Using a Fuzzy Logic Integrated Machine Learning Algorithm for Information Fusion in Smart Parking

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Abstract

The free flow of people and products within metropolitan areas depends on well-managed transportation systems. However, public parking places in smart cities are often limited by traffic, causing cars and residents to waste time, money, and fuel. To counteract this issue, today's automobile systems combine information fusion with intelligent parking solutions. In this research, we present a Fuzzy Logic Integrated Machine Learning Algorithm (FL-MLA) for use in smart parking and traffic management in a metropolis. The FL-MLA use fuzzy induction to distinguish between parked and moving vehicles while calculating traffic flow. The suggested technique efficiently resolves the problem of locating suitable parking places by avoiding incorrect configurations that govern traffic management difficulties. Therefore, the FL-MLA is used in traffic management systems to boost performance metrics like efficiency ratio (98.1%) and accident detection (98.1%) based on simulation results like reduced energy consumption (95.3%), more accurate traffic estimation (97.9%), higher average daily park occupancy (97.2%), and higher efficiency ratio (98.1%).

Keywords: Traffic management; artificial neural network; information fusion; smart parking; smart transport system; information fusion; fuzzy controller.

1. Introduction

A smart city uses modern information and communication technologies to improve the efficiency of its institutions, share information with the public, and give its residents better health care and public services [1]. Parking sensors offer real-time data about available parking spaces [2]. When it comes to city planning and utility distribution, smart parking in smart cities has little effect on the underlying technologies, such as parking [3]. Cameras, sensors, and wireless data transfers must gather and deliver the data for a solution to work [4]. It is developed to provide travelers and drivers with real-time parking information and traffic management [5]. The effectiveness of city councils can be increased even further by intelligent parking policies, which support the emergence of intelligent communities [6]. A growing sector of smart parking will be critical to the growth of smart cities as metropolitan areas expand today and, in the future, [7]. With smart parking, communities can help individuals save time and money by offering a variety of choices [8]. The same strategies would reduce traffic and increase municipal efficiency [9]. Equipment and human

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creativity are used in intelligent parking to ensure vehicles stay stationary many times and park more quickly, cheaply, and far apart while using as little power, time, and space as feasible [10].

Traffic management refers to a collection of policies and procedures designed to keep traffic moving while enhancing the transportation network's overall security, safety, and dependability [11]. On a day-to-day basis, these initiatives utilize ITS systems, services, and projects to improve road network performance [12]. Distracted driving can be reduced by enabling empty parking spaces using smart parking, which reduces traffic problems [13]. Smart parking technology helps drivers locate available spots by detecting whether or not a space is occupied via sensors and LED indications [14]. It's a smart parking system that makes it easier for motorists to locate a parking space [15]. Several roads include mobile applications or digital signs that display when the roads are clear to help vehicles find an open spot [16]. The gadget uses wireless parking sensors and a battery that doesn't need much care to get real-time data [17]. Drivers may utilize the information to find available parking spots more easily. When drivers are directed straight to parking, they spend less time driving around in circles looking for available spaces [18]. Using less gas and traveling more effectively, all while keeping an eye out for available parking spaces [19]. Reducing the number of miles driven to find a parking spot helps the environment reduce individual emissions. Observing the roadways reduces injuries and improves vehicle and pedestrian safety [20].

In this paper, a fuzzy logic integrated machine learning algorithm has been suggested to increase mobility while improving travel safety.Utilizing various forms of machine learning A smart traffic parking system will optimise available parking space to reduce the amount of time spent in traffic. Sensors are installed in various parking locations to gather data on available and occupied space using a neural network model. Intelligent traffic systems improve the detection of congested areas and, as a result, in their reduction. Sensor data is used to evaluate and synchronize the activity in real time. As long as there is enough congestion, the traffic signal will blink. Pollution will be reduced, and road accidents will be prevented.

The main contribution of FL-MLA in traffic management will reduce traffic problems and boost productivity in smart cities. New technology is helping us improve the quality of our everyday lives in many ways. The Traffic Management System is one of the most practical applications. A fuzzy-based machine learning algorithm has the potential to decrease traffic congestion significantly. It transmits and receives data from one another without the assistance of a person.

The remaining article is organized as follows: Section 2 describes the literature survey, and section 3 elaborates on the proposed traffic management and smart parking using a fuzzy logic integrated machine learning algorithm. Section 4 shows the numerical result of the proposed method. Finally, the conclusion with the future scope is deliberated in section 5.

2. Literature survey

This section presents the review's approach and methodology. The purpose of this paper is to examine the previous scholarly contributions. In addition, the literature review is a contribution aimed at assembling relevant papers on traffic management and smart parking.

In smart cities, parking allocation was a significant problem that gave rise to a number of smart parking systems (SPS). This article in [21] aims to give a comprehensive analysis of SPSs from a technical standpoint, sensor usage from a networking perspective, user interface and computational perspective. This study closes a research gap by outlining the advantages and disadvantages of SPSs under different environmental conditions.

For efficient traffic flow and increased road safety, communication between vehicles and RSUs needed to be low latency. Several research communities have taken notice of the Vehicular Ad hoc Network (VANET). In [22], VANETs were always monitored to ensure correct operation, which opens the door for applying Machine Learning algorithms to vast amounts of data produced by various applications. VANET's goal was successfully implemented due to these algorithms, which enable fast and Precise unsupervised and supervised learning of the gathered data using machine learning. This study looked at how machine learning algorithms can help solve the safety, communication, and traffic problems associated with VANET systems and their implementation infeasibility.

