Congestion Articulation Control Using Machine Learning Technique

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I. Abstract

Congestion is the most serious issue in both Adhoc mobile networking and regular road traffic systems. The definition of a vehicle is changing as the automotive industry advances. Nowadays, all automobiles are outfitted with the most up-to-date sensors and communication capabilities. Mobile Ad Hoc Network that avoids traffic jams and articulation issues while also saving time by receiving direction from the GPS system on the shortest path using various algorithms. It also provides information on road safety and where to go. It repeatedly recalculates the shortest way using multiple algorithms to ensure that the user does not become stuck and stranded in traffic. From the point of view of research, this paper defines the architecture and protocols. However, VANETs are a subset of MANETs and constitute the future of Intelligent Transportation Systems. The development of big data, the latest sensors and probing vehicle data, as well as the widespread use of machine learning technologies, has given articulation control measurement in the traffic congestion area a completely new and different direction. By examining multiple traffic metrics. With machine learning, it is straightforward to forecast traffic congestion. This study is based on traffic congestion forecasting in real-time. This paper presents a summary of recent research conducted using various AI approaches and machine learning models.

KEYWORDS: Ad-hoc networks, sensors, IOT, vehicular ad hoc networks, Cloud Computing, Sharing-Resources, Auto-detect, Traffic clear, Scaling, Hidden Markov Model.

II. INTRODUCTION

The Most Recent Technology The automotive business has been completely transformed by artificial intelligence, machine learning, and mobile communication systems. Now Communication between multiple devices is possible thanks to sensors. In the field of traffic networking, it has created a new paradigm. Vehicle Ad-hoc Network use has created new opportunities. and opened the door to traffic applications that are fault and congestion free.[1] The ad-hoc network was invented by VANET and comprises of many moving cars and other connecting devices that form a temporary network over a wireless medium and exchange data. Simultaneously, a small temporary network is built, with cars and other equipment acting as nodes in the peer network. It works in the same way that topologies do. Where all nodes communicate with each other.[3] Similarly, all nodes that pass their data receive the data that other nodes are transmitting. Nodes generate useful information after summarising and aggregating data and establish a link by communicating the data to other gadgets. [2][4]. It is an open network because device communication grows in a way that nodes are free to join and depart at any time.[5] Advanced sensors are now standard on new vehicles, making it simple for them to join and traverse the network.

MANET has a subset called VANET. An inter-vehicle link enables data to be transmitted back and forth, enhancing network efficiency, boosting traffic efficiency, monitoring road conditions, detecting congestion and jams, lowering collisions, and identifying emergency situations. VANET can transfer data via many hops to far-off devices. [6]. On the VANET, a dynamic topology was used. Vehicles in a dynamic topology move at varying speeds and directions, which makes communication difficult. When a connection between two devices that are exchanging information changes often, such as when it is possible for the connection to break at any time, this is known as intermittent connectivity. It has a number of Mobility Patterns, which are large groupings of vehicles that move according to predetermined patterns as a result of, among other things, traffic signs, speed limits, highways, streets, and road conditions. As these patterns are discovered, VANET routing protocols can be created with their help. A variety of algorithms determine these patterns. The power and storage capabilities of the nodes in the VANET are expected to be limitless.

As these patterns are discovered, VANET routing protocols can be created with their help. A variety of algorithms determine these patterns. The power and storage capabilities of the nodes in the VANET are expected to be limitless. All new cars now come with on-board sensors as standard equipment. Another crucial element of intelligent transportation systems is VANET.[7]

Traffic congestion happens when there is a lot of traffic and the demand for space exceeds the capacity of the road. The saturation or articulation point is another name for this. [8] The majority of the factors that contribute to articulated aggravate congestion restrict a road's capacity in one location or over a certain length, or they raise the number of vehicles needed to transport a particular number of passengers or goods. Majority of traffic delays result in accidents, congestion, and lost time. [9]. Research into traffic congestion has yet to be able to precisely anticipate when it will occur. Individual incidents have been found to have ripple effects, causing a persistent traffic bottleneck where normal flow would have lasted longer [10]. We can reduce traffic congestion in cities by utilizing cloud computing technologies.

III. PROTOCOLS FOR TRANSMISSION

The communication technology that enables cars to talk to one another is the foundation of VANET. Certain protocols or laws are required to enable the systematic and coordinated transfer of the data that the automobiles collect and communicate. In a VANET, data is transferred between nodes via routing protocols.[12] These protocols define the distribution of a data packet among nodes. [18] For VANET communication, two types of protocols are used: unicast and broadcast, based on the senders and receivers involved.

