL signal to the car making the right turn, indicating that it has successfully passed the junction. Otherwise, look for any feasible detours from route “i.” As a result, each car that is presently parked at the intersection will have its data displayed. It will determine the maximum duration for the present car by calculating the t_{max} for all vehicles and returning the correct max leaving time, or t_{max} , to vehicle “i.” If no vehicles enter the internal monitoring unit, adjust t_{max} to zero [28].

Vehicle “i” adjusts its acceleration in response to $T_{max}(i)$ using information received from the IM unit. When a feedback signal is larger than zero and t_{max} has elapsed, vehicle “i” must ensure that the intersection is reached. It is important to emphasize that autonomous vehicles may adjust their speed in several ways. The car must proceed through the crossing as quickly as possible but no later than T_{max} . You should also consider a safe length of time. The vehicle then sends the expected time of intersection departure through the IM component $T_{max}(i)$. The IM unit modifies the variables I route “i” and T_{max} in the data list (i). Any vehicle leaving the junction must tell the impedance monitoring unit beforehand if they want their name eliminated from the list. As a consequence, the procedure will be repeated [29].

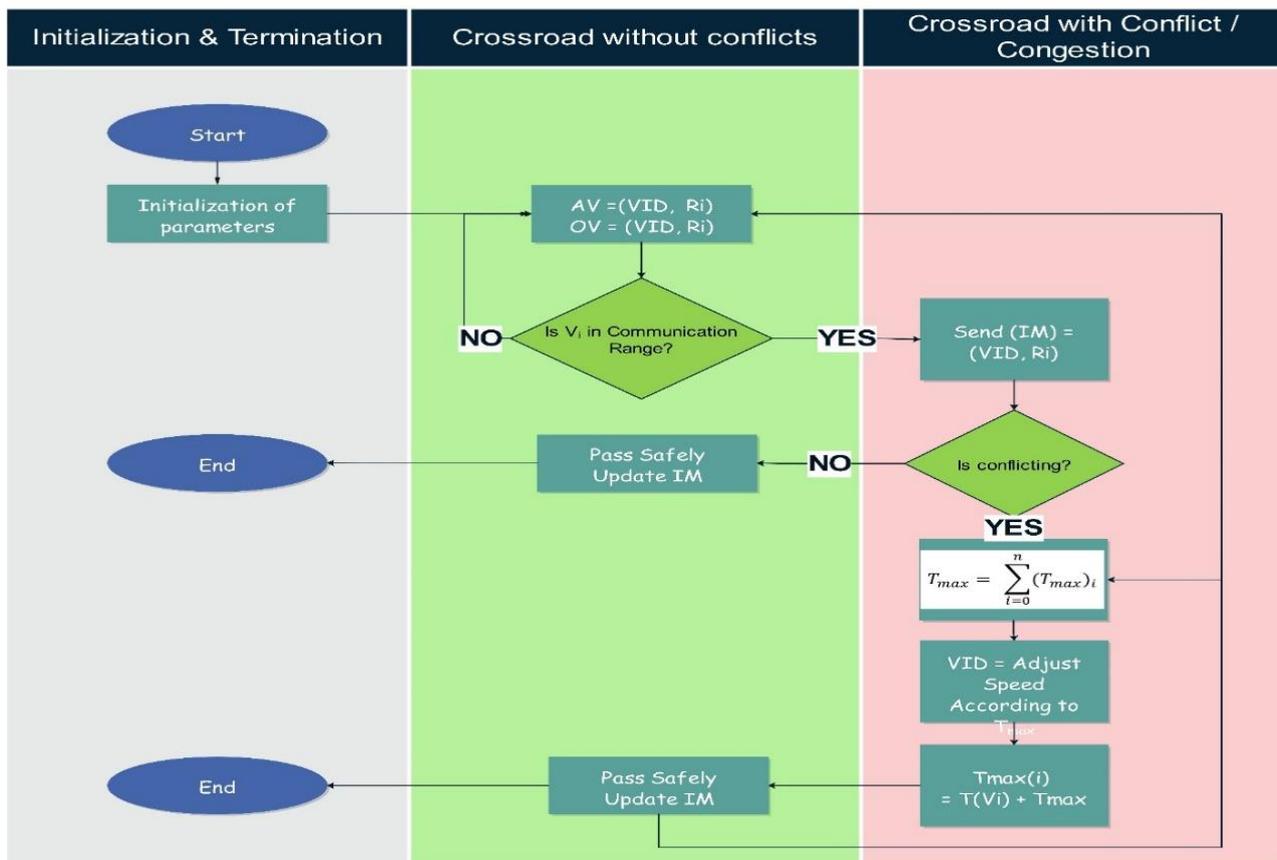


Figure 2. Flow diagram for AV/OV process.