Traffic congestion was a significant problem in metropolitan settings, and town planners were particularly concerned with managing vehicle traffic. In [23], the new position is a novel method called the Modified Grasshopper Optimization Algorithm (MGOA) to measure vehicle transmission and distribution numbers. For this smart system to work, the barrier location must be determined by

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considering nature and traffic density when determining whether a barricade should be open or partially opened. The system focuses on identifying optimum membership limitations.
In [24], the author suggested that Internet of Things (IoT)-based smart monitoring applications were transformed by combining meta-heuristics methods (MHM) with machine learning techniques. Such systems can resolve complicated issues faster while preventing and anticipating emergencies. Combining meta-heuristics with machine learning methods increases their combined efficiency.
Smart cities require the integration of transportation systems with other elements of urban planning. Accurate traffic flow predictions can be achieved through the use of a multi-stage prediction approach based on attention-based convolution neural networks with long short-term memory (CNN-LSTM). By incorporating geographic and time-based data, the model becomes more accurate when traffic data from LSTM and CNN networks is used. The results show that the attention-based CNN-LSTM prediction model had higher prediction accuracy on weekdays and weekends, during peak and non-peak times.
Based on the survey, to overcome the proposed FL-MLA has been established to enhance energy consumption, traffic estimation, the daily average park occupancy, efficiency ratio, and accident detection when compared to the existing method. The following section discusses the proposed model briefly.

3. Proposed method: Traffic management and smart parking using fuzzy logic integrated machine learning algorithm

Congested traffic and an increase in the number of vehicles need ever-evolving and increasingly sophisticated solutions to traffic problems, including traffic signal management. Traffic monitoring and control in the city became a crucial task because of the potential to control roads and significantly impact quality of life. Smart Parking integrates technology and human innovation to achieve faster, easier, and denser parking for largely idle vehicles while using the least amount of resources (such as fuel, time, and space).

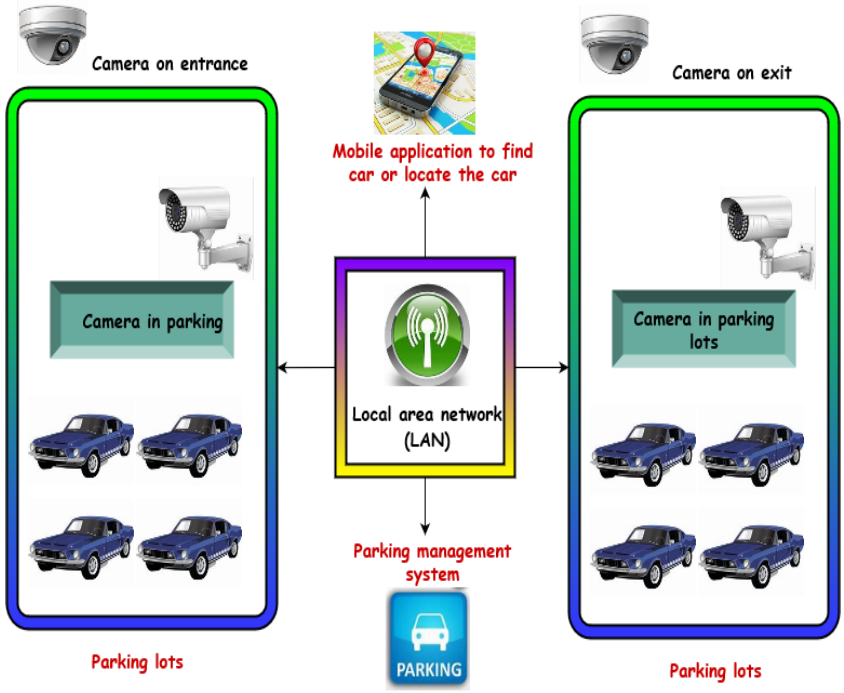

Figure 1: Smart parking system

The smart parking system is shown in Fig. 1. Worldwide movement of people and things is constant due to today's rapid development. As a result, a lot of cars are being produced. Nowadays, everyone uses either private or public transportation in every city, which has significantly increased global pollution, traffic congestion, and time consumption. People looking for free parking spots, typically during rush hour, make this issue worse. A recent study found that more than 30% of traffic jams in big cities are caused by cars looking for parking spots. There are no facilities for people looking for a free spot, and drivers are given a mobile application to help them remember their parking spot. Because it doesn't currently alert approaching drivers to the parking situation, the system's range is limited.
Managing and solving parking traffic issues $R(m)$ is important since they impair employee productivity and lead them to be late for work is defined as,

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$R(m) = \frac{1}{1+e^{(ms)}}$ (1)

There are many different kinds of networks, but the local area network is the most prevalent (LAN). Wide area networks (WANs) and metropolitan area networks (MANs), as shown in equation, can connect numerous LANs together (1). Smart Parking uses pavement-mounted sensors, such as cameras and vehicle counters, to measure parking occupancy. Vehicles receive information from wireless sensors connected to the Internet of Things (IoT) about parking spaces that are available. As a result of increased traffic and a general lack of confidence in parking availability and cost, smart parking solutions are becoming more and more necessary. The use of more parking spaces is made possible by smart parking technology, which also improves traffic flow.

A computerised parking system is known as a parking management system (PMS). This approach works more efficiently and makes better use of parking spaces. The number of vehicles and available slots is updated in real-time, and both open spots and reserved parking options are visually displayed. They also offer a variety of other features, such as simple payments, thorough reports, and many others. An automated and highly developed Parking Management System (PMS) based on technology is used to manage cars from the moment they enter the parking space until they leave. This system may support a variety of parking applications if sensor nodes are monitoring a slot and the confidence values measured from each sensor node, making it simple to manage and organise vehicle data. A comprehensive analysis can be carried out once the confidence values for each node have been combined (statically dislocated and have static values of the monitored parking slots).. Equation (1) calculates the summing measure $s^j(r)$:

$s^j(r) = \sum_{z=0}^{m} \varphi_{z,j} s_z^j(r)$ (2)

As shown in equation (2), $\varphi_{z,j}$ are the nonnegative weights, m refers single sensor node at a time (r), z indicates the smart camera network's physical configuration, $s_z^j(r)$ regarding the slot z.

