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Quantum-Inspired Technologies and Intelligent Traffic Management Systems are Utilized for Managing Four-Way Crossroad Safety for Autonomous Vehicles in American Busiest Cities

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Abstract: - Given the increasing demand for both autonomous and non-autonomous vehicles, modern generations require a technologically advanced, quantum-driven intelligent traffic management system. Both autonomous and non-autonomous cars utilize intelligent road management tactics to improve traffic efficiency. Intersection management units (IM) control all types of vehicles using preemptive and non-preemptive scheduling approaches. The simulation, which utilizes road and transport sections in various cities in the United States' busiest roadways (NYC, Chicago, and Tampa), employs a time delay of 3.62 seconds for emergency autonomous cars and 4.33 seconds for non-autonomous cars. It is based on the Open Streat Map (OSM) and follows the NHSTA guidelines to improve road performance for all types of automobiles. We conducted a second-phase simulation using Simulation of Urban Mobility (SUMO) on four different junction routes in the United States of America, focusing on NYC, Chicago, and Tampa. This simulation highlighted the enhanced performance and advantages of quantum technologies for human welfare and roads that yielded the best outcomes for autonomous buses (AB), non-autonomous vehicles (OV), and emergency autonomous cars (EAC). The proposed system's ability to reduce average time delays for a variety of autonomous vehicles demonstrates the usefulness of an autonomous junction management system. The application of quantum mechanics to quantum computing has considerable potential for breakthroughs in a variety of sectors. This outstanding paper explores how quantum computing may revolutionize fields including traffic planning, logistics, routing, and autonomous cars. It focuses on the developing interface between quantum computing and intelligent transportation systems. This survey seeks to offer a thorough picture of how quantum computing might affect transportation in the future by looking at current research efforts, obstacles, and future possibilities in the futured intelligent traffic management systems in North American region

***Keywords**:* Vehicular Technology,QAI, QML Non-Preemptive Scheduling, Preemptive Scheduling, Emergency Autonomous Cars, Autonomous Bus, Quantum technologies

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1. Introduction

The growing population on American Roadways leads to increased transportation demand, causing road congestion. City forecasting can reduce problems, but it's not always effective. To address overcrowding, autonomous transportation systems and self-driving cars are being developed, with increased funding from industry, government, and universities. California's Automated Highway System initiative was introduced in 1990. [1]. Conditional automation (level 3) allows human drivers to delegate DDT to the ADS and only regain control in emergencies. The system should provide a Take Over Request for safe transition from ADS-engaged mode to manual driving (TOR) [2]. The driver's condition is crucial in this situation, as it may take longer to take control. This study reviews prior research on conditional automation and the TOR process, presenting conceptual underpinnings for successful designs, real-world examples, norms and recommendations, research gaps, methods and constraints, and findings. Mobility and increasing traffic demands pose challenges for wireless networks [3]. Companies invest in autonomous vehicles with advanced driving assist systems, as explained in the text [4]. Automated vehicles and collision avoidance can significantly increase traffic capacity. Optimization techniques are used to improve intersection management performance. A linear inequality in narrative linear programming formulation is used to ease non-linear constraints, while trek time is a part of the optimization problem's object function [5]. The study recommends a new street type for pedestrians, cyclists, ABs, and micro-mobility modes using data-driven methodology [6]. The five steps consider urban factors and transportation contexts, using GIS tools. Implementing route design for ABs in the transportation network with pedestrians and cyclists contributes to sustainable and socially inclusive transportation in the Athens suburb of Kallithea. This work presents a distance-based V2V-Pair matching method and PL-selection technique for managing V2V charging [7]. It implements a V2V charging reservation to ensure high usage and equally distributed selection. The strategy incorporates parking duration to maximize charging under temporal restrictions, as EV drivers typically park at PLs for short periods [8]. All vehicles communicate online, sharing predictable times for passing. Wireless synchronization is a challenge. A decentralized optimal control problem for autonomous vehicles is presented, determining the best acceleration or deceleration for each vehicle to save gasoline [9]. Research focuses on control techniques for autonomous car traffic flow [10]. Emergency response time is crucial for human lives, with injured individuals reaching operating tables within one hour. Emergency vehicles are crucial during congestion-prone intersections. [11]. By deploying a siren and light for vehicle-to-vehicle communication, emergency vehicles may go through tight intersections more quickly. [12]. AIM Management was created by Dresner and Stone to manage emergency vehicles, maintain traffic flow, and reduce non-emergency vehicle impact [13]. Only emergency cars are given a traffic lane by the algorithm, which decreases delays and improves safety [14]. It lacks worldwide coordination and has significant impacts on non-emergency

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vehicles. A similar strategy using a genetic algorithm is proposed, but it is not allowed to operate cars on competing routes simultaneously [15].

As per the NHTSA divides self-driving cars into six groups based on how they interact with their environment, how much control human drivers have over the vehicle, how well they do certain tasks without interruption, how well they comply with traffic laws or conditions, and how well they perform safety-critical tests [16]. The study looks at how to handle high-priority (ambulance) and VIP cars. The Simulation of Urban Mobility, which employs database-managed vehicle data and proactive scheduling strategies, offers a remedy. cars that are given priority move more quickly than non-prioritized cars [17], which might be parked in one lane. Vehicles with priority access have a dedicated, continuous lane to their destination. [18]. According to research, VIP cars disturb traffic patterns and add to delays [19]. Through innovative methods, efficient junction management decreases traffic, delays, and increases road safety. [20]. The following key novelty contributions have been made by this paper:

1) Reduced load on IM units and shorter junction wait times are two benefits of the intelligent road approach, which combines vehicle kinds and communication.
2) The proposed technique uses V2X communication to handle EAC/ABs and OACs in real-time environments as per the NA’s busiest Roadways.
3) The research focuses on four real-time routes in few American cities including (Chicago, NYC, Tampa’s) Road Transports Systems by using OpenStreetMap (OSM) as per the authenticated software simulator by SUMO.
4) The autonomous system manages route junctions and assigns routes to autonomous buses and cars, with pre-emptive scheduling applied to prevent collisions.
5) Simulations using Simulation of Urban Mobility (SUMO) show that the suggested scheduling significantly reduces delay time caused by ABs and EACs and OAC compared to other commonly used pre-emptive and non-preemptive scheduling techniques.
6) The overall performance of the network shows that EAC performance is better than OAC, while OAC performance is significantly better than AB.
7) This paper also addresses the benefits of Quantum Computing’s, QML, QAI and Some of smart tools to support the Intelligent Traffic Management Systems in American few busiest cities (NYC, Rest of Tampa area, Chicago and Tampa).