3.3. Algorithm Contains the Pseudo-Code for the Algorithm Used by the IM Unit

Your instant messaging system plays artwork that seems to belong on a desk and alerts the driver to the earliest safe arrival time. It is up to the automobile to decide how fast to go and how long it will take to cross the bridge. When compared to techniques in the literature where the IM unit is meant to calculate the lower velocity through a reservation system or optimization approach, our strategy uses much fewer processing resources at the IM unit side and is more likely to manage high visitor situations (Algorithm 1).

3.4. Method

Vehicles should pass through the region without issue, and unconnected visitors should be allowed to come and leave as they like. When a standalone vehicle and a non-independent vehicle use the highway because the IM unit has grown sufficiently to handle this circumstance, this device allows the VIP independent car to pass. The IMU approves or rejects a message sent to the autonomous vehicle with a specified rate of acceleration or deceleration.

SUMO imports, creates, and requests visitor representation sources. Each vehicle is assigned a range, arrival time, and neighborhood route. Such automobiles are assigned variables, and the simulation displays them alongside those variables. OSM is a free map that can be accessed from anywhere. Local knowledge is prioritized in OSM, which invites individuals from every corner of the globe to participate. Edges are one-way connections that link nodes with an identical number of lanes. Several types of vehicles may pass one another without collision.

Algorithm 1: Finding the maximum vehicle departure time.

input: the oncoming vehicle, autonomous vehicle B as it normally is, and autonomous vehicle A.

Id "i" and its route ID path

Output: The autonomous vehicle's maximum departure time is t.

1. If an autonomous vehicle is present on route A, then
2. $t_{max} = \text{NULL}(\text{ZERO})$
3. Preemptive Autonomous Vehicle
4. else
5. For every automated car Vid in A
6. Get the lane Rid and departure time Vid from B in step 5.
7. end
8. $t_{max} = \text{Tmax}(i)$
9. Preemptive scheduling and non-preemptive scheduling.
10. end [29]

3.5. Simulations in SUMO

The proposed diagram in Figure 3 shows a flow diagram for the VIP vehicle process, implying that when an automobile joins the road, an incoming name is sent to AIMS.

