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A Novel Traffic Prediction Model for Intelligent Transportation System using Machine Learning

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Abstract: Machine learning is a set of algorithms and statistical models that computers use to perform required tasks. Machine learning can be used in many applications such as face detection, voice recognition, medical diagnosis, mathematical reasoning, traffic prediction, etc. The traffic area includes everything that can affect the traffic on the road, whether it is a traffic light, an accident, an assembly or even a road repair that can lead to a traffic stop. If we first get information close to all of the above and many daily situations that can affect the road, the driver or passenger can make a smart decision. It also contributes to the future of cars. In recent decades, traffic data has been generated extensively and we have moved to a big data concept for transportation. Brilliant visitor forecasting uses a few types of site visitor forecasting and they are still not good enough to meet real world applications. It is tedious to understand the correct direction of the road because the information available for the transport system is very complex. In this work, we have planned to use machine learning, genetics, soft computing and deep learning algorithms to analyze the big data of transportation system with a big reduction of complexity. In addition, image processing algorithms participate in traffic sign recognition, which helps in the proper training of autonomous vehicles. In the economic years, GPS Mobility has become popular in large cities to determine the percentage of traffic that uses central traffic management - distribution. The collected data can be used to build an idea that shows the current traffic in the city and can be used in the future to predict the traffic and the summary can be done.

Keywords: Traffic Environment, Deep Learning, Machine Learning, Genetic Algorithms, Soft Computing, Big Data, Image Processing**.**

I. INTRODUCTION

Intelligent transportation system is used for analyzing the information. ITS is used to control communication technologies for road transportation to improve safety and efficiency. Intelligent transportation system includes a wide range of applications which is used to get information, to control congestion, to improve traffic management, to reduce the environmental effects and increase the benefits of transportation. ITS refers to the different types of needs and the transport field with many others policing. But also due to less connection of traffic flow. Smartphones having different sensors.it can be used to detect/track the traffic speed and density. Now a days, smartphones are used by drivers and it is monitored to detect the speed of traffic and quality of the road. Data is connected through the audio and GPS .it tracks the identity of traffic and possible jams occurred in the traffic.

The transportation business enterprise was answerable for 28% of global carbon dioxide emissions in 2014. The type of site visitors-related deaths in 2013 was 1.25 million. Additionally, site visitors congestion at top hours reaches unacceptable stages in lots of additives of the world. These are all severe issues because of contemporary-day transportation systems, and optimization via using contemporary-day era is important for the required improvements. ITS combine telecommunications, electronics and statistics era with delivery engineering a very good manner to plan,

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design, operate, maintain and manage delivery systems. This definition suggests that any statistics generation that aids transportation in a single way or each different can be blanketed as one of the many innovations under the time period ITS. Applications that provide excursion times or the most inexperienced direction to a given holiday spot are examples of such era. Traditionally, the ones era functioned based mostly on simplistic evaluations, and could best be reactively updated based mostly on happening activities.

However, proactive version to the ever-changing dynamics of metropolis site visitors can be achieved. This is finished via approximatively forecasting of future site visitors' patterns. Naturally, this could appreciably decorate the general overall performance of gift ITS era. Achieving this however requires unintended measurements of the parameters to be forecasted. Such parameters need to encompass the site visitors waft and speed at some locations. Measurements of these parameters can be finished in lots of ways, such as video detection, inductive loops and magnetic sensors. Additionally, possession of unintended records of visitor's incidents and several climate parameters can also be useful, as the ones regularly impact the site visitors quite heavily. Subsequently, those records can be analyzed and may display screen several visitor's patterns. In turn, the ones patterns need to make it feasible to forecast future visitor's situations Forecasting the future based mostly on anciently records dates once more to 1805 with techniques like linear regression and is a nicely studied area.

These studies have given upward thrust to many statistical models for predicting some future parameter primarily primarily based totally mostly on ancient records. However, site visitors waft as a function of time isn't absolutely deterministic because of several random activities which have an impact at the site visitors. There exists a limitless type of the ones activities but examples of the most impactful ones are the contemporary-day climate, site visitors incidents and holidays.