Quantum Computing’s and Vehicular Technology:

In many industries, particularly manufacturing and smart traffic management, where autonomous cars, electric vehicles, and guided vehicles (AGVs) are required to support industrial facilities' end-to-end tasks, the field of quantum computing, using the concepts of quantum mechanics, has great potential for substantial breakthroughs. This paper will cover

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the benefits of applying quantum computing and quantum mathematical formulas to vehicle technology. We will also discuss the intersection of quantum computing and intelligence transportation systems and how it may revolutionize fields like traffic optimization, logistics, routing, and autonomous vehicles. We will scrutinize current research projects, identify challenges, and consider future paths. This poll aims to provide an extensive summary of potential future effects of quantum computing transit.The rapid development of quantum computing technology has made it possible to solve complicated issues in many fields, including intelligent transportation systems (ITS). ITS includes a broad variety of technologies and applications to raise the sustainability, safety, and efficiency of transportation networks. However, the enormous volumes of data and complex optimization issues that come with ITS are sometimes too much for conventional computational methods to manage. Quantum computing presents new opportunities for the management and improvement of transportation networks due to its exceptional capabilities in machine learning, optimization, and parallel processing. Because of this potential, there is a lot of interest in applying quantum computing to several aspects of ITS research. Certain domains, like traffic flow optimization, intelligent routing, autonomous driving, and traffic prediction, have demonstrated the potential of quantum algorithms. These algorithms, which utilize quantum concepts such as superposition and entanglement, have the potential to be faster, more accurate, and more efficient than their classical counterparts. Furthermore, quantum machine learning algorithms may uncover hidden patterns and correlations in large-scale traffic records, leading to more precise prediction and decision-making. However, there are inherent difficulties in integrating quantum computing with ITS. One major obstacle still stands in the way of developing scalable and fault-tolerant quantum hardware—a process that is extremely complicated. Interdisciplinary collaboration is critical because developing quantum algorithms specifically for ITS applications necessitates knowledge of both transportation engineering and quantum computing. Notwithstanding these difficulties, quantum computing has enormous potential benefits for ITS, which makes the integration process even more important and valuable to mankind [23].

Quantum Computing's and Quantum Technologies in Advanced Traffic Management:

The cutting-edge paradigm of quantum computing leverages the ideas of quantum physics to address challenging issues that are nearly unsolvable for conventional computers. Quantum computers employ qubits that exist in a superposition of states (0 and 1) simultaneously, as opposed to conventional computers that use bits (0 or 1), which enables quantum computers to perform many operations at once. It is vital to provide some fundamental background information on quantum computing concepts and algorithms before delving into comparisons with classical computers and applications. Quantum gates, similar to logic gates in classical computers, manipulate qubits in gate-based quantum computing. As previously established, n bits in classical computers can represent one of 2 n integers. A suitable state of n qubits can represent all two n integers simultaneously in quantum superposition. Using quantum gates on qubits results in an exponential speedup when performing any operation on all states simultaneously. One cannot directly read the outcome of a quantum-parallel operation; instead, one must use the Born rule to determine the state probability P(x).

$P(x) = A(x) *A(x) = |A(x)|\ 2 = \langle x|x\rangle$----1

where ∗ is the complex conjugate operation and A(x) is the amplitude of state x. The Dirac notation for the same amount is displayed by the dot product ⟨x|x⟩ shows the same quantity expressed in Dirac notation in the quantum technologies. At the moment, quantum computing depends on adjusting the phase of quantum amplitudes in order to combine them and get the intended outcome. As a result, several operations that are considered standard in classical computers, such copying and erasing state data, were not possible with quantum amplitudes and could only be altered by unitary transformations. Shor's algorithm, which finds an integer's prime factors, and Grover's algorithm, which targets unstructured search, are two examples of gated-based quantum computing algorithms. Shor's approach finds a function's period, which may be used to factor the number, by utilizing the quantum Fourier transform and other quantum features. Grover's approach increases the likelihood of locating the right item in the database by using amplitude amplification. Shor's technique has an algorithm complexity of O(log(n)), whereas the conventional brute force search has an algorithm complexity of O(√ n). Grover's algorithm achieved O(√ n) as opposed to O(n) for traditional algorithms. While gated-based quantum computing offers an all-encompassing paradigm, it necessitates exact manipulation of qubits, which are incredibly error-prone. A key method for solving quantum optimization issues is quantum annealing (QA), which uses a quantum phenomenon to determine a system's lowest energy state. This energy state relates to the best possible resolution for a certain issue. The theoretical notion of adiabatic quantum processing finds practical application in annealing procedures. This method employs an approximation of optimization using a quantum wave function, much to classical simulated annealing. Qubit states can be engineered to represent candidate solutions, where better solutions are indicated by lower energy levels. QA starts with high kinetic energy and simulates a cooling process using a Hamiltonian matrix. All configurations are accessible at first, but access is progressively restricted to prioritize low-energy, so-called excellent solutions. Although optimality is guaranteed by an unlimited cooling period, practical constraints lead to approximations. In general, quantum annealing provides quadratic improvement over classical annealing, with the possibility of exponential improvement under certain circumstances. Indeed, this acceleration has been shown in real-world applications like transport network design issues.

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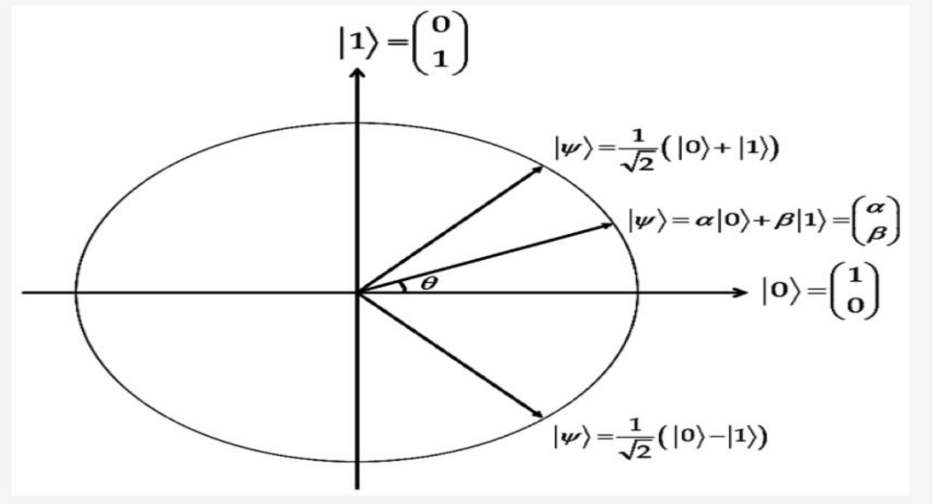

Figure-1 Qubit transformations with Hadamard gate

Quantum Machine Learnings in VTS:

Classical computers with GPUs or TPUs for quick processing have greatly benefited conventional machine learning methods. Examples of these include vision-based traffic monitoring, forecasts of vehicular moments, traffic prediction, and traffic management. By making use of quantum phenomena like superposition and entanglement, quantum computers have the potential to further accelerate certain tasks exponentially faster than conventional computers. This allows them to investigate several answers at once. This section will provide a quick introduction to the quantum versions of supervised and unsupervised machine learning techniques. The aggregation of non-linear functions applied to layers and sequences of neurons builds a basic model known as an Artificial Neural Network (ANN). However, because quantum physics is linear, it is difficult to construct non-linear activation blocks. An ANN model structure that is more complex is the Convolution Neural Network (CNN). Quantum CNN (QCNN) offers a new way to improve the performance of an existing learning model. It does this by using a quantum computing environment and a shallow circuit technique that uses non-linear activation and pooling operations. They also showed new ways to use probabilistic sampling in data processing, which led to a quantum way of doing gradient descent computation when the gradient is an affine function and the time it takes to do a single step is a lot less than the classical cost. These developments resulted in a new quantum tomography algorithm with l-infinity norm guarantees. The Generative Adversarial Network (GAN) pits two neural networks—the discriminator and generator—against each other in a zero-sum game framework. In order to increase training stability, Wasserstein GAN (WGAN), a GAN version, leverages the Wasserstein distance between the discriminator and generator outputs. First, we proposed a hybrid quantum GAN that combines a parameterized quantum circuit generator and a classical neural network discriminator to produce classical discrete