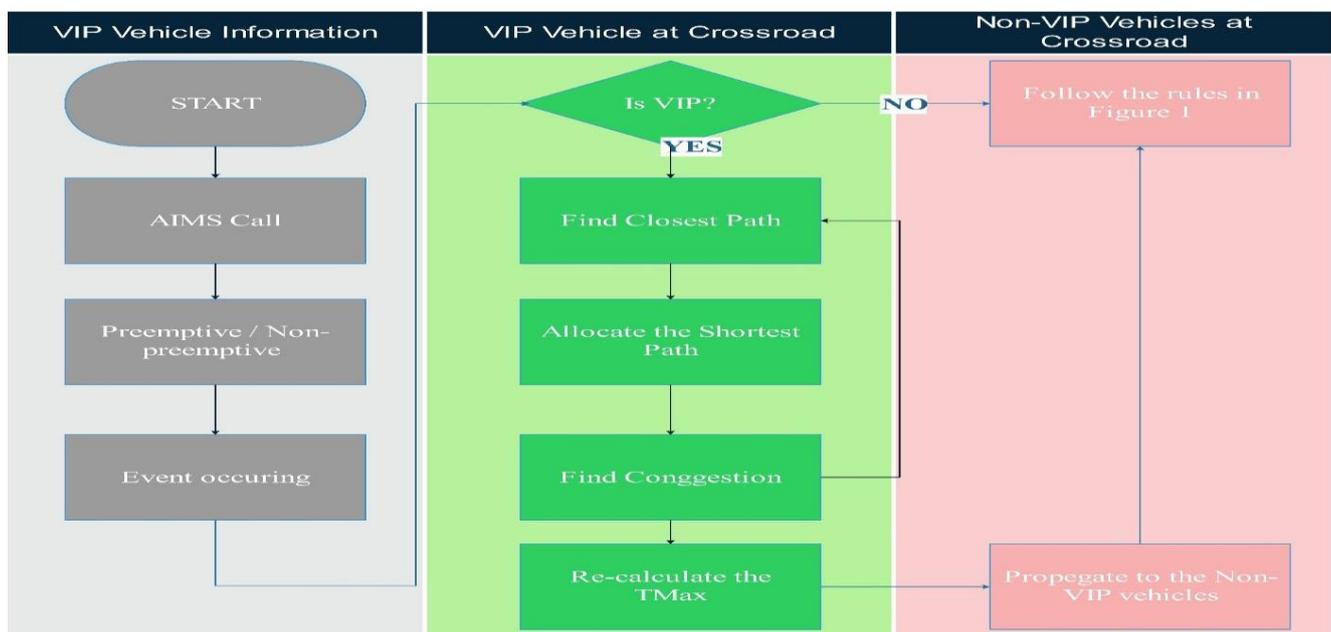


Figure 3. Flow diagram for VIP vehicle process.

Regardless of whether it is autonomous or not, the AIMS evaluates the vehicle to decide if it is an OV or a VIP car. If it is a typical vehicle, the non-preemptive timeline is used. The preemptive schedule is activated if the vehicle is designated as the VIP car. The quickest route must be found and recommended to AIMS by the IM. The shortest path should consider both time and distance. The IM will alert AIMS once it has discovered the quickest route and update the Tmax list to modify the plan for all other cars. At the completion, the route for all autonomous cars will be changed.

3.6. SOMU Environmental Setup

1. Each avenue's start line and stop line are separated by fewer than 500 m.
2. The entire size of the simulation is 5 km by 5 km.
3. All vehicles always go at the same distance from one another. The intersection's centroid is 15 m away from the stop line.
4. The IM unit is in the heart of the junction and has a 200 m communication range.
5. The car travels at an average speed of 50 km/h.
6. All other cars are planned to move over to create room for high-priority vehicles when a vehicle is categorized as VIP and given the proactive scheduling technique. All other vehicles are on a non-preemptive schedule.
7. Routes are assigned for VIP cars. Under normal conditions, the speed of every vehicle is the same. The non-VIP cars swiftly leave the area when a VIP vehicle enters the network by adjusting their settings.
8. The IM unit gives a VIP car high priority and transmits the path to it as well as the car's maximum speed. This information enables the VIP car to cross the street as quickly as possible.

3.7. Collision between Vehicles

As shown in Figure 4's network collision process, there are five conceivable accidents between two automobiles traveling in opposite directions. A collision area is a location where vehicles may collide. Where two autos, one VIP1 and the other a non-VIP ordinary vehicle OV1, arrive at the crossroads, both automobiles must choose to cross the crossing at this point. The AIMS will set their speed depending on input from the IM unit. This wait time is referred to as delay time and is shown in Equation (3).

