United States Patent	12384375
Kind Code	B2
Date of Patent	August 12, 2025
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Vehicle system, control method, and storage medium

Abstract

A vehicle system executes a first operation of presenting lane change to an adjacent lane adjacent to a lane in which a host vehicle travels to a driver without considering of guiding the host vehicle to a set destination, and causing the host vehicle to perform the lane change on the basis of an instruction of the driver, a second operation for proposing a lane change required for guidance of the host vehicle to the destination to the driver and causing the host vehicle to perform a lane change on the basis of approval of the proposal by the driver, and a third operation for stopping presenting and proposing the lane change in a set period between the first operation and the second operation when a plan is to execute the second operation after the first operation.

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Appl. No.:	**18/119852**
Filed:	**March 10, 2023**

Prior Publication Data

Document Identifier	Publication Date
US 20230311887 A1	Oct. 05, 2023

Foreign Application Priority Data

JP	2022-060890	Mar. 31, 2022

Publication Classification

Int. Cl.: B60W30/18 (20120101); **B60W40/02** (20060101); **B60W50/10** (20120101); **B60W50/14** (20200101); **B60W60/00** (20200101)

U.S. Cl.:

CPC **B60W30/18163** (20130101); **B60W40/02** (20130101); **B60W50/10** (20130101); **B60W50/14** (20130101); **B60W60/001** (20200201);

Field of Classification Search

CPC: B60W (30/18163); B60W (50/14); B60W (60/001); B60W (30/12); B60K (2360/175)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
2020/0180639	12/2019	Mizoguchi	N/A	B60W 60/001
2021/0139044	12/2020	Ishioka	N/A	N/A
2022/0203992	12/2021	Taniguchi	N/A	N/A

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
2020-138578	12/2019	JP	N/A
2018/131290	12/2017	WO	N/A
2020/230303	12/2019	WO	N/A

OTHER PUBLICATIONS

JP 2016071513 (Maruyama, filed Sep. 24, 2014) (Year: 2016). cited by examiner
CN 117396384 (Taniguchi, filed May 28, 2021) (Year: 2024). cited by examiner
Japanese Office Action for Japanese Patent Application No. 2022-060890 mailed Oct. 3, 2023. cited by applicant

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION
(1) Priority is claimed on Japanese Patent Application No. 2022-060890, filed Mar. 31, 2022, the content of which is incorporated herein by reference.
BACKGROUND
Field
(2) The present invention relates to a vehicle system, a control method, and a storage medium.
Description of Related Art
(3) In recent years, efforts to provide a sustainable transportation system that takes various

situations into account have become active. In order to realize this, research and development are focused on further improving the safety or convenience of traffic through research and development regarding driving assistance technology. For example, a vehicle control device that executes automatic lane change control has been disclosed (Japanese Unexamined Patent Application, First Publication No. 2020-138578).

SUMMARY

(4) In vehicle control systems of the related art, proposals to a driver regarding a lane change have not been considered in detail. Therefore, convenience for a user is not sufficiently high.

(5) The present invention has been made in consideration of such circumstances, and one object thereof is to provide a vehicle system, a control method, and a storage medium capable of further improving convenience for a user. Further, the present invention contributes to the development of sustainable transportation systems.

(6) A vehicle system, a control method, and a storage medium according to the present invention adopt the following configurations. (1): A vehicle system according to an aspect of the present invention includes a storage medium configured to store computer-readable instructions; and one or more processors connected to the storage medium, wherein the one or more processors execute the computer-readable instructions to: recognize a situation of surroundings of a host vehicle, automatically control at least steering of the host vehicle to cause the host vehicle to perform a lane change on the basis of the recognized situation of the surroundings, a first operation of presenting, to a driver, a lane change to an adjacent lane adjacent to a lane in which the host vehicle travels without considering of guiding the host vehicle to a set destination, and causing the host vehicle to perform the lane change on the basis of an instruction of the driver, a second operation of proposing a lane change required for guidance of the host vehicle to the destination to the driver and causing the host vehicle to perform a lane change on the basis of approval of the proposal by the driver, and a third operation of stopping presenting and proposing the lane change in a set period between the first operation and the second operation when a plan is to execute the second operation after the first operation. (2): In the aspect (1), the one or more processors execute the computer-readable instructions to cause the host vehicle to perform a lane change a plurality of times to guide the host vehicle to the destination according to one approval when the driver performs one approval of the proposal in a case in which a plurality of lane changes are required to guide the host vehicle to the destination in the second operation. (3): In the aspect (1) or (2), the instruction or approval is one or both of the driver operating a predetermined button and the driver gripping a steering wheel. (4): In any one of the aspect (1) to (3), the second operation is an operation of proposing a lane change to a branch lane to the driver when the host vehicle is traveling in a lane different from a branch lane in which the host vehicle is scheduled to travel toward the destination, and causing the host vehicle to perform the lane change to the branch lane without relying on driving of the driver on the basis of the approval of the proposal by the driver. (5): In any one of the aspects (1) to (4), in the first operation, presenting the lane change from the lane in which the host vehicle travels to an adjacent lane in which lane change is possible is repeated, and the host vehicle is caused to perform the lane change to the adjacent lane on the basis of an instruction of the driver. (6): In any one of the aspects (1) to (5), the one or more processors execute the computer-readable instructions to cause a first image recommending a lane change to be displayed on the display in the first operation, cause a second image recommending a lane change to be displayed on the display after third operation ends and the second operation is started, and cause a third image different from the first image and the second image to be displayed on the display in the third operation. (7): In the aspect (6), the third image is not an image showing presenting or proposing the lane change, but is an image showing that causing the host vehicle to perform the lane change is possible without relying on driving of the driver on the basis of an operation according to an intention of the driver. (8): In the aspect (7), the third image is an image showing that causing the host vehicle to perform the lane change by the driver operating an

