Artificial Intelligence Powered Congestion Free Transportation System Through Extensive Simulations

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Abstract – Intelligent traffic monitoring is a prominent topic of investigation due the emergence of advancements like the Internet interconnected Things and intelligent computers. Combining these technologies will make it easier to methods to aid in making better choices and accelerating urban growth. Intelligent sensing has come to the forefront in recent years due to its capacity to make calculated decisions on its own to address difficult issues. Automatic vehicles and smart gadgets are equipped with sensors that are part of an IoT-based system in order to recognize, gather, and transmit data. Artificial intelligence (AI)-based techniques allow machines to acquire knowledge and keep tabs on their surroundings through continuous sensing. Improvements in variable traffic control strategies for overcrowded cities have numerous positive outcomes, one of which is increased road safety. Since the sensors on which conventional dynamic controllers relied had their own shortcomings, we might use vision sensors (like cameras) to avoid these issues. Image and video-based computing has a lot of potential for measuring traffic volumes. A new traffic management system named Enhanced Transportation Technologies (ETT) is implemented to relieve congestion at the busy intersection after the old one was deemed to be inadequate. The term "intelligent transportation system" (ITS) refers to a group of transportation systems to keep drivers and passengers safe on the road and to facilitate autonomous mobility by optimizing control systems. To further improve urban planning, crowd behavior, and traffic forecasting, dependable AI models have been developed to work in tandem with ITS. Compared to controllers using conventional sensors, the proposed model has been shown through extensive simulations to reduce waiting time and increase movement speed on average.

Keywords – Artificial Intelligence, Transportation, Congestion, Traffic Conditions, Technologies, Sensors.

I. INTRODUCTION

As a nation advances economically, more and more cars and trucks are produced and registered [1]. This has resulted in gridlock, slowed logistical supplies, an increase in road accidents, and increased pollution [2]. The need for ITM infrastructure has grown. Greater numbers of people were needed to operate the older, manual traffic control systems [3]. Authorities in these systems cannot properly manage traffic in all cities due to weak traffic policies and insufficient personnel resources [4]. The smartness and longevity of the idea of a smart city are dependent on the technology implemented to better the lives of its citizens [5]. Smart city governance is an important aspect of smart city initiatives since it facilitates strategies for better decision making through planning [6]. The Internet of Things (IoT) has many advantages for intelligent transportation management (ITM), including increased data transfer, the generation of heterogeneous communication, and the deployment of low-bandwidth devices in high-capacity places around the world [7].

In order to maximize the public's return on the investment in smart city solutions, governments must focus on a wide range of sectors, encompassing medical services, management of buildings, congestion control, parking remedies, transport, etc [8]. The concept of "smart cities" has progressed with the advent of the IoT. Smart devices are embedded into the city's physical infrastructures, producing a steady stream of multidimensional data across a variety of locations; this data is then analyzed to give the infrastructures the ability to learn and adapt [9]. More people were needed for manual traffic control systems. Authorities are unable to efficiently manage traffic in all cities utilizing a manual system due to the dismally bad traffic policies and human resources strength of these systems [10]. Congestion in metropolitan areas can be alleviated with the installation of traffic signals. The traffic light frequency distribution, however, is consistent and uniform across all roads [11]. Because of the unpredictable flow of traffic from both directions, resources are being wasted because the signals are not uniform. Microelectronic devices with built-in artificial intelligence are referred to as "smart" because of their "smart" capabilities [12]. The development of increasingly sophisticated computational methods paved the way for the emergence of intelligence technology. These smart gadgets are characterized by their ability to (i) gather information from signals, (ii) process those signals, and (iii) carry out given instructions. Artificial intelligence encompasses every significant advancement in this field of technology, such as RNNs, CNNs, Transfer Learning, Continual AI, etc [13]. Therefore, intelligent sensing is formed by combining smart sensors with AI to create smart applications [14]. Today's sensors are utilized for much more than data collection; they may be programmed to do a variety of tasks based on the sequence of data they've collected [15]. Intelligent sensors that can observe their surroundings, form opinions, and draw conclusions being developed to help sift through the mountain of data [16]. There are several reasons why intelligent sensing is crucial. It has a wide range of potential uses, from self-driving cars and drones to medicine and the military [17].

Incorporating several technical advances and inventions into the development of a more modern mode of transportation would boost efficiency, lessen traffic, and enhance the trip as a whole [18]. Creating futuristic modes of transportation that utilize artificial intelligence (AI) to reduce travel and waiting times is a fascinating prospect. Intelligent transportation systems can't exist without the shift toward greener, electric vehicles [19]. Electric cars, buses, and bicycles can help create a more sustainable transportation system by reducing harmful emissions and the need for fossil fuels. Because of this increase in population, urban transportation is likely to become a major contributor to air and water pollution [20]. One of the tenets of a smart city is "smart mobility," which employs the use of better urban transportation is possible with the use of new technologies that connect users, infrastructures, and vehicles, lessen the burden on public services, make citizens safer, and lessen environmental damage. The Internet of Things (IoT) and the maturation of smart mobility strategies have led to the creation of numerous innovations that improve upon existing public transportation options, cater to individual users' needs in areas like parking, emergency situations, and battery charging, and incentivize the widespread adoption of electric vehicles. The topic of smart mobility systems, however, could not be separated from AI and transportation logistics. In addition, the foundation of tomorrow's smart mobility must be built through a cross-sector partnership between the governmental, business, academic, and citizen sectors. For the purpose to make the goal of smart mobility a reality, we provide a suite of optimization tools that includes vehicle routing systems, e-mobility systems, and intelligent intelligence-driven smart mobility systems.

The following are the paper's most significant contributions:

1. A new traffic control system, named Enhanced Transportation Technologies (ETT), was deployed at the backed-up intersection to cut down on car wait times.
2. By optimizing control systems, Intelligent Transportation Systems (ITS) ensure the safety of drivers and passengers through the use of communication technology.
3. Extensive simulations show that the suggested model reduces waiting time and increases movement speed on average compared to controllers employing standard sensors.

