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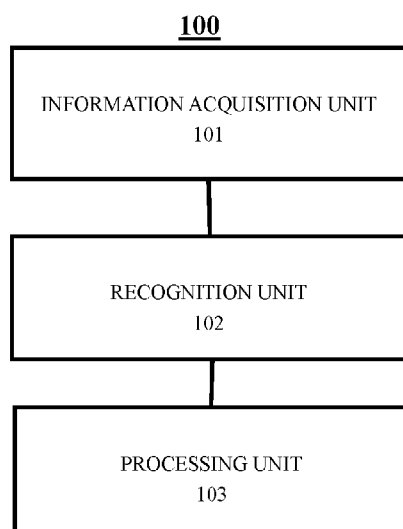


Fig. 1

(57) Abstract: The present invention proposes a driving assisting device for a vehicle, as well as a corresponding vehicle, method, computer device, and medium. The driving assisting device comprises an information acquisition unit configured to acquire information about a traffic condition ahead of the vehicle; a recognition unit configured to recognize that there is a traffic jam ahead of the vehicle and recognize a degree of the traffic jam based on the information; and a processing unit configured to provide an output for the vehicle based on the degree of the traffic jam and a current speed of the vehicle in response to the traffic jam being recognized, the output indicating that the vehicle starts decelerating at a braking acceleration at a point that is a control distance from a starting position where the traffic jam starts. With the solution of the present invention, it helps to increase the driving safety of a vehicle and the comfort of the vehicle's occupant(s) in the case of a traffic jam.

**DRIVING ASSISTING DEVICE, AS WELL AS CORRESPONDING VEHICLE,
METHOD, COMPUTER DEVICE, AND MEDIUM**

FIELD OF THE INVENTION

5 **[0001]** The present invention relates to the field of vehicle technologies, and more particularly, to a driving assisting device for a vehicle, a vehicle comprising the same, as well as a corresponding method, computer device, and computer readable storage medium.

BACKGROUND OF THE INVENTION

10 **[0002]** Currently, it is common that a traffic jam occurs on a road. The traffic jam may cause various problems. For example, a vehicle traveling to a road section with a traffic jam may need to perform emergency braking to avoid colliding with a front vehicle, thereby making the vehicle's occupant(s) feel uncomfortable. As another example, a vehicle that suddenly encounters a traffic jam may be late for braking and collide with a
15 front vehicle, causing an accident.

SUMMARY OF THE INVENTION

[0003] It is an object of the present invention to provide a solution that can at least alleviate some of the above problems and help to increase the driving safety of a vehicle and the comfort of the vehicle's occupant(s) in the case of a traffic jam.

20 **[0004]** Specifically, according to a first aspect of the present invention, there is provided a driving assisting device for a vehicle, which comprises:
an information acquisition unit configured to acquire information about a traffic condition ahead of the vehicle;
a recognition unit configured to recognize that there is a traffic jam ahead of the vehicle
25 and recognize a degree of the traffic jam based on the information; and
a processing unit configured to provide an output for the vehicle based on the degree of the traffic jam and a current speed of the vehicle in response to the traffic jam being

recognized, the output indicating that the vehicle starts decelerating at a braking acceleration at a point that is a control distance from a starting position where the traffic jam starts.

[0005] According to a second aspect of the present invention, there is provided a vehicle comprising the driving assisting device described above.

[0006] According to a third aspect of the present invention, there is provided a driving assisting method corresponding to the driving assisting device for a vehicle described above.

[0007] According to a fourth aspect of the present invention, there is provided a computer device comprising a memory and a processor, the memory having stored thereon a computer program that, when executed by the processor, causes the driving assisting method described above to be performed.

[0008] According to a fifth aspect of the present invention, there is provided a non-transitory computer readable storage medium having stored thereon a computer program which, when executed by a processor, causes the driving assisting method described above to be performed.

[0009] According to the solution of the present invention, a traffic jam existing ahead of a vehicle and its degree are recognized based on information about a traffic condition ahead of the vehicle, and based on the degree of the traffic jam and a current speed of the vehicle, an output for the vehicle is provided to indicate that the vehicle starts decelerating at a braking acceleration at a point that is a control distance from a starting position of the traffic jam. With the present invention, it is possible to provide, in response to a traffic jam existing ahead of a vehicle, an output directing the vehicle to decelerate in a timely manner accordingly, thereby avoiding or alleviating sudden braking or an accident that may be caused due to the traffic jam, which helps to increase the driving safety of the vehicle and the comfort of the vehicle's occupant(s) in the case of the traffic jam, and improve the experience of the vehicle's occupant(s).

