(54) **A METHOD AND A DEVICE FOR PROVIDING DRIVING SUGGESTIONS**

(57) A device 1000 to provide at least one driving suggestion is disclosed. The device 1000 comprises a time calculation means 101 to calculate a time to reach at least one narrow road section along a route for an ego vehicle 200 and each of at least one surrounding vehicle 300; a congestion prediction means 102 to predict a congestion at a starting location of the at least one narrow road section based on the calculated time of the ego vehicle 200 and each of the surrounding vehicle 300; and a suggestion means 103 to provide at least one suggestion to driver of the ego vehicle 200 based on the prediction.
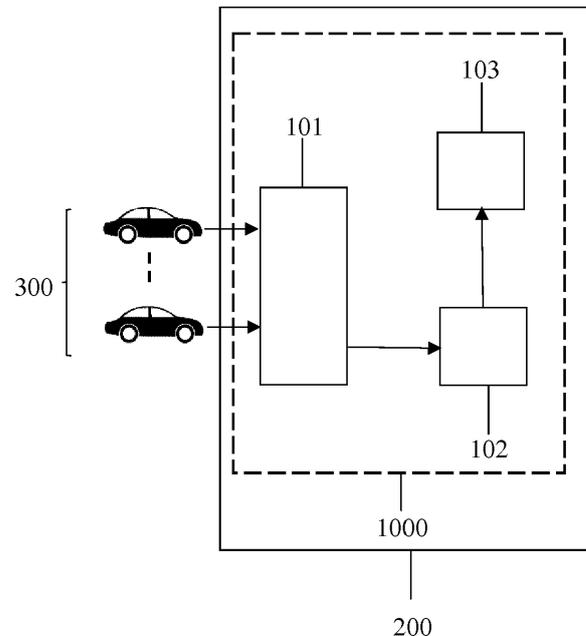
Figure 1

Description

[0001] The following specification describes and ascertains the nature of this invention and the manner in which it is to be performed:

Field of the invention

[0002] The invention relates to a device and method for providing driving suggestions to a driver of a vehicle.

Background of the invention

[0003] Traffic in urban areas has increased over the years. Narrow road sections exist due to poor planning of the cities or due to geographical conditions of the places. As the width of the roads decreases at the narrow road sections, it easily leads to traffic congestion. Sometimes it may lead to dangerous situations such as traffic accidents. Also, the traffic congestion leads to increased travel times in reaching the destination. Efforts are made to combat the increasing traffic congestion in various ways, for example, receiving information about current traffic conditions and providing the information to individuals. Traffic sensors are installed to measure traffic flow. But such infrastructure involves high cost and complex features to be of significant use. Also, if the information about the traffic conditions is not available in a timely manner, then the value of the information is greatly reduced. Hence, a device capable of providing low cost, timely and accurate information about traffic congestion is required.

[0004] US patent application, 20070208501, discloses a method of receiving indications of multiple road segments of roads, and receiving information related to current traffic conditions of the segments during a period of time. Average traffic speed for vehicles is estimated. A weighted average of the reported speeds of the data samples is determined, and the estimated average speed of all vehicles traveling on the road segment is determined. The estimated average traffic speeds are used for the period of time to facilitate future travel on the roads.

Short description of the drawing

[0005] An exemplifying embodiment of the invention is explained in principle below with reference to the drawings. The drawings are,

Figure 1 illustrates a device to provide at least one driving suggestion in accordance with this invention;

Figure 2 exemplary illustrates the ego vehicle and a plurality of vehicles surrounding the ego vehicle approaching a starting location of a narrow road section; and

Figure 3 illustrates a method for providing at least one driving suggestions in accordance with this invention.