The remaining parts of the paper are summarized here. The many perspectives on these issues are set in context in Section I. Next Section II describes the literature review The Section III segment delves into how to implement the Enhanced Transportation Technologies into existing urban environments to create smart cities. In Section IV, we will provide a concise summary of our findings and some suggestions for future studies. After this format description, Section V provides an overall summary of the discussion.

II. LITERATURE REVIEW

Adopting innovative technologies can help the transportation sector address a variety of urgent issues. Issues that pertain to expanding or improving facilities access, and interoperability should be tackled first. Although many studies have brought attention to the problem, little has been accomplished.

In [20] incorporated Information on Traffic Jams in Real Time [ITJ-RT]. The purpose of these roadside messaging systems is to increase accessibility by informing drivers of current traffic conditions and any odd situations. Citizens will appreciate these advance warnings, especially during rush hour. The system provides administrative traffic updates via radio broadcast. Through the creation of a prototype, we are able to evaluate the viability of the model, and the results show promise, with high accuracy in vehicle identification and low relative deviation in road occupancy prediction. The strategies for improved decision-making and urban development will be facilitated by the incorporation of these technologies. While highway and urban traffic control have benefited greatly from existing traffic prediction systems, collector routes and closed campuses have received comparatively less attention.

The [21] determined Adaptive Traffic Management (ATM) using Machine Learning and the Internet of Things. The suggested system is built on a foundation of infrastructure and events. The design is flexible enough to accommodate numerous transport use cases. The suggested ATM system makes use of the DBSCAN clustering approach, which is based on machine learning, to identify any unexpected occurrences. The proposed ATM concept would have traffic lights reschedule themselves in response to fluctuations in volume and expected movement. It generates a smoother transition between green lights, resulting in much less traffic and shorter commute times. The experimental results demonstrate that the proposed ATM system outperformed the conventional method of traffic management and will be a frontrunner in the field of transportation planning for smart city-based systems. Reduced traffic congestion, fewer accidents, and a more pleasurable ride are all benefits of the ATM solution offered.

Work [22] elaborated Artificial intelligence techniques for Intelligent Sensing [AI-IS] which allow machines to acquire knowledge and keep tabs on their surroundings through direct sensing of relevant data. Intelligent sensing holds great promise for the integration of these two technologies. This review compiles the most up-to-date findings on artificial intelligence (AI)-based algorithms for intelligent sensing. This paper provides a comprehensive comparison of existing intelligent sensing algorithms, models, influential parameters, datasets, applications, and initiatives. We provide a taxonomy of AI models and discuss state-of-the-art methods. We conclude by pointing out some of the interesting and rapidly developing field's challenges and outstanding questions, and by outlining potential future research possibilities.

Authors [23] described Controlling traffic with Bayesian Belief Networks (CT-BBN) where real-time traffic management is crucial to the success of smarter modes of transportation (SMT). Improvements in dynamic traffic management systems for crowded cities have numerous positive outcomes, one of which is increased road safety. Knowledge-based systems are increasingly being used as decision-making frameworks in the real world. We may use visual sensors (like cameras) to circumvent the disadvantages of typical dynamic controllers that rely on sensors. Image and video-based computing can provide valuable insights on traffic numbers. After determining that the preexisting road junction traffic management system was inadequate, a new system was designed and implemented to reduce delays. The effectiveness of the proposed framework is evaluated using Lab VIEW and MATLAB. Extensive simulations using the proposed technology demonstrate it decreases waiting time and increases movement speed roughly compared to controllers using conventional sensors.

In [24] proposed Intelligent transportation systems (ITS) use communication technologies to keep drivers and passengers safe on the road and to facilitate autonomous mobility by optimizing control systems; this article gives a survey of these and other techniques and technology. When integrated with reliable AI models developed to improve urban planning, examine crowd behavior, and forecast traffic situations, ITS becomes even more useful. The peak of mobility data produced by the proliferation of smartphones and other digital devices AI-driven ITS is now becoming a reality. As this paper explains, traffic congestion issues can be avoided and vehicle routing capacities can be improved through urban planning optimization. We look at the incentives and policies put in place to promote the usage of mobility systems from an environmental perspective. We emphasize the need of political will in encouraging open data in transportation, which is vital to the creation of technical solutions that will make cities safer, healthier, and more self-sufficient in the future.

The Transportation Department employs numerous tried-and-true strategies to advocate for the extension and improvement of the state's infrastructure, including ITJ-RT, ATM, AI-IS, CT-BBN, and ITS. Enhanced Transportation Technologies [ETT] were developed to facilitate their application in reducing congestion at the bottlenecked intersection. This is put to use by setting the stage for research into the many facets of Smart City Development in the medium-sized cities of India, with a particular emphasis on smart city importance and growth.

III. ENHANCED TRANSPORTATION TECHNOLOGIES [ETT]

The evolution of "smart cities" is greatly aided by real-time traffic monitoring systems. Smart city infrastructures rely on autonomous traffic sensing to monitor traffic patterns, anticipate bottlenecks, and optimize traffic flows through the use of high-tech wireless sensors. Having this kind of insight allows for more economical utilization of existing facilities and equipment when used correctly. The first stage in traffic management is to locate and quantify points of congestion. Traffic congestion metrics including flow, occupancy, and density are typically derived from visual data recorded by vision systems. These metrics inform the content of the traffic alerts that get sent out by various mediums like mobile phones, radio, television, flashing lights, DVMs, and screens. Web applications accessible from a mobile device are a particular focus of academic research.