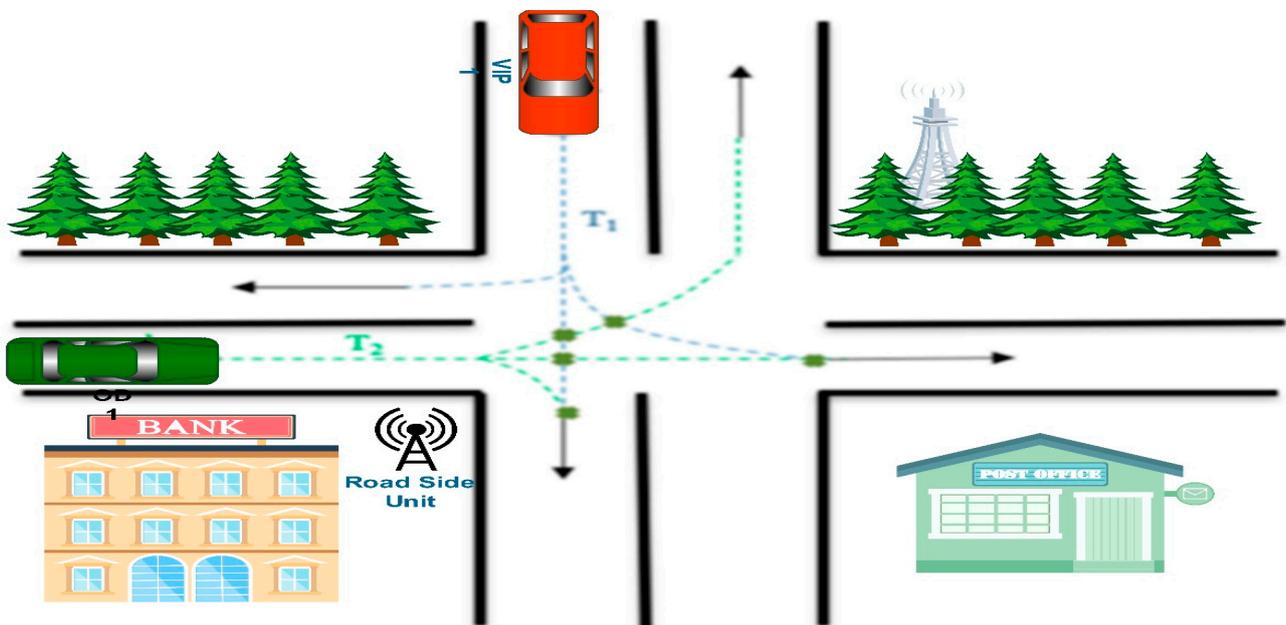


Figure 4. Network collision process.

In this situation, one vehicle follows a preemptive timetable, while the other follows a non-preemptive plan. As a result, the vehicle will be prioritized with a non-preemptive timetable. If both vehicles employ the identical scheduling approach, the distance, time, and speed for all vehicles will be examined, and in the event of a tie, the vehicle with the lowest Vid will be prioritized.

- VIP 1: VIP vehicles;
- OV1: ordinary vehicles;
- T1: The time to reach the intersection for VIP1;

- T2: Time for OV1 to reach the crossing point of the intersection.

As a consequence, safety measures should be used to divide the time that automobiles arrive at the conflict location. Assume VIP1 may pass through the junction with just a little decrease in OV1, which causes a time delay (DT). The length of the delay varies according to the kind of trajectory. Since T1 and T2 vary in real time, it also varies from vehicle to vehicle and is influenced by the speed and size of each vehicle.

Time delay

$$t = T_1 - T_2 + \Delta t_{12} \quad (1)$$

The variation of delay time may be used to assess approach fairness and how well the dataset will perform. As a result, variance is utilized to evaluate the system's performance.

Variance:

$$s^2 = \frac{\sum_{i=1}^N (t_i - \bar{t})^2}{N} \quad (2)$$

Average Time delay:

$$\bar{t} = \frac{\sum_{i=1}^N t_i}{N} \quad (3)$$

To ascertain the vehicle's directional fault, modeling the system will provide information on its existing operational effectiveness and higher-pressure control. To calculate cross-sectional efficiency, a simulation method based on the demand for pedestrians is utilized. Due to the poor correlation between traffic delays for cars and pedestrians, this algorithm will change the trajectory of the conflict between pedestrian demand and traffic. The algorithm may change to enable vehicles to pass at crossings on opposing streets if demand for people and cars increases. Three different combinations of traffic volume and speed are used in the simulation. The main goal of the research was to shorten delays in these situations. High-pressure control in combination with independent control devices called AIM-peds will result in total output.

4. Results and Discussions

In Washington, the self-driving vehicle performed flawlessly. Before the intersection, there is 800 m between the beginning of each road and the stop line. In a short period, AIMS constructs a route for the autonomous vehicle. AIMS quickly decides on a path for an autonomous vehicle.

Table 1 summarizes the simulation findings for the whole road network generated from several routes in Pakistan and one foreign city, and it explains the simulation results for different networks. Multan and the highway are two examples of city roadways in Pakistan, with Multan featuring Nishtar roads and the highway including the M4 motorway. Washington roads' performance is better for VIP (3.62 s) compared to AV (4.02 s) and the performance of AV (4.02 s) is better compared to OV (4.33 s) among 50 vehicles, when SUMO work is completed using our pre-scheduled and non-pre-programming scheduling technique. When SUMO work is performed utilizing our pre-scheduled and non-pre-programming scheduling techniques for the Mexico route network, the VIP (6.14 s) performance outperforms AV (8.42 s) and the AV (8.42 s) performance outperforms OV (9.31 s) among 50 cars and so on. It signifies that the completion time delay for VIP vehicle routes is shorter than that of all other routes for each kind of vehicle (VIP, AV, or OV). Table 1 clearly shows that Washington roads lead to a shorter time delay for all cars.

The performance of various networks is shown in Figure 5 in terms of time wasted. The rate of delay of all vehicles and the resulting change in speed is used to evaluate the effectiveness of the junction management system. Due to variations in T1 and T2 in real time, the delay duration varies depending on the trajectory type and even from vehicle to vehicle.