Algorithm: Resource allocation algorithm based on traffic forecasts

```
Input: M(B,s), F(n), R(n) and U_m(A_m, g_m, t_m, w_m, Q_m)
Output: Resource allocation and adequate end of datacenter
Start the evaluation factor X
Obtain predicted outcome U_m
for each U_m
    if no route is found and X_m = min{X_m}
    block the request
    else
      if X_m > min {X_m} then
        if there exists FL-MLA in the queue, then
          for each FL − MLA_i in the queue
            block the FL − MLA_i and compute F_i(n')
             F_i(n') = F_i(n') + F_{i+1}(n')
              for each upcoming traffic
                compute R_j(n')
              end for
           end for until (F_i(n') > F(n))
               resource allocation for U_m when it vehicle landing
        end if
      end if
         block the request
    end if
         upgrade F(n) and R(n)
end for
```

A resource allocation algorithm based on traffic forecasts increases resource consumption efficiency through a traffic prediction-based resource allocation. TP-RA prioritizes traffic and sets aside resources for it in the future based on predictions and current resources. The accuracy of long-term traffic predictions $M(B,s)$ and worldwide resource consumption are taken into account by this

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global assessment factor $F(n)$, which can demonstrate predicted traffic arrival $R(n)$ and the resources U_m that must be preserved.

Using the evaluation factor, we can determine the priority of optical signals A_m and continuous spectrum paths by minimizing the minimal value for each. Once the traffic priority has been determined g_m, resources should be allocated to each projected arrival following the t_m traffic's priority. At times of excessive traffic, high-priority traffic (HPT) must get special treatment w_m, and additional resources will be reserved for high-priority forecasted traffic to Q_m assure the message's delivery. Following HPT, FL-MLA needs a minimum service provision and can be broadcast. Instead of being fixed, the HPT and FL-MLA are determined according to the overall assessment factor. A threshold is chosen based on the current state of the network to discriminate between HPT and FL-MLA. Consequently, there are two alternative conditions of arrival traffic priority.

Each expected traffic might be assigned sufficient resources when it enters the data center network. It's not necessary to do anything further in this scenario. When traffic arrives, servers will allocate the necessary network and transport resources. Second, resources will be exhausted if the expected volume of traffic materializes. Until HPT is complete, we need to see whether the expected traffic queue contains FL-MLA and subsequently reject or block it. If there aren't enough consecutive resources available when the anticipated traffic arrives, see if there are any FL-MLA in the current traffic queue. Block FL-MLA to conserve resources for FL-MLA if the evaluation factor exceeds the threshold.

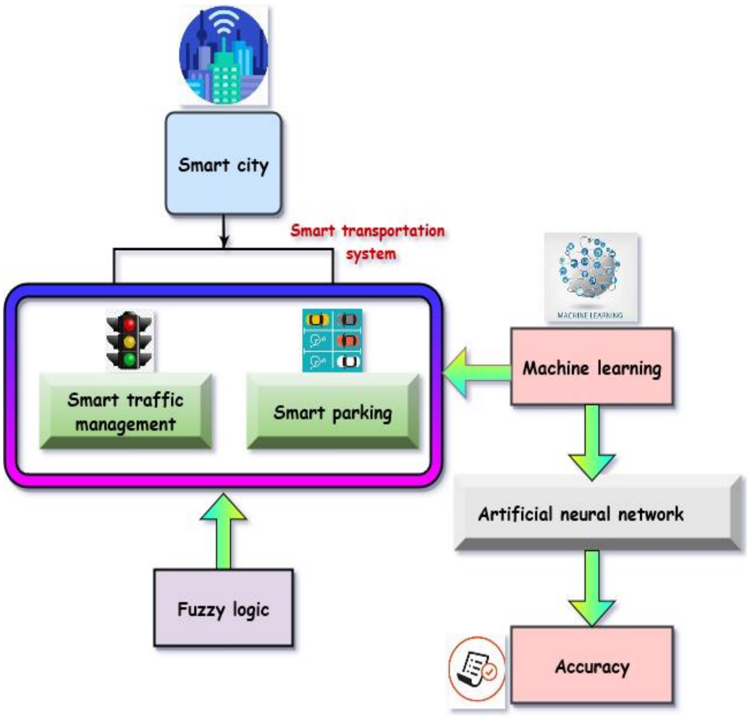

Figure 2: Traffic management and smart parking using FL-MLA

Figure 2 illustrates smart parking and traffic management using FL-MLA. In order to improve operational efficiency, public information sharing, governmental services, and citizen welfare, digitalization is used in smart cities. An intelligent transport system (ITS) can assist people in using transportation networks safely, effectively, and intelligently by providing new services related to various modes of transportation, such as traffic management. In the event of an accident, technology can use cameras to enforce the law and modify the speed limit sign accordingly. It may also make a help request. Although it can apply to any mode of transportation, the definition of ITS in this definition is systems that use ICTs in the field of road transportation. This covers everything from traffic and mobility management to infrastructure, vehicles, and people. Mobility, traffic control, and road transportation are just a few of the transportation scenarios where ITS can be helpful. People all over the world use ITS technology to speed up commute times and expand the capacity of congested highways.