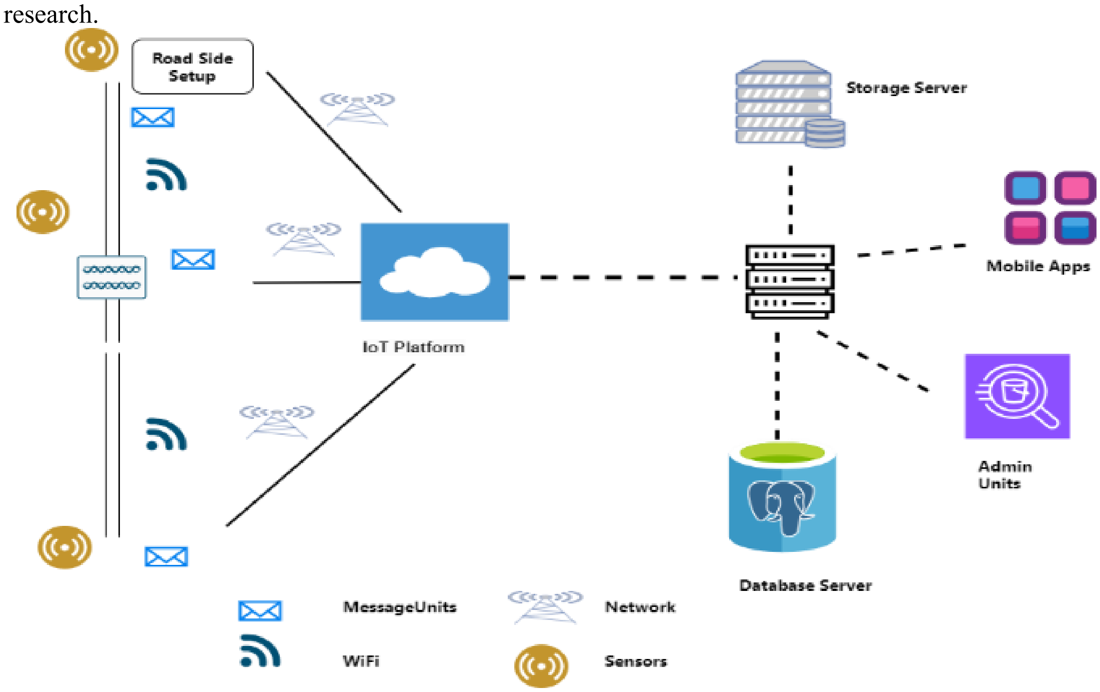

Fig 1. A Model for Systemic Communication

The proposed system's overall architecture is covered here. As shown in **Fig 1**, the proposed system's communication paradigm includes both on-the-ground and remote components. It's a sensor network and electronic billboards by the road. Between the two junctions of road segments is where the sensors and boards will be positioned. Data storage, cloud services, and user interfaces are all part of the central server. Wi-Fi allows for inter-part communication. Storage Server, Mobile apps, admin units and database server are all connected to the central hub of the system. IoT platform is interconnected with roadside setup and Wifi points along with the display unit and sensors.

$$\mathrm{CS}_d(x) = SS(\mathrm{x}) + \mathrm{DBS}(\mathrm{x})\mathrm{j} + \left(A_d(\mathrm{x}) + \mathrm{MA}_d(\mathrm{x})\right) \quad (1)$$

In Equation (1) $\mathrm{CS}_d(x)$ indicates the central server of the system, $SS(\mathrm{x})$ be the secondary server, $\mathrm{DBS}(\mathrm{x})$ be the database server, $A_d(\mathrm{x})$ be the admin units, $\mathrm{MA}_d(\mathrm{x})$ be the mobile applications.

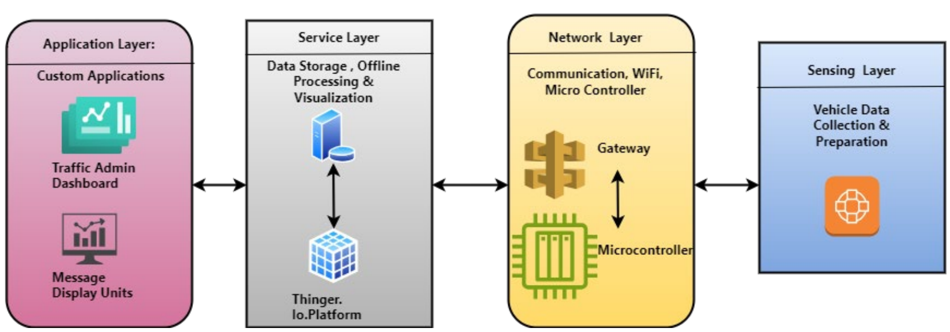

Fig 2. Architecture of a System

Fig 2 depicts the multilayered design. The sensor layer, network layer, service layer, and application layer are the mainstays of an IoT-based system architecture. The items' data is collected by the sensory layer, delivered by the network layer to the service layer to be regulated and evaluated, and finally presented to the user by the application layer. (i) The four main functions of a developed system are (i) presenting traffic updates, (ii) providing geographical plan information for an exact location, (iii) recognizing cars and evaluating vehicle in length. and (iv) calculating an expanding queue.

$$\mathrm{DTR} = \arg\left(\mathrm{L}\, y_j \ (\mathrm{T} = \mathrm{t}|\mathrm{x_j})\right) \tag{2}$$

As per the equation (2) indicates that DTR is the Display Traffic rules at maximum level in given y_j. L denotes the development layers for the particular traffic. t is the traffic estimation factor.

$$\mathrm{AL} = \sum(CA + TAD + MDU) \tag{3}$$

The equation (3) denotes that AL is the Application layer which is the sum of custom applications denoted by . TAD is the Traffic admin Dashboard MDU is the message display units.

$$\mathrm{SVL} = \emptyset - \partial - \pi + \mathrm{TIP} \tag{4}$$

In the above equation, it represents that SVL is the Service layer which is the contributions of $\emptyset$ be the data storage, ∂ be the offline processing, π be the visualization factor. TIP is the Thinger IoT platform.

$$\mathrm{NL} = \frac{\Delta\mathrm{C} + \beta + \mu\mathrm{c}}{G-1} - SL \tag{5}$$

NL represents the network layer where ΔC is the communication factor, βis the wifi control , μc be the micro controller. G be the gateway part. SL be the sensing layer.