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Non-limiting and non-exhaustive examples of the present invention are

described by way of example with reference to the following figures, in which:

[0011] Fig. 1 is a schematic diagram illustrating a driving assisting device for a vehicle according to an example of the present invention;

[0012] Fig. 2 is a flow chart schematically illustrating a driving assisting method for a vehicle according to an example of the present invention; and

[0013] Fig. 3 is a graph illustrating a relationship between a control distance and a current speed of a vehicle determined according to the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0014] Fig. 1 illustrates a driving assisting device 100 according to an example of the present invention. The driving assisting device 100 may be used for a vehicle. Hereinafter, the vehicle may be represented by a vehicle V.

[0015] The driving assisting device 100 comprises an information acquisition unit 101, a recognition unit 102, and a processing unit 103. The recognition unit 102 is communicatively coupled with the information acquisition unit 101, and the processing unit 103 is communicatively coupled with the recognition unit 102.

[0016] The information acquisition unit 101 may be configured to acquire information about a traffic condition ahead of the vehicle V. Here, the information about the traffic condition ahead of the vehicle V may comprise at least some of various information related to the traffic condition ahead of the vehicle, for example: information related to a traffic flow ahead of the vehicle; and other possible traffic-related information, for example, information related to a road condition ahead of the vehicle, etc. The traffic flow ahead of the vehicle V may comprise a traffic flow along at least part of a driving route that the vehicle will travel through (for example, a road part or a lane part within a certain distance range (for example, 200 meters, 500 meters, or a longer or shorter distance range) ahead of the vehicle). In one example, traffic participant(s) forming the traffic flow may comprise one or more types of various types of traffic participants on a road, for example, but not limited to, vehicle(s), cyclist(s), pedestrian(s), etc. For the traffic flow, information related to it may be in various forms and may be acquired in various possible ways or by a combination thereof, which will be further described

below.

[0017] Depending on the circumstances, the information acquisition unit 101 may be further configured to acquire other possible information, for example: information of traffic participant(s) (e.g., other vehicles) ahead of the vehicle V, especially within a predetermined distance range ahead of the vehicle V, including the traffic participant(s)' position, orientation, speed, etc. The predetermined distance range may be appropriately determined in various ways. For example, in the case where the vehicle V is in Adaptive Cruise Control (ACC), the predetermined distance range may correspond to a preset distance that the vehicle V should maintain from an adjacent front vehicle ahead of it according to the Adaptive Cruise Control.

[0018] The information acquisition unit 101 may acquire the above information in various possible ways or by any suitable combination thereof. For example, the information acquisition unit may comprise, and/or be adapted to be connected to, a sensor installed at a suitable position on the vehicle (for example, a front and/or top portion of the vehicle), thereby performing information capture by means of the sensor. The sensor may comprise a camera, a lidar, a millimeter wave radar, an ultrasonic sensor, a speedometer, or any other suitable sensor, or any suitable combination thereof, and for example, may be placed and configured to be adapted to acquire information of traffic participant(s) ahead of the vehicle V. As another example, the information acquisition unit may be adapted to communicate with a source capable of providing information which is inside and/or outside the vehicle, for example, an in-vehicle Global Navigation Satellite System (GNSS), a Highly Automated Driving (HAD) map, an online server, other vehicles, and/or available infrastructure, to obtain relevant information from it and acquire the information about the traffic condition ahead of the vehicle V therefrom.

[0019] In one example, the information acquisition unit 101 detects a speed of the vehicle V by a speed sensor installed on a wheel of the vehicle, detects traffic participant(s), e.g., vehicle(s), in front of the vehicle and information thereof by a millimeter wave radar and a camera installed at a front and/or top portion of the vehicle, and by communicating with an online server providing online traffic information,

acquires information about a traffic condition ahead of the vehicle from the latter. For example, the online server is configured to collect and store traffic-related data uploaded by various data providers. Optionally, based on the collected and stored traffic-related data, the online server may determine information about a traffic condition of a relevant road part, area or unit, for example, information indicating whether there is a traffic jam in the relevant road part, area or unit, and information indicating a position (e.g., a starting position), a degree, etc. of a traffic jam that exists.

[0020] The data providers may comprise a vehicle or a roadside traffic monitoring device arranged at the roadside. The roadside traffic monitoring device may collect, by various sensors (for example, a camera, a lidar, a millimeter wave radar, an ultrasonic sensor and/or a speedometer, etc.) installed on it, traffic-related data (for example, a position, an orientation, a speed, etc.) of traffic participant(s) (for example, vehicle(s), cyclist(s), pedestrian(s), etc.) near a position where it is located, and upload the same to the server. Traffic-related data uploaded by a vehicle as a data provider may comprise a position, an orientation, a speed, etc. of the vehicle, and/or positions, orientations, speeds, etc. of other traffic participants (for example, other vehicles, cyclists, pedestrians, etc.) around the vehicle or communicating with the vehicle that are obtained by the vehicle.