operator for operating the direction indicator is possible. (9): In any one of the aspects (6) to (8), the second operation is an operation of proposing a lane change to a branch lane to the driver when the host vehicle is traveling in a lane different from a branch lane in which the host vehicle is scheduled to travel toward the destination, and causing the host vehicle to perform the lane change to the branch lane without relying on driving of the driver on the basis of the approval of the proposal by the driver, and the one or more processors execute the computer-readable instructions to cause an image, the image being not an image showing presenting or proposing the lane change but being an image showing that causing the host vehicle to automatically perform the lane change is possible without relying on driving of the driver on the basis of an operation according to an intention of the driver, to be displayed on a display, when the host vehicle has performed lane change to the branch lane. (10): In any one of the aspects (1) to (9), the one or more processors execute the computer-readable instructions to cause the host vehicle to perform the lane change in response to a predetermined operation when the driver performs the predetermined operation with respect to an operator for operating a direction indicator in a case in which the third operation is being performed. (11): In any one of the aspects (1) to (10), when the host vehicle is traveling in a first lane on a road having the first lane, a second lane serving as an overtaking lane adjacent to the first lane, and a third lane adjacent to the first lane connecting to a branch lane, the one or more processors execute the computer-readable instructions to perform presenting causing the host vehicle to perform a lane change to the second lane serving as an overtaking lane in the first operation, and make a proposal to cause the host vehicle to perform a lane change to the third lane in the second operation after the third operation. (12): A control method according to another aspect of the present invention including: processing for recognizing, by a control device, a situation of surroundings of a host vehicle; processing for automatically controlling, by the control device, at least steering of the host vehicle to cause the host vehicle to perform the lane change on the basis of the recognized situation of the surroundings; first processing for presenting, by the control device, a lane change to an adjacent lane adjacent to a lane in which the host vehicle travels to a driver without considering of guiding the host vehicle to a set destination, and causing the host vehicle to perform the lane change on the basis of an instruction of the driver; second processing for proposing, by the control device, lane change required for guidance of the host vehicle to the destination to the driver and causing the host vehicle to perform a lane change on the basis of approval of the proposal by the driver; and third processing for stopping, by the control device, presenting and proposing the lane change in a set period between the first processing and the second processing when a plan is to execute the second processing after the first processing. (13): A non-transitory computer storage medium having a program stored therein, the program causing a control device to execute: processing for recognizing a situation of surroundings of a host vehicle; processing for automatically controlling at least steering of the host vehicle to cause the host vehicle to perform the lane change on the basis of the recognized situation of the surroundings; first processing for presenting lane change to an adjacent lane adjacent to a lane in which the host vehicle travels to a driver without considering of guiding the host vehicle to a set destination, and causing the host vehicle to perform the lane change on the basis of an instruction of the driver; second processing for proposing a lane change required for guidance of the host vehicle to the destination to the driver and causing the host vehicle to perform a lane change on the basis of approval of the proposal by the driver; and third processing for stopping presenting and proposing the lane change in a set period between the first processing and the second processing when a plan is to execute the second processing after the first processing.
(7) According to aspects (1) to (13), the vehicle system stops presenting and proposing a lane change during the set period between the first operation and the second operation, thereby improving convenience for a user.
(8) According to the aspect (2), since the vehicle system causes the host vehicle to perform the lane change a plurality of times with one approval, the user can direct the host vehicle to the destination

without performing a plurality of approvals.

(9) According to the aspect (6), the vehicle system causes a third image different from the first image and the second image to be displayed on the display in the third operation, making it possible for the user to easily recognize that the third operation is performed and lane change is not recommended.

(10) According to the aspect (7) or (8), since the vehicle system causes an image showing that the driver causing the host vehicle to perform a lane change by performing a predetermined operation is not restricted to be displayed on a display, convenience for the driver is improved.

(11) According to the aspect (9), since the vehicle system causes an image showing that the lane change is not recommended but is possible according to an operation of the driver when the host vehicle has performed the lane change to the branch lane to be displayed on a display, convenience for the driver is improved.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a configuration diagram of a vehicle system using a vehicle control system according to an embodiment.

