Smart traffic congestion learning model for Dynamic Emergency Vehicle Routing Using (DCN) Deep Cross Network

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Abstract:- **Evaluation of smart city paved the way for creating smart transport systems. Smart cities focused on smart traffic management platforms. Routing the vehicles appropriately without affecting the vehicle speed and utilization points. Dynamic traffic management is getting attracted nowadays to ensure the smart vehicle drivers to get routed without getting further delay or traffic wait time. The updates are provided during the run time. Smart congestion management system uses a set of learning model in which the global dataset is utilized. In the proposed system, a real time datasets are collected from publicly available websites named KAGGLE. The dataset consists of traffic data collected from four junctions. The proposed model modified the existing dataset with the information of emergency vehicle to create novelty. The dataset holds the random distribution of emergency vehicle data combined with the existing traffic data. The proposed Deep cross neural network with the preprocessing analysis using Linear discriminated analysis (LDA) model for improved prediction. The model achieves optimized routing strategy and improved performance, with less error rate.**

Keywords:- *Smart Traffic Congestion, Optimized Routing, Deep Neural Networks, Linear Analysis, Internet Of Things, Routing Algorithms, High Speed Networks.*

I. INTRODUCTION

Due to increased number of vehicle usages and increased number of various transport options, the city is becoming more traffic in certain time slots and creates the trouble to emergency vehicles too. The main motive of analyzing the traffic congestion is to provide the optimized routing model that help the overall traffic signal comes under the single network. Traffic signals at each junction play an important role in controlling the traffic congestion. Due to the increased road transports, lack of road infrastructure strategy, the actual delay of the individual transport become vital. The accumulation of large set of delay from all the vehicles provides exponential growth on traffic congestion delay. The current scenario becomes even worse during the peak hours of the road utilization. In case of any emergency vehicle need to be crossed, such as the ambulance, fire station vehicles, it is become very difficult in current scenario to manage and optimize the routing to clear the traffic immediately. Hence our presented system analyzes the previous research works [1],[2],[3] and more to define a inspired optimization model to provide the routing strategy and machine learning based approach to detect the emergency vehicles too.

A. Methods of traffic Congestion prediction

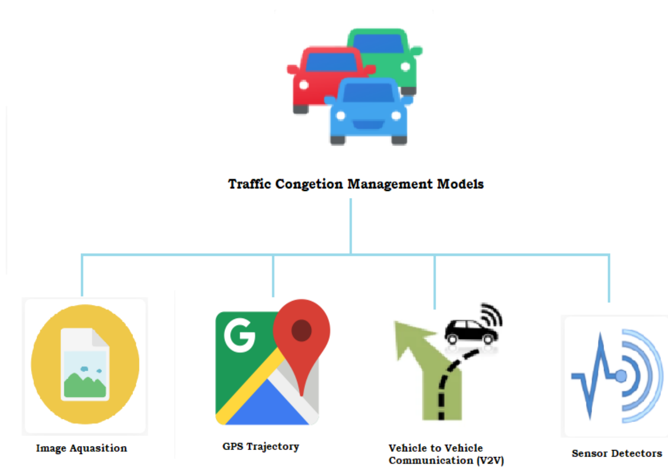

Fig 1. Different methods on Traffic Congestion detection

Image processing techniques

Detection of Traffic congestion scene using CCTV footages that provides optimum result on density prediction is discussed in [9]. The image processing techniques are used to detect the vehicle blobs to measure the density. The traffic scenes are not having clarity in view, hence image filtering is done and morphological operations are adapted to extract the blob portion. Since the image models work with the feature based pattern matching process, the convolution neural network model is utilized for matching the pattern.

GPS trajectory

Acquiring the GPS signals from the vehicles provides the accurate location of the vehicle to track easily comparing other methods. Dedicated methods are evaluated to store the large set of data collected through GPS locations. These location based tracking and adjacent vehicle count provides reliable density measurement process. These data are optimized with dynamic routing algorithm to achieve high potential routes that guide the traffic management system.