[0021] A vehicle, for example, the vehicle V, may acquire its position, orientation and speed by any suitable means, for example, but not limited to: acquiring its position by a technology such as GNSS or Real-Time Kinematic (RTK), etc., acquiring its orientation using an azimuth gyroscope, etc., and acquiring its speed using an in-vehicle sensor, a navigation device, etc. In addition, the vehicle may acquire positions, orientations, speeds, etc. of other traffic participants around it or communicating with it using a sensor on it or through inter-vehicle communication, etc.

[0022] The recognition unit 102 may be configured to recognize whether there is a traffic jam ahead of the vehicle V and recognize a degree of the traffic jam in the case where the traffic jam exists, based on the information from the information acquisition unit 101.

[0023] Two or more different degrees of traffic jam may be set. In one example, the

degrees of traffic jam comprise degree 1, normal; degree 2, serious; and degree 3, very serious. In one example, when an average travel speed of a traffic flow in a traffic jam is within a first speed range, a second speed range, and a third speed range, respectively, a degree of the traffic jam is normal, serious, and very serious, respectively. The first, second, and third speed ranges may be appropriately determined, and for example, may be 10-25 km/h, 5-10 km/h, and 0-5 km/h, respectively. In one example, a traffic jam of degree 1, a traffic jam of degree 2, and a traffic jam of degree 3 correspond to, for example, a traffic jam shown in yellow, a traffic jam shown in red, and a traffic jam shown in dark red on a signpost or a display screen erected along a road, respectively, and a case where there is no traffic jam may correspond to a traffic condition shown in green on such a signpost or display screen.

[0024] Traffic jams of different degrees may correspond to different allowable travel speeds. For traffic jams of degree 1, degree 2, and degree 3, corresponding allowable travel speeds may be a first allowable travel speed, a second allowable travel speed, and a third allowable travel speed, respectively, the first allowable travel speed is greater than the second allowable travel speed, and the second allowable travel speed is greater than the third allowable travel speed. The first, second, and third allowable travel speeds may be appropriately determined in various possible ways, and each of them may be a speed value or a value within a speed range.

[0025] In one example, the information from the information acquisition unit 101 directly indicates the following: whether there is a traffic jam ahead of the vehicle V; and, if there is a traffic jam, a position and a degree of the traffic jam. In this case, the recognition unit 102 may directly recognize a traffic jam existing ahead of the vehicle V and its position and degree from the information. In this case, for a traffic jam of each degree, a corresponding allowable travel speed may be, for example, determined as an allowable travel speed corresponding to the degree based on a pre-established look-up table, or determined by an online server based on an average travel speed of each of one or more traffic flows in a traffic jam of the degree, and provided to the recognition unit via the information acquisition unit.

[0026] In another example, the information from the information acquisition unit 101

comprises traffic-related information of each traffic participant forming a traffic flow ahead of the vehicle V. In this case, the recognition unit 102 may recognize a traffic jam existing ahead of the vehicle V and its position and degree based on the traffic-related information in various possible ways. In one example, the recognition unit calculates an average travel speed of the traffic flow based on the traffic-related information, and determines that there is a traffic jam when the average travel speed is lower than a speed threshold. The recognition unit may, for example, recognize a degree of the traffic jam based on a speed range which the average travel speed is in. The speed threshold may be appropriately determined, and for example, may be 25 km/h, or a higher or lower speed. In this case, for a traffic jam of the recognized degree, a corresponding allowable travel speed may be, for example, determined as an allowable travel speed corresponding to the degree based on a pre-established look-up table, or determined by the recognition unit based on the calculated average travel speed.

[0027] In one example, the first allowable travel speed is 20 km/h, the second allowable travel speed is a value within a range of 5 km/h to 10 km/h, and the third allowable travel speed is a speed value that is zero or close to zero.

[0028] The processing unit 103 may be configured to provide an output for the vehicle V based on the degree of the traffic jam and a current speed of the vehicle in response to the traffic jam being recognized. In one example, the output indicates that the vehicle V starts decelerating at a braking acceleration at a point that is a control distance from a starting position where the traffic jam starts.

[0029] In one example, the processing unit is configured to, in response to the traffic jam being recognized, judge whether the current speed of the vehicle V is higher than an allowable travel speed in the case of the traffic jam, and perform the above operation of providing an output only when a judgment result is positive.

[0030] In one example, the processing unit 103 is configured to, in response to the traffic jam being recognized, calculate a first acceleration according to the following formula:

$$A_1 = (V_j^2 - V_c^2) / (2 * D_c)$$

where V_c is the current speed of the vehicle V , V_j is an allowable travel speed in the case of the traffic jam that is determined based on the degree of the traffic jam, D_c is the control distance, and A_1 is the first acceleration.

[0031] Here, the current speed V_c of the vehicle V may be acquired by the information acquisition unit 101, as described above. In addition, the control distance D_c may be determined based on the current speed of the vehicle V , which will be further described later.