A. PROPOSED MODEL

In order to implement VANET, we required a variety of data sources, such as the ITS environment, vehicle information, roadside units, base stations (BS), traffic infrastructure (traffic lights, CCTV cameras, web cameras), GPS data, etc. The sources listed above have numerous sensors and a processor that generate a considerable amount of data. In addition, mobile devices connected to the VANET produce data.

Significant amounts of data are produced, which can be used for a number of things and has several advantages.

Because the data is so large, data science could be a potent system-level solution for ITS.

The database is made to work well with VANET applications and handle huge, diverse, and complex datasets produced from a range of data sources in automotive networks, including sensors, GPS, and other available source data. The GPS data and several sensors mounted on the cars, which have comparatively straightforward values, are the main focus. The collection, processing, and analysis of these datasets, however, poses major technical challenges, calling for the creation of fresh vehicular network solutions. Unstructured or raw data should first be filtered and analysed in the specified architecture., as shown in Fig. 1.1

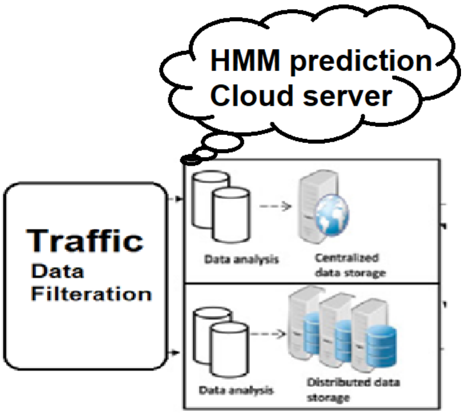


Figure 1: Filtration and Analysis of Unstructured Data

Data pre-processing and data post-processing are the two steps involved in data collection for information from various vehicles and sources. The vehicles are equipped with numerous sensors and GPS datasets since data might come from a variety of sources. A method for obtaining unprocessed data from a particular environment for data generation is called data collecting. [23] The suggested model also gathers raw data from the vehicle and its sources. Moreover, a fast transmission method is needed to send the raw data to the proper data storage system for processing after it has been gathered. The environment within the car needs to be particularly supportive for high-speed transmission. Redundancy exists in the bulk of datasets gathered by vehicle sensors, which can be reduced using a variety of data reduction techniques.[13] As illustrated in Fig. 1.1, the data collection method involves a pre-processing mechanism that filters the datasets that are obtained. After the information has been classified, the data is analysed. As a result, it is proposed to use pattern matching, data prediction, and data detection based on prior data to perform data validation in vehicular networks, with a vehicular cloud server serving as a backup or restoration of the necessary valid data.

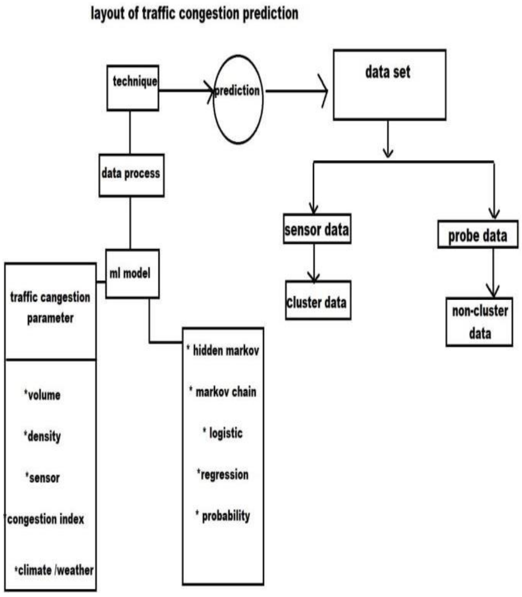


Figure 2: Layout of Traffic Congestion Prediction

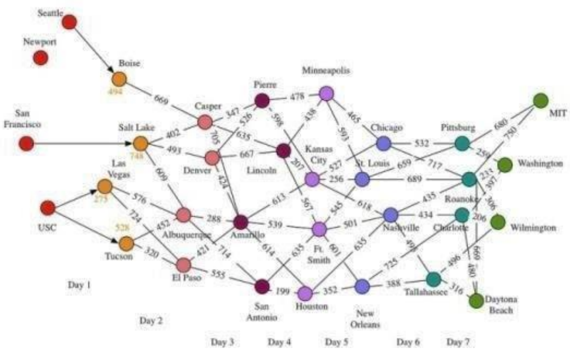
B. CONGESTION FREE TRAFFIC SYSTEM Through HMM