(2) FIG. **2** is a diagram showing an example of a scene in which a recommender recommends a lane change.

(3) FIG. **3** is a diagram showing an example of a scene in which a host vehicle M travels in a branch lane.

(4) FIG. **4** is a flowchart showing an example of a flow of processing that is executed by a driving assistance device.

(5) FIG. **5** is a diagram for describing comparative example 1.

(6) FIG. **6** is a diagram for describing comparative example 2.

DETAILED DESCRIPTION

(7) [Overall Configuration]

(8) FIG. **1** is a configuration diagram of a vehicle system **1** using a vehicle control system according to an embodiment. The vehicle system **1** is mounted on a vehicle such as a two-wheeled vehicle, a three-wheeled vehicle, or a four-wheeled vehicle, and a driving source thereof includes an internal combustion engine such as a diesel engine or a gasoline engine, an electric motor, or a combination thereof. The electric motor operates using power generated by a power generator connected to the internal combustion engine or discharge power of a secondary battery or a fuel cell.

(9) The vehicle system **1** includes, for example, a camera **10**, a radar device **12**, a light detection and ranging (LIDAR) **14**, an object recognition device **16**, a communication device **20**, a human machine interface (HMI) **30**, a vehicle sensor **40**, a navigation device **50**, an MPU **60**, a driver monitor camera **70**, a driving operator **80**, a driving assistance device **100**, a travel driving force output device **200**, a brake device **210**, and a steering device **220**. These devices or equipment are connected to each other by a multiplex communication line such as a controller area network (CAN) communication line, a serial communication line, a wireless communication network, or the like. The configuration shown in FIG. **1** is merely an example, and part of the configuration may be omitted or other configurations may be added thereto. The driving assistance device **100** is an example of a "control device".

(10) The camera **10** is, for example, a digital camera using a solid-state imaging device such as a charge coupled device (CCD) or a complementary metal oxide semiconductor (CMOS). The camera **10** is attached to any location on a vehicle on which the vehicle system **1** is mounted (hereinafter referred to as a host vehicle M). When a forward side is imaged, the camera **10** is

attached to, for example, an upper portion of a front windshield, a rear surface of a rearview mirror, or the like. The camera **10**, for example, periodically and repeatedly images surroundings of the host vehicle M. The camera **10** may be a stereo camera.

(11) The radar device **12** radiates radio waves such as millimeter waves to the surroundings of the host vehicle M and detects radio waves (reflected waves) reflected by an object to detect at least a position (a distance and orientation) thereof. The radar device **12** is attached to any location on the host vehicle M. The radar device **12** may detect a position and a speed of the object using a frequency modulated continuous wave (FM-CW) scheme.

(12) The LIDAR **14** irradiates the surroundings of the host vehicle M with light (or an electromagnetic wave having a wavelength close to that of light) and measures scattered light. The LIDAR **14** detects the distance to a target on the basis of the amount of time from light emission to light reception. The light to be radiated is, for example, pulsed laser light. The LIDAR **14** is attached to any location on the host vehicle M.

(13) The object recognition device **16** performs sensor fusion processing on detection results of some or all of the camera **10**, the radar device **12**, and the LIDAR **14** to recognize a position, type, speed, and the like of the object. The object recognition device **16** outputs recognition results to the driving assistance device **100**. The object recognition device **16** may output detection results of the camera **10**, the radar device **12**, and the LIDAR **14** as they are to the driving assistance device **100**. The object recognition device **16** may be omitted from the vehicle system **1**.

(14) The communication device **20**, for example, communicates with another vehicle present around the host vehicle M using a cellular network, a Wi-Fi network, Bluetooth (registered trademark), dedicated short range communication (DSRC), or the like or communicates with various server devices via a wireless base station.

(15) The HMI **30** presents various types of information to an occupant of the host vehicle M and receives an input operation from the occupant. The HMI **30** includes various display devices, speakers, buzzers, touch panels, switches, keys, and the like. The HMI **30** has a display device. The display device is a so-called multi-information display, which is a display device that is provided, for example, in a central part of an instrument panel of the host vehicle M and displays various types of information in the host vehicle M, of a speedometer that indicates a traveling speed of the host vehicle M or a tachometer that indicates the number of rotations (a rotational speed) of an internal combustion engine included in the host vehicle M.

(16) The vehicle sensor **40** includes, for example, a vehicle speed sensor that detects a speed of the host vehicle M, an acceleration sensor that detects an acceleration, a yaw rate sensor that detects an angular speed around a vertical axis, and an orientation sensor that detects a direction of the host vehicle M.