[0032] The processing unit 103 may be further configured to determine whether there is a front vehicle within a preset distance ahead of the vehicle V in the case where the vehicle is in Adaptive Cruise Control.

[0033] Adaptive Cruise Control is a known assisted driving technology implemented by an intelligent automatic control system, and its basic function is to control a vehicle to make it maintain a preset distance from a front vehicle (e.g., a front vehicle in the same lane). When it is detected that a distance between the vehicle and the front vehicle is too small, for example, being less than the preset distance, an ACC control unit decelerates the vehicle to increase the distance between the vehicle and the front vehicle. When the distance between the vehicle and the front vehicle increases to the preset distance, the ACC control unit controls the vehicle to drive at a set speed. The preset distance may be, for example, preset by the vehicle's driver, and for example, may correspond to a minimum longitudinal safety distance that the vehicle must have between it and an adjacent front vehicle ahead of it during driving, or be determined based on the latter. A value of the longitudinal safety distance may be dependent on the vehicle's driving speed.

[0034] In the case where the vehicle V is in Adaptive Cruise Control: in response to there being no front vehicle within a preset distance ahead of the vehicle, the processing unit takes the first acceleration as the braking acceleration; and in response to there being a front vehicle within the preset distance ahead of the vehicle, the processing unit obtains an adaptive acceleration that is automatically determined by the Adaptive Cruise Control in response to presence of the front vehicle and determines one with a greater absolute value of the first acceleration and the adaptive acceleration

as the braking acceleration. The adaptive acceleration is a braking acceleration of the vehicle V that the Adaptive Cruise Control determines in order to brake the vehicle to make a distance between it and the front vehicle increase in the case where the vehicle is less than the preset distance from the front vehicle. The manner in which the adaptive
 5 acceleration is determined and the involved elements may be known in the prior art, and are not further described in detail here.

[0035] The output provided by the processing unit may be provided to an ACC control unit of the vehicle V so that the ACC control unit controls the vehicle to start decelerating at the braking acceleration at a point that is the control distance from the
 10 starting position of the traffic jam. Optionally, the processing unit may present the provided output to the vehicle's driver in the form of acoustic and/or visual information through a loudspeaker and/or a display screen on the vehicle V.

[0036] Although the solution of the present invention is particularly applicable to a case where a vehicle is in Adaptive Cruise Control, it can also be used in other cases,
 15 including a case where a vehicle is not in Adaptive Cruise Control -- in this case, the first acceleration may be directly taken as the braking acceleration.

[0037] Referring to Fig. 3, in one example, the processing unit 103 is configured to: determine the control distance D_c as a first distance value D_1 when the current speed of the vehicle V is greater than a first speed threshold V_{TH1} and not greater than a
 20 second speed threshold V_{TH2} ; determine the control distance as a second distance value D_2 when the current speed of the vehicle is greater than a third speed threshold V_{TH3} ; and determine the control distance according to the following formula when the current speed of the vehicle is greater than the second speed threshold and not greater than the third speed threshold:

$$D_c = D_1 + (D_2 - D_1) * (V_c - V_{TH2}) / (V_{TH3} - V_{TH2})$$

[0038] Here, $V_{TH1} < V_{TH2}$, $V_{TH2} < V_{TH3}$, and $D_2 > D_1$, as shown in Fig. 3.

[0039] In one example, a speed lower than the second speed threshold is considered as a low speed, and a speed equal to or higher than the second speed threshold is considered as a high speed.

[0040] The first speed threshold, the second speed threshold, the third speed threshold, the first distance value, and the second distance value may be appropriately determined based on possible factor(s), and the factor(s) may be, for example: 1) a comfortable braking acceleration at which an occupant of the vehicle V feels comfortable -- for example, being no more than $-2 \text{ m}^2/\text{s}$ in the case where the vehicle is at a low speed, and being no more than $-1.5 \text{ m}^2/\text{s}$ in the case where the vehicle is at a high speed; 2) an allowable braking acceleration of an assisted system of the vehicle V -- for example, being no more than $-5 \text{ m}^2/\text{s}$ (for example, being $-4 \text{ m}^2/\text{s}$) in the case where the vehicle is at a low speed, and being no more than $-3.5 \text{ m}^2/\text{s}$ (for example, being $-3 \text{ m}^2/\text{s}$) in the case where the vehicle is at a high speed; and/or 3) a braking buffer distance of the vehicle V, for example, being 5~10 meters. In one example, the first, second, and third speed thresholds as well as the first and second distance values are determined so that an absolute value of the first acceleration is not greater than a maximum absolute value of braking acceleration allowed by the assisted system of the vehicle V, or is not greater than a maximum absolute value of braking acceleration at which an occupant of the vehicle V feels comfortable, or is not greater than a smaller one of the two absolute values.