Advantages of Magnetic Sensors: (i) it may be simply mounted on roadsides, (ii) it lowers detection error, and (iii) it is not affected by weather conditions. These boards' sensors are hardware- and software-based. In addition to saving money, moving forward with these prefabricated nodes is wise because their individual projected costs are low.

$$\mathrm{L} = \mathrm{AL} + \mathrm{SVL} + \mathrm{NL} \tag{6}$$

Equation (6) represents the combination of layers which is represented by L. The combination of three layers are denoted by AL be the application layer, SVL be the service layer and NL be the network layer.

Substituting equation (3), (4) and (5) in equation (6) we have

$$\mathrm{L} = \sum(CA + TAD + MDU) + \emptyset - \partial - \pi + \mathrm{TIP} + \frac{\Delta\mathrm{C} + \beta + \mu\mathrm{c}}{G-1} - SL \tag{7}$$

Thinger. io is a free platform for IoT that helps with the gathering, organizing, analyzing, and displaying of data from sensors. By bringing together cloud computing, Internet of Things (IoT) infrastructure, and big data, launching data fusion apps is made easier with Thinger. io (www.thinger.io). It allows any sensor to be controlled remotely and provides pre-built services for network connectivity. When it comes to optimizing transmission efficiency, no service compares to Thinger. io and its exclusive encoding method.

The electronic bulletin board may take the form of a Character LCD with WiFi connectivity display. However, a 16 x 02 LCD device, which can show 32 characters, served the purpose for testing purposes.

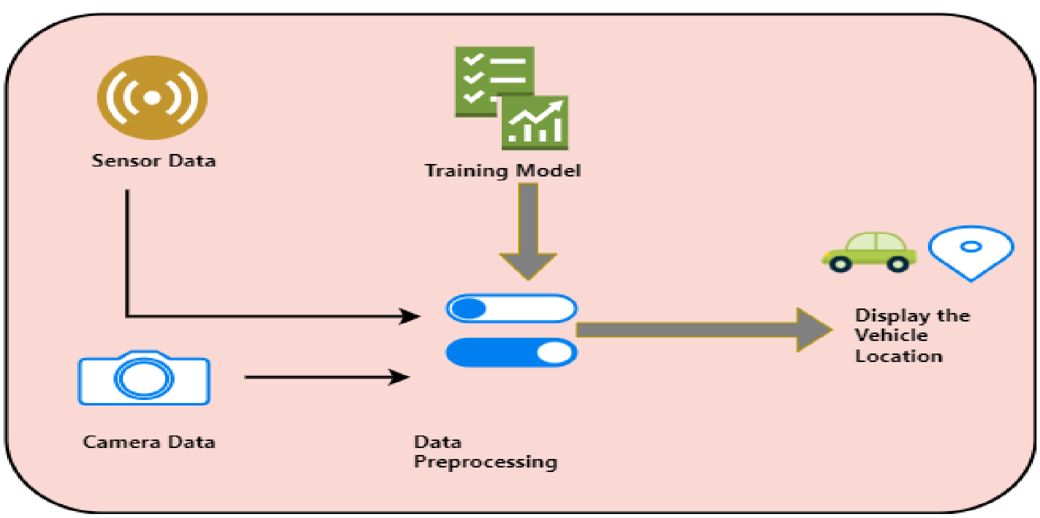

Fig 3. Tracking the Movement of Vehicles

The proposed vehicle position monitoring system module is depicted in motion in **Fig 3**. In the first step, information is gathered with the help of sensors and cameras. Sensor and camera data gathering, as well as data preparation, play critical roles in ITM. During this stage of data preparation, missing value estimation techniques are implemented. After collecting the necessary information, the processing technique processes it before feeding it into the training method to produce a trained dataset. All of the vehicle's movements and locations are recorded. The suggested system uses intelligent traffic control to lessen the likelihood of accidents and the toll of fatalities from such incidents. The intelligent accelerometer sensor used in the proposed system aids in the detection of traffic accidents caused by vehicle falls.

$$\mathrm{DTR} = \arg\left(\sum(CA + TAD + MDU) + \emptyset - \partial - \pi + \mathrm{TIP} + \frac{\Delta C + \beta + \mu c}{G-1} - SL\, y_j\, (\mathrm{T} = \mathrm{t}|\mathrm{x_j})\right) \quad (8)$$

The above equation (8) shows the DTR which is the combination of all layers which is represented by the above equations.

The primary forces that an accelerometer is able to measure are those of motion. The gravitational pull, for example, is a constant, as is the prevalence of mobile devices capable of detecting motion, such as smartphones. The technique is trained with pressure and distance data using preprocessed samples of vehicle accidents. Using information gathered from sensors, such as a sensor for measuring distance, the source of the pressure can be determined. A motion detector measures velocity, and a strain gauge determines volume.

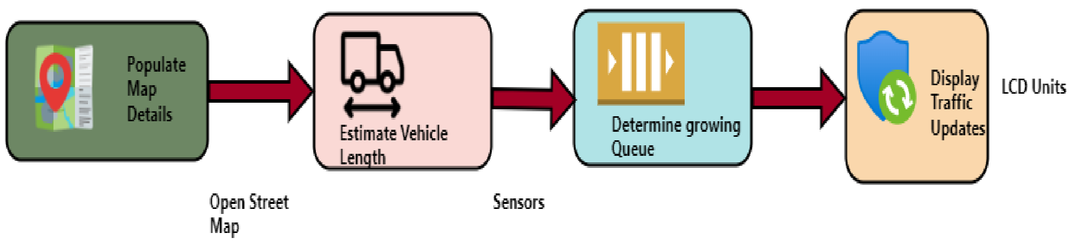

Fig 4. Developmental Work on Systems

Fig 4 depicts the suggested system development activities that will be addressed below.

Populate Map Details

The map shows where the roads are, where they intersect, and where to go. Both the road data and the message board locations are extracted from the maps and added to the database. The map was created by users and can be used to locate the bulletin board. The best places to post traffic alerts are at intersections that connect multiple roads. The locations of the message boards are chosen with the intention of maximizing the readability of the posted messages. Since the goal of choosing a bulletin board is to have your post seen by as many people as possible, this decision is viewed as a maximization problem.

