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# A Novel Algorithm for predicting road traffic congestion in a IOT based smart city

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**Abstract** — *Accurate and promptly flow of road traffic information is important for the successful deployment of intelligent transportation systems. Existing traffic flow prediction methods mainly use Neural Networks and other prediction models which take presumably more time and need manual intervention due to which they are still unsatisfying for many real-world applications. So, here, we predict the traffic congestion problem using a novel algorithm which runs at regular t time intervals and predicts the traffic congestion well before, so that the traveler approaching a junction can decide which direction to go well in advance.*

***Keywords***-*IOT, road traffic congestion, prediction, smart city, Graph.*

## I. INTRODUCTION

In the current scenario prompt and accurate traffic flow information is critically needed for commuters, private vehicle travelers and public transportation system. It has the information to help road users make better travel decisions, overcome traffic congestion, reduce carbon emissions and improve traffic operation efficiency. The objective of traffic congestion prediction is to provide information about the traffic congestion well in advance. Traffic congestion prediction has gained more and more popularity with the rapid development and deployment of intelligent transportation systems (ITSs). It is regarded as a important element for the successful deployment of ITS subsystems, particularly advanced traveler information systems, advanced traffic management systems, advanced public transportation systems and commercial vehicle operations.

Traffic congestion prediction greatly depends on past and current real-time traffic data collected from various sensor sources, including RFIDs, cameras, mobile Global Positioning System, social media, etc. In a smart city with the widely deployed traffic sensors and new emerging traffic sensor technologies, traffic data are accumulated a lot. We can make use of these data to find out interesting knuggets and utilize these knowledge for the prediction of congestion like problems. So, we come up with an algorithm which makes use of the data and predicts well in advance whether there would be a traffic congestion or not.

The remaining sections of the paper is organized as follows, section 2 discusses about the related works and problem definition is given in section 3 of this paper. In section 4 the proposed algorithm is presented and discussed in detail. Section 5 gives the conclusion and future scope of this work.

## II. RELATED WORKS

Lot of work has been done in the related areas of this field. To mention a few, Sherif et al[1] had done a identification of operational setting and anticipated forecasting accuracy on a real-time data collected form 62.5km corridor of insterstate_4 in Orlando, Florida. Congestion Index, the prediction horizon and the rolling horizon are the important features he had identified for prediction. He concluded that prediction of long term accuracy is possible with the help of hybrid information. Kranti Kumar et al [2] applied Artificial Neural Network(ANN) for short term prediction of traffic volume and has taken volume, speed and density, time and day of the week in a Indian context as input variables and predicted the traffic volume with the help of ANN and concluded that ANN gives a better accuracy for various types of vehicles on a specified sector road in India.

Traffic congestion prediction can be regarded as a key functional component in ITSs. Over the past few decades, a number of traffic flow prediction models have been developed to assist in traffic management and control for improving transportation efficiency ranging from route guidance and vehicle routing to signal coordination.

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The proliferation of devices with communicating –actuating capabilities is bringing closer the version of Internet of Things (IOT) where the sensing and actuating functions seamlessly blend into the background and new capabilities are made possible through access of rich new information sources Gubbi[3] et al. They worked on the Internet Of Things (IOT) and defined many concepts of IOT.

Vlahogianni, Eleni et al[4] used Genetic Algorithms based multilayered structural optimization strategy that can assist both I the proper representation of traffic flow data as well as the selection of appropriate neural network structure. He concluded that, the capabilities of simple static Neural Network with genetically optimized step size, momentum and number of hidden units are very satisfactory when modeling both univariate and multivariate traffic data.

Vlahogianni, Eleni et al (2014)[5] had done a review of all methods of techniques used in Intelligent Transport Systems(ITS) research and applications and suggested although lot of short term prediction models are available, there is a lot of important research directions that will attract the interest of researcher. They suggested that advanced computing and IOT can be used for prediction of short term traffic forecasting applications.

Ma, Xiaolei et al[6] has applied long short term neural network for traffic speed prediction using remote microwave sensor data. He has shown that the comparisons between dynamic neural networks and other parametric and non parameteric algorithms and concluded that his model is superior compared to other existing models. Kortuem et al[7] has given a clear picture of what and Internet of Things(IOT) is how the data is accumulated from different sources using different means of collection methods like RFIDs, sensors, cameras, etc.

## III. PROBLEM DEFINITION

Here we can define the problem of traffic congestion prediction as a static graph which contains interconnected vertices and edges to represent a path between the source and destination. Formally, a graph is a pair of sets **(V, E)**, where **V** is the set of vertices and **E** is the set of edges, connecting the pairs of vertices. In our case, the vertices turns out to be the junction points where more than two roads meet and the edges are the paths or road segments which connect two vertices. A snapshot of a graph may be seen in the ***Figure 1.***