[0041] In one example, the first speed threshold is 0 km/h, the second speed threshold is within a range of 20 km/h to 40 km/h, the third speed threshold is within a range of 70 km/h to 90 km/h, the first distance value is within a range of 16 meters to 30 meters, and the second distance value is within a range of 120 meters to 160 meters.

[0042] Fig. 2 schematically illustrates a driving assisting method 200 for a vehicle according to an example of the present invention. The driving assisting method may be implemented using the driving assisting device of the present invention as described above.

[0043] At step S201, information about a traffic condition ahead of the vehicle is acquired.

[0044] At step S202, based on the information, it is recognized that there is a traffic jam ahead of the vehicle and a degree of the traffic jam is recognized.

[0045] At step S203, in response to the traffic jam being recognized, an output for the

vehicle is provided based on the degree of the traffic jam and a current speed of the vehicle, the output indicating that the vehicle starts decelerating at a braking acceleration at a point that is a control distance from a starting position where the traffic jam starts.

5 **[0046]** In one example, the driving assisting method further comprises: when the vehicle is in Adaptive Cruise Control, in response to the traffic jam being recognized,

calculating a first acceleration based on the degree of the traffic jam and the current speed of the vehicle according to the following formula: $A_1 = (V_j^2 - V_c^2) / (2 * D_c)$, where V_c is the current speed of the vehicle, V_j is an allowable travel speed in the case of the traffic jam that is determined based on the degree of the traffic jam, D_c is the control distance, and A_1 is the first acceleration;

in the case where there is no front vehicle within a preset distance ahead of the vehicle, taking the first acceleration as the braking acceleration; and

15 in the case where there is a front vehicle within the preset distance ahead of the vehicle, obtaining an adaptive acceleration that is automatically determined by the Adaptive Cruise Control in response to presence of the front vehicle, and determining one with a greater absolute value of the first acceleration and the adaptive acceleration as the braking acceleration.

[0047] In one example, the driving assisting method further comprises:

20 determining the control distance as a first distance value when the current speed of the vehicle is greater than a first speed threshold and not greater than a second speed threshold, wherein the second speed threshold is greater than the first speed threshold;

determining the control distance as a second distance value when the current speed of the vehicle is greater than a third speed threshold, wherein the third speed threshold is greater than the second speed threshold, and the second distance value is greater than the first distance value; and

determining the control distance according to the following formula when the current speed of the vehicle is greater than the second speed threshold and not greater than the third speed threshold:

$$D_c = D_1 + (D_2 - D_1) * (V_c - V_{TH2}) / (V_{TH3} - V_{TH2})$$

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where D_c is the control distance, D_1 is the first distance value, D_2 is the second distance value, V_c is the current speed of the vehicle, V_{TH2} is the second speed threshold, and V_{TH3} is the third speed threshold.

[0048] Each of the above steps can be performed by a corresponding unit of the driving assisting device of the present invention as described above in connection with Fig. 1. In addition, various operations and details as described above in connection with various units of the driving assisting device of the present invention can be incorporated or reflected in the driving assisting method of the present invention.

[0049] The solution of the present invention is applicable for various vehicles, including a vehicle adapted to be driven by a human driver and an autonomous vehicle, and is particularly applicable for a case where a vehicle is in Adaptive Cruise Control.

[0050] It should be understood that all or some of the various units of the driving assisting device of the present invention may be implemented through software, hardware, firmware or a combination thereof. The various units may each be embedded, in a hardware or firmware form, in a processor of a computer device or independent therefrom, and may also be stored, in a software form, in a memory of a computer device, so as to be invoked by a processor for executing operations of the various units. The various units can each be implemented as independent components or modules, or two or more of the units can be implemented as a single component or module.

[0051] Those ordinarily skilled in the art would understand that the schematic diagram of the device shown in Fig. 1 is merely an exemplary illustrative block diagram of a partial structure related to the solution of the present invention, and does not constitute limitation of a computer device, processor or computer program embodying the solution of the present invention. A particular computer device, processor or computer program may include more or less components or modules than those shown in the figure, or combine or subdivide some components or modules, or may have a different arrangement of components or modules.

[0052] In one example, a computer device is provided, including a memory and a processor, the memory having stored thereon a computer program executable by the processor, the computer program, when executed by the processor, performing part or

all of the steps of the method of the present invention. The computer device may broadly be a server, an in-vehicle terminal, or any other electronic device having necessary computing and/or processing capability. In one example, the computer device may include a processor, a memory, a network interface, a communication
5 interface, etc., connected through a system bus. The processor of the computer device can be used to provide necessary computing, processing and/or controlling capability. The memory of the computer device may include a non-volatile storage medium and an internal storage. The non-volatile storage medium may store an operating system, a computer program, etc. therein or thereon. The internal storage may provide an
10 environment for running of the operating system and computer program in the non-volatile storage medium. The network interface and communication interface of the computer device may be used to connect and communicate with an external device through a network. The computer program, when executed by the processor, performs the steps of the method of the present invention.