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distributions. This improved the robustness and scalability of adversarial quantum generative models training on noisy quantum hardware. The quantum circuit makes use of only basic gates that are present in gadgets today. While quantum techniques require a logarithmic processing time to address these issues, clustering algorithms, which are characteristic of unsupervised learning, may require polynomial time. We have presented a novel quantum clustering algorithm that draws inspiration from support vector clustering and scale-space clustering. Support-vector clustering uses Gaussian wave functions to translate data points to states in Hilbert space. This makes it possible to give particular points weights that highlight them as possible cluster centers. offered three quantum clustering techniques: c-neighborhood network construction, k-medians, and divisive clustering. These algorithms used supervised and unsupervised quantum machine learning algorithms for cluster assignment and cluster identification. They achieved this by utilizing quantization and Grover's algorithm. They achieved exponential speedup by reducing the processing time from O(n) to O(log(n).) Here are a few key use cases within in our research objectives.

1. *Quantum Computing for Traffic Management:*

Transportation management encompasses the planned, implemented, and optimized movement of people and products. Managing shipping schedules, tracking shipments, and guaranteeing on-time delivery are just a few of the tasks involved in this process, which also includes choosing the best providers and means of transportation. Automatic optimization often yields benefits for transportation management. The Quantum Genetic Algorithm-Learning Vector Quantization (QGA-LVQ) neural network has been used to create a new traffic flow prediction algorithm. This opens the door to using quantum algorithms to look at real-time traffic data, like the number of vehicles, their speeds, and the condition of the roads, to improve traffic signal timing and ease congestion. This method combines the global optimization powers of QGA with the structural simplicity and efficient clustering of LVQ. This hybrid model gets around the problems with linear algebra quantization (LVQ), like how it can be affected by starting weights and local optimization, by using the quantum-behaved particle swarm optimization (QPSO) method to study traffic flow predictions. We apply a hybrid method that combines quantum particle swarm optimization and genetic simulated annealing to find the optimal initial cluster centers for the radial basis function neural network (RBFNN) prediction model. The RBFNN's function approximation capabilities subsequently produce the needed data. In their traffic prediction protocol, Huang et al. introduced Modified Ensemble Empirical Mode Decomposition (MEEMD) and Quantum Neural Networks (QNNs), two tools to handle the long- and short-range interdependence of backbone network traffic. To break down traffic data into components of the Intrinsic Mode Function (IMF), the approach preprocesses the data using MEEMD. The QNN then predicts each IMF component due to its exceptional nonlinear processing and convergence abilities. Given the dynamic nature of traffic data and complex traffic networks, predicting traffic congestion is just as difficult as predicting traffic flow.

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Researchers developed a quantum Spatial-Temporal Graph Convolution Network (STGCN) to address these issues, learning spatial features by building a quantum GCN and applying Schrodinger's closed form solution.

2. *Smart Technologies for the Intelligent Traffic Management*

Instead of using public transit, many choose to commute in private cars, which is the main cause of "traffic congestion." Individuals who are unable to use public transit may have a variety of personal reasons. However, encouraging people to use public transportation instead of their personal vehicles will not suffice to address this problem. We devised a clever solution to this problem by combining several data analysis algorithms and recent advancements in machine learning. With the rapid growth of communication and sensing technologies, inexpensive and efficient sensors, improved data storage and retrieval effectiveness, and inexpensive storage of substantial volumes of data, extracting and using data for our convenience is now straightforward. The current traffic control system uses an interval mechanism with preprogrammed timing to alter signals. Collecting pertinent and useful data in order to provide a solution is the main challenge in data analytics. The algorithmic prediction methods must be able to produce accurate reports from this constantly expanding data, and the data model must receive updates on a regular basis. For this initiative, crowdsourced data is the main source of information. Advances in car technology have led to the use of GPS sensors for automotive smart applications. When building the data model, GPS data from cars could be quite helpful. The GPS sensor (global positioning system) determines the exact location of the vehicle. Anticipating whether there is traffic congestion is achievable. This data is very helpful for figuring out the volume or density of traffic at a specific location. We can determine the traffic density by using the location of a car and the number of automobiles within a 100-meter radius around it. The vehicle's speed is another important factor. CCTV cameras around the road are another source of useful information.

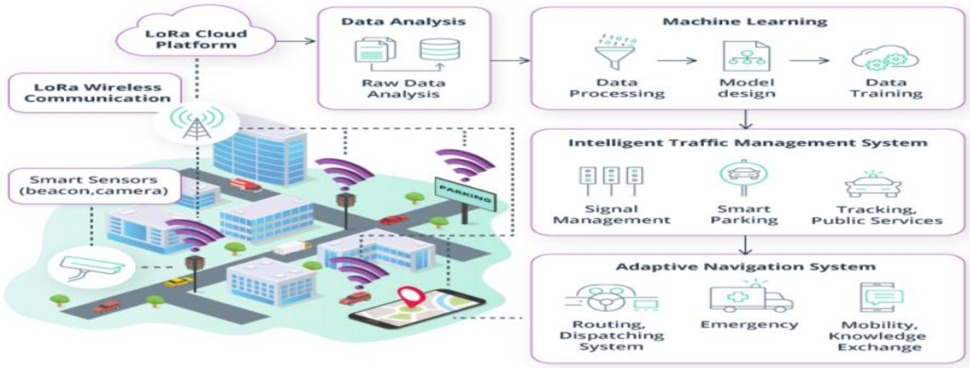

***Figure**-2: Smart Traffic Management System by AI, ML*

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3. AI, ML for Intelligent Traffic Management Systems

Computers train well-labeled training data in supervised learning, a subset of machine learning, and then predict the output based on that data. Labeled data indicates that some input data has already been marked with the desired output. In supervised learning, the training data presented to the machines functions as a supervisor, instructing them on how to accurately anticipate the output. It employs the same principle that a student learns under the teacher's supervision. Supervised learning is the process of giving the machine learning model both proper input and output data. A supervised learning algorithm's objective is to discover a mapping function that maps the input variable (x) to the output variable (y).