II. RELATED WORK

Irrespective of vehicles increases on roads, the traffic also increases. And the available road network capacity is not feasible to handle this heavy load. There are two possible approaches to resolve this issue. The first one is to make new roads and new highway lanes for the smooth functioning of vehicles. It requires extra lands and also the extensive infrastructure to maintain it, and due to this, the cost of expenditure also high. Sometimes many problems came into the network like in the urban area. This land facility is not available for the expansion of the roads and lanes. The second approach uses some control strategies to use the existing road network efficiently. By using these control strategies, the expenditure also reduces, and it is cost-effective models for the government or the traffic managers. In this control, strategies identify the potential congestions on the roads, and it directed to the passengers to take some alternative routes to their destinations.

The review process is divided into five stages to find the process in a simple and adaptable way. It is necessary to start with a particular domain of any division/city of interest and it causes a specific problem. Literature also tells us that AVs would reduce vehicle ownership, travel timing, parking lots, and emissions It is also telling that AVs would increase the road capacity, traffic flow stability, vehicle miles travelled, fuel efficiency and safety. The ACC (Adaptive Cruise Control) can perform total control of the vehicle by focusing on the speed without any data from the driver/conductor.

DL provides a method to add intelligences in the wireless network with complex radio data and large- scale topology. In DL, use concepts of a neural network, by using this feature, it is beneficial to find network dynamics (such as spectrum availability, congestion points, hotspots, traffic bottleneck. [8] The travel time is the essential aspect in ITS and the exact travel time forecasting also is very challenging to the development of ITS. Support Vector Machine (SVM) is one of the most effective classifiers among those which are sort of linear. It is advantageous to prevent overfitting of data. SVM is great for relatively small data sets with fewer outliers. Another algorithm (Random Forest, Deep Neural Network, etc.) require more data but always came up with very robust models. SVM support linear and nonlinear regression that we can refer to as support vector regression, instead of trying to fit the most significant possible roads between two classes while limiting margin violation.

Gaurav Meena, Deepanjali Sharma et.al. [1] In this paper, the author proposed that the development and deployment of Intelligent Transportation System (ITSs) provide better accuracy for Traffic flow prediction. It is deal with as a crucial element for the success of advanced traffic management systems, advanced public transportation systems, and traveler information systems. The dependency of traffic flow is dependent on real-time traffic and historical data collected from various sensor sources, including inductive loops, radars, cameras, mobile Global Positioning System, crowd sourcing, social media. Traffic data is exploding due to the vast use of traditional sensors and new technologies, and we have entered the era of a large volume of data transportation and make meaningful inferences from the data.

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Alfonso, Oscar et.al. [3] The purpose of traffic forecasting is to predict future traffic conditions on a transportation network based on historical observations. This data can be helpful in ITS applications such as traffic congestion control and traffic light control. Traffic prediction can be divided into two types of techniques: parametric, including stochastic and temporal methods, and non-parametric, such as machine-learning (ML) models [10], recently used to solve complex traffic problems. The experimental results show that the M5P regression tree outperforms the other regression models. The authors in [13] reported some multi-model ML methods for traffic flow estimation from floating car data. In particular, they evaluated the capacity of Gaussian Process Regressor (GPR) to address this issue.

The simulations showed a decrease in forecast error in comparison to the results of the mean and Autoregressive Integrated Moving Average (ARIMA) models that used traffic data from previous periods. Back-Propagation Neural Network (BPNN) is one of the most typical architectures of Neural Networks and is widely used in many prediction and classification tasks. Xie, Huang et al. In this paper, the author provided a comprehensive survey of ML techniques applied to SDN. Different types of ML/DL algorithms and their applications in the SDN environment are presented. Nevertheless, they did not review the traffic prediction application. Additionally, the paper lacks several recent approaches as well as a dataset in the literature review. He briefly reviewed the application of AI with SDN. Then, they presented an extensive overview of AI techniques that have been used in the context of SDN.

III. MACHINE LEARNING PREDICTIONS IN ITS

ML techniques have achieved a high level of performance on prediction challenges in ITS, primarily delivering tasks that may be classified into predicting TF, travel time, vehicle behavior, user behavior, and road occupancy [11]. Table 1 shows the various prediction category coming under traffic forecasting.