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Vehicle to Vehicle communication

The light based fidelity access control enables the vehicles to communicate with the other vehicles in the form of light signaling. The collection of such information gathers the number of vehicles all together travelling within the certain area of high way. Higher the vehicle count then higher the density will be. Information of the each vehicle is further identified through unique identity model.

Sensor based detection

Another way also the traditional way of detecting the vehicles in the high way is through RSU(Road side units) or sensors that detect the vehicles. Microcontrollers are used to measure and process the sensor data to evaluate the count. Such sensor based measuring approach is considered robust and flexible. The disadvantage of the sensor based approach extends the installation and replacement expenses more.

II. LITERATURE SURVEY

[1] The author discussed about the deep Q learning model, in which the application of modern technologies makes it possible for a transportation system to collect real-time data of some specific traffic scenes, helping traffic control center to improve the traffic efficiency. The agent is trained by using Q-learning with experience replay in traffic simulator SUMO, so as to generate traffic signal control policy.

[2] The presented paper discussed about, Profound Reinforcement learning on traffic management. has the potential of practically tending to one of the most squeezing issues in road traffic the executives specifically that of traffic light optimization (TLO).

[3] The presented paper discuss the Signal timing of traffic via DRL, Using High-Resolution Event-Based Data, The analysis is concluded after a lot of calculations to configuration signal planning plans through profound fortification learning.

[4] The author discussed about the traffic congestion impact on vehicle to vehicle communication model. To overcome the drawbacks in the v2v model, the proposed a Internet of things based intelligent traffic congestion monitoring and control system that dynamically controls the traffic signals to detect the high density. They defined a reconfigurable preprogrammed structure that vary depends on the density of the traffic queue.

[5] The author discussed on the improper road infrastructure and its impact on traffic congestion. They proposed a real time CCTV footage based image acquisition model that gathers the traffic videos and convert it into images. Those images are processed and density of the vehicles are detected. Based on the density of the vehicles, the traffic signals are being completely controlled. Depends upon the current traffic density, the delay of the stop light and start lights are controlled.

[6] The author discusses the software based approach that analyze the traffic congestion based on self-organized mapping model. The simulation is used to detect the whole day traffic operation, the average delay rate is detected. The effectiveness of the proposed method is being measured through various statistical performance measurements.

[7] The presented paper consist of hidden Markov model (HMM) based traffic congestion measurement in multiple linked roads and junctions. The proposed system took the Ningbo City real time data as input and analyzes the congestion parameters. The result shows the most impacted factor of multi-link roads traffic congestion. The system achieved the accuracy of 83.4% and comparatively auto regression model having the accuracy of 77.7%.

[8] The author presented a system based on traffic flow theory. The system considers the vehicle count from GPS trajectory data and Vehicle detector to confirm the vehicle type. The convolution neural network model is created with the quantity of vehicles in the traffic congestion data. Analyzing the cause and influence of traffic vehicles are considered here to provide a optimized routing model.

III. SYSTEM DESIGN

KAGGLE – Traffic Congestion dataset

Traffic congestion is ascending in urban communities all throughout the planet. Contributing components incorporate growing metropolitan populaces, maturing foundation, wasteful and awkward traffic light planning and an absence of constant information.

The effects are huge. Traffic information and investigation organization INRIX gauges that gridlock cost U.S. suburbanites $305 billion of every 2017 because of squandered fuel, lost time and the expanded expense of moving products through blocked regions. Given the physical and monetary constraints around building extra streets, urban communities should utilize new techniques and advances to improve traffic conditions.

This dataset contains 48.1k (48120) perceptions of the quantity of vehicles every hour in four unique intersections:

1) Date Time
2) Junction
3) Vehicles
4) ID

The sensors on every one of these intersections were gathering information at various occasions; thus you will see traffic information from various time-frames. A portion of the intersections have given restricted or inadequate information requiring care while making future projections.