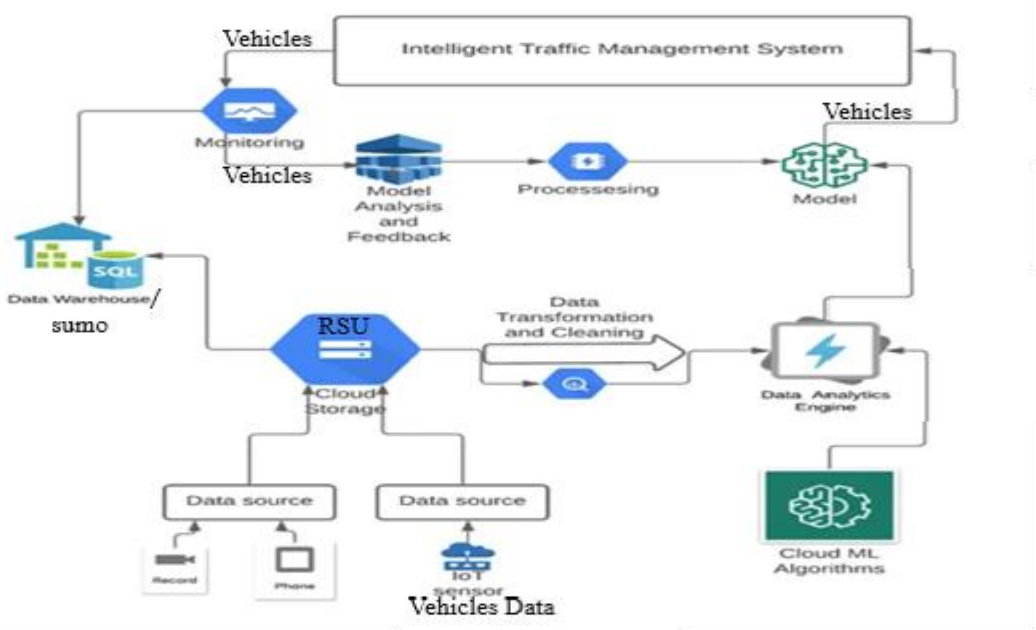

Figure-3: Architecture of automated traffic control and Smart Tools

2. Related Work

The condition of the driver is crucial in this situation since it may take longer for them to take control of the car if they are not paying enough attention. Prior research on conditional automation and the TOR process is reviewed and analyzed in this study. It introduces the subject in a suitable setting while highlighting several worries related to the TOR. Additionally, it offers conceptual underpinnings for successfully implemented designs and reports on real-world instances that are geared toward designers and the public. Mobility and rising traffic demands provide several difficulties for wireless networks [21]. Mobility managers face difficulties due to insufficient wireless resources and solutions that involve adding more small cell base stations to networks. Due to the difficulty in predicting the occupation state at PLs, a

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V2V charging reservation has been implemented to ensure high PL usage and equally distributed PL selection. The authors took into account factors including vehicle use, bicycle, and pedestrian use, and indicators for public transportation [25]. Additionally, strategies including shared space, creating bike lanes and public transit networks, segmenting different means of transportation, cutting down on travel time and distance, changing policies, and technology advancement are suggested [26]. Intelligent evacuation programs for crowd control management are designed and implemented primarily using soft computing techniques. The research analyses the video and non-video-based aspects of crowd surveillance and crowd catastrophe prediction while briefly addressing the evacuation navigation path and evaluating evacuation choices [25]. Deep learning architectures make it easier for AVs to be accepted and deployed in everyday situations by leveraging traditional methods to address computational problems. To alleviate challenging junction and behind-intersection traffic congestion, we suggest an intelligent traffic control system [28]. Emerging trends and problems like automated delivery services, urban flying cars, and autonomous vehicles must be considered in such a system. In addition to optimizing flows, this management strategy seeks to provide the best reaction to disruptions and emergency circumstances [27,28]. A new traffic signal design has been developed particularly for the E.V.S.P scenario to enhance safety and traffic flow [29]. This strategy can let everyone driving through the junction know which way the emergency assistance vehicle (EAC) is traveling, explains AVs, which have recently drawn a lot of media attention. They are designed to assist or replace human drivers while maneuvering cars, reducing the possibility of accidents caused by driver mistakes and improving street traffic safety. Before they can be extensively employed, AVs have their own unique set of health and security issues. To evaluate the dependability and effectiveness of artificial neural networks that are targeted by artificial intelligence (AI) techniques for lowering or removing traffic volume while non-autonomous vehicles are taking part in mixed traffic flow situations in South Africa [31]. Statistics have shown that human error is the main factor in car accidents. This is unquestionably a factor in the growing appeal of autonomous cars since they are allegedly capable of navigating the roads safely and effectively while reducing the possibility of human error and its consequences. However, because their safety and security concerns have not yet been fully examined and resolved, autonomous cars are not yet prepared for broad usage. On collaborative examination of the security and safety of autonomous cars, there is little literature. This study suggests a system that suggests buddies based on a user's daily activity. Here, a friend suggestion is made using semantics and the users' preferences. We present a user's daily activities as life archives via text mining, and then we utilize the Latent Dirichlet Allocation method to extract the user's ways of living from these archives. At that point, using a similarity matching diagram, we develop a similarity measure to assess the degree to which users' lifestyles are similar to one another. Finally, we provide a feedback feature to further improve the proposal's accuracy, an experimental framework for autonomous articulated buses. The

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platform's goal is to enable comprehensive experimentation under realistic circumstances for the evaluation of new technologies and control algorithms. The experimental platform is situated inside the (CSIC) facilities and consists of a fully instrumented commercial articulated bus and an asphalt road ground test area. The master control center, the meteorological information system, and the pollutant adaptive traffic control system (PATC) are the three main components of the scalable updated roadside unit provided by [32]. To improve traffic flow, it tries to open or close certain routes through PATC[33]. MCC is also used to drive and maintain bad weather, plan road maintenance initiatives, and track the weather [31.,34]. Recent research has looked into non-intrusive identification methods with an emphasis on characterizing drivers' driving behavior through the study of driving behavior, which calls for a sizable amount of labeled data. For data reduction and categorization, the system makes use of deep belief and decision tree machine learning techniques. Simulations are performed to evaluate the framework and show how well the solution can identify intrusion attempts. The framework keeps an eye on the significance of the city-scale situation while considering the significance of technology footprints integrated with social behavior as well as crucial space and mobility elements. We created a cellular automaton using an actual, high-quality raster map of a medium-sized city in central Europe (CA). The fine-grained CA enables the pedestrian movement with ease and may be simply expanded to support other forms of transportation. On a true parallel and distributed hardware platform with software that is compatible with CA, the urban mobility simulation is run. In an emergency scenario that takes into account citywide mobility, an examination of the simulation's effectiveness and agent behavior is provided. By simplifying municipal procedures, governments may work more effectively and spend less money. To fulfill the increasing demand for mobility while minimizing any potential negative social, economic, and environmental effects, rapid urban growth and sustainable transportation solutions are necessary. ACV-specific clever black hole attack detection system (IDBA). A car-driven, heuristic-based solution to the vehicle-sharing problem of relocation. We concentrated on the non-preemptive variant of this problem and applied a hierarchical decomposition method to solve it[35]. The slave problem included managing such requests using a Pick-up and Delivery technique, whereas the master problem involved finding a set of transportation requests that were well-suited

3. Methodology:

3.1 AIMS Architecture

Figure 2 depicts the proposed System's architecture, which is made up of three subsystems: an RSU, an OBU, and an AIM system. The autonomous intersection management system is linked to the RSU controller. In practice, handling an emergency autonomous car on the road is a difficult undertaking. Autonomous buses include characteristics such as vehicle platooning, a sophisticated traffic control and management system, and trajectory optimization. Controlling

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emergency autonomous autos (autonomous Buses and emergency autonomous Cars) after pre-emptive scheduling is difficult in intense highway traffic. Several routes are necessary at various points in building the route and conducting the procedure to meet with protocol requirements. While autonomous traffic flow is maintained, prioritized buses and prioritized autos should have unobstructed access. The purpose of this project is to develop a smart road management system for the pre-emptive and non-pre-emptive scheduling of autonomous buses. Figure 1 depicts AIMS's architecture.