Description of the invention

[0006] Figure 1 illustrates a device 1000 to provide at least one driving suggestion in accordance with this invention. The device 1000 comprises a time calculation means 101 to calculate a time to reach at least one narrow road section along a route for an ego vehicle 200 and each of at least one surrounding vehicle 300; a congestion prediction means 102 to predict a congestion at a starting location of the at least one narrow road section based on the calculated time of the ego vehicle 200 and each of the surrounding vehicle 300; and a suggestion means 103 to provide at least one suggestion to driver of the ego vehicle 200 based on the prediction.

[0007] The device 1000 is mounted in the ego vehicle 200. When the driver of the ego vehicle 200 selects a destination using the device 1000 present in the ego vehicle 200, the device 1000 provides routes to reach the destination. In an embodiment, the device 1000 is a navigation device mounted in the ego vehicle 200. In another embodiment, the device 1000 is a portable device, for example, a mobile phone, of the driver. The device 1000 identifies a current location of the ego vehicle 200 using standard techniques such as global positioning system (GPS). The device 1000 generates a route to the destination selected by the driver from the current location of the ego vehicle 200.

[0008] The device 1000 obtains a vehicle speed of the ego vehicle 200 from at least one speed sensors mounted in the ego vehicle 200. As the ego vehicle 200 travels along the route to the destination, the device 1000 also receives the speed of at least one surrounding vehicle 300. The device 1000 determines the speed of each of the surrounding vehicle 300 which are within a predefined radius from the ego vehicle 200. In an embodiment, each of the surrounding vehicle 300 transmit the corresponding vehicle speed to the device 1000 using vehicle to vehicle communication. In another embodiment, the device 1000 in the ego vehicle 200 comprises sensors and computations systems to monitor the speed of the surrounding vehicles 300 within the predefined radius.

[0009] The device 1000 also receives information about narrow road sections along the selected route to the destination using GPS or navigation map data. The narrow road sections are prestored in a memory of the device 1000. The device 1000 receives information regarding the route to the destination from the GPS. The road sections with width less than a threshold are defined as narrow road sections by the device 1000. The device 1000 marks the narrow road sections once the route to the destination is selected by comparing the width of the road sections with the threshold. Since the width of a narrow road section is lesser than the threshold, the chances of a traffic congestion at the start of a narrow road section is high.

[0010] The time calculation means 101 receives the vehicle speed of the ego vehicle 200. The time calculation means 101 also calculates a distance of the starting location of the at least one narrow road section from the current location of the ego vehicle 200. The time calculation means 101 of the device 1000 calculates a time (T) to reach at least one narrow road along the route for the ego vehicle 200 using the below equation 1.

$$T = D/S \text{ ------------ Equation 1}$$

[0011] The term 'D' is the distance of the ego vehicle 200 to reach the narrow road section from the current location of the ego vehicle 200. The term 'S' is the vehicle speed of the ego vehicle 200.

[0012] The time calculation means 101 receives the vehicle speed of each of the surrounding vehicles 300 via vehicle to vehicle communication. The time calculation means 101 calculates the distance of the starting location of the at least one narrow road section from the current location of each of the surrounding vehicles 300. In an embodiment, the speed and distance for each of the surrounding vehicle 300 to reach the at least one narrow road section along the route is received by the device 1000 in the ego vehicle 200 via vehicle to vehicle communication. The time calculation means 101 calculates the time for each of the at least one vehicle surrounding the ego vehicle 200 in the same manner as explained above.