Many of them are locations and industries where new applications are likely to enhance quality of life, such as at work or home, while travelling, when you're ill, while participating in sports, and in the gym is defined as,

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$$n_k = \sum_{k=0}^{m} w_{k,j} x_{m,j} + u_{k,j} \quad (3)$$

The fluctuating traffic system can be better managed $w_{k,j}$ using a fuzzy logic control system $x_{m,j}$. According to the traffic signal controllers $u_{k,j}$, the green light cycle duration should be adjusted to optimize traffic flow while minimizing regular waiting times based on the number of cars arriving at the intersection. FL lighting control is a better alternative to conventional movement lights for large movement displays at every traffic intersection. Sensors in the FLC light movement assist in tallying cars at a particular junction. These sensors provide controllers with information on movement density at junctions, allowing them to assess changing activity designs more effectively. As long as the activity stack is shaky, the fuzzy controller will adjust the flag light, changing color while the stack moves. In order to reduce traffic congestion, parking spaces are managed by a smart parking system. Sensors are installed in various parking locations to collect information on available and occupied space using an Artificial Neural Network model. It accurately detects cars in garages and parking lots

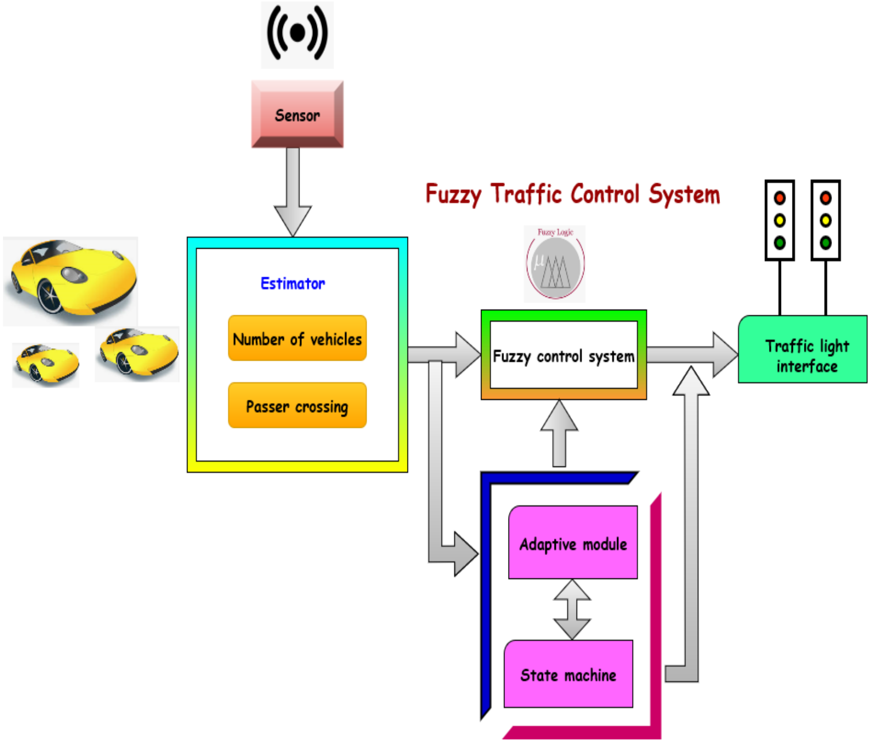

Figure 3: Fuzzy logic with traffic control system

Fig 3 shows the fuzzy logic with the traffic control system. The city's traffic is a significant issue that has a broad impact. Many societal issues are associated with traffic, including stress, pollution, excessive use of fossil fuels, and lost time. Numerous machine learning studies have been conducted to help with traffic flow and transportation safety. Various traffic management techniques have been examined in various publications, including expert systems, fuzzy logic systems, and others. The traffic management system is developed using fuzzy logic in this study. The machine can make decisions like an expert person using fuzzy inference. An automated traffic management system can choose the best junction flow option in the shortest time possible. The machine receives several characteristics as part of the design process for traffic control systems. Input parameters could include traffic density, traffic flow, vehicle speed, and the presence of a particular vehicle.

Light, heat, motion, humidity, and pressure are all examples of natural phenomena $x_{m,j}$ that can be used as inputs as follows,

$$x_{m,j} = T_f\left(\sum_{k=0}^{m} w_{k,j} x_{m,j} + u_{k,j}\right) \quad (4)$$

Many variables are used as inputs T_f by the created intelligent system $w_{k,j}$, including the number of vehicles present $x_{m,j}$ at a road intersection $u_{k,j}$ shown in equation (4). They can be generated from sensors at intersections or image processing by putting particular machines into intersections where their existence can be verified via image processing, GPS, or the warning sound. The crossroads are congested with pedestrians from all directions. In each direction, the requirements for vehicle density are transmitted into the system with a greater degree of fuzziness. The system then uses rules established by the expert man's knowledge to figure out how long cars should wait before passing to

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minimize wait times and traffic volume overall. Sensor data, such as those indicating the presence of a special vehicle and those indicating pedestrians crossing an intersection, are sent into a decision-making algorithm. For each direction, this technique builds a state machine in Verilog using parameters supplied in real-time and then determines the current and following traffic light status (red, yellow, green). This technique uses fuzzy logic to determine how long each state's traffic light should be.

To react and detect electrical or optical impulses, sensors $T_o C_{k,j}$ are often utilized, stated as follows,

$$T_o C_{k,j} = T_o\left(\sum_j w_{k,j} x_{k,j} + u_{k,j}\right) \quad (5)$$

A committed fuzzy management T_o the framework state machine for managing independent agency $w_{k,j} x_{k,j}$ standing succession and a hypothetical flexible module $u_{k,j}$ make it possible to use fuzzy management frameworks better to execute the management framework's policies and procedures shown in equation (5). Several countries use this technology to monitor and regulate the continuing migration. It's used to handle the dispersed traffic at all street crossings. It is in charge of the activity flag's green light and has set its clock to match the heap at the crossing point's indication. The management framework has been linked to a free multilane crossing throughout the town. No contributions have changed; however, traffic volume and section breadth increase the novice signal weight. Due to the decrease in conventional vehicle delay, there is an unmistakable connection between the fuzzy management framework and the commitment included in the supposed adaptable module.