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IV. DESIGN METHODOLOGY

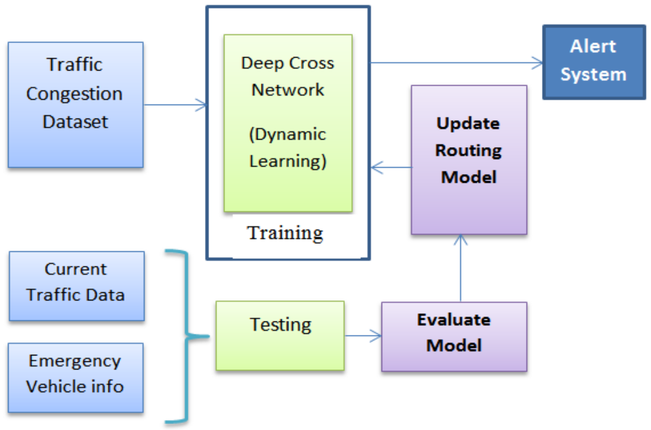

Fig 2. Architecture of Proposed Traffic congestion detection method using DCN

This module is used to read the raw information from the dataset and arrange it into a constant sized matrixes, the dataset is screened to remove the unknown numbers and infinite values, junk values, characters present in the dataset. The Traffic data is segregated into column wise and stored in unique variables. Visualize the preprocessed data as a whole and compare the cleaned up features.

Linear Discriminant Analysis(LDA)

LDA (Linear discriminant analysis) act as the dimentionality reduction method that is commonly utilized in the model where the data is supervised in nature. The process is used to organize the unstructured input data to identify the unique features alone such as peak values, sudden rise or variation data that present with the raw dataset. In case of two classes, where both the class has different features, LDA used to correlate the features and identifies the unique features to evaluate the scalable feature vector.

Deep Cross Network(DCN)

Deep cross network or the correlation finder is a kind of neural network model that detects the similarities and regularities present with the input processing unknown data. The prediction of similarity is structured through iterative comparisons of hidden pattern of target data (that randomly generated) with the input data. The higher the correlation, then the higher the matching rate will be. The predefined features are analyzed with some sort of previous pattern of information and their feature mappings. The present unknown features are iteratively correlated with the random combinations of the target. Statistical approaches such as Mean square Error(MSE), Cross Entropy(CE), Root mean square error(RMSE), true positive rate(TPR), True negative rate(TNR), False positive rate(FPR) and False negative rate(FNR) are evaluated to identify the statistically correlated features of both the inputs. The overall system performance is measured through accuracy, precision and F1Score of the system.

Accuracy = (TP + TN)/(TP+FP+TN+FN) (1)

Algorithm Pseudocode

Data_Scaling
Data=Preprocess(Input_Raw)
For loop_index=1:Scaling_Factor
    Rand_Size=Randi(Max(Scaling_Factor))
    TempData(Loop_Index)=Data(Rand_Size)
Repeat UNTIL Loop Ends
Store_Data= TempData;
Emergency_Vehicle_Check_Routine
If (Stored_Data(Loop_index)==EmergVeh_Const)
Count=count++;
Else
Exit Loop
Optimize the Route = ScatterPlot(opt_data)

V. SYSTEM IMPLEMENTATION RESULTS

Fig 4. Shows the Cleaning of data that normalize the unknown variables, junk values and spaces to the nearest round off or constant round off like -1 or 0 as per the program. These normalized value that filled up the junk columns are ignore during the pattern prediction.