[0013] Figure 2 exemplary illustrates the ego vehicle and a plurality of vehicles surrounding the ego vehicle approaching a starting location 400 of a narrow road section. The ego vehicle 200 is represented by EV. The surrounding five vehicles within the predefined radius from the ego vehicle EV are represented by V1, V2, V3, V4 and V5. The time to reach the starting location 400 of narrow road section by the ego vehicle EV and each of the five surrounding are represented by T, t1, t2, t3, t4 and t5 respectively. The time calculation means 101 of the device 1000 present in the ego vehicle EV calculates the time to the narrow road section by the ego vehicle EV and the five surrounding vehicles V1, V2, V3, V4 and V5. The time for the ego vehicle EV to reach the narrow road section is given by T=D/S, D being the distance from the current location of the ego vehicle EV to the starting location 400 of the narrow road section and S being the vehicle speed of the ego vehicle EV. Similarly, the time calculation means 101 calculates the time for each of the surrounding vehicles V1, V2, V3, V4 and V5 to reach the narrow road section and is given by t1= D1/S1, t2=D2/S2, t3=D3/S3, t4=D4/S4 and t5=D5/S5 respectively. The terms 'D1', 'D2', 'D3', 'D4' and 'D5' are the distance of to reach the starting location 400 of the narrow road section from each of the five surrounding vehicles V1, V2, V3, V4 and V5. The terms 'S1', 'S2', 'S3', 'S4' and 'S5' are the vehicle speed of each of the five surrounding vehicles V1, V2, V3, V4 and V5.

[0014] The time calculation means 101 transmits the calculated time for the ego vehicle 200 and the at least one surrounding vehicle 300 to the congestion prediction means 102 of the device 1000. The congestion prediction means 102 compares the time (T) for the ego vehicle 200 to reach the narrow road section with the time (t) of each of the surrounding vehicles 300 to reach the starting location 400 of the narrow road section. The congestion prediction means 102 identifies the surrounding vehicles, for which the time to reach the narrow road section within a predefined range. The predefined range is given by the below equation 2.

$$T-x < t < T+x \text{ ------ Equation 2}$$

[0015] The term 'T' is the time required for the ego vehicle 200 to reach the starting location 400 of the narrow road section. The term 't' is the time required for an surrounding vehicle 300 within the predefined radius to reach the starting location 400 of the narrow road section. The term 'x' is a value of time. For example, 'x' is equal to 3 minutes.

[0016] The congestion prediction means 102 identifies the vehicles surrounding the ego vehicle, which satisfy the Equation 2. The congestion prediction means 102 counts the number of surrounding vehicle 300 surrounding the vehicle satisfying the Equation 2. When the number of surrounding vehicles 300 is greater than a threshold, then the congestion estimation means predicts a congestion at the starting location 400 of a narrow road section. When the number of vehicles is lesser than or equal to the threshold, then the congestion prediction means 102 estimates that the possibility of congestion at the starting location 400 of the narrow road section is low. Possibility of congestion at the narrow road section depends on the number of surrounding vehicles 300 reaching the starting location 400 of the narrow road section around the same time as the ego vehicle 200.

[0017] The congestion prediction means 102 of the device 1000 transmits the prediction of a congestion at the starting location 400 of at least one narrow road to the suggestion means 103 of the device 1000. The suggestion means 103 of the device 1000 provides at least one driving suggestions to the driver of the ego vehicle 200 based on the prediction to avoid the congestion.

[0018] In an embodiment, when the congestion prediction means 102 predicts the congestion at the starting location 400 of the narrow road section, the suggestion means 103 of the device 1000 suggests at least one alternate route to the driver of the ego vehicle 200. This enables the driver of the ego vehicle 200 to avoid congestion along the route to the destination. In another embodiment, when the congestion prediction means 102 predicts the congestion at the narrow road section, the suggestion means 103 of the device 1000 suggests a

suitable vehicle speed to the driver of the ego vehicle 200 to avoid the congestion.

[0019] In an embodiment, the device 1000 in the ego vehicle 200 transmits the predictions to a central traffic control server. The central traffic control server may also receive information regarding estimated congestion from other vehicles travelling along the route to the destination. The central traffic control server estimates the traffic density along the route based on the information received regarding the prediction from a plurality of vehicles travelling along the route to the destination.