(17) The navigation device **50** includes, for example, a global navigation satellite system (GNSS) receiver **51**, a navigation HMI **52**, and a route determiner **53**. The navigation device **50** holds first map information **54** in a storage device such as a hard disk drive (HDD) or a flash memory. The GNSS receiver **51** specifies the position of the host vehicle M on the basis of a signal received from a GNSS satellite. The position of the host vehicle M may be specified or complemented by an inertial navigation system (INS) using an output of the vehicle sensor **40**. The navigation HMI **52** includes a display device, a speaker, a touch panel, keys, and the like. The navigation HMI **52** may be partly or wholly shared with the HMI **30** described above. The route determiner **53**, for example, determines a route (hereinafter, an on-map route) from the position of the host vehicle M specified by the GNSS receiver **51** (or any input position) to a destination input by the occupant using the navigation HMI **52** by referring to the first map information **54**. The first map information **54** is, for example, information in which a road shape is represented by links indicating roads and nodes connected by the links. The first map information **54** may include a curvature of the road, point of interest (POI) information, and the like. The on-map route is output to the MPU **60**. The navigation device **50** may perform route guidance using the navigation HMI **52** on the basis of the on-map

route. The navigation device **50** may be realized, for example, by a function of a terminal device such as a smartphone or a tablet terminal possessed by the occupant. The navigation device **50** may transmit a current position and a destination to a navigation server via the communication device **20** and acquire the same route as the on-map route from the navigation server.

(18) The MPU **60** includes, for example, a recommended lane determiner **61**, and holds second map information **62** in a storage device such as an HDD or a flash memory. The recommended lane determiner **61** divides the on-map route provided from the navigation device **50** into a plurality of blocks (for example, divides the route every 100 [m] in a traveling direction of the vehicle), and determines a recommended lane for each block by referring to the second map information **62**. The recommended lane determiner **61** determines in which lane from the left the host vehicle M travels. The recommended lane determiner **61** determines the recommended lane so that the host vehicle M can travel on a reasonable route to a branch destination when there is a branch location in the on-map route.

(19) The second map information **62** is map information with higher accuracy than the first map information **54**. The second map information **62** includes, for example, information on the center of the lane or information on a boundary of the lane. The second map information **62** may include road information, traffic regulation information, address information (an address and postal code), facility information, telephone number information, information on a prohibited section in which a mode A or mode B is prohibited, which will be described later, and the like. The second map information **62** may be updated at any time by the communication device **20** communicating with another device.

(20) The driver monitor camera **70** is, for example, a digital camera using a solid-state imaging device such as a CCD or CMOS. The driver monitor camera **70** is attached to any location on the host vehicle M at a position and orientation at which a head of an occupant (hereinafter referred to as a driver) seated in a seat of the driver of the host vehicle M can be imaged from the front (in an orientation in which a face is imaged). For example, the driver monitor camera **70** is attached to an upper part of the display device provided in the central part of the instrument panel of the host vehicle M. The driver monitor camera **70** outputs to the driving assistance device **100** an image obtained by imaging the vehicle cabin including the driver of the host vehicle M from a position at which the driver monitor camera **70** is disposed.

(21) The driving operator **80** includes, for example, an operation switch of a direction indicator, an accelerator pedal, a brake pedal, a shift lever, and other operators, in addition a steering wheel **82**. A sensor that detects an amount of operation or the presence or absence of an operation is attached to the driving operator **80**, and a detection result thereof is output to the driving assistance device **100**, or some or all of the travel driving force output device **200**, the brake device **210**, and the steering device **220**. The steering wheel **82** does not necessarily have to be annular but may be in the form of a modified steering wheel, joystick, buttons, or the like. A steering grip sensor **86** is attached to the steering wheel **82**.

(22) The steering grip sensor **86** is realized by, for example, a capacitance sensor or a piezoelectric element. The steering grip sensor **86** detects whether or not the driver is gripping the steering wheel **82**. The gripping is a state in which the driver grips the steering wheel, a state in which a hand comes into contact with the steering wheel and a predetermined degree or more of force is applied to the steering wheel, or the like.

(23) The steering grip sensor **86** may detect grip based on an image captured by a camera or detect the grip using an optical scheme such as a radar device (a scheme that does not require contact with a sensor).

(24) The driving assistance device **100** includes, for example, a recognizer **110**, a driver recognizer **120**, a speed controller **130**, a lane keeping controller **140**, a lane change controller **150**, a recommender **160**, a specifier **170**, a control manager **180**. Some or all of these functional units are realized, for example, by a hardware processor such as a central processing unit (CPU) executing a

program (software). Some or all of these components may be realized by hardware (circuit; including circuitry) such as a large-scale integration (LSI), an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or a graphics processing unit (GPU), or may be realized by software and hardware in cooperation. The program may be stored in a storage device (a storage device including a non-transitory storage medium) such as an HDD or a flash memory of the driving assistance device **100** in advance or may be stored in a detachable storage medium such as a DVD or a CD-ROM and installed in the HDD or flash memory of the driving assistance device **100** by the storage medium (a non-transitory storage medium) being mounted in a drive device. A functional configuration including the lane change controller **150**, the recommender **160**, and the control manager **180** is an example of a "controller".