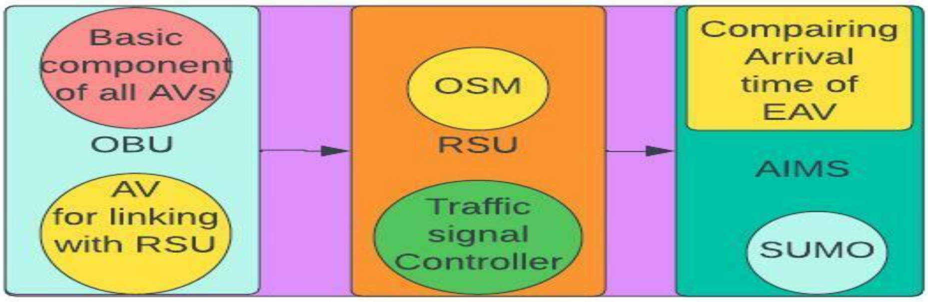

Figure-4: Architecture of AIMSs.

2.2. Managing Traffic Flow

In this research proposal, ABs and EACs propose using the following technique to control traffic on roads:

1. The information list is now empty at the beginning.
2. When a vehicle reaches the route designated by AIMS, a connection is made with RSU. When a car joins the system, all its information is saved there. All cars entering AIMS are given a special number. Its identifying vehicle number is "i" and its routes are "Id" (K1, K2, K3,...K12). An autonomous vehicle entering AIMS is first examined to determine if it is an AB or EAC. The A.I.S.M. unit will send a null signal to this AB or EAC, and in order for it to effectively finish its path, the shortest route is allocated to this EAV. If the route is congested, AIMS gives AB and/or EAC a potential route.
3. By scanning the information list as empty, all cars now operating on the upcoming vehicle routes. Send the corresponding vehicle with the quickest arrival time (in "kmin") on the emergency route if there is no vehicle. Set the emerging route's min parameter to null.
4. The vehicle's speed changes in accordance with the AIM unit's findings, indicating that the vehicle is moving. The car is it moving? If the response is "no," it signifies that the pre-emptive scenario is being taken into account to determine whether to move the vehicle as an AB, EAC, or OAV. And it has to get at the intersection no later than k minutes. The

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message's value is not NULL. AB/EAC may use a variety of speed-adjusting techniques. The car must travel through the intersection as soon as is practical, but not more than the allotted amount of time. A safe time interval might also be taken into account, at a minimum.

5. If the two- autonomous bus and automobile arrive at AIMS at the same moment, Intersection Management evaluates the arrival time. Then it is determined that these two vehicles have the shortest arrival times, thus that route should be given to them. AIMS increase the "i" routes to enlarge the list.
6. AIMS tracks each and every vehicle. When a vehicle is going to cross an intersection, it should signal the I.M. unit to turn it on. The information in the list may be deleted.
7. Repeat steps (2) through (4) (5).

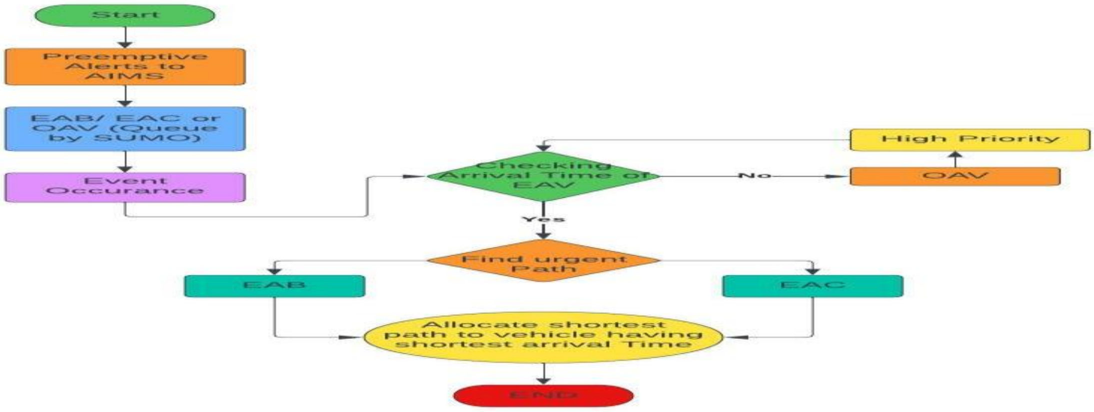

Figure-5: Traffic Flow in AIMS.

Figure 3 depicts the smooth traffic flow in AIMS. AIMS is constantly receiving precautionary calls from motorists on the road. So, when an autonomous bus joins the road, an Autonomous Intersection Management System (AIMS) gives it a route, but when an emergency autonomous automobile also enters the road at the same time, the arrival time is compared to manage the problem. Following pre-emptive and non-pre-emptive scheduling, all ABs and EACs operate well, with no disruption on the road.

1. Autonomous Intersection Management System Its function is comparable to that of a database management system.
2. When an autonomous vehicle reaches the region of the IM unit, the unit saves all records of the vehicle and checks its acceleration and speed.
3. The database assigns an Id to each automobile.
4. This Database assigns a unique number to each vehicle entering this area.

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5. If the road is clear, the entering vehicle is given the maximum speed; if the road is crowded, each vehicle is given a defined time, and all of this is done using pre-emptive and non-pre-emptive scheduling.
6. When an EAC joins the road, it takes priority over other vehicles (AB/OB) and is given the shortest route and the fastest speed to reach the destination in the least amount of time.
7. All other non-pre-emptive vehicles have a low priority, but when an EAC departs the road, they have a high priority while continuing following non-pre-emptive scheduling.

2.3 Computational Method:

Vehicles may collide at a position known as a conflict point. Assume that two automobiles, AB and EAC, arrive at the intersection. At the intersection, a vehicle must slow down so that AIMS may select which car should be relocated first based on the arrival time of the vehicle.

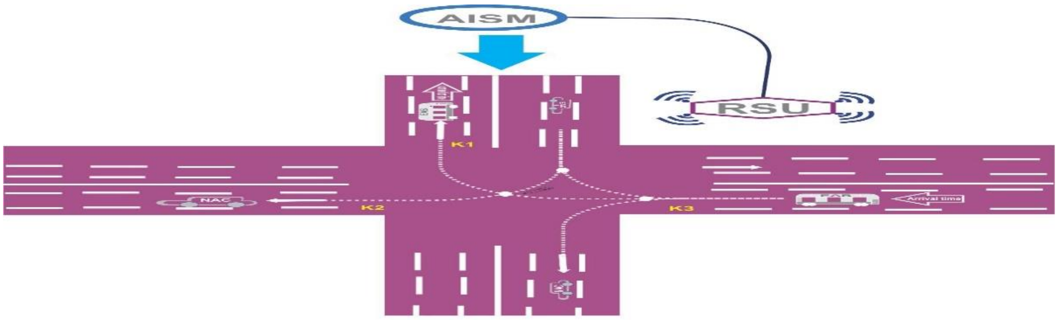

Figure-6: AIMS handles AB and EAC.

Figure 4 shows when AB and EAC reach the junction and how AIMS manages them and allocates priority without causing a collision in the road network.

As indicated in Figure 3, there should be a safe zone between the arrival times of the vehicles and the conflict location. If AB is the first to reach the junction, the amount of slowing experienced by EAC will be equal to the delay time (D.T). As a result, the delay duration varies depending on the kind of trajectory and from vehicle to vehicle. K1 and K2 change in real time as a result of the vehicle's speed, size, and arrival time. The vehicle must then wait for AIMS to determine whether or not to move the vehicle; this period is referred to as Delay period (D.T). The IM unit looks for the time when these vehicles arrive to the IM unit, which is known as Arrival Time (A.T). And the time taken by the IM unit when the Emergency bus or automobile completes its trip and departs the IM unit is known as Burst Time (B.T). Completion Time (C.T) is the time at which the vehicle completes its journey. The turn-around time (T.A.T.) is the time between completion and arrival.