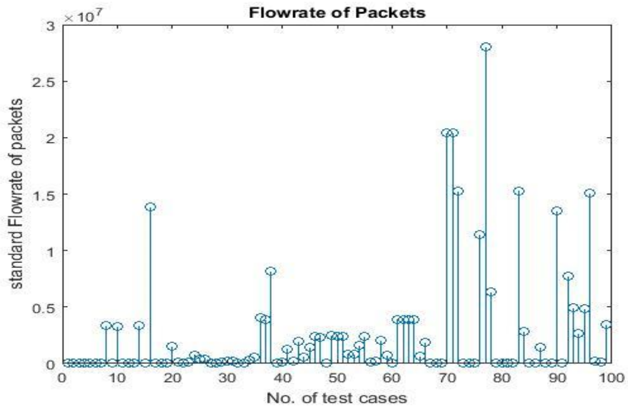

Fig 3. Visualization of raw flow of data

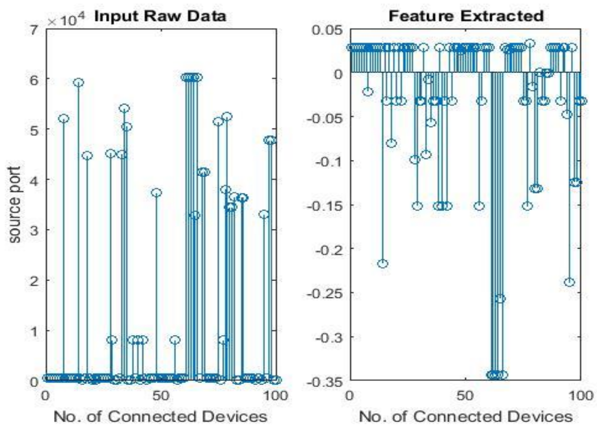

Fig 4. Cleaning the data and feature extraction from raw dataset

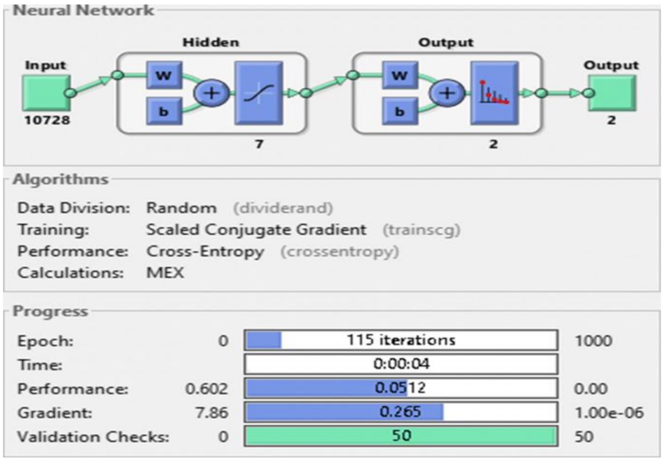

Fig 5. Deep Cross neural Network model

The above figure 5. Shows the Deep cross neural network model that divides the input data in a random manner. The performance is measure through various error rates and validation points. Here cross entropy is the method adapted. For evaluation, the input data is considered with 70% for training, 15% for testing and 15% for validations. The epochs are iterations shown are depends upon the complexity of the congestion data.

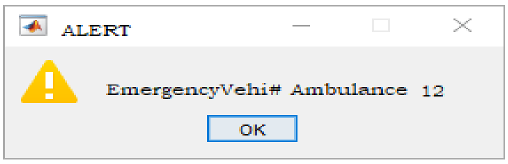

Fig 6. Alert on Emergency Vehicle

The hybrid combination of Linear discriminate model as feature selector, Deep cross network as similarity pattern detector combines and provides reliable outcome of traffic congestion modeling and prediction of emergency vehicles. In such prediction cases the route is optimized and modeled again for smart traffic congestion management. The test input is fetched to the DCN model for congestion prediction. As per the data, in case of emergency vehicle in the dataset, it alerts finally and counts the number of emergency vehicle for analysis. The Count value is being displayed as a notification message box.

VI. CONCLUSION

The Evaluation of intelligent traffic congestion prediction system and adaptable routing model through dynamic programmer approach is simulated here. The proposed model considers the KAGGLE's traffic congestion dataset that holds the vehicle ID and density of the vehicle with time stamps. The proposed model is formulated as two things. The first one to analyze the given dataset on density prediction. The second one is to modify the dataset a little and inject few emergency vehicle information is fetched randomly. The deep cross network is designed to analyze the maximum similarity between the input data and the target data. The outcome of the proposed system detects the type of emergency vehicle and calculate the density of data through the congestion dataset as well as the unique information about the vehicles to determine the type of transport that produce more congestion. The evaluated system achieves average of 90% of accuracy and the error rates are predicted as -0.567 through random test.

Further the system is extendable in research scope by considering the global datasets of different cities and analyze the congestion pattern with other countries to improve the prediction systems much better.

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