(25) The recognizer **110** recognizes a status such as a position, speed, and acceleration of an object present around the host vehicle M on the basis of information input from the camera **10**, the radar device **12**, and the LIDAR **14** via the object recognition device **16**. The position of the object, for example, is recognized as a position at absolute coordinates with a representative point (a centroid, a drive shaft center, or the like) of the host vehicle M as an origin and is used for control. The position of the object may be represented by a representative point such as a centroid or a corner of the object or may be represented by an area. The "status" of the object may include an acceleration or jerk of the object, or an "action status" (for example, whether or not the object is changing lanes or is about to perform a lane change).

(26) The recognizer **110**, for example, recognizes a lane (a traveling lane) in which the host vehicle M is traveling. For example, the recognizer **110** compares a pattern of road demarcation lines (for example, an arrangement of solid lines and broken lines) obtained from the second map information **62** with a pattern of road demarcation lines around the host vehicle M recognized from an image captured by the camera **10** to recognize the traveling lane. The recognizer **110** may recognize not only the road demarcation lines but also a traveling road boundary (a road boundary) including road demarcation lines, a road shoulder, a curb, a median strip, a guard rail, or the like to recognize the traveling lane. In this recognition, the position of the host vehicle M acquired from the navigation device **50** or a processing result of the INS may be additionally considered. The recognizer **110** recognizes a temporary stop line, an obstacle, a red signal, a toll gate, and other road events.

(27) The recognizer **110** recognizes the position or orientation of the host vehicle M with respect to the traveling lane when recognizing the traveling lane. The recognizer **110** may recognize, for example, a deviation of a reference point of the host vehicle M from a center of the lane and an angle formed between a traveling direction of the host vehicle M and a line connecting the center of the lane as a relative position and orientation of the host vehicle M with respect to the traveling lane. Instead, the recognizer **110** may recognize, for example, a position of the reference point of the host vehicle M with respect to any one of side edge portions (the road demarcation line or the road boundary) of the traveling lane as the relative position of the host vehicle M with respect to the traveling lane.

(28) The driver recognizer **120** detects whether the driver is in a predetermined state on the basis of the image captured by the driver monitor camera **70**. The predetermined state is a state in which hands-off lane keeping control, which will be described later, is executable. Hands-off is a state in which the driver does not grip the steering wheel, and hands-on is a state in which the driver grips the steering wheel. The state in which the hands-off lane keeping control is executable is a state in which the driver monitors the forward side. Monitoring the forward side means, for example, that the driver monitors the forward side so that the driver can rapidly perform takeover from control of the vehicle by the system to an operation with respect to the vehicle by the driver. Monitoring the forward side means, for example, that a line of sight of the driver is directed to the forward side.

(29) The speed controller **130** automatically controls the travel driving force output device **200** and the brake device **210** without relying on an operation of the driver to automatically control the

speed of the host vehicle M. The speed controller **130** executes so-called adaptive cruise control (ACC).

(30) For example, when another vehicle is not present in front of the host vehicle M and within a predetermined distance from the host vehicle M, the speed controller **130** automatically controls the travel driving force output device **200** and the brake device **210** without relying on an operation of the driver so that the host vehicle M moves at a speed set by the driver or a legal speed.

(31) For example, when another vehicle is present in front of the host vehicle M and within the predetermined distance from the host vehicle M, the speed controller **130** automatically controls the travel driving force output device **200** and the brake device **210** without relying on an operation of the driver so that the host vehicle M follows the other vehicle. Following means that the host vehicle M travels while maintaining a position behind the other vehicle and at a predetermined distance from the other vehicle.

(32) The lane keeping controller **140** controls the steering device **220** so that the host vehicle M does not deviate from the traveling lane. For example, the lane keeping controller **140** controls the steering device **220** so that the host vehicle M travels at a center or near the center of the traveling lane recognized by the recognizer **110**. Hereinafter, this control may be referred to as "lane keeping control". The Lane keeping controller **140** performs hands-on lane keeping control and hands-off lane keeping control.

(33) The hands-on lane keeping control is control that is executed in the state in which the driver is gripping the steering wheel (a state in which the steering grip sensor **86** is detecting gripping of the steering wheel). The conditions under which the hands-on lane keeping control is executable are looser than the conditions under which the hands-off lane keeping control is executable. For example, the hands-on lane keeping control is executed on the condition that the speed of the host vehicle M is equal to or higher than a predetermined speed and the driver is monitoring the forward side.

(34) The hands-off lane keeping control is control that is executed in a state in which the driver does not grip the steering wheel (a state in which the steering grip sensor **86** does not detect gripping of the steering wheel). The hands-off lane keeping control is executable, for example, when the following conditions are satisfied. The conditions are that the speed of the host vehicle M is equal to or higher than the predetermined speed, that the host vehicle M travels on a predetermined road (for example, a road or a type of road set in advance as the hands-off lane keeping control being executable), and that the driver monitors the forward side. The hands-off lane keeping control is executed when the driver monitors the forward side, and the hands-off lane keeping control is not executed or stopped when the driver does not monitor the forward side.