Figure 6 shows the result of autonomous vehicles, time loss and complete details of the Washington network.

Table 1. Explain simulation results of four different networks.

Network	Time Loss for Autonomous Vehicles	Time Loss for VIP Autonomous Vehicles	Time Loss for Ordinary Vehicles
Washington	4.02	3.62	4.33
Mexico	8.42	6.14	9.31
Nishtar	9.23	7.89	10.08
M4 Motorway	10.02	8.54	10.55

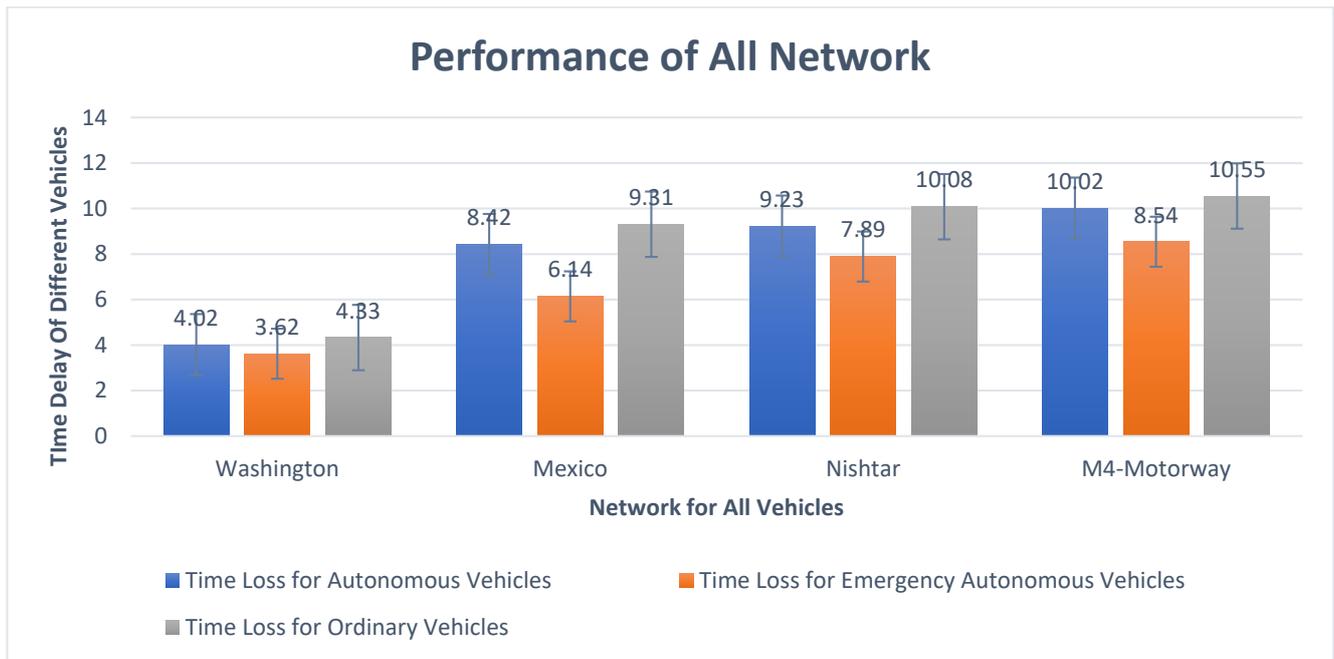


Figure 5. Time loss of four different networks.