[0053] The present invention can be implemented as a computer readable storage medium, on which a computer program is stored, the computer program, when executed by a processor, implementing part or all of the steps of the method of the present invention. In one example, the computer program is distributed across multiple network-coupled computer devices or processors, so that the computer program is
20 stored, accessed and executed by one or more computer devices or processors in a distributed manner. A single method step/operation, or two or more method steps/operations, may be performed by a single computer device or processor, or by two or more computer devices or processors. One or more method steps/operations may be performed by one or more computer devices or processors, and one or more
25 other method steps/operations may be performed by one or more other computer devices or processors. One or more computer devices or processors may perform a single method step/operation, or perform two or more method steps/operations.

[0054] Those ordinarily skilled in the art would understand that all or some of the steps of the method of the present invention can be completed by relevant hardware, such as
30 a computer device or processor, which is directed by a computer program, and the

computer program may be stored in a non-volatile computer readable storage medium, and when executed, causes the steps of the method of the present invention to be performed. Any reference to a memory, storage, database or other medium herein may include a non-volatile and/or volatile memory, depending on the circumstances.

- 5 Examples of a non-volatile memory include read-only memory (ROM), programmable ROM (PROM), electrically programmable ROM (EPROM), electrically erasable programmable ROM (EEPROM), flash memory, magnetic tape, soft disk, magneto-optical data storage device, optical data storage device, hard disk, solid state disk, etc. Examples of a volatile memory include random access memory (RAM),
10 external cache, etc.

[0055] Various technical features described above may be combined arbitrarily. Although not all possible combinations of these technical features are described, any combination of these technical features should be deemed to be covered by the present specification provided that there is no conflict for such a combination.

- 15 **[0056]** While the present invention has been described in connection with examples, those skilled in the art would understand that the above description and figures are only illustrative rather than restrictive, and the present invention is not limited to the disclosed examples. Various modifications and variations are possible without departing from the spirit of the present invention.

WHAT IS CLAIMED IS:

1. A driving assisting device for a vehicle, comprising:

an information acquisition unit configured to acquire information about a traffic condition ahead of the vehicle;

5 a recognition unit configured to recognize that there is a traffic jam ahead of the vehicle and recognize a degree of the traffic jam based on the information; and

a processing unit configured to provide an output for the vehicle based on the degree of the traffic jam and a current speed (V_c) of the vehicle in response to the traffic jam being recognized, the output indicating that the vehicle starts decelerating at a
10 braking acceleration at a point that is a control distance (D_c) from a starting position where the traffic jam starts.

2. The driving assisting device according to claim 1, wherein the processing unit is further configured to do as below in response to the traffic jam being recognized, when
15 the vehicle is in Adaptive Cruise Control:

calculate a first acceleration based on the degree of the traffic jam and the current speed of the vehicle according to the following formula: $A_1 = (V_j^2 - V_c^2) / (2 * D_c)$

where V_c is the current speed of the vehicle, V_j is an allowable travel speed in the case of the traffic jam that is determined based on the degree of the traffic jam, D_c is the
20 control distance, and A_1 is the first acceleration;

in the case where there is no front vehicle within a preset distance ahead of the vehicle, take the first acceleration as the braking acceleration; and

in the case where there is a front vehicle within the preset distance ahead of the vehicle, obtain an adaptive acceleration that is automatically determined by the Adaptive
25 Cruise Control in response to presence of the front vehicle, and determine one with a greater absolute value of the first acceleration and the adaptive acceleration as the braking acceleration.

3. The driving assisting device according to claim 1, wherein the processing unit is further configured to:
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determine the control distance as a first distance value (D_1) when the current speed of the vehicle is greater than a first speed threshold (V_{TH1}) and not greater than a second speed threshold (V_{TH2}), wherein the second speed threshold is greater than the first speed threshold;

- 5 determine the control distance as a second distance value (D_2) when the current speed of the vehicle is greater than a third speed threshold (V_{TH3}), wherein the third speed threshold is greater than the second speed threshold, and the second distance value is greater than the first distance value; and

- 10 determine the control distance according to the following formula when the current speed of the vehicle is greater than the second speed threshold and not greater than the third speed threshold:

$$D_c = D_1 + (D_2 - D_1) * (V_c - V_{TH2}) / (V_{TH3} - V_{TH2})$$

- 15 where D_c is the control distance, D_1 is the first distance value, D_2 is the second distance value, V_c is the current speed of the vehicle, V_{TH2} is the second speed threshold, and V_{TH3} is the third speed threshold.

- 20 4. The driving assisting device according to claim 3, wherein the first speed threshold is 0 km/h, the second speed threshold is within a range of 20 km/h to 40 km/h, the third speed threshold is within a range of 70 km/h to 90 km/h, the first distance value is within a range of 16 meters to 30 meters, and the second distance value is within a range of 120 meters to 160 meters.