Prediction	Category	Description Role of ML
Traffic Flow	TFP using Spatio-temporal dependencies.	Learning traffic patterns may use weather data, time-series data, historical data, accident-prone area data, road maintenance work information, etc.
Travel Time	Predicting the travel time for cars, buses, bikes, and other vehicles.	Learning traffic patterns based on temporal data. Extracting features & learning travel time patterns.
The behavior of Vehicle & User	Predicting lane changes, vehicle steering angle, pedestrian movements.	Learning & classifying driver's intentions, finding patterns from pedestrians, & future movement of vehicles.
Road Occupancy	Road density prediction for the urban region, predicting parking availability.	Modeling long or short-term predictions, learning parking occupancy patterns.

Table 1: Prediction Categories under Traffic Forecasting

Fig. 3: The Traffic Congestion in an Urban Areas

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IV. SYSTEM TECHNICAL DRAWING

To provide a well ordered and secured move of road transportation, the main advantage of ITS is. This gives many opportunities to automobile production to increase the security of their travelers [6]. Traffic is increasing with increases in vehicles on roads. We can problem by two things. The first one way is that, for even functioning of motor vehicles construct the new roads, highways, but it is issue of budget, because it will requires more money to purchase lands and to build the infrastructure. But if you want to do this all in urban areas the road network is bad and unavailability of lands also costs more. And main problem or cost of that is, regular maintenance.

Make the use of controlling plans for existing road efficiently is the second way. Controlling plans will be cost reduction model and budget will also become less for the governments. If capacity of one road is less then move some part of traffic to its alternative road. Deep learning is a part of machine learning, which is a very famous way to handle a big amount of data [7]. Deep learning use of neural network concepts which is profitable to find network dynamics like spectrum availability, traffic points, hotspots, traffic jam. Travelling time is important point for ITS and additional travelling time prediction makes challenging to the development of ITS [8]. Support Vector Machine is most productive class in those are linear sort. Overflow of data is stop. For small dataset SVM is great. It supports linear and non-linear regression which is also called as support vector regression. To know classification, regression we have used the decision tree algorithm .The objective of this way is to forecast the value of target variables.

Decision tree represents a method that takes as input, a vector of attributes value, return decision, single valued output. Comes under the classification of supervised learning algorithm. Decision tree knows its results by doing a set of tests on the training dataset [10]. Outliers detection is difficult one for right result, for this, we have used Support vector machine. The SVM is good for great dimensional spaces, and it also helps in the condition where a number of samples are less than the number of dimensions [11]. The random forest algorithm is a robust machine learning algorithm. The random forest algorithm is built on prediction models, and it is mostly used to categorise the data. The bootstrap algorithm is used to generate multiple models from a single training data sets.