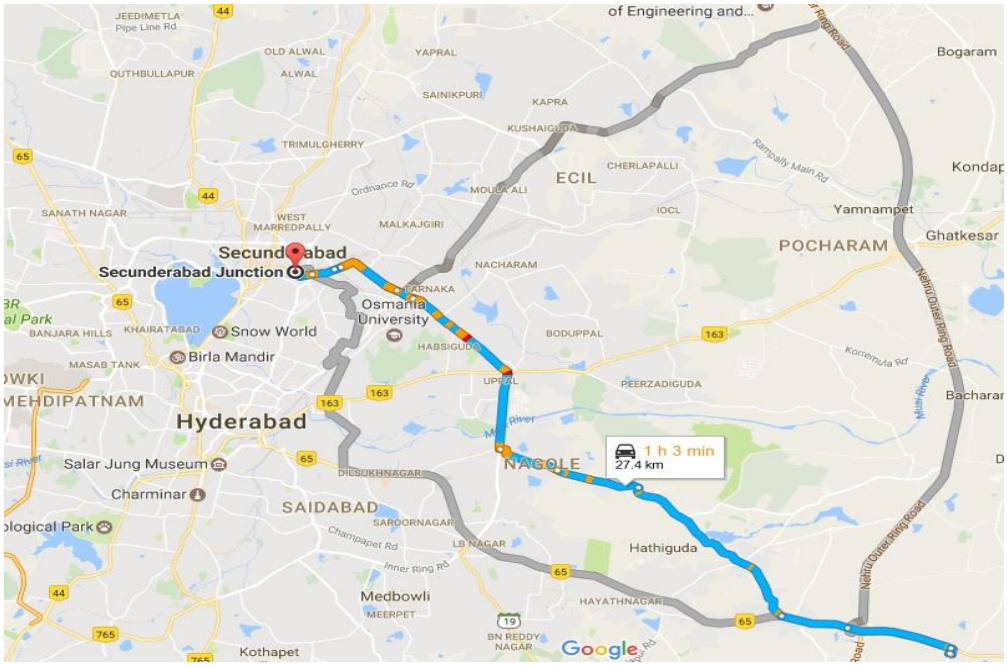


***Figure 1. Snapshot of the static path which is taken for predicting traffic congestion.***

The problem which we are going to address in this paper is defined as below,

***Problem:*** *Given a set of vehicle's position on a road network at a specific time interval, find congestion in different road segments of a path at a particular point of time* ***t.***

## IV. PROPOSED ALGORITHM

Before the solution to the above problem is given, we need to know the data which are used for solving this above solution. So, the data used in this problem contains five attributes which are having a mixed type of categorical and numerical data. The five attributes are, Congestion, Vehicle Number, Time, Junction, Path. The data attributes are defined in detail in the algorithm along with their types and initialization values.

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**Assumptions:** The data is assumed to be generated on the fly having the below mentioned attributes.

**Algorithm:**

***Data:***

*/* variable: type; initialization */*
*Congestion: numeric; initialized with a zero*
*Vehicle Number: numeric; initialized with a unique numeric value*
*Time: numeric; is initialized with a time stamp*
*Junction: vertex; is a meeting point of more than two roads*
*Path: edge; defined as an alternate sequence of junction and road segments.*
*Direction: edge; initialized with the edge in step 1.*

*Assume that the data is sorted based on the vehicle number and based on the time stamp.*

***Step 1:***

*Determine the vehicle direction*
*There can be maximum of eight possible edges in any vertex in a road network scenario. So,*
*For each new time stamp data of the same vehicle compare with the previous time stamp data up to say* ***T*** *time*
*Check the edge chosen by the vehicle with the help of* $x_1$ *and* $y_1$ *coordinates with respect to* ***x*** *and* ***y*** *coordinates*
*(Where* $x_1$ *and* $y_1$ *coordinates are the new time stamp coordinates)*
*If* ***x*** *value is changing and* ***y*** *is constant then*
*The vehicle is moving in direction* ***d1*** *if* ***x*** *is changing positively or* ***d2*** *if x is changing negatively*
*(where* ***d1*** *represents edge 1 and* ***d2*** *represents edge 2)*
*Else if* ***y*** *value is changing and* ***x*** *is constant then*
*The vehicle is moving in direction d3 is* ***y*** *is changing positively or d4 if* ***y*** *is changing negatively*
*(where* ***d3*** *represents edge 3 and* ***d4*** *represents edge 4)*
*Else if* $x_1$ *is greater than* ***x*** *and* $y_1$ *is greater than* ***y*** *then*
*The vehicle is moving in direction* ***d5***
*Else The vehicle is moving in direction* ***d6***
*(where* ***d5*** *represents edge 5 and* ***d6*** *represents edge 6)*
*Else if* $x_1$ *is less than* ***x*** *and* $y_1$ *is less than* ***y*** *then*
*The vehicle is moving in direction d7*
*Else The vehicle is moving in direction d8*
*(where* ***d7*** *represents edge 7 and* ***d8*** *represents edge 8)*

***Step 2:***

***Congestion checking function:***
*For each path*
*For all vehicles on the path*
*Compute the average speed*
*If average speed <* ***P*** *where* ***P*** *may be least speed defined by the user then*
*Congestion is high*
*Else if average speed <* ***Q*** *where* ***Q*** *may be the moderate speed defined by the user then*
*Congestion is moderate*
*Else*
*Congestion is null*

***Step 3:***

*Main method*

1. *For each vehicle find its path direction*
2. *When the vehicle is approaching a junction point say some* ***d*** *meters ahead of the junction*
   a. *Display/announce path congestion of all the paths emerging from the ahead junction except the road segment or edge on which this vehicle is traversing, with the help of Congestion checking function which runs at every* ***T*** *minutes.*
3. *Driver may try an alternate path if there is any congestion in his way ahead.*

## V. CONCLUSION AND FUTURE SCOPE

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The *algorithm* proposed in this paper gives a simple and early prediction of the traffic congestion for a given static road network which can be considered as a graph. The complexity of the algorithm mentioned above would be constant. So, this is can be effectively used by any devices which has a less computation capability and with less resources. As a future direction the traffic congestion prediction can be predicted using various Machine Learning techniques.

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