[0020] In an embodiment, the device 1000 measures a rate of change in the vehicle speed of the surrounding vehicles 300 along the route to the destination. When a driver of a surrounding vehicle 300 prepares to take a turn or deviation from the route, the/she reduces the vehicle speed. As a result, the distance of the surrounding vehicle 300 from the ego vehicle 200 also increases. The device 1000 considers all these factors in predicting the congestion at the starting location 400 of at least one narrow road section along the route by reducing the probability of such surrounding vehicles to cause congestion at the narrow road section.

[0021] In an embodiment, the device 1000 receives alternate routes to the destination via navigation map data. The higher the popularity of an alternate route, the higher would be the probability of the vehicles moving into the alternate route. The device 1000 considers a probability of the surrounding vehicles 300 considering the alternate route while predicting the congestion at the starting location 400 of at least one narrow road section along the route.

[0022] Consider a case where a surrounding vehicle 300 changes a lane to join the ego vehicle's lane. This results in a delay in the movement of traffic in the ego vehicle's lane. The device 1000 considers a probability of vehicles changing their lanes in predicting the congestion at the starting location 400 of at least one narrow road section along the route. This probability is based on the change in the direction of movement of the surrounding vehicles 300 and a rate of change of the surrounding vehicles' 300 vehicle speed.

[0023] Figure 3 illustrates a method for providing at least one driving suggestions in accordance with this invention. At step S1, the time calculation means 101 to calculate a time to reach at least one narrow road section along a route for an ego vehicle 200 and each of at least one surrounding vehicle 300. At step S2, the congestion prediction means 102 to predict a congestion at a starting location 400 of the at least one narrow road section based on the calculated time of the ego vehicle 200 and each of the surrounding vehicles 300. At step S3, the suggestion means 103 to provide at least one suggestion to driver of the ego vehicle 200 based on the prediction to avoid the congestion.

[0024] The method provides a low cost solution for predicting as well as providing information about the traffic along a route and the road conditions. The method also requires less infrastructure and can be set up easily. The method provides a low cost infrastructure for monitoring the traffic especially in countries with vast area and large road networks with large traffic. The method provides a low cost solution for traffic monitoring involving very less infrastructure and avoiding overhead or underground constructions, etc., which poses high cost.

[0025] It must be understood that the embodiments explained and the example provided in the above detailed description are only illustrative and does not limit the scope of this invention. The scope of this invention is limited only by the scope of the claims. Many modification and changes in the embodiments aforementioned are envisaged and are within the scope of this invention.

Claims

1. A method for providing at least one driving suggestion, said method comprising:

   calculating a time to reach at least one narrow road section along a route for an ego vehicle 200 and each of at least one surrounding vehicle 300;
   predicting a congestion at a starting location of said at least one narrow road section based on said calculated time of said ego vehicle 200 and each of said surrounding vehicles 300; and
   providing said at least one driving suggestion to driver of said ego vehicle 200 based on said prediction.

2. The method as claimed in claim 1, wherein calculating said time to reach said at least one narrow road section along said route for said ego vehicle 200 comprises:

   calculating a vehicle speed of said ego vehicle 200; and
   calculating a distance of the starting location of said at least one narrow road section from said ego vehicle 200.

3. The method as claimed in claim 1, wherein calculating said time to reach said at least one narrow road section along said route for each of said surrounding vehicle 300 comprises:

   calculating a vehicle speed of each of said surrounding vehicle 300; and
   calculating a distance of the starting location of said at least one narrow road section from each of said surrounding vehicle 300.

4. The method as claimed in claim 1, wherein said at least one surrounding vehicle 300 is within a predefined radius from said ego vehicle 200.

5. The method as claimed in claim 1, wherein providing at least one alternate route to a driver of said ego vehicle 200 based on said prediction.

6. The method as claimed in claim 1, wherein suggesting a suitable vehicle speed to a driver of said ego vehicle 200 based on said prediction to avoid said congestion.

7. The method as claimed in claim 1, wherein determining at least one said narrow road along said route using global positioning system (GPS).