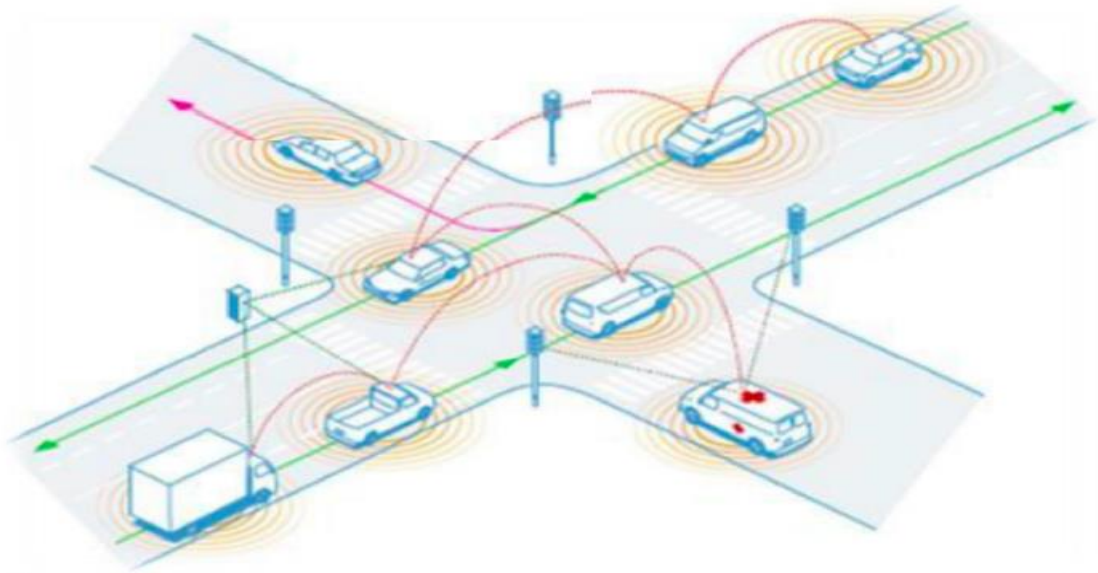

Figure 2: Intelligent Transportation Work

We give the algorithm for forecasting the traffic congestion which is as follows:

Algorithm 1: For identifying the congested situation

1. Get the traffic data in every 5 min with details of:
   - Location
   - Direction
   - Speed
   - Start-End Junction
2. accumulate 5 min interval with the related data.

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3. Calculate the gap between vehicle with all other vehicles within specified junction. If the gap is less than the specific distance, between two vehicles then those are observed to be the neighborhood vehicles else, not considered as neighbor.

Algorithm 2: For classifying the traffic situation

1. This will give us the matrix .
2. Now give 1 to A[i, j], if A[i, j] < threshold then A[i, j] = 1 else A[i, j] = 0
3. Count A[i, j]=1 and name i, j as neighbourhood vehicles.
4. Repeat above after every 5 min for 45 min
5. Plot the graph between neighbourhood vehicles and time interval. If neighbourhood vehicles shows an increasing graph then traffic is identified else no traffic

Steps in implementation:-

a) Provide the GPS coordinates by the application.
b) Execute the given algorithm.
c) Evaluate matrix for dataset.
d) Make split the dataset into training and testing.
e) Examine discrete machine learning algorithms.
f) Forecast 45 min interval through machine learning algorithm
g) Conclude about the traffic

Doing above steps we can apply the algorithm and we can obtain the model which gives the more correctness of the machine learning models than the existing. It is quite easy to teach the deep network by applying the BP methodology with the gradient-based development technique. Unfortunately, its notable that deep networks coached by this method have bad performance. So we have not included the deep learning models in the work. Following the proposed algorithm we solved many of problems like big-data, also the huge dataset is reduced to avoid overflow of the model.

V. DISCUSSION

The table shows the results of performance obtained through different machine learning algorithms that are discussed in this paper. In this table we have defined the different attributes like accuracy, precision, recall and time taken.

We generated our own dataset (IITM-HeTra) from cameras monitoring road traffic in Chennai, India. To ensure that data are temporally uncorrelated, we sample a frame every two seconds from multiple video streams. We extracted 2400 frames in total. We manually labeled 2400 frames under different vehicle categories. The number of available frames reduced to 1417 after careful scrutiny and elimination of unclear images. We initially defined eight different vehicle classes commonly seen in Indian traffic. Few of these classes were similar while two classes had a smaller number of labeled instances; these were merged into similar looking classes. For example, in our dataset, we had different categories for small car, SUV, and sedan which were merged under the light motor vehicle (LMV) category.

The most critical factor affecting the success of machine learning is the training and testing process. An effective training process improves the quality of the developed system. Researchers divide datasets into two parts for training and testing. However, the separation process is done according to specific rules. These are described in detail in section “Sampling Methods.” The amount of training and test is the most critical factor in the success rate. If there is a high correlation between the features and the label, the Training-Test set is divided by 70%–30%. This means that 50% of all the data will be used for training and 30% for the test. However, if there is a fear of success falling, the rate of training can be increased. The training-testing ratio used in the literature varies according to the data structure. Less than 50% of the training data is not preferred because the test results will be negatively affected. After the machine learning model is trained according to the training data, it is also tested using the training data.

The purpose of this is to determine how much data is learned. Performance evaluation procedures are performed according to specific criteria. These criteria vary according to the structure of the data. Section “Performance Evaluation Criteria” presents the performance evaluation criteria in detail. Once the training process is completed, the machine learning model tested with test data has never been seen before. The researcher evaluates the test performance according to the performance evaluation criteria (section “Performance Evaluation Criteria”). The research can be repeated by changing the training and test data in the training and testing process to avoid the situation of unstable data. In this case, the researcher uses the average of performance values.