Estimation of Vehicle Length

Vehicles are detected and their lengths estimated using data collected in real time by magnetic sensors. Predicted vehicle speed is utilized as a primary criterion in establishing vehicle length. Vehicles generate a disturbance in the Earth's magnetic field that can be detected by magnetic sensors and quantified as magnetic length [16]. In order to approximate the actual length of a vehicle, its magnetic length (VML) is measured. Vehicles are detected when the magnetic field strength is greater than a certain threshold.

Highway Congestion and Lengthening Wait Times

Typical indicators used to evaluate traffic congestion include velocity, duration, delay, dependability, service, available area, etc. One indicator of an increasing traffic congestion is the percentage of time spent in use of available road space. Vehicle length at the road's beginning and end points is used to estimate traffic volume. The VPL is calculated by adding the vehicle's physical length to the road occupancy measure at entry points and subtracting that value when the vehicle leaves the sensor node.

Present Cautionary Prompts

There are two sorts of traffic alert messages: (i) those that provide up-to-the-minute information on traffic volumes, and (ii) those that inform drivers of odd situations on the road. While driving, motorists can obtain these updates through a variety of mediums, including smart mobile applications, radios, televisions, etc. Use of roadside message boards at key crossroads is another option. These devices will aid the largest possible audience in finding safe, alternative means of transportation.

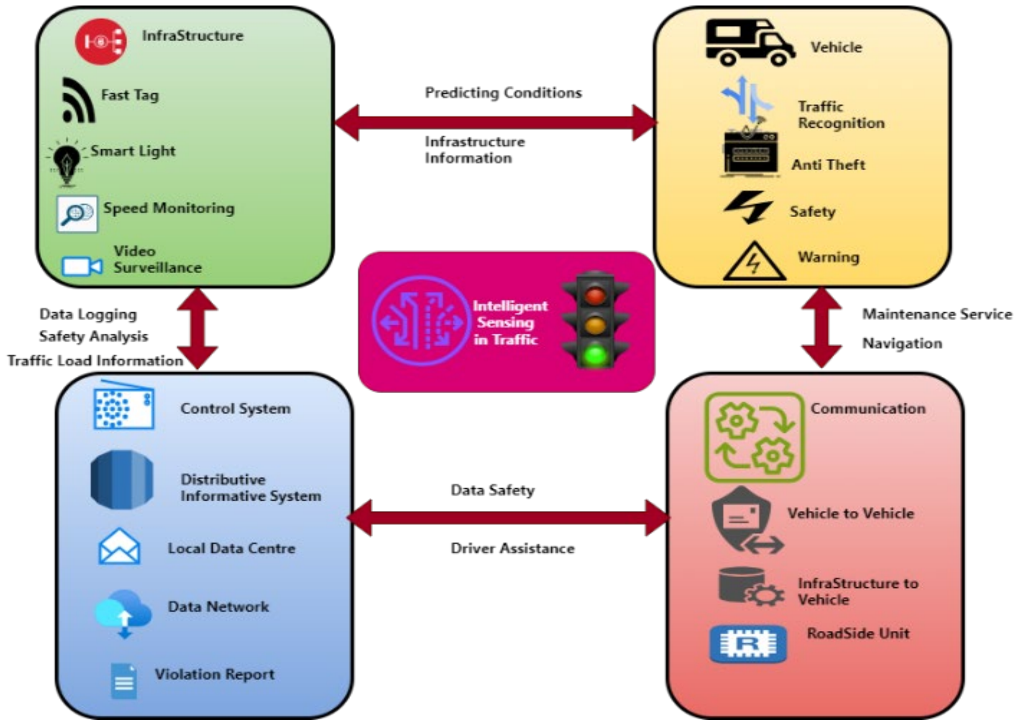

Fig 5. Smart Traffic Control Through Enhanced Sensing

Fig 5 displays a Smart Traffic Control Through Enhanced Sensing to traffic management. Artificial intelligence (AI)-based techniques have been used for traffic management. A genetic algorithm (GA) based method is used to enhance the current traffic light arrangement in order to optimize the light cycle times. The article delves into the planning and construction of a traffic light controller that adjusts the interval between green and red lights in response to the volume of traffic waiting at each. In addition, extension neural network (ENN)-based methods are utilized to identify objects in natural settings. The number of vehicles going through an intersection can be used to generate useful data for traffic signal monitoring. The emergence of smart sensors has allowed traffic management authorities to address a wide range of issues, including traffic congestion, the best possible route, travel costs, average waiting times, etc.

The current research uses Enhanced Transportation Technologies (ETT) to illustrate how an Internet of Things-based traffic control system can be analyzed for its protocols and security. Each author independently confirmed the measured values for throughput, accuracy, safety, performance, and lifetime security.

IV. RESULTS AND DISCUSSION

The experimental results prove that the proposed system is effective. First, a prototype that actually works is built. The following procedures constitute the experiment's execution (i) The steps involved are as follows: (i) The steps involved in developing a traffic dashboard using real-time data are as follows: (i) loading geographic map information; (ii) conducting on-road testing for spotting vehicles, vehicle length estimation, and road occupancy measurement.

Table 1. The Analytical Data Set

S.No	Content	Description
1.	User count	10,20,30,40,50
2.	For customers	10,20,30,…90
3.	Variables to be considered sample size	80
4.	Instructional Materials Examples	70%
5.	Initial Evaluations	90%

The above **Table 1** shows the dataset used in this analysis taken for consideration.