As system input rules specified by expert knowledge, the number of vehicles, average flow speed, and time required to turn on the green light in the desired direction are all part of the fuzzy system proposed for this intelligent traffic controller. The following equation (6) can be used to estimate the average traffic flow speed W_{dwk}:

$$W_{dwk} = \frac{m}{\sum_{z=0}^{m} \frac{1}{w_z}} \quad (6)$$

As shown in equation (6), z is the average flow speed (measured in meters per second); w_z is the speed of each vehicle, and m is the number of vehicles. The fuzzy sets reflect the linguistic notions of large in each input variable (linguistic variable). The following equation (7) provides the membership function equations for large fuzzy states $\tau(y)_{wide}$ and their associated forms:

$$\tau(y)_{wide} = \begin{cases} 0 & if\ y \leq 10 \\ 0 & if\ 10 < y \leq 30 \\ \frac{y-30}{10} & if\ 30 \leq y < 50 \\ 1 & if\ y > 50 \end{cases} \quad (7)$$

Fuzzy models and sets are used to express ambiguity and imprecision in mathematics—fuzzy sets for crowded regions and long queues of vehicles waiting at red lights in a traffic light management system. Fuzzy logic depends on the assumption that people often make choices based on vague or non-numerical data. Depending on the traffic volume and wait time, the duration of the green period can be adjusted dynamically. The green phase length can be adjusted to minimize a car's waiting time at a red light.

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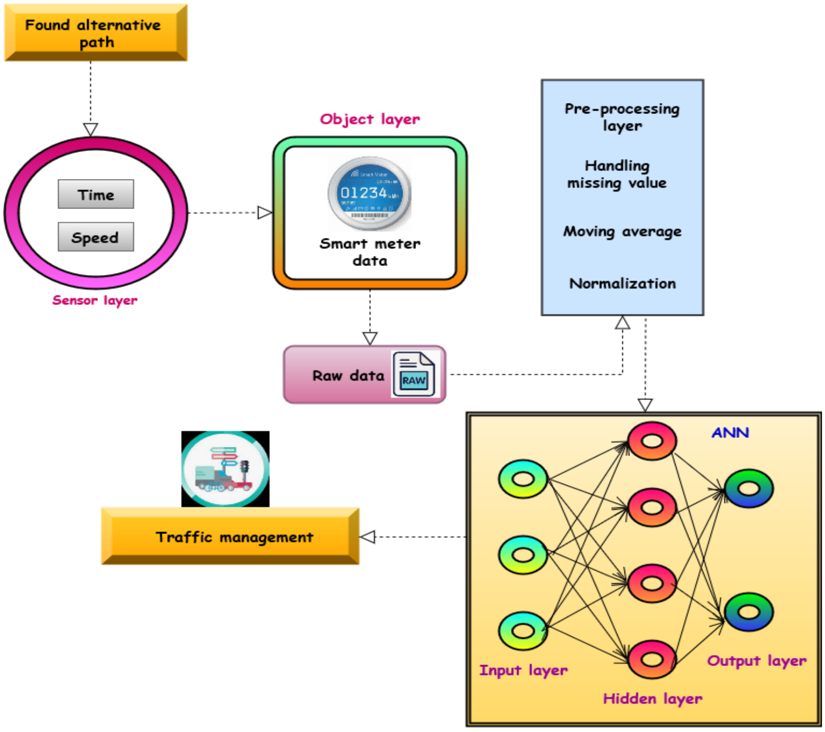

Figure 4: Design of Artificial neural network (ANN)

Fig 4 shows the design of an artificial neural network. Sensory data is stored in this layer, which trains a neural network to anticipate congestion based on the input parameters. Congestion points are located using sensors, and then messages are sent to cars' LCDs, which utilize Google Maps to identify an alternative route. Identify the congestion at that specific location again, as if there has been no congestion. Traffic then proceeds and encounters new congestion sites. Predictive and performance layers are separated further in the proposed ANN system application.

When detecting occupancy in the prediction layer, ANN is utilized, whereas, in the performance layer, traffic management is used to assess how well the prediction layer performs. Weather conditions directly impact traffic congestion since they reduce visibility and deteriorate the road's condition. Rain, humidity, temperature, and others are all components of bad weather. Historical data from the present system is critical when attempting to forecast weather disasters. A neural network is an effective tool for tackling challenging issues. Different techniques are available for calculating uncertainty estimates, which can be done with the assistance of a neural network to compute and forecast future trendsA multilayer perceptron consists an input and an output layer. The input layer is located on the left side of the chip and receives an input signal before transmitting it, one layer at a time, to the right side. Multilayer perceptrons have been trained using ANN, and congestion has been predicted using weather and traffic data.

Additionally, the data is utilized to track traffic flow and weather conditions every ten minutes of the day using the same method described above. Various variables, including weather, accidents, and construction cause congestion. This study utilizes a neural network model known as the ANN to forecast traffic flow. Using a neural network with a hidden layer, specified input, and output layer structure, it forecasts traffic congestion with the highest degree of precision. This structure consists of error propagation in both forward and reverse directions. Information is processed from the input layer to the hidden layer and then forwarded to the output layer for final approval. Suppose the output layer is unable to do so. In that case, the process of ANN errors is initiated. The values of the different weights are adjusted to minimize error, and the information is again sent to the forward propagation process. This paper's primary goal is to forecast traffic flow in bad weather conditions. For convergence and bit-per-data rate, hidden, the input, and output layers of an ML are combined with ANN method. The output layer in ANN manages traffic control in a smart city.

The sigmoid input function τ_z is represented as equation (8), while the hidden layer of the proposed ML System is written as equation (8),

$$\tau_z = a_1 + \sum_{j=1}^{n}(\vartheta_{zj} \times t_j) \quad (8)$$

As shown in equation (8), a_1 indicates hidden layer with delays, ϑ_{zj} is the initialization of weight, t_j refers to sets as training, n denotes the number of data.

The output layer μ_jEquation (9) is used as the basic raw data.