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Algorithm	Accuracy	Precision	Recall	Time
Decision Tree	88%	88.56%	82%	108.4sec
SVM	88%	87.88%	80%	94.1sec
Random Forest	91%	88.88%	82%	110.1sec

Table 2. Comparison of algorithms

Performance evaluation criteria vary according to the data structure and method. If data labels have categorical variables (such as Heavy Traffic/Medium Traffic and Less/No Traffic). Accuracy is defined as the ratio of efficiently classified samples to overall samples. Accuracy is a suitable metric whilst the dataset is balanced. In actual network environments; however, everyday samples are far extra considerable than are unusual samples; hence, accuracy may not be an appropriate metric.

A. Decision Tree

We employed and tested different machine algorithms for achieving higher efficiency and accurate results. To identify classification and regression we have used a Decision Tree Algorithm (DT) in our model. Based on the parameters supplied, it's a graphical depiction of all possible solutions to a problem/decision.

B. Support Vector Machine

The SVM method was used to solve the problem. The SVM approach can help you find the best decision boundary, or hyperplane. SVM is used to find support vectors from various classes. When the number of features in the data set is enormous in comparison to the number of data points, we use SVM, a two class classifier.

C. Random Forest

Random forest is a multi-class problem solver that can handle both numerical and categorical data. Random Forest is a classifier that classifies distinct subsets of a dataset using a number of decision trees. The random forest accumulates and anticipates data from each tree, then predicts the ultimate output based on the majority of votes, rather than relying on a single decision tree. [7]

D. Logistic Regression

Logistic regression is a useful analytical approach for classification issues. As it can compute probabilities and classify new data using both continuous and discrete datasets, logistic regression is an essential machine learning approach. Logistic regression can quickly discover the most helpful features for classification and may categorize observations based on a variety of data sources.

Steps Involved in implementation-
1) Developed an app that can supply us with GPS coordinates.
2) Execute the suggested algorithm
3) Evaluate the dataset's matrix.
4) Split the dataset into two sections: training and testing.
5) Compare and contrast various machine learning algorithms.
6) Using a machine learning technique, predict the 45-minute interval parameters.
7) Draw a conclusion about traffic congestion.

Bayesian Network

A Bayesian people group (BN), moreover alluded to as a causal rendition, is a coordinated graphical variant for addressing contingent independencies among a rigid of irregular factors. It is a combination of plausibility guideline and chart rule and presents a natural gadget for overseeing inconveniences that emerge by means of done number-crunching and designing vulnerability and intricacy. Asencio-Cortés et al. done a troupe of 7 device dominating calculations to process the guests clog forecast. This strategy changed into cutting edge as a twofold kind problem utilizing the HIOCC

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set of rules. Machine dominating calculations completed on this look at had been K-closest neighbor (K-NN), C4.five choice trees (C4.five), manufactured brain local area (ANN) of backpropagation procedure, stochastic inclination plummet streamlining (SGD), fluffy unordered rule enlistment set of rules (FURIA), Bayesian people group (BN), and guide vector contraption (SVM). Three of those calculations (C4.five, FURIA, and BN) can deliver interpretable designs of distinguishable information. A bunch of ensembled dominating calculations had been done to improve the results found from those forecast designs. The group set of rules association safeguarded sacking, supporting (AdaBoost M1), stacking, and Probability Threshold Selector (PTS). The creators found a tremendous improvement in Precision for BN subsequent to utilizing gathering calculations. On the elective hand, Kim and Wang [4] did BN to conclude the components that affect clog introduction on exceptional road segments. The high level rendition of this look at gave a structure to assess standout situation rating and focusing on. Bayesian people group is noticeable to do higher with ensembled calculations or while altered, e.g., different conveyance areas of guests float expectation and boundary assessment at signalized convergence.