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As a result, AB: north autonomous Bus, EAC stands for eastern emergency autonomous Car.

d1: the distance between AB and the point where it intersects with EAC.

d2: the radius between the EAC and the AB is a topic of contention.

K1: the time it takes AB to reach the moment of impact with EAC.

K1 = d1/x1 K2: the amount of time it takes EAC to reach the point where it clashes with AB.

d2/x2 = T2 s1: The speed of AB. EAC's speed is denoted by s2.

EAC must provide a 3-second safety buffer in order for AB to pass first.E

So, Delay Time:

$$D.T = K1 - K2 + \triangle K12 \qquad (1)$$

Arrival time:

$$T.A.T = C.T - A.T \qquad (2)$$

3. Results and Discussions:

In American Business Cities, the autonomous car worked brilliantly. The distance between the starting point of each road and the stop line is 800 meters before the junction. AIMS creates a path for emergency autonomous cars in a short amount of time. AIMS makes a rapid choice to provide a route for an autonomous vehicle.

Network	**Time Loss for Emergency Autonomous Car/ sec**	**Time Loss for Autonomous Bus/ sec**	**Time Loss for Ordinary car/ sec**
Washington/NYC	3.62	5.62	4.33
Chicago, Ryan Expressway	0.02	1.90	0.03
Tampa City	0.19	*4.08*	0.21
Florida(Rest of Busiest)	0.89	*5.45*	2.41

TABLE I. Simulation Results of Different Network

Table 1 shows the highway system from the American Cities and one foreign city, including Chicago, Tampa and Washington/NYC, Florida. NYC runs through the busiest City, whereas

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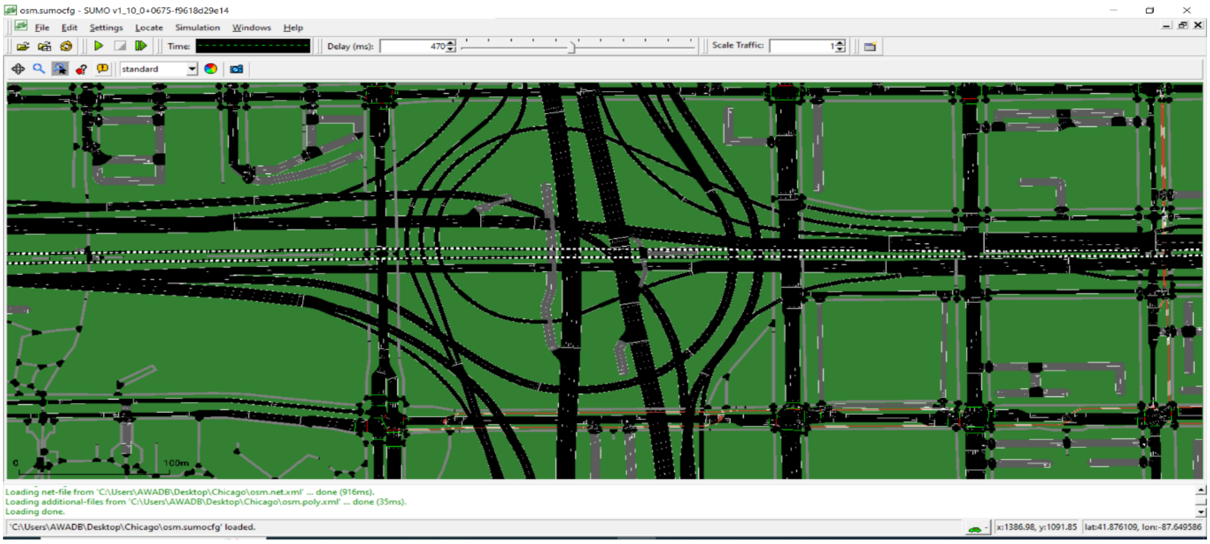
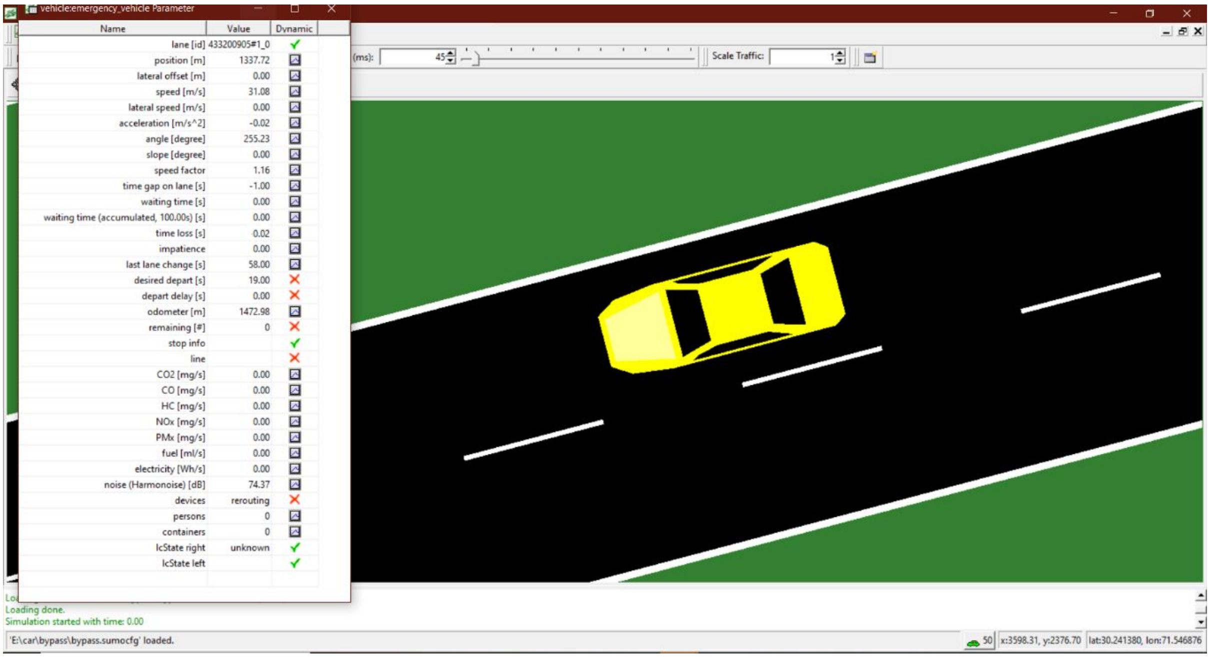
the Tampa and Chicago are part of the highway. According to research work utilizing pre-programmed and non-pre-programmed scheduling systems, OAC performance is much better than AB while Washington road performance is superior to OV. The Washington road network's time delay is shown in Figure 4, and the effectiveness of the junction management system is indicated by the rate of delay and speed change. Real-time changes in K1 and K2 cause the delay duration to vary depending on the trajectory type and the individual vehicle.



```
Loading net-file from 'C:\Users\AWADB\Desktop\Chicago\osm.net.xml' ... done (916ms).
Loading additional-files from 'C:\Users\AWADB\Desktop\Chicago\osm.poly.xml' ... done (35ms).
Loading done.
'C:\Users\AWADB\Desktop\Chicago\osm.sumocfg' loaded.
```