Throughput Analysis

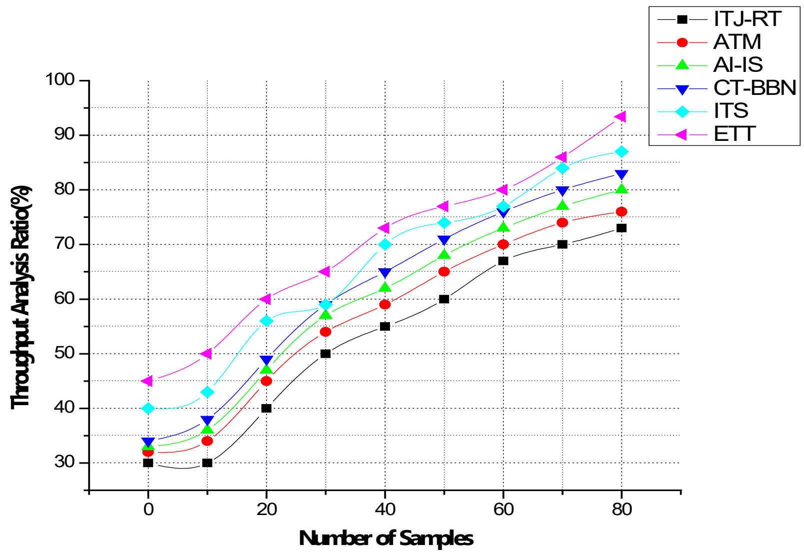

Fig 6. Throughput Analysis

The aforementioned Throughput Analysis Ratio was used for the analysis of the results. **Fig 6** displays the sample count as a function of the throughput analysis ratio. The route given by the ETT model performs better than any alternative methods through the node. Therefore, the model is efficient since the path must reach its destination as quickly and accurately as possible.

Accuracy Analysis

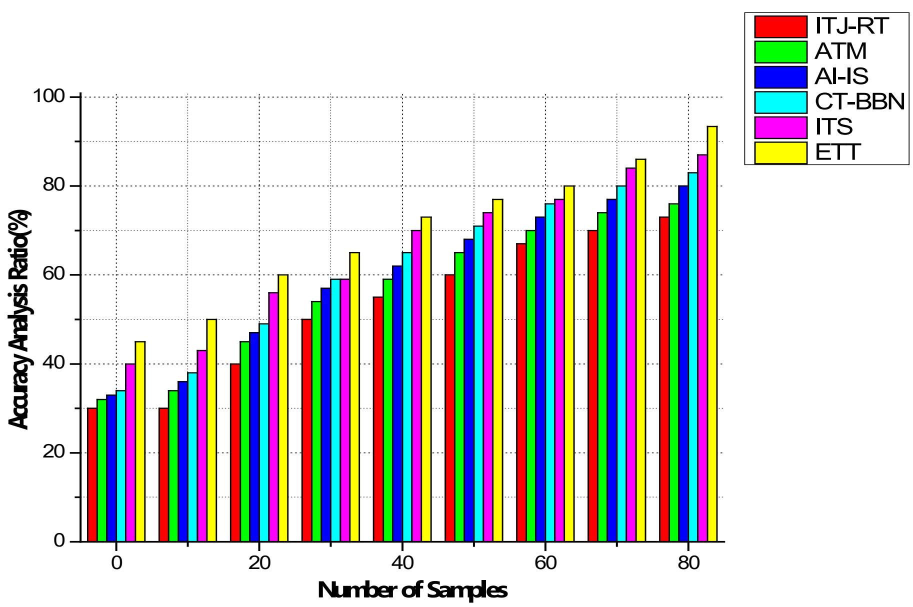

Fig 7. Accuracy Analysis

The safeguarding of samples against accuracy analysis ratios is depicted in **Fig 7**. Compared to other popular methods, ETT ensures more precise data delivery. To prevent data degradation caused by infiltration, it is critical that the data be transferred with zero errors and via a network with minimal interference. Data transmission accuracy surpasses state-of-the-art levels.

Performance Analysis

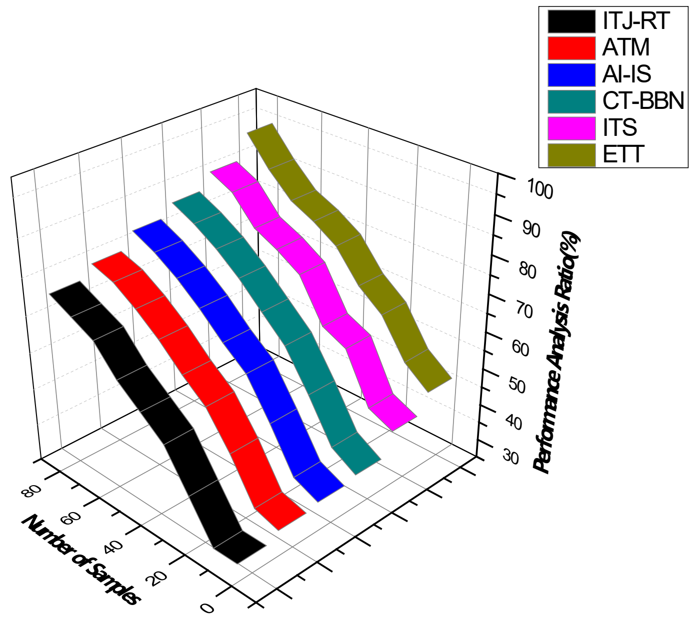

Fig 8. Performance Analysis

Fig 8 shows how to protect samples from ratios found in performance analysis. ETT guarantees more exact data transfer than other common approaches. It is vital that the data being delivered be completely accurate and sent through a traffic with as little noise as possible to prevent data traffic caused by intrusion. The data transfer performance exceeds the state of the art.

Security Analysis

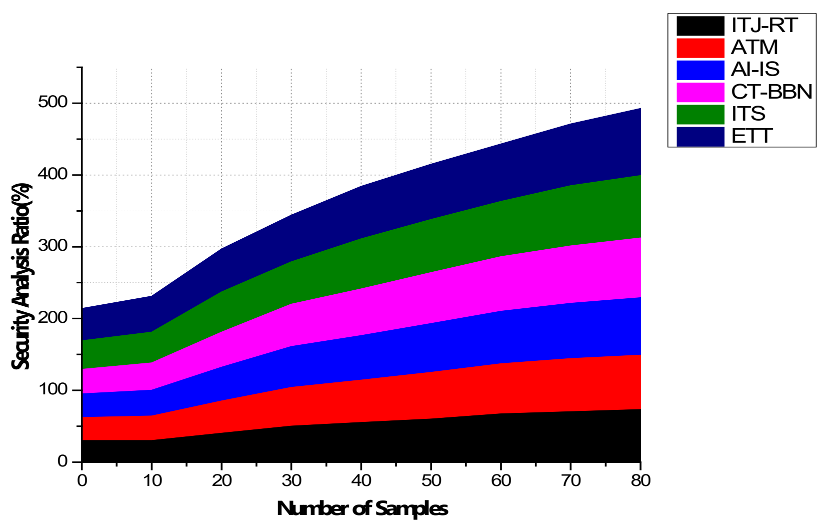

Fig 9. Security Analysis

Fig 9 depicts a method for shielding samples from ratios typically seen in security analysis. When compared to conventional methods, ETT ensures a more secure transport of data. Data traffic created by incursion can be avoided if it is given through a highway with as little noise as possible. Data transmission security is at or above industry standards.