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$\mu_j = a_2 + \sum_{i=1}^{n}(\lambda_{zj} \times \tau_z)$ (9)

As shown in equation (9), a_2 is the regression analysis, λ_{zj} indicates to predict the traffic flow, τ_z Denotes sigmoid input function. The activation function τ_j for the output, the layer is given in equation (10),

$\tau_j = \frac{1}{1-e^{\mu_j}}$ where j=1,2,3,……n. (10)

As shown in equation (9), e^{μ_j} is the learning rate. Error analysis in an artificial neural network is given in equation (11),

$R = \frac{1}{2}\sum_z(\omega_z - \tau_j)^2$ (11)

Subequation (10) in equation (11),

$R = \frac{1}{2}\sum_z(\omega_z - \frac{1}{1-e^{\mu_j}})^2$ (12)

As shown in equations (10) and (11), R is an error analysis, ω_z denotes preferred output and τ_j is evaluated output. Error analysis is the process of analyzing instances of development sets where the method made an error to figure out what went wrong. This can assist in determining which problems need immediate attention and how much of that focus should be devoted to each. It directs the response to the errors.

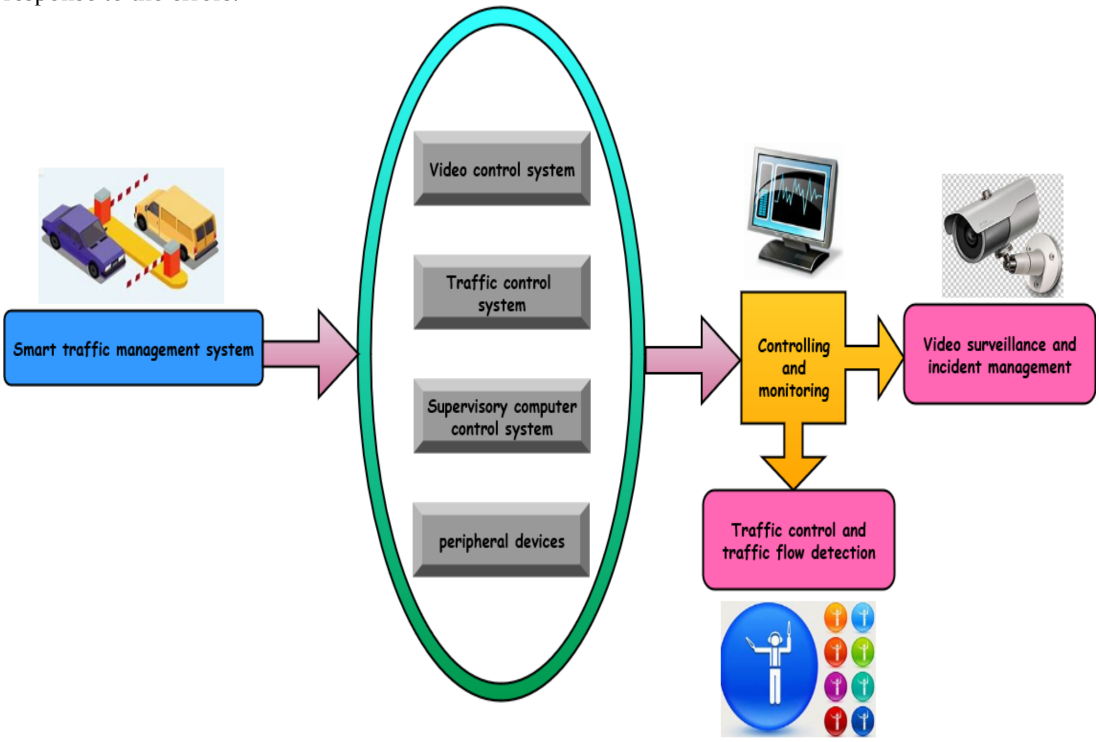

Figure 5: Intelligence traffic management system

As indicated in fig 5, the intelligent traffic management system includes video, traffic control, computer control, and peripheral unit modules. Heavy traffic on the road may be managed and controlled with the help of a traffic control device. Installed cameras assist in keeping track of traffic and alert traffic control supervisors when vehicle numbers rise in a specific area, allowing them to avoid traffic congestion. The above-described system architecture depicts the components utilized with the controlling system. The traffic management device keeps traffic flowing smoothly and communicates clearly between the transmitter and receiver. The peripherals are responsible for following up on the sensors and analyzing their data to identify and respond to the central unit. Traffic flow detection and other peripheral devices can communicate using the control unit.

Despite the driver's use of automobile gadgets M_d, the person who opens the gate of authority is stated as,

$M_d = M_1 + M_2 + M_3 + M_4 + M_5$ (13)

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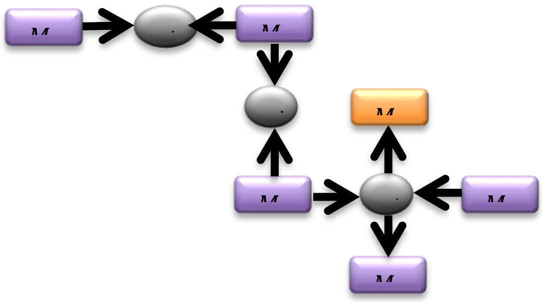

Figure 6: Usage of automobile gadgets

Fig 6 shows the usage of automobile gadgets. This list of car accessories includes anything from dash coverings to mirrors to shifter knobs to steering wheel covers to fuel economy meters to window tint. Automobile seat coverings can be obtained in various materials at any retail store or auto shop. Car cleaning tools like cloths and brushes, which are of the highest quality, are crucial for keeping a vehicle clean. A mat is a must when it comes to keeping the inside of your vehicle clean. Additionally, they keep dirt and grime out of the vehicle's interior.

$$M_1 = \sum_{k=1}^{s=s} w_{g-1} * T_{k,q} \quad (14)$$

A Road Traffic Control System (RTCS) collects and analyses driving data w_{g-1} from cars in the vicinity, controls traffic signals $T_{k,q}$ optimally based on the continuously changing road traffic situation, and provides drivers with relevant traffic information based on the gathered data, as shown in equations (13) and (14). Traffic management methods can increase throughput, avoid congestion, and enhance traffic speed. Because of the abundance of real-time data it provides, ITS software is utilized to create optimum management and control methods that help the network's policy goals. Although they will differ from place to place, typical goals are to increase throughput while decreasing delays and congestion. To ensure road safety for everyone on the road – including pedestrians and bicyclists – and to meet environmental goals (such as lowering noise levels and pollution levels).