Ficture-7 Newtok Performance of Chicago, Ryan Expressway



Name	Value	Dynamic
lane [id]	433200905#1_0	✓
position [m]	1337.72	📈
lateral offset [m]	0.00	📈
speed [m/s]	31.08	📈
lateral speed [m/s]	0.00	📈
acceleration [m/s^2]	-0.02	📈
angle [degree]	255.23	📈
slope [degree]	0.00	📈
speed factor	1.16	📈
time gap on lane [s]	-1.00	📈
waiting time [s]	0.00	📈
waiting time (accumulated, 100.00s) [s]	0.00	📈
time loss [s]	0.02	📈
impatience	0.00	📈
last lane change [s]	58.00	📈
desired depart [s]	19.00	✗
depart delay [s]	0.00	✗
odometer [m]	1472.98	📈
remaining [#]	0	✗
stop info		✓
line		✗
CO2 [mg/s]	0.00	📈
CO [mg/s]	0.00	📈
HC [mg/s]	0.00	📈
NOx [mg/s]	0.00	📈
PMx [mg/s]	0.00	📈
fuel [ml/s]	0.00	📈
electricity [Wh/s]	0.00	📈
noise (Harmonoise) [dB]	74.37	📈
devices	rerouting	✗
persons	0	📈
containers	0	📈
lcState right	unknown	✓
lcState left		✓

```
Loading done.
Simulation started with time: 0.00
'E:\car\bypass\bypass.sumocfg' loaded.
```

Figure-8 Performance for emergency autonomous.

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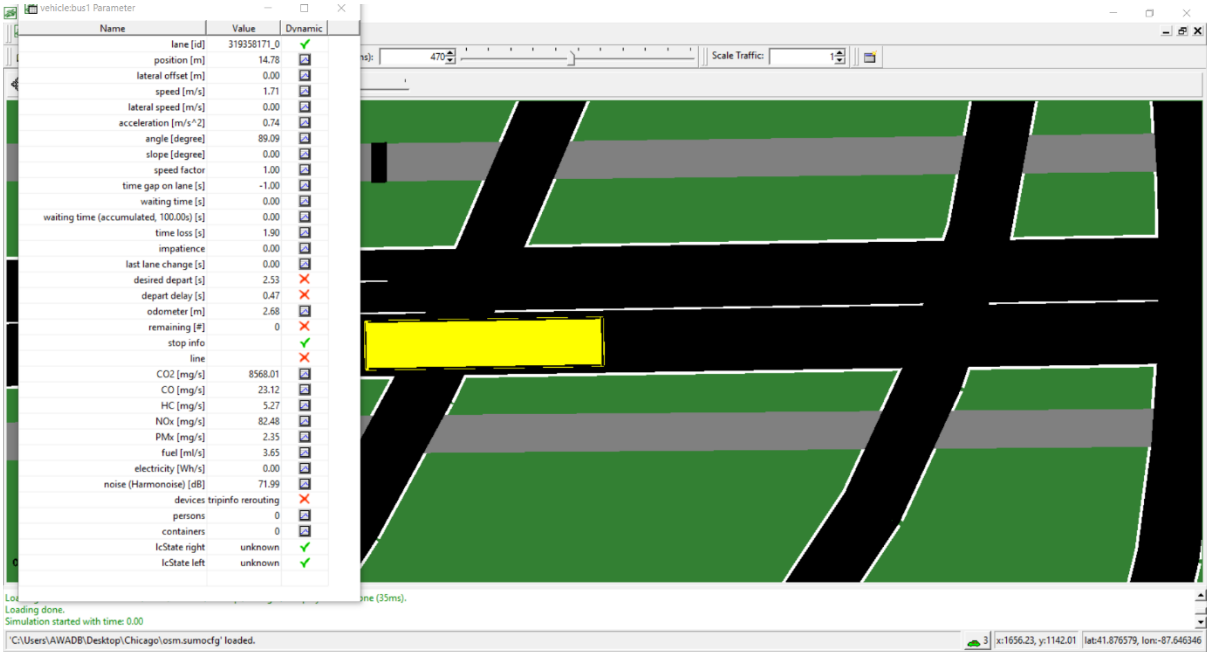


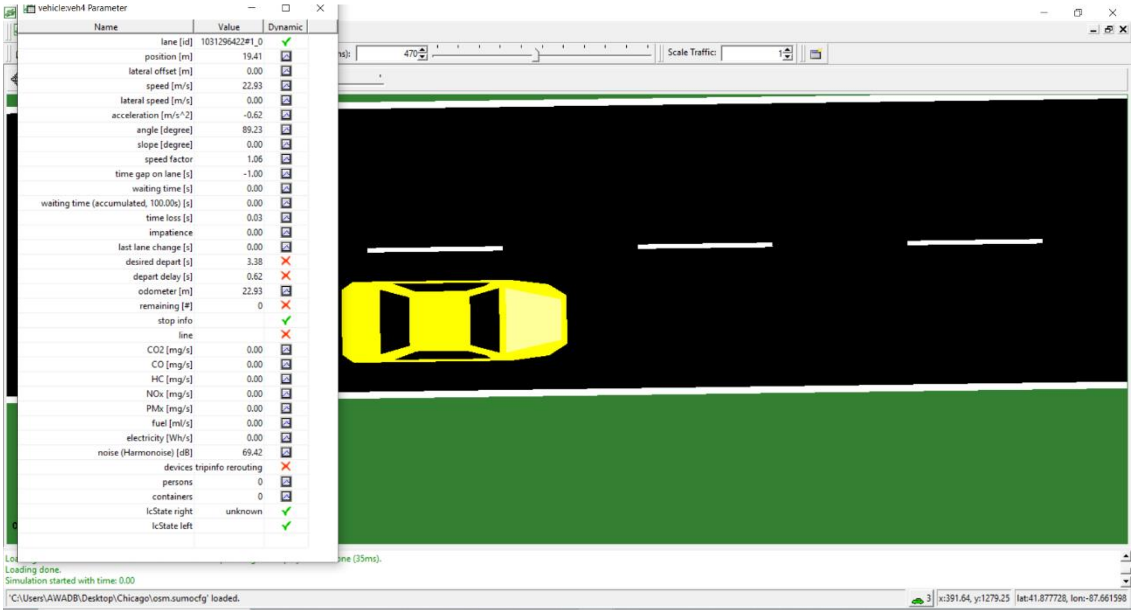
vehicle:bus1 Parameter

Name	Value	Dynamic
lane [id]	319358171_0	✓
position [m]	14.78	📈
lateral offset [m]	0.00	📈
speed [m/s]	1.71	📈
lateral speed [m/s]	0.00	📈
acceleration [m/s^2]	0.74	📈
angle [degree]	89.09	📈
slope [degree]	0.00	📈
speed factor	1.00	📈
time gap on lane [s]	-1.00	📈
waiting time [s]	0.00	📈
waiting time (accumulated, 100.00s) [s]	0.00	📈
time loss [s]	1.90	📈
impatience	0.00	📈
last lane change [s]	0.00	📈
desired depart [s]	2.53	✗
depart delay [s]	0.47	✗
odometer [m]	2.68	📈
remaining [#]	0	✗
stop info		✓
line		✗
CO2 [mg/s]	8568.01	📈
CO [mg/s]	23.12	📈
HC [mg/s]	5.27	📈
NOx [mg/s]	82.48	📈
PMx [mg/s]	2.35	📈
fuel [ml/s]	3.65	📈
electricity [Wh/s]	0.00	📈
noise (Harmonoise) [dB]	71.99	📈
devices	tripinfo rerouting	✗
persons	0	📈
containers	0	📈
lcState right	unknown	✓
lcState left	unknown	✓

```
Loading done.
Simulation started with time: 0.00
'C:\Users\AWADB\Desktop\Chicago\osm.sumocfg' loaded.
x:1656.23, y:1142.01   lat:41.876579, lon:-87.646346
```