Accuracy

This is a plot of organized errors, a predisposition measure; poor accuracy produces a difference between an outcome and a true value. In certain instances, data are checked with the same method, and the exact performance of the implemented model is evaluated. The quality of the overall data is the percentage of actual outcomes (both positive and negative).

$$\text{Accuracy (A)} = (TP + TN)/(TP + TN + FP + FN)$$

Precision

Precision is a portrayal of random errors that is a measure of algebraic variability.

$$\text{Precision} = TP/(TP + FP) \quad (26)$$

Recall

Recall in certain fields calculates the proportion of positive facts and correctly defines the true optimistic rate, warning, or probability of identification.

$$\text{Sensitivity} = TP/(TP + FN)$$

Mean square error

This measures the average of the squares of the errors, that is, the average squared difference between the estimated values and the actual value.

$$\text{MSE} = \frac{1}{N}\sum_{i=1}^{N}(x_i - \hat{x}_i)2$$

Dice co-efficient

We assume b and c are the properties of the fundamental truth data and the data characteristics found. Then, we can then determine the Dice coefficient as

$$D(b,c) = (2b \setminus c/a + b) = 2TP/2TP + FN + FP$$

Research in traffic congestion prediction is developing dramatically. Among the 2 sources, limit of the examination utilized work area bound sensor/advanced digicam insights. Despite the fact that sensor measurements can't hold onto the powerful guests extrude, normal extrude in supply makes it complex to evaluate the float styles for test measurements. Information series skyline is an essential component in guests blockage research. The little skyline of certain days can't hold onto the genuine situation of the blockage as guests is dynamic. Other examination that pre-owned insights for certain months affirmed the difficulty of irregularity. The circumstance of the circling plays out a significant component in guests blockage.

A couple of examination focused on those components. Two exploration thought about web-based entertainment commitment in enter boundary, and 5 thought about environment circumstance. Occasions, e.g., country wide occasion, personnel occasion, and popular games exercises events, play an enormous capability in guests clog. For instance, Melbourne, Australia, has public get-aways sooner than and at some stage in greatest popular games exercises events of

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the country. The public authority close to certain guests courses to address the guests and the motorcade, following in guests clog. Thusly, additional consideration ought to be introduced which incorporate those components simultaneously as estimating. Managing lacking insights is an endeavor withinside the measurements handling. A few rejected the separate insights by and large, others did restrictive strategies to recover the measurements, and a couple changed with various insights. Missing measurements ascription might be a useful examinations scope in transportation designing. Machine dominating calculation, extraordinarily DML models, is progressed with time. This shows a perfect impact at the vertical push in their execution in guests blockage estimating.

VI. CONCLUSION

Traffic congestion is a promising region of research. Therefore, there are more than one directions to conduct in predetermination research. Numerous determining designs have proactively been done in road site guests clog anticipating. Notwithstanding, with the recently advanced anticipating designs, there's additional degree to make the blockage forecast extra exact. Likewise, in this time of data, utilizing extended to be had site guests records with the guide of utilizing the recently developed determining styles can improve the forecast precision. The semi supervised variant changed into completed least difficult for the EML adaptation. Other gadget concentrating on calculations must be investigated for the utilization of each named and unlabeled records for better expectation precision. Likewise, a restricted scope of examination have designated on constant clog estimating. In fate, explores must know about ongoing site guests clog assessment issue. Another predetermination way might be that have practical experience in the degree of site guests blockage. A couple of exploration have separated the site guests clog into certain states. In any case, for higher site guests the board, it is fundamental to figure out the grade of blockage. Along these lines, predetermination explores need to acknowledgment on this. Additionally, greatest exploration designated on easiest one site guests boundary to gauge blockage for clog expectation. This might be a splendid predetermination way to introduce interest to several boundary and blending the outcomes over blockage estimating to make the determining extra dependable. Although deep learning and genetic algorithm is problem in data analysis, it is not deep by the machine learning. The given algorithm gives more accuracy than the existing algorithm. We are making design to use website or application for easier one. The proposed method gives increased accuracy it was designed to aid with more precise traffic movement forecast we will be further be able to enhance it in the future as deep learning technology progresses we looked into current traffic control systems and how they could be improved the proposed project concept seeks to be beneficial in traffic management in a smart cities we can apply this model to improve traffic flow of parking systems criminal tracking and in in case of an emergency as a consequence residents will receive improved services resulting in satisfaction across all service sectors

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