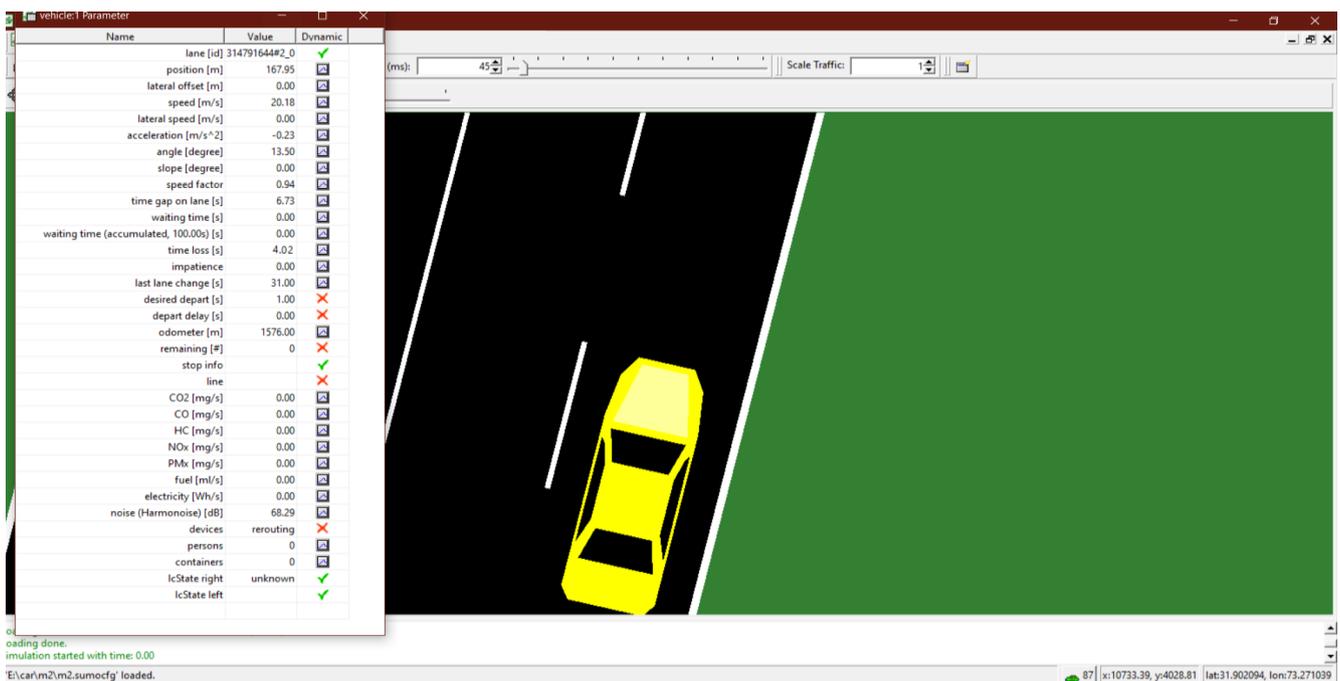


Figure 6. Result of autonomous vehicle.

Figure 7 displays the time lost, the impact of the VIP autonomous cars, and full network information for Washington.