(35) The conditions under which the hands-on lane keeping control and the hands-off lane keeping control described above are executable are examples, and other conditions (for example, the host vehicle M follows a preceding vehicle) may be included, or some of the conditions may be omitted. The conditions under which the hands-on lane keeping control is executable may be looser than the conditions under which the hands-off lane keeping control is executable (the conditions under which the hands-off lane keeping control is executable may be stricter than the conditions under which the hands-on lane keeping control is executable).

(36) The lane change controller **150** causes the host vehicle M to automatically change lanes. The lane change controller **150** causes the host vehicle M to automatically change lanes (ALC: auto lane change) when a lane change instruction is issued by the driver in a state in which the hands-off lane keeping control is being executed. The lane change instruction is, for example, an operation with respect to a lever of the operation switch of the direction indicator. For example, when the driver operates the lever in a direction in which the host vehicle M is desired to perform lane change, the host vehicle M performs a lane change in a direction corresponding to the operation. The lane change instruction may be an operation different from the operation with respect to the lever of the operation switch of the direction indicator. For example, the lane change may be

performed when a set operation button is pressed. When the driver instructs or approves the recommendation (presentation or proposal) of the recommender **160**, which will be described later, the lane change controller **150** causes the host vehicle M to perform a lane change on the basis of the instruction or approval.

(37) The lane change controller **150**, for example, may execute lane change on the condition that the driver is gripping the steering wheel (the steering grip sensor **86** detects gripping of the steering wheel). The lane change controller **150** executes the lane change when the driver grips the steering wheel and further when the following conditions are satisfied, for example.

(38) The conditions are, for example, that there are no obstacles in a lane that is a lane change destination, that the host vehicle M does not interfere with other vehicles around the host vehicle M when the host vehicle M performs the lane change, that a section is not a section in which a lane change is prohibited (there are no road marking or sign indicating prohibition of a lane change), that the lane that is a lane change destination is recognized (actually present), that a yaw rate detected by the vehicle sensor is smaller than a threshold, and that a radius of a curvature of a road on which the host vehicle M is traveling is equal to or larger than a predetermined value. The conditions for executing the lane change may include other conditions, or some of the conditions may be omitted.

(39) The recommender **160** presents or proposes the lane change of the host vehicle M to the driver. This processing will be described in detail later.

(40) The specifier **170** specifies the position of the host vehicle M in the map information on the basis of map information (the first map information **54** or the second map information **62**) including information on lanes, and the position of the host vehicle M. The map information includes information on lanes. The information on the lane is, for example, information such as a position at which a lane disappears or the number of lanes decreases, or a position at which the lane connects to the branch lane. The specifier **170** specifies the position of the host vehicle in the map information on the basis of the map information and the position of the host vehicle M. The specifier **170** specifies, for example, a position at which the lane corresponding to the position of the host vehicle M connects to the branch lane. For example, the specifier **170** specifies that the branch lane connects to the traveling lane 5 km ahead.

(41) The control manager **180** causes the recommender **160** to recommend a lane change on the basis of the position of the host vehicle M. The control manager **180** causes the lane change controller **150** to change the lane of the host vehicle M when the driver performs an instruction for or approval of the recommendation. The control manager **180** instructs the lane change controller **150** to perform the lane change and causes the lane change controller **150** to execute the lane change of the host vehicle M. Details of processing of the control manager **180** will be described below.

(42) The travel driving force output device **200** outputs a travel driving force (torque) for traveling of the vehicle to driving wheels. The travel driving force output device **200** includes, for example, a combination of an internal combustion engine, an electric motor, a transmission, and the like, and an ECU that controls these. The ECU controls the above configuration according to information input from the driving assistance device **100** or information input from the driving operator **80**.

(43) The brake device **210** includes, for example, a brake caliper, a cylinder that transfers hydraulic pressure to the brake caliper, an electric motor that generates hydraulic pressure in the cylinder, and a brake ECU. The brake ECU controls the electric motor according to the information input from the driving assistance device **100** or the information input from the driving operator **80** so that a brake torque according to a braking operation is output to each wheel.

(44) The steering device **220** includes, for example, a steering ECU and an electric motor. The electric motor, for example, changes orientations of steerable wheels by causing a force to act on a rack and pinion mechanism. The steering ECU drives the electric motor according to the information input from the driving assistance device **100** or the information input from the driving

operator **80** to change the orientations of the steerable wheels.

(45) [Recommendation for Lane Change (Road Recommendation)]

(46) The recommender **160** recommends (presents) a lane change to the driver. FIG. **2** is a diagram showing an example of a scene in which the recommender **160** recommends a lane change. In FIG. **2**, a first lane L**1** and a third lane L**3** are traveling lanes, and a second lane L**2** is an overtaking lane. The first lane L**1** is a lane provided between the second lane L**2** and the third lane L**3**.