- 25 5. A vehicle, comprising the driving assisting device according to any one of claims 1 to 4.

6. A driving assisting method for a vehicle, comprising:

acquiring information about a traffic condition ahead of the vehicle;

recognizing that there is a traffic jam ahead of the vehicle and recognizing a degree of the traffic jam based on the information; and

in response to the traffic jam being recognized, providing an output for the vehicle based on the degree of the traffic jam and a current speed (V_c) of the vehicle, the output indicating that the vehicle starts decelerating at a braking acceleration at a point that is a control distance (D_c) from a starting position where the traffic jam starts.

5

7. The driving assisting method according to claim 6, wherein the driving assisting method further comprises: when the vehicle is in Adaptive Cruise Control, in response to the traffic jam being recognized,

calculating a first acceleration based on the degree of the traffic jam and the current
10 speed of the vehicle according to the following formula: $A_1 = (V_j^2 - V_c^2) / (2 * D_c)$

where V_c is the current speed of the vehicle, V_j is an allowable travel speed in the case of the traffic jam that is determined based on the degree of the traffic jam, D_c is the control distance, and A_1 is the first acceleration;

in the case where there is no front vehicle within a preset distance ahead of the
15 vehicle, taking the first acceleration as the braking acceleration; and

in the case where there is a front vehicle within the preset distance ahead of the vehicle, obtaining an adaptive acceleration that is automatically determined by the Adaptive Cruise Control in response to presence of the front vehicle, and determining one with a greater absolute value of the first acceleration and the adaptive acceleration
20 as the braking acceleration.

8. The driving assisting method according to claim 6, wherein the driving assisting method further comprises:

determining the control distance as a first distance value (D_1) when the current
25 speed of the vehicle is greater than a first speed threshold (V_{TH1}) and not greater than a second speed threshold (V_{TH2}), wherein the second speed threshold is greater than the first speed threshold;

determining the control distance as a second distance value (D_2) when the current speed of the vehicle is greater than a third speed threshold (V_{TH3}), wherein the third
30 speed threshold is greater than the second speed threshold, and the second distance

value is greater than the first distance value; and

determining the control distance according to the following formula when the current speed of the vehicle is greater than the second speed threshold and not greater than the third speed threshold:

$$D_c = D_1 + (D_2 - D_1) * (V_c - V_{TH2}) / (V_{TH3} - V_{TH2})$$

where D_c is the control distance, D_1 is the first distance value, D_2 is the second distance value, V_c is the current speed of the vehicle, V_{TH2} is the second speed threshold, and V_{TH3} is the third speed threshold.

9. The driving assisting method according to claim 8, wherein the first speed threshold is 0 km/h, the second speed threshold is within a range of 20 km/h to 40 km/h, the third speed threshold is within a range of 70 km/h to 90 km/h, the first distance value is within a range of 16 meters to 30 meters, and the second distance value is within a range of 120 meters to 160 meters.

10. A computer device comprising a memory and a processor, the memory having stored thereon a computer program that, when executed by the processor, causes the driving assisting method of any one of claims 6 to 9 to be performed.

11. A non-transitory computer readable storage medium having stored thereon a computer program which, when executed by a processor, causes the driving assisting method of any one of claims 6 to 9 to be performed.