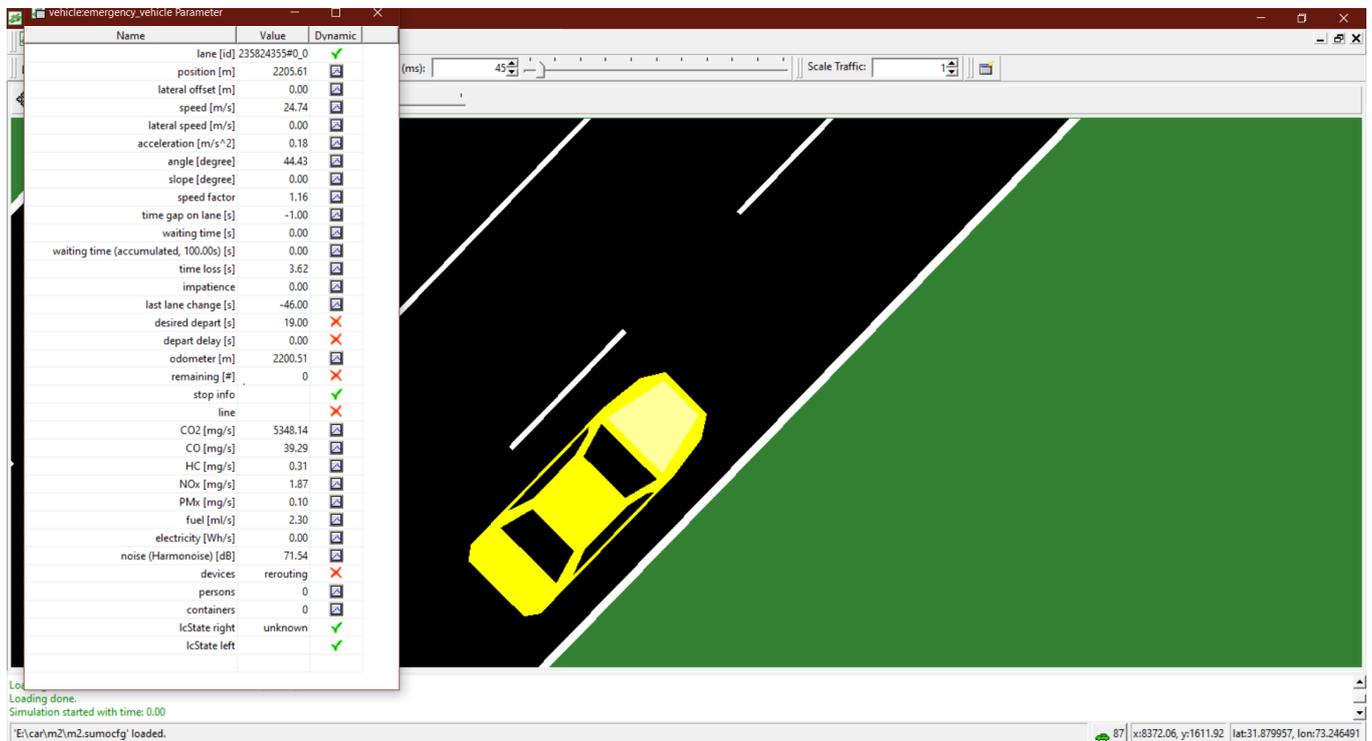


Figure 7. Result of VIP autonomous vehicle.

Figure 8 explains the result of the ordinary vehicle Washington network performed in terms of common cars, time delay, and other important data. The Washington route network performs better than the Mexico route network for VIP automobiles traveling from to AV to OV. The Mexico routes network outperforms the Nishtar routes network for VIP automobiles traveling from to AV to OV. Additionally, the Nishtar routes network outperforms the M4 Motorway routes network for VIP automobiles traveling from AV to OV. According to our data, the M4 motorway performs badly in comparison to other route networks.

The results show that the delay time for all vehicle types is used to evaluate the efficacy of a management strategy in the transportation management systems and understand the delay time reduction. It also demonstrates the IM's efficacy, and delay time variation may be used to evaluate the method's fairness. When compared to the road networks in Mexico, the M4 motorway, and Nishtar, the Washington system has more fully automated cars, non-fully autonomous vehicles, and VIP vehicles. Improvements to crossings and junctions, managed by IM, will allow for more precise calculations of the junction's efficiency. The simulation findings suggest that all vehicles benefit more from using the Washington network routes. The delay times of various vehicle types and their varying distances are used to determine the efficiency of the junction management strategy. Since T1 and T2 are dynamic quantities, the delay time varies not only with trajectory type but also with vehicle. Results from a simulation using Nishtar roads, the M4 motorway, México, and Washington roads reveal that the latter is superior at handling all vehicle types associated. On average, an autonomous vehicle will be stuck in traffic for 4.02 s, a VIP autonomous vehicle will be stuck for 3.62 s, and a non-autonomous vehicle will be stuck for 4.33 s among 50 vehicles.