Using the Internet system offers real-time updates on the state of parking spaces HG throughout the city or company is defined as,

$$HG = \sum_{s=1}^{s=s} w_s * T_s \quad (15)$$

Devices receive radio signals from beacons positioned on each side of the roadw_s and use that information to determine the intensity of the devices 'T_s a radio signal is shown in equation (15). Travel time, traffic congestion, and pollution can all be reduced using this method. Cones and drums are common channelizing tools, and these traffic control devices are often used to separate construction zones from general traffic or separate opposing traffic flows. The suggested method improves energy consumption, traffic estimation, the daily average park occupancy, efficiency ratio, and accident detection.

4. Numerical result

Increasing traffic congestion and a lack of clarity about where to park and how much it will cost have necessitated the implementation of Smart Parking systems. Improved traffic flow and more efficient parking operations will be achieved by implementing a smart parking system. The outcomes indicated in the graph are highly significant. Comparing the findings to what would be expected under normal circumstances, it becomes clear that a larger-scale implementation of this approach would be advantageous. Fuzzy logic integrated machine learning has been used to complete this investigation, and the proposed method improves the numerical outcome. The 100 vehicles and the existing methods SPS and VANET are taken to analyze the proposed method.

Table 1: Energy consumption

Number of Vehicles	SPS	VANET	FL-MLA
10	58	72.1	81
20	64.5	76	85

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30	67	79	87
40	79	83	86
50	75	80.6	89
60	62	62	71
70	69	70	76.3
80	71.7	73	92
90	76	80	86
100	79	84	97.4

Table 1 shows the energy consumption. The nodes' energy consumption is measured as the energy used per number of revolutions. The primary goal of this experiment is to see how much energy the road traffic density affects the whole network. Because the detection statuses of the sensors quickly vary with the number of vehicles in circulation, the proposed system uses less energy in the initial rounds when traffic density is 50%. The remaining sensors will not communicate their steady detection statuses, consuming energy while the data is being sent. Other systems transmit worthlessly and duplicate data every cycle compared to this system's stability algorithm and verification procedure for sensor detection statuses. This increases energy consumption and causes quick depletion of the sensor nodes and the Sensor technologies in other systems.

FL-MLA uses more energy at a 97.4% traffic density than 50.8% traffic density because more vehicles are on the road, which means more data is sent over the network. Energy usage is the same for all the other systems since their sensor nodes continuously transmit data. However, the proposed method uses a considerable amount of energy in smart cities with 80% traffic density due to the many vehicles that utilize city roads. However, due to heavy road traffic and reduced vehicle traffic, FL-MLA has seen stability in the network's energy consumption.

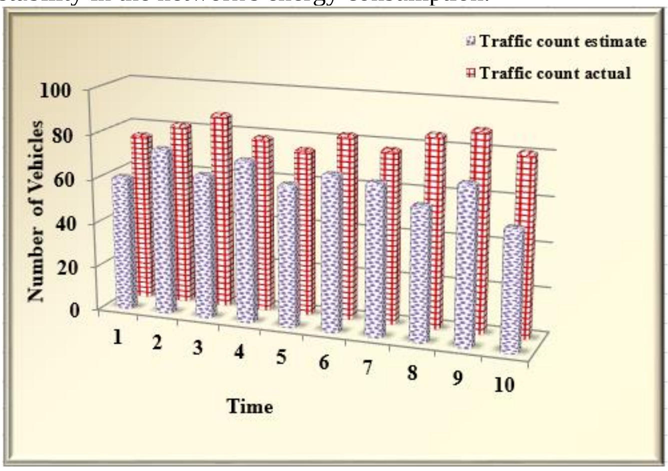

Figure 7: Traffic Estimation

Player and simulation outcome analysis for the suggested ASF-AI system are shown in Figures 7(a) and 7(b), respectively. Nine players are taken into account for the simulation analysis of the proposed ASF-AI system, and the simulation results are analysed and plotted. Higher simulation results are shown by the proposed ASF-AI system using artificial intelligence technology. The deep learning model accelerates learning and yields quicker outcomes. The improved decision-making model outperforms the current models in many ways.

Table 2: The daily average park occupancy

Number of Vehicles	SPS	VANET	FL-MLA

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10	55	61	75
20	58	72	78
30	58	68	70
40	65	78	86
50	57	75	89
60	67	62	71
70	62	69	76
80	53	71.8	79
90	72	76	77
100	65	64	97.9

Table 2 shows the daily average park occupancy. Sensors are mounted in an outdoor parking lot to simulate what it would be like to park a vehicle there throughout a normal workday. The above fig depicts the daily average park occupancy. This 12-hour chart indicates a greater occupancy rate in the first eight hours, then a sharp decline and near-vacancy in the last eight hours. Furthermore, the parking lot is not used to its full potential, with attendance peaking between 10:00 and 12:00. (97.9%). When demand reaches its highest, the number of available parking spaces drops steadily until the end of the 12 hours. They can be explained by the surrounding area, which is mostly made up of places where people work: workplaces and the campus.