(47) When the host vehicle M is traveling in the third lane L**3** on the basis of the ACC and the hands-off lane keeping control (at time T), the recommender **160** recommends the host vehicle M perform a lane change to the first lane L**1**, for example. The recommendation is made by a vocal sound, an image, or the like via the HMI **40**, for example. When the driver operates a predetermined button (not shown) and grips the steering wheel in response to the recommendation, the lane change controller **150** causes the host vehicle M to perform the lane change. An instruction for the recommendation may be one or both of the operation with respect to a predetermined button (an operation with respect to an instruction button) and the gripping of the steering wheel.

(48) When the host vehicle M is traveling in the first lane L**1** (at time T+1), the recommender **160**, for example, recommends the host vehicle M to perform a lane change to the third lane L**3**, which is the overtaking lane. When the host vehicle M performs the lane change and travels in the second lane L**2** (at time T+2), the recommender **160**, for example, recommends the host vehicle M to perform a lane change to the first lane L**1**, which is the traveling lane, and when the host vehicle M performs the lane change to the first lane L**1** (at time T+3), the recommender **160** recommends the host vehicle M to perform a lane change to the third lane L**3**, which is the overtaking lane.

(49) Thus, the recommender **160** recommends the host vehicle M to perform the lane change to the overtaking lane when the host vehicle M is located in the traveling lane, and the host vehicle M to perform the lane change to the adjacent traveling lane when the host vehicle M is located in the overtaking lane. Hereinafter, this processing may be referred to as "road recommendation". The lane change according to the road recommendation is an example of "a first operation of presenting, to the driver, a lane change to an adjacent lane adjacent to the lane in which the host vehicle is traveling without considering guiding the host vehicle to a set destination and causing the host vehicle to perform the lane change on the basis of an instruction of the driver."

(50) When the host vehicle M is scheduled to travel on a branch road connecting to the third lane L**3**, the recommender **160** stops the road recommendation and recommends the host vehicle M to perform a lane change to the third lane L**3**. The recommender **160** stops the road recommendation when the position of the host vehicle M satisfies a condition as will be described below.

(51) The road recommendation may be made in the following manner. The recommender **160** may recommend a lane change for overtaking a preceding vehicle when there is the preceding vehicle in front of the host vehicle M and the host vehicle M is likely to catch up with the preceding vehicle after a predetermined time. The recommender **160** may recommend a lane change for giving way to a vehicle behind the host vehicle M when there is a vehicle behind the host vehicle M and the vehicle behind the host vehicle M is likely to catch up with the host vehicle M after a predetermined time. In a case in which it is assumed that the host vehicle M travels in the first traveling lane L**1** and the host vehicle M will interfere with traveling of another vehicle traveling in the second lane L**2** when the host vehicle M performs the lane change to the second lane L**2**, the recommender **160** may recommend causing the host vehicle M to perform a lane change to the third lane L**3**. That is, the recommender **160** may present lane change to a lane in which the lane change is possible.

(52) [Control when Host Vehicle is Scheduled to Travel in Branch Lane]

(53) When the destination of the host vehicle M is set and the host vehicle M travels in the branch lane toward the destination, the following control is executed. FIG. **3** is a diagram showing an example of a scene in which the host vehicle M travels in the branch lane. In the example of FIG. **3**, a third lane L**3** connects to the branch lane. The host vehicle M is present at a predetermined

distance in the traveling direction from a connection position P in which the third lane L3 connects to the branch lane. The host vehicle M passes through a position (1), a position (2), a position (3), a position (4), and a position (5), reaches the connection position P, passes through a position (6), enters the branch lane, and passes through a position (7) and a position (8). Description of speed control of the host vehicle M will be omitted hereinafter, but the speed is appropriately adjusted (ACC is executed) in consideration of the surroundings situation and is controlled so that the lane changes can be performed smoothly when the host vehicle M performs the lane change.

(54) The hands-off lane keeping control is executed and the road recommendation is made until the host vehicle M reaches the position (1). In this case, the control manager **180** causes an image A**1** to be displayed in a first area of the display, causes an image not to be displayed in a second area, and causes an image A**3** to be displayed in a third area. The image A**1** is an example of a "first image".

(55) The first area, the second area, and the third area may be different displays (display devices) or may be different areas in one display. For example, the first area, the second area, and the third area may be different areas in a multi-information display provided in front of a seat of the driver. The image displayed in the first area is, for example, an image corresponding to an indicator that notifies the driver of a state of the host vehicle M.

(56) The image A**1** is, for example, an image that recommends a lane change to the second lane L**2**, which is an overtaking lane. The image A**3** is, for example, an image including a situation around the host vehicle M. The situation around the host vehicle M is, for example, an image showing information on other vehicles, road demarcation lines, or the like detected by the vehicle system **1**. When the host vehicle M reaches the position (1), the road recommendation stops. An operation in this case is an example of "a third operation of stopping presenting or proposing the lane change in a set period between the first operation and the second operation when a plan is to perform the second operation after the first operation is performed."