Safety Analysis

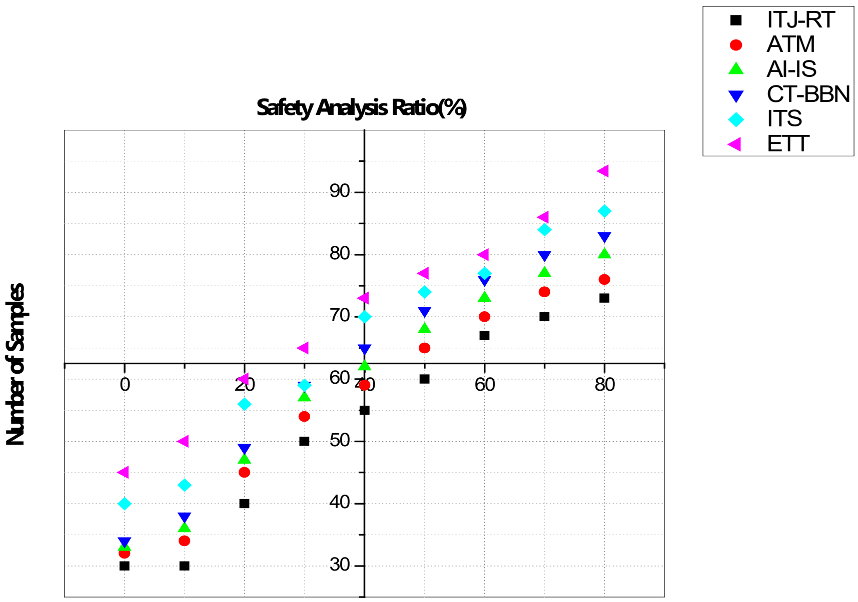

Fig 10. Safety Analysis

Protecting samples from the ratios usually seen in safety studies is shown in **Fig 10**. ETT guarantees safer data delivery when compared to traditional methods. If data is transmitted along a highway with as little background noise as feasible, the incursion-caused data traffic can be avoided. Data transfer security is at or above industry standards.

When compared to conventional means of guarding traffic-related data, the suggested ETT's many benefits stand out. In terms of smart city performance, safety, accuracy, security, and throughput, it exceeds ITJ-RT, ATM, AI-IS, CT-BBN, ITS, and ETT.

V. CONCLUSION

As the use of intelligent sensors expands, new problems arise in areas including system integration, data sharing, security, and flexibility. In this work, we have provided an overview of the technological prerequisites, prospects, and future directions for intelligent sensing that is enabled by artificial intelligence. We began by highlighting the role of AI in sensing technology developed for intelligent environments. We then provided a brief overview of the work's accomplishments, focusing on its most significant implications for intelligent sensing. We have surveyed several different kinds of learning models and compared them to one another. Recent studies' findings on the parameters that affect intelligent sensing's performance are reviewed. Then, the research community is provided with a presentation of accessible datasets for use in intelligent sensing. In this paper, we have outlined many plans for bringing the idea of smart mobility to large, expansive cities. In the context of a quickly evolving transportation market and increasingly demanding consumers, cutting-edge technologies are a must. We have discussed the challenges of ITS reliability and latency, and how it interacts with AI, and we have shown how ITS can improve traffic management and driver safety by providing services in real time. In the context of autonomous transportation, this combination greatly improves the quality of predictions that may be made. The vehicle routing problem and its solution, which makes use of the data collected in real time, have been presented. We have highlighted the value of open data in improving mobility services, which might help address transportation bottlenecks and ultimately increase output and efficiency. The suggested Enhanced Transportation Technologies [ETT] model paves the way for an intelligent transport system by facilitating services such as vehicle-specific geolocation, parking lot administration, and traffic control. Vehicle traffic management systems have recently grown increasingly interested in the concept of automatic accident detection. Keeping an eye on an accident scene can help us prevent similar events in the future and make it easier for law enforcement to reopen a blocked off section of road to traffic. The projected ETT system will be improved in the future to incorporate energy-efficient systems and security. Instead of using a simulator, the suggested technology will operate in a real-world setting with actual traffic conditions.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflicts of Interests

The author(s) declare(s) that they have no conflicts of interest.

Funding

No funding agency is associated with this research.

Competing Interests

There are no competing interests.