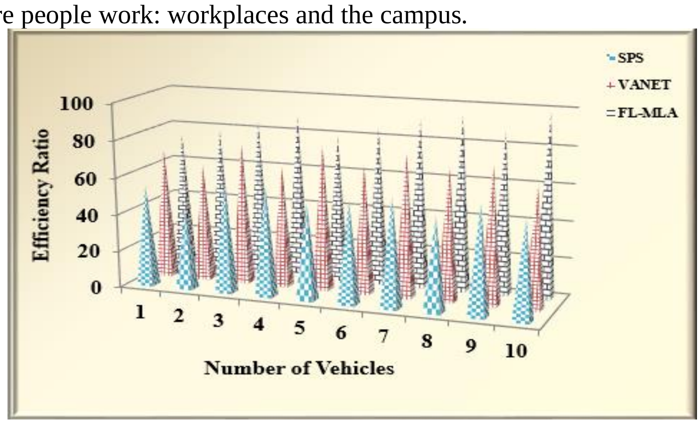

Figure 8: Efficiency ratio

Figure 8 shows the efficiency ratio. The most effective way to increase the flow of traffic is to calculate and propose alternative routes in order to lower the likelihood of accidents. Although this is a challenge, the most important one is figuring out how to finish it quickly without adding an unnecessary overhead cost in order to keep the flow of traffic uninterrupted. Because of its improved management and comprehensive picture of the situation as a whole, relying on central entities to compute and suggest alternative routes to all vehicles is the most effective way to use resources. However, depending on the quantity and complexity of the vehicles that need to be rerouted, a high overhead may be added to the computation of the alternative route, which will result in the performance of the alternative route being lowered.

In comparison to SPS and VANET, the FL-MLA improves (98.1%). Therefore, for alternate route advice to be effective, efficiency and complexity must be balanced. Finding a practical detour that doesn't clog up traffic using FL-MLA to balance and manage traffic is a concern. The real challenge is to give every vehicle a complete picture of the traffic situation so they can plan an efficient route without congesting the network.

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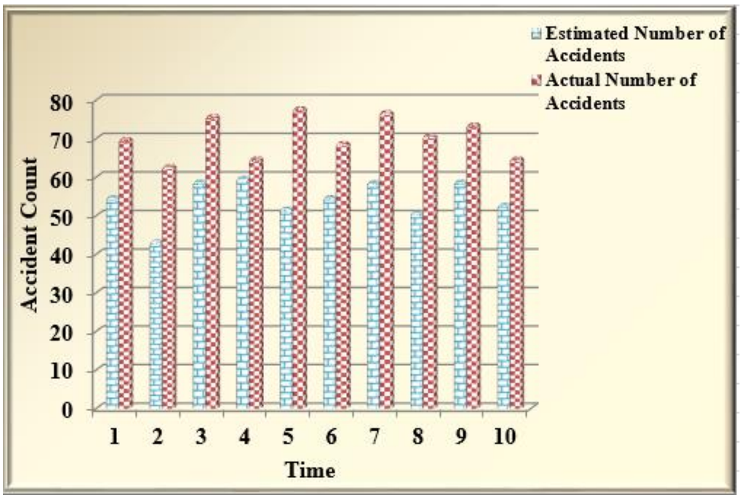

Figure 9: Accident detection

The accident detection is shown in Fig 9. On a specific route, the average wait time is reduced by the suggested intelligent traffic management system, which also produces precise forecasts of shifting traffic levels. The aforementioned graphs look at the accident detection system and contrast the estimated and actual accident rates for a particular route at various times. The two statistics above show that the expected number of accidents is always higher than the actual number. This means that the proposed method can identify actual accidents and classifies other situations with features similar to an accident as an accident itself. Consequently, the number of reported accidents is higher than the actual number.

Table 3: Traffic management system

Number of Vehicles	SPS	VANET	FL-MLA
10	49.7	65.7	77
20	48	71	89
30	57	75	80
40	60.5	62.9	74.4
50	47	72	88
60	52	78	83.3
70	55	68.2	79
80	45	74.1	85
90	51	77	90.8
100	53	75.2	96.7

Table 3 shows the traffic management system. Traffic management systems aim to optimize traffic flow and keep passengers and drivers safe and secure when using public transit. Using Smart Traffic Management Systems, cities can quickly and affordably enhance traffic flow and safety on their streets. These systems may be installed in traffic cabinets or at junctions at a cheap cost. Sensors, cameras and other devices monitor traffic volume, movement, congestion, highway conditions, and data on pedestrians and bikers as part of a smart city traffic management system. Smart Traffic Management is a system in which traffic lights and sensors are centrally managed to govern traffic flow through the city. The current road network is utilized to its maximum potential while reducing the negative impacts of traffic thanks to traffic management. It is now more crucial than ever due to financial restrictions on road construction and a growing public awareness of the environmental

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issues brought on by automobile traffic. Compared to the current system, the suggested solution improves traffic by a whopping 96.7%. Traffic lights, speed limits, vehicle parking, and other measures are part of traffic management. The ideal vehicle capacity ratio can be achieved by using traffic control techniques that regulate traffic on roadways. This paper evaluates energy consumption, traffic estimation, the daily average park occupancy, efficiency ratio, and accident detection.

5. Conclusion

The Traffic Management System is one of the many aspects of a Smart City where extensive research can be seen. An artificial neural network was used in the study's methodological approach to control traffic congestion with information fusion. Compared to traditional systems, which lack the flexibility to automatically regulate neighboring signal timings to ease traffic congestion, smart transportation systems have been shown to significantly influence smart cities. Because traffic signal timers are managed by machine learning techniques, a smart traffic congestion management system has been created. The intelligent traffic management system's key features, which lessen traffic, pollution, and the amount of time it takes to cross a junction, are speed and accuracy. The use of such a system undermines the confidence of those involved in the parking process and undermines transparency. In the future, genetic algorithms and neural networks can be used to train intelligent traffic management systems, enabling flexible systems with excellent accuracy by combining a suggested algorithm with parameters from a simulation-related comprehensive state machine. Energy consumption (95.3%), traffic estimation (97.9%), daily average park occupancy (97.2%), the efficiency ratio (98.1%), and accident detection (98.9%) are all calculated numerically as a result of the suggested method. We want to implement vehicle-to-vehicle communication and research how speed bumps will affect traffic flow and congestion in the future.

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