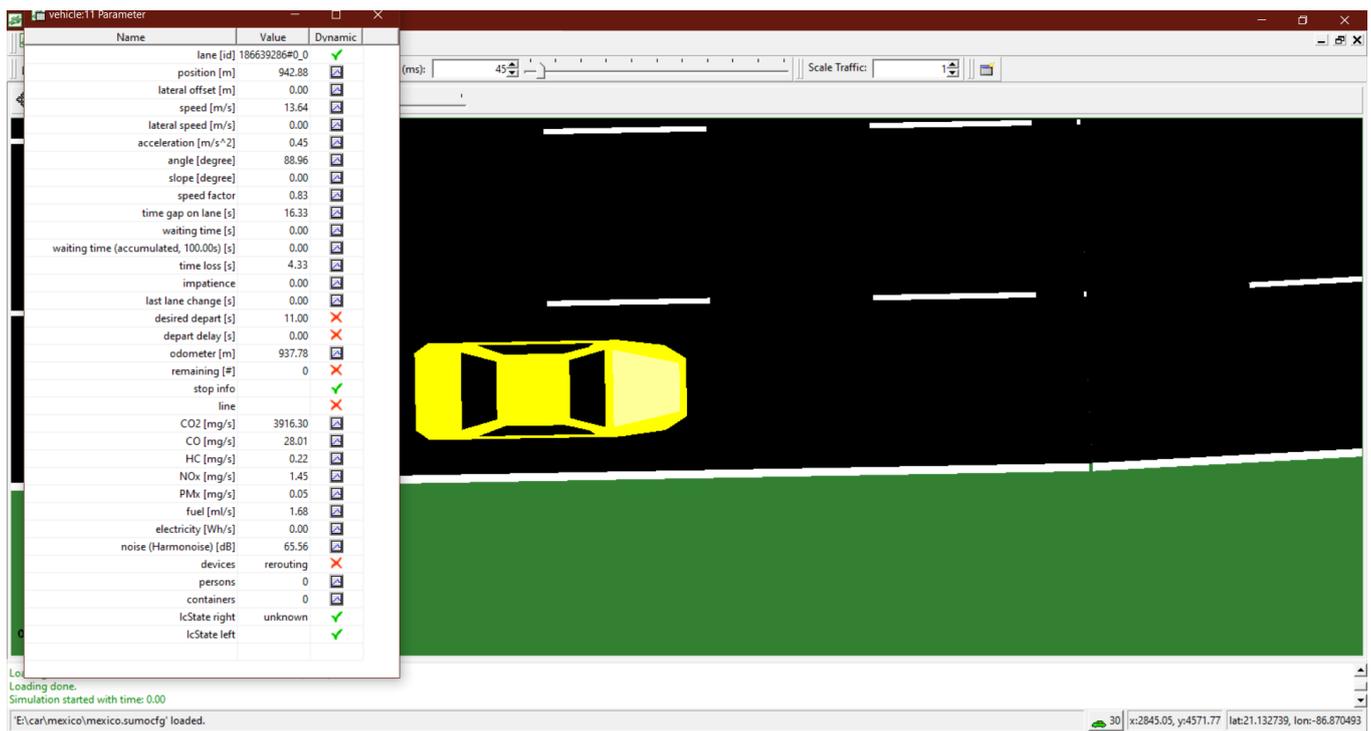


Figure 8. Result of ordinary vehicle.

5. Conclusions and Further Work

It is a severe challenge to manage private automobiles on public roadways in a natural setting. The Washington route has a large number of automobiles (VIP/AV/OV). The flow of traffic on the Washington railway system is managed by private vehicles. By building a private car route, this research absolves the institution's regulatory body of responsibility. All other vehicles, whether VIP, AV, or OV, operate in pre-programmed and non-pre-programmed modes, creating no disturbance to any of them. This study focuses on the transportation system, especially on intersections where VIP cars cause traffic congestion. Junctions are responsible for 40% of traffic accidents and more than 80% of road delays, negatively impacting traffic congestion, automobile numbers, and road safety. The paper calls for Intelligent Mobility (IM), which creates intelligent channels for all sorts of vehicles and their communication. The IM unit monitors junction use and gives traffic updates, enabling cars to avoid approaching a junction before it is safe to do so. As difficult computational operations are performed on the vehicle side, the load on the IM unit is reduced. SUMO (Simulation of Urban Mobility) simulations demonstrate that the suggested design may drastically minimize the average wait time caused by crossings.

The new technique demonstrates that SUMO simulation results greatly outperform the conventional way of managing traffic lights. This technology will govern traffic by allowing access to both private and conventional autos. After the traffic control unit issues a permission or refusal message, private automobiles will continue to drive on the road following the pre-planning and non-planning processes. According to research, when a private car joins a highway, an inbound call to AIMS is made, which validates that the vehicle is moving and provides direction depending on its mobility. The IM unit successfully controls traffic for all vehicle types by using preemptive and non-preemptive scheduling strategies. With traffic waits of 4.02 s for autonomous cars, 3.62 s for VIP autonomous vehicles, and 4.33 s for non-autonomous vehicles, the Washington road route surpasses other routes. Future recommendations for a better strategy to manage ambulance traffic on the road may be developed in an attempt to reinforce the route by collaborating with VIP cars, private automobiles, and public vehicles.

Author Contributions: A.B.N. Conceptualization, Methodology, Software, Field study, Writing—review and editing. B.S.: Data curation, Writing—Original draft preparation, Software, Field study. M.S.I.S.: Writing—review and editing, Visualization, Investigation. K.B.: Software and Writing—review and editing. A.E.M.A.: Investigation and Methodology. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The authors declare that all data supporting the findings of this study are available within the article.

Acknowledgments: We thank Awad Bin Naem (NCBA&E) for writing the research article evaluation, simulation work in SUMO, paper methodology, and paper conceptualization. Biswaranjan Senapati (Parker Hannifin Corp) provided software assistance, while Md. Sakiul Islam Sudman (the University of Texas at Arlington) reviewed and modified the paper in response to journal reviews and simulation work. Ayman EM Ahmed (King Salman international University) assisted with investigation and methodology of the work. Pakistan and the United States Transportation System contributed to this study.

Conflicts of Interest: The author declares no potential conflict of interest.

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