8. A device 1000 to provide at least one driving suggestion, said device 1000 comprising:

   a time calculation means 101 to calculate a time to reach at least one narrow road section along a route for an ego vehicle 200 and each of at least one surrounding vehicle 300;
   a congestion prediction means 102 to predict a congestion at a starting location of said at least one narrow road section based on said calculated time of said ego vehicle 200 and each of said surrounding vehicle 300; and
   a suggestion means 103 to provide said at least one driving suggestion to driver of said ego vehicle 200 based on said prediction.

9. The device 1000 as claimed in claim 8, wherein said suggestion means 103 to suggest at least one alternate route to a driver of said ego vehicle 200 based on said prediction.

10. The device 1000 as claimed in claim 8, wherein said suggestion means 103 to suggest a suitable vehicle speed to a driver of said ego vehicle 200 based on said prediction to avoid said congestion.

Figure 1

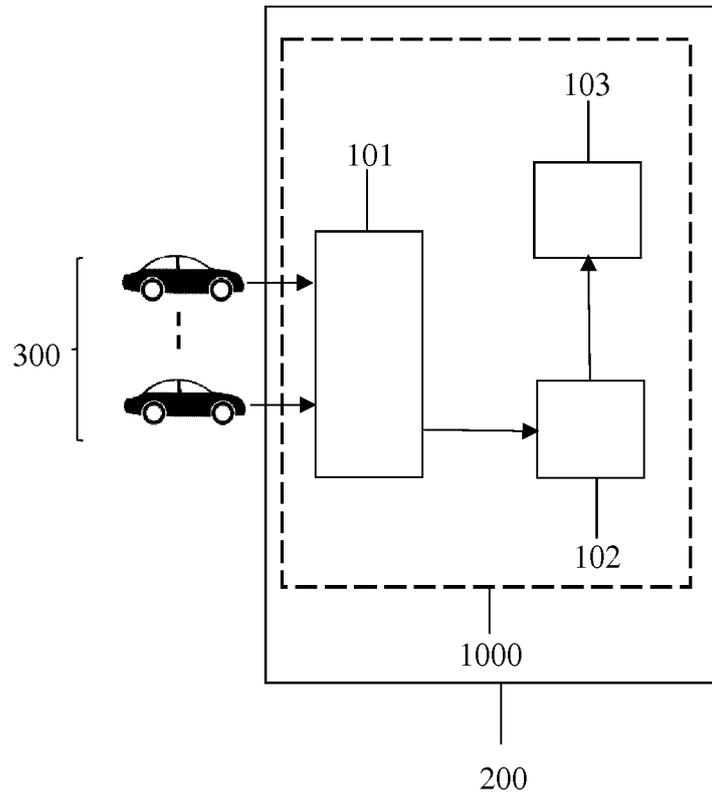Figure 2
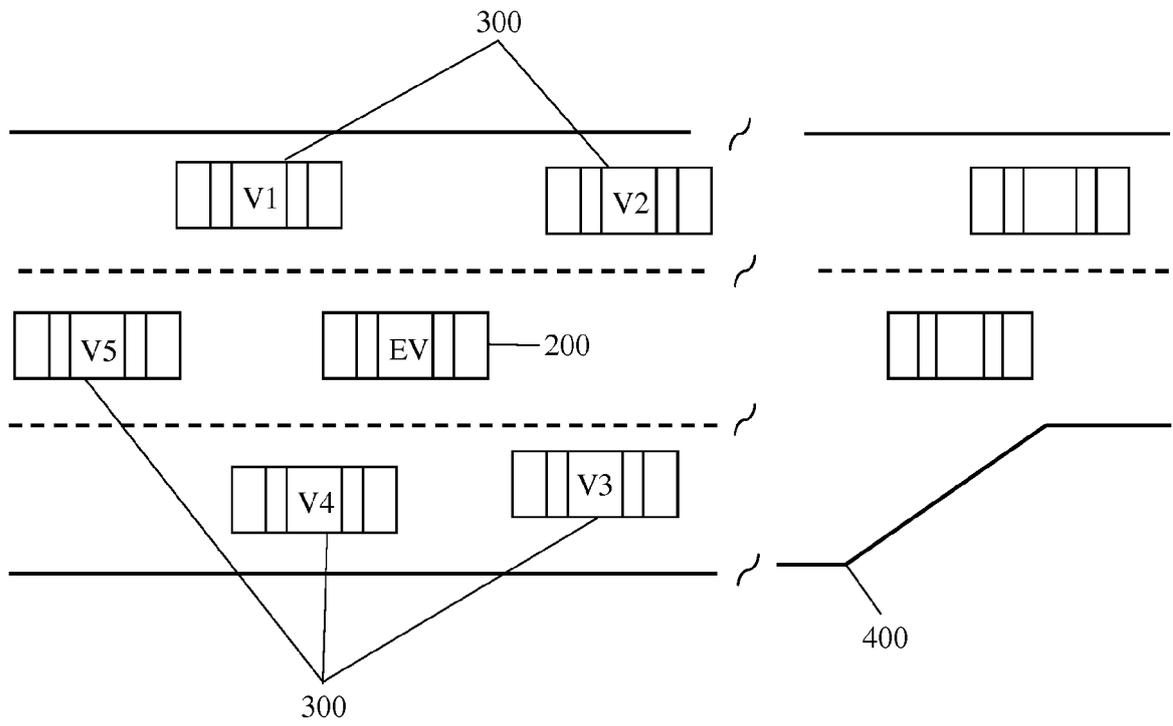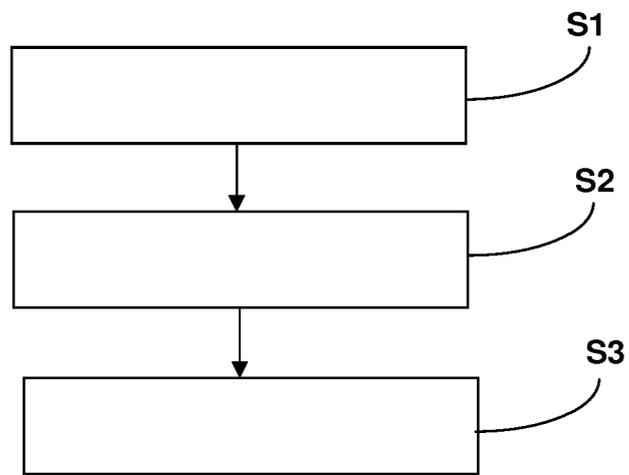
Figure 3

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EUROPEAN SEARCH REPORT

Application Number

EP 16 17 2618

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 8 810 431 B2 (MUDALIGE UPALI PRIYANTHA [US] ET AL) 19 August 2014 (2014-08-19) * abstract; figure 3 * * column 1, line 39 - line 55 * * column 3, line 12 - line 35 * * column 4, line 58 - line 62 * * column 6, line 60 - column 7, line 7 * -----	1-4,6-8, 10 5,9	INV. G08G1/16 G08G1/0968
X	US 2015/100216 A1 (RAYES FREDDY [US]) 9 April 2015 (2015-04-09) * abstract; figures 3,5-10 * * paragraph [0033] * * paragraph [0037] - paragraph [0038] * * paragraph [0042] * -----	1-4,7,8, 10	

TECHNICAL FIELDS SEARCHED (IPC)

G08G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 December 2016	Wagner, Ulrich

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 16 17 2618

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02-12-2016

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US 2015100216	A1	09-04-2015	CN EP JP US WO	105593700 A 3052961 A1 2016533289 A 2015100216 A1 2015049100 A1	18-05-2016 10-08-2016 27-10-2016 09-04-2015 09-04-2015

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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