The hidden Markov model (HMM) combines the traits of discrete Markov chains and stochastic Markov processes. It is a stochastic method for recognising events in time series [10]. The Markov chain model has been employed in a number of research on traffic congestion to identify traffic patterns and anticipate congestion. The Markov chain needs to be extended in order for the HMM to work. [20] The likelihood of sequences of random variables, or states, each of which can have values drawn from a variety of possibilities, is explained by a Markov chain[12]. The Pearson correlation coefficient between the elements is widely utilised while creating patterns. Examine the state variables q1, q2,..., and qi. A Markov model embodies the Markov assumption on the probabilities of this sequence, which states that only the present matters when predicting the future.

$$P(qi = a|q1...qi1) = P(qi = a|qi1) = P(qi = a|qi1) \qquad [17]$$

The adaptive neuro fuzzy inference system is used to construct a set of models, and HMM is used to select the best prediction model out of those models. To accomplish the optimum state transition, they used four processing phases: initialization, recursion, termination, and backtracking. The Viterbi algorithm was employed in the last stage to evaluate the earlier step and assess the likelihood of the current situation. The highest a posteriori probability, or possibility that something will happen, can be determined using the Viterbi method, a dynamic programming technique. The term "posterior probability" refers to the total of prior probability and fresh likelihood data. The Viterbi route, which in the context of hidden Markov models is based on a series of pragmatic events and is based on the log-likelihood of the basic model parameter, is an estimation of the most likely hidden state sequence (HMM). This tactic was foreseen using a reliable traffic pattern congestion model. To predict future states, a discretised multiple symbol HMM (MS- HMM) prediction model was used (FSP). They examined the model's adaptability to various road types. From a label containing MS-HMM hidden states, the output of FSP was used to create the next hidden state label. [15]

In the context of hidden Markov models, the Viterbi route is an estimate of the most likely hidden state sequence. It is based on a series of pragmatic events and the log-likelihood of the basic model parameter (HMM). This plan was anticipated using a good traffic pattern congestion model. Future states were predicted using a discretised multiple symbol HMM (MS- HMM) prediction model (FSP). The model's suitability for various kinds of roads was examined. The next hidden state label was created from a label comprising MS-HMM hidden states using the FSP output.[16] In the context of hidden Markov models, the Viterbi route is an estimate of the most likely hidden state sequence. It is based on a series of pragmatic events and the log-likelihood of the basic model parameter (HMM). This plan was anticipated using a good traffic pattern congestion model. Future states were predicted using a discretised multiple symbol HMM (MS- HMM) prediction model (FSP). [14] The model's suitability for various kinds of roads was examined. The next hidden state label was created from a label comprising MS-HMM hidden states using the FSP output.




```
function VITERBI(O, S, Π, Y, A, B) : X
    for each state i = 1, 2, ..., K do
        T_1[i, 1] ← π_i · B_{i y_1}
        T_2[i, 1] ← 0
    end for
    for each observation j = 2, 3, ..., T do
        for each state i = 1, 2, ..., K do
            T_1[i, j] ← max_k (T_1[k, j − 1] · A_{ki} · B_{i y_j})
            T_2[i, j] ← arg max_k (T_1[k, j − 1] · A_{ki} · B_{i y_j})
        end for
    end for
    z_T ← arg max_k (T_1[k, T])
    x_T ← s_{z_T}
    for j = T, T − 1, ..., 2 do
        z_{j−1} ← T_2[z_j, j]
        x_{j−1} ← s_{z_{j−1}}
    end for
    return X
end function
```

Figure 3: Multiple Symbol HMM (MS- HMM) Prediction Model (FSP)

GPS tracking technology has advanced significantly in this satellite era. As a result, HMM modelling is currently increasingly important for map matching. HMM is also employed in various aspects of transportation, including traffic prediction [12], modified HMM for speed prediction [14], and traffic flow state transition[21]

IV. CONCLUSION

VANET provides a variety of applications that make road travel more efficient, safer, convincing, effective, easy, and enjoyable by reducing travel time, reducing traffic congestion, boosting road capacity, avoiding congested areas, and avoiding emergency situations, among other things. In general, metropolitan city areas are overcrowded, making traffic control a significant issue in that area. We may be able to mitigate this difficulty by using the proposed cloud-based web control model of traffic control and through hidden Markov model implementation in traffic jams, the VANET system will undoubtedly reduce saturation and articulation points.

V. References

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