Drawings

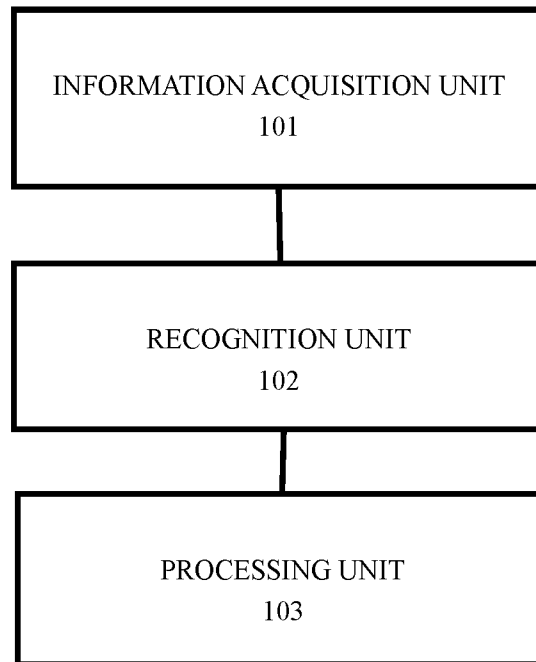
100

Fig. 1

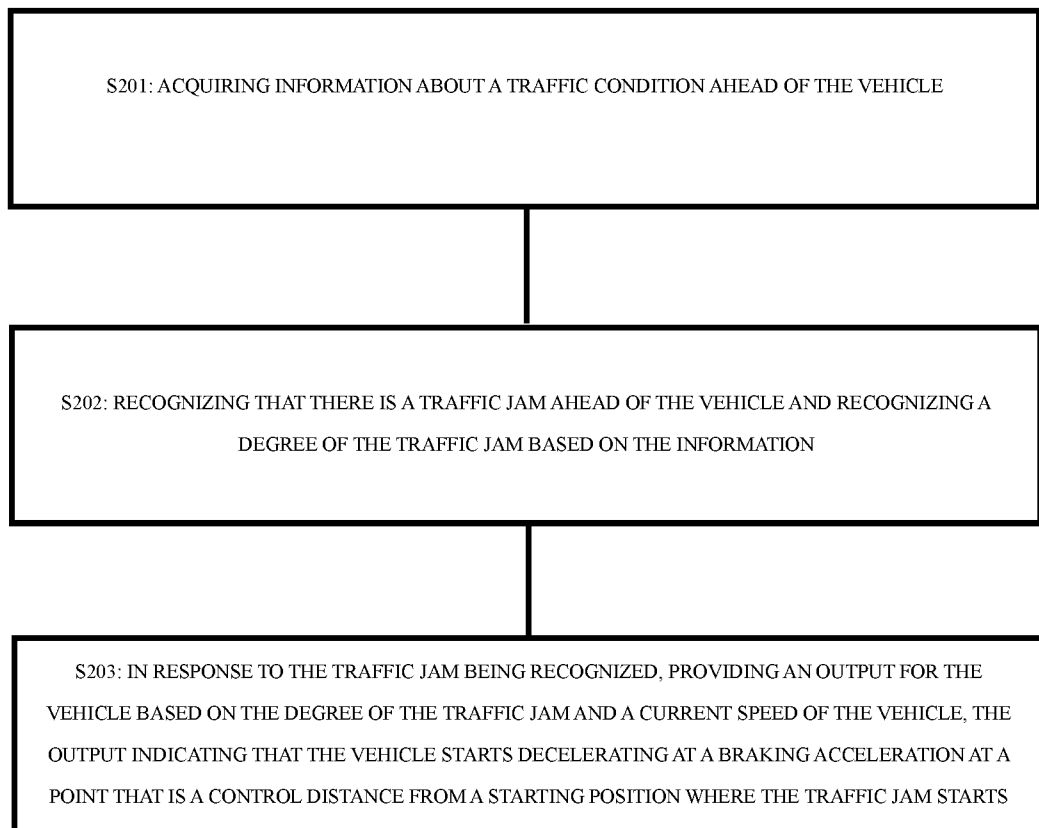
200

Fig. 2

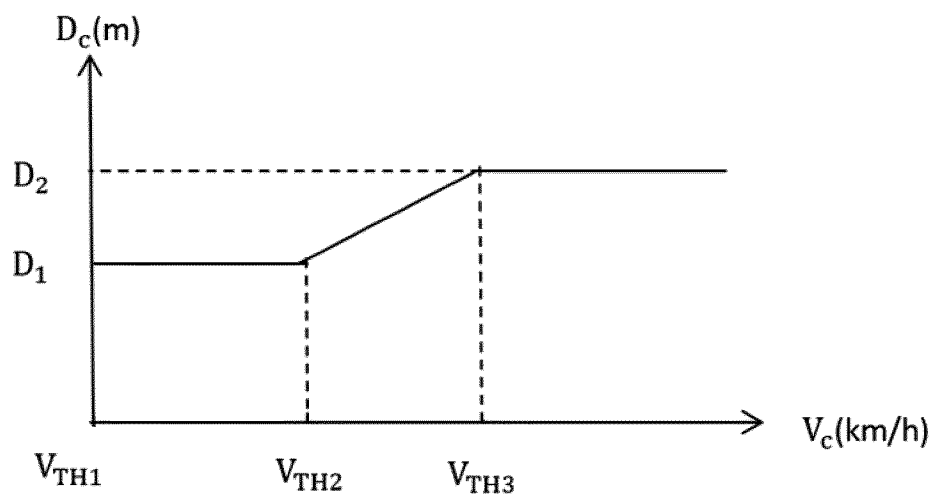


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/069756

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60W30/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2012/014042 A2 (TOYOTA MOTOR CO LTD [JP]; SHIDA MITSUHISA [JP]) 2 February 2012 (2012-02-02)	1,3-6, 8-11
A	paragraphs [0034], [0039], [0057] - [0062], [0069] figures 4,6	2,7
X	JP 2019 098914 A (SUBARU CORP) 24 June 2019 (2019-06-24)	1,3-6, 8-11
A	paragraph [0029] - paragraph [0040]	2,7
A	EP 2 154 043 A1 (BOSCH GMBH ROBERT [DE]) 17 February 2010 (2010-02-17) paragraph [0022] claim 6	1,5,10, 11



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

24 September 2021

Date of mailing of the international search report

05/10/2021

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2021/069756

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