Ficture-9 for the performance of BUS

Figure 9 shows how junction management system efficiency is calculated based on vehicle delay rate and speed change for the Washington road network. Due to real-time fluctuations in K1 and K2, delay length varies depending on trajectory type and even from OV to AB.



vehicle:veh4 Parameter

Name	Value	Dynamic
lane [id]	1031296422#1_0	✓
position [m]	19.41	📈
lateral offset [m]	0.00	📈
speed [m/s]	22.93	📈
lateral speed [m/s]	0.00	📈
acceleration [m/s^2]	-0.62	📈
angle [degree]	89.23	📈
slope [degree]	0.00	📈
speed factor	1.06	📈
time gap on lane [s]	-1.00	📈
waiting time [s]	0.00	📈
waiting time (accumulated, 100.00s) [s]	0.00	📈
time loss [s]	0.03	📈
impatience	0.00	📈
last lane change [s]	0.00	📈
desired depart [s]	3.38	✗
depart delay [s]	0.62	✗
odometer [m]	22.93	📈
remaining [#]	0	✗
stop info		✓
line		✗
CO2 [mg/s]	0.00	📈
CO [mg/s]	0.00	📈
HC [mg/s]	0.00	📈
NOx [mg/s]	0.00	📈
PMx [mg/s]	0.00	📈
fuel [ml/s]	0.00	📈
electricity [Wh/s]	0.00	📈
noise (Harmonoise) [dB]	69.42	📈
devices	tripinfo rerouting	✗
persons	0	📈
containers	0	📈
lcState right	unknown	✓
lcState left		✓

```
Loading done.
Simulation started with time: 0.00
'C:\Users\AWADB\Desktop\Chicago\osm.sumocfg' loaded.
x:391.64, y:1279.25   lat:41.877728, lon:-87.661598
```

Figure-10- Performance for OC

Figure 10 demonstrates that Chicago performance on Washington routes is lower and that time delays on Washington routes are shorter in EAV than in OC. The Chicago motorway's

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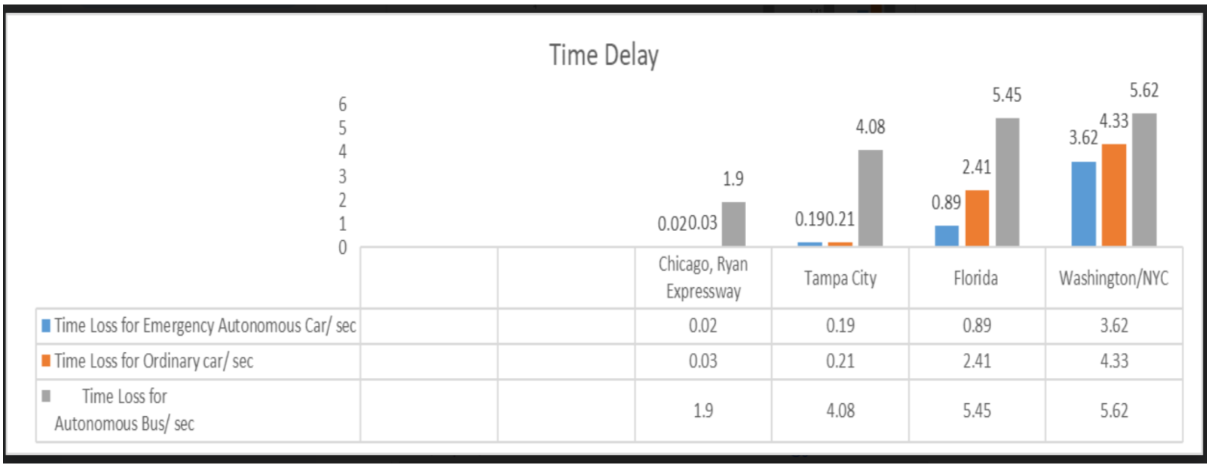
performance is subpar as a result of the gridlock. The Tampa motorway routes perform better than all other routes, and OV has a shorter time delay than AB. Due to its intelligent routes, AB performs better on common routes.



			Chicago, Ryan Expressway	Tampa City	Florida	Washington/NYC
🟦 Time Loss for Emergency Autonomous Car/ sec			0.02	0.19	0.89	3.62
🟧 Time Loss for Ordinary car/ sec			0.03	0.21	2.41	4.33
■ Time Loss for Autonomous Bus/ sec			1.9	4.08	5.45	5.62

Figure-11: Performance for emergency autonomous Vehicles

4. Conclusions and Recommendations:

Along with self-driving vehicle technology, quantum computing is one of the boundaries of current technological advancement. Through its combination, the initiative offers a way forward for quick development. Classical computers are impractical because they require a lot of data processing to be able to move properly in the environment. Pedestrian detection must be a rapid process for autonomous cars. The research guarantees successful detection with very negligible false negatives by utilizing quantum computing. Subroutine implementations enhance the capabilities of quantum computing, despite the optimality of a fully integrated quantum k closest neighbor's model. In the long run, a world powered entirely by quantum computers is feasible when combined with wireless networking. There are plenty of development alternatives, even though a fully networked pedestrian detection system was not feasible. The ability to test programs with a high number of qubits, implement new algorithms, and detect alternative features has improved this project. This research serves as a proof of concept in addition to the anticipated use of this framework for self-driving car pedestrian detection. If pedestrian detection works well, it might someday be possible to use a quantum computer to operate a fleet of self-driving automobiles by expanding the detection range to include a wider variety of objects. The difficulty of regulating private automobiles on highways in natural settings is enormous. Private cars are employed to regulate traffic flow on the Washington train network. This research attempts to reduce the regulatory unit's workload by establishing a private vehicle route, with all other automobiles operating in pre-scheduled and non-pre-programming modes. The suggested technique outperforms existing ways of managing traffic lights in terms of simulation results. The system allows standard and private

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cars to use it, with private vehicles driving after getting permission or rejection signals from traffic control units. When a private car joins a roadway, AIMS receives an incoming call and verifies the vehicle's direction. In a smart transportation system, V2X communication is utilized to manage emergency priority autonomous vehicles (AB, EAC, and OV) on the road in real-time. AIMS prioritizes incoming cars based on pre-emptive and non-pre-emptive principles for safe pathways. Disturbances arise in the network of running vehicles because of emergency autonomous vehicles, and AB and EAC are allocated the shortest arrival time with the shortest route at maximum speed. Consequently, all OAVs experience less disturbance and run more smoothly. The network's overall performance demonstrates that EAC performs better than OAC, while OAC performs much better than AB. To optimize the trajectory, an improved junction management system for flying buses and flying vehicles on the road may be proposed in the future.

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