References

[1]. "Medical Big Data and Wearable Internet of Things Healthcare Systems in Remotely Monitoring and Caring for Confirmed or Suspected COVID-19 Patients," American Journal of Medical Research, vol. 8, no. 2, p. 78, 2021, doi: 10.22381/ajmr8220216.
[2]. M. Adil and M. K. Khan, "Emerging IoT Applications in Sustainable Smart Cities for COVID-19: Network Security and Data Preservation Challenges with Future Directions," Sustainable Cities and Society, vol. 75, p. 103311, Dec. 2021, doi: 10.1016/j.scs.2021.103311.
[3]. D. Singh, N. Pal, S. K. Sinha, and B. Singh, "Allocation of Reserved Green Energy Transmission Corridors to Secure Power Purchase Agreements in Smart Power Networks during Congestion Management," Electric Power Systems Research, vol. 209, p. 108006, Aug. 2022, doi: 10.1016/j.epsr.2022.108006.
[4]. V. Singh, M. Fozdar, H. Malik, and F. P. García Márquez, "Transmission congestion management through sensitivity-based rescheduling of generators using improved monarch butterfly optimization," International Journal of Electrical Power & Energy Systems, vol. 145, p. 108729, Feb. 2023, doi: 10.1016/j.ijepes.2022.108729.
[5]. S. Lv, Z. Wei, S. Chen, G. Sun, and D. Wang, "Integrated demand response for congestion alleviation in coupled power and transportation networks," Applied Energy, vol. 283, p. 116206, Feb. 2021, doi: 10.1016/j.apenergy.2020.116206.
[6]. Z. (Aaron) Cheng, M.-S. Pang, and P. A. Pavlou, "Mitigating Traffic Congestion: The Role of Intelligent Transportation Systems," Information Systems Research, vol. 31, no. 3, pp. 653–674, Sep. 2020, doi: 10.1287/isre.2019.0894.
[7]. P. Kaushik, "Congestion Articulation Control Using Machine Learning Technique," Amity Journal of Professional Practices, vol. 3, no. 01, May 2023, doi: 10.55054/ajpp. v3i01.631.
[8]. P. Kasture and H. Nishimura, "Analysis of Cooperative Perception in Ant Traffic and Its Effects on Transportation System by Using a Congestion-Free Ant-Trail Model," Sensors, vol. 21, no. 7, p. 2393, Mar. 2021, doi: 10.3390/s21072393.
[9]. T. Adbeb, W. Di, and M. Ibrar, "Software-Defined Networking (SDN) based VANET Architecture: Mitigation of Traffic Congestion," International Journal of Advanced Computer Science and Applications, vol. 11, no. 3, 2020, doi: 10.14569/ijacsa.2020.0110388.
[10]. G. Manogaran, I. Alrayes, A. Alshaikhi, and D. B. Rawat, "Pre-Predictive Congestion-Based Data Allocation for Sixth Generation Cooperative Intelligent Transportation Systems," IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 10, pp. 18655–18667, Oct. 2022, doi: 10.1109/tits.2022.3198806.
[11]. S. Abbas, M. A. Khan, A. Athar, S. A. Shan, A. Saeed, and T. Alyas, "Enabling Smart City with Intelligent Congestion Control Using Hops With a Hybrid Computational Approach," The Computer Journal, vol. 65, no. 3, pp. 484–494, Jul. 2020, doi: 10.1093/comjnl/bxaa068.
[12]. W. Zhu and C. Zhu, "A Prediction-Based Route Guidance Method Toward Intelligent and Green Transportation System," IEEE Internet of Things Journal, vol. 10, no. 14, pp. 12763–12776, Jul. 2023, doi: 10.1109/jiot.2023.3255200.
[13]. G. Manogaran and T. N. Nguyen, "Displacement-Aware Service Endowment Scheme for Improving Intelligent Transportation Systems Data Exchange," IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 11, pp. 22467–22477, Nov. 2022, doi: 10.1109/tits.2021.3078753.
[14]. N. Kumar, S. Mittal, V. Garg, and N. Kumar, "Deep Reinforcement Learning-Based Traffic Light Scheduling Framework for SDN-Enabled Smart Transportation System," IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 3, pp. 2411–2421, Mar. 2022, doi: 10.1109/tits.2021.3095161.
[15]. T.-H. Nguyen and J. J. Jung, "Swarm intelligence-based green optimization framework for sustainable transportation," Sustainable Cities and Society, vol. 71, p. 102947, Aug. 2021, doi: 10.1016/j.scs.2021.102947.
[16]. E. Khoza, C. Tu, and P. A. Owolawi, "Decreasing Traffic Congestion in VANETs Using an Improved Hybrid Ant Colony Optimization Algorithm," Journal of Communications, pp. 676–686, 2020, doi: 10.12720/jcm.15.9.676-686.
[17]. S. Singh et al., "A novel framework to avoid traffic congestion and air pollution for sustainable development of smart cities," Sustainable Energy Technologies and Assessments, vol. 56, p. 103125, Mar. 2023, doi: 10.1016/j.seta.2023.103125.
[18]. H. M. M, R. H. Mulangi, and V. Kulkarni, "Visualization and Assessment of the Effect of Roadworks on Traffic Congestion Using AVL Data of Public Transit," Journal of Geovisualization and Spatial Analysis, vol. 6, no. 2, Sep. 2022, doi: 10.1007/s41651-022-00123-z.
[19]. M. Amini, M. F. Hatwagner, G. Cs. Mikulai, and L. T. Koczy, "An intelligent traffic congestion detection approach based on fuzzy inference system," 2021 IEEE 15th International Symposium on Applied Computational Intelligence and Informatics (SACI), May 2021, doi: 10.1109/saci51354.2021.9465637.
[20]. M. Sarrab, S. Pulparambil, and M. Awadalla, "Development of an IoT based real-time traffic monitoring system for city governance," Global Transitions, vol. 2, pp. 230–245, 2020, doi: 10.1016/j.glt.2020.09.004.
[21]. U. K. Lilhore et al., "Design and Implementation of an ML and IoT Based Adaptive Traffic-Management System for Smart Cities," Sensors, vol. 22, no. 8, p. 2908, Apr. 2022, doi: 10.3390/s22082908.
[22]. Sharma et al., "Recent Trends in AI-Based Intelligent Sensing," Electronics, vol. 11, no. 10, p. 1661, May 2022, doi: 10.3390/electronics11101661.
[23]. P. Singhal, K. M. P., and P. K. Faujdar, "The development of a smarter mode of transportation using ai to reduce travel and waiting times," Multidisciplinary Science Journal, vol. 5, p. 2023ss0117, Aug. 2023, doi: 10.31893/multiscience.2023ss0117.
[24]. Z. Mahrez, E. Sabir, E. Badidi, W. Saad, and M. Sadik, "Smart Urban Mobility: When Mobility Systems Meet Smart Data," IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 7, pp. 6222–6239, Jul. 2022, doi: 10.1109/tits.2021.3084907.