(57) The control manager **180** stops the road recommendation in a section from when the host vehicle M reaches the position (1) to when the host vehicle M reaches the position (2). When the road recommendation is stopped, the recommendation of the lane change in the recommender **160** is not made. Lane change based on an operation according to an intention of the user can be executed. For example, a lane change that is performed by the driver operating a lever of an operator of the direction indicator, or a lane change that is performed by the driver driving is executed.

(58) The control manager **180** causes an image X**1** to be displayed in the first area of the display, causes an image not to be displayed in the second area, and causes an image X**3** to be displayed in the third area. The image X**1** is an image showing that the road recommendation (lane change recommendation by the vehicle system **1**) has not been made and the lane change according to the operation of the driver is possible. When the image X**1** is displayed, a lane change by the lane change controller **150** is possible when the driver operates the direction indicator as described above. The image X**3** is, for example, an image showing the situation around the host vehicle M.

(59) The image X**1** is an example of the "third image", "an image showing that the controller can causes the host vehicle to perform a lane change without relying on driving of the driver on the basis of an operation according to an intention of the driver, which is not an image showing that the controller presents or proposes the lane change", or "an image showing that causing the host vehicle to perform the lane change by the driver operating an operator for operating the direction indicator is possible".

(60) When the host vehicle M reaches the position (2), route guidance recommendation is made. The route guidance recommendation is a recommendation (proposal) for causing the host vehicle M to perform the lane change when the lane change is necessary. The lane change according to the route guidance recommendation is an example of "a second operation of proposing a lane change required for guidance of the host vehicle to the destination to the driver and causing the host

(61) The control manager **180** causes an image B**1** to be displayed in the first area of the display, causes an image B**2** to be displayed in the second area of the display, and causes an image B**3** to be displayed in the third area of the display. The route guidance recommendation is made for a first time (for example, a maximum of 10 seconds). The image B**1** is an image in which an arrow for recommending a lane change to the right in the image A**1** is replaced with an arrow for recommending a lane change to the left. The image B**2** includes information indicating that there is a branch at a predetermined distance ahead, information indicating that the lane change can be performed by operating an approval button (which may be the same as the predetermined button described above), and the image B**1**. The image B**3** includes an image showing a future trajectory of the host vehicle M when the lane change is performed, in addition to the information of the image A**3**. The image B**1** is an example of a "second image".

(62) It is assumed that the driver has approved the lane change in a section from when the host vehicle M reaches the position (2) to when the host vehicle M reaches the position (3). In this case, the control manager **180** causes an image C**1** to be displayed in the first area of the display, an image C**2** to be displayed in the second area, and an image C**3** to be displayed in the third area. The images C**1**, C**2**, and C**3** are displayed for a second time (for example, a maximum of 30 seconds). The second time is longer than the first time.

(63) The image C**1** is an image in which an arrow indicating a direction of the lane change of the host vehicle M included in the image B**1** is emphasized as compared to than the arrow of the image B**1**. The image C**2** includes information indicating that the lane change has been received, information indicating that the lane change can be suspended when the approval button is operated, and the image C**1**. The image C**3** is the same information as the image B**3**, but colors of arrows, road demarcation lines, and the like of the image B**3** are different. In the image C**3**, acceptance of the lane change is represented by colors different from colors used in the image B**3**.

(64) When the recommendation is not approved at the position (3) or at a predetermined distance before the position (3), the following steering assistance is not started, and the driver needs to perform a lane change of the host vehicle M. For example, the driver drives the host vehicle M to perform lane change, or operates the direction indicator to cause the lane change controller **150** to perform a lane change of the host vehicle M.

(65) When the host vehicle M reaches the position (4), the steering assistance is started. The start of the steering assistance means starting an operation in which the host vehicle M performs the lane change. The start of the operation may be that the control manager **180** turns on the direction indicator or may be that the host vehicle M has started a lateral movement. The start of the operation may be another preset operation. A condition of the steering assistance is hands-on.

(66) During the steering assistance, an image showing that operation assistance is in progress is displayed. The control manager **180** causes an image D**1** to be displayed in the first area of the display, an image D**2** to be displayed in the second area, and an image D**3** to be displayed in the third area.

(67) The image D**1** is an image in which the image C**1** is included and road demarcation lines included in the image C**1** are emphasized as compared to the road demarcation lines in the image C**1**. The image D**2** includes information for requesting the driver to confirm a movement destination, information indicating that lane change is being performed, and the image D**1**. The image D**3** includes information (an arrow assigned to the left side of the vehicle) indicating that the host vehicle M is changing lanes, in addition to the information included in image C**3**.

(68) The host vehicle M completes the lane change to the third lane L**3** at the position (5), and at the position (6), the control manager **180** turns on the direction indicator without relying on an operation of the driver and causes the host vehicle M to perform the lane change from the third lane L**3** to the branch lane. In the steering assistance, the image in the steering assistance described above is displayed. When the route guidance recommendation is approved in a case in which a

plurality of lane changes are required, the control manager **180** causes the host vehicle M to perform a lane change a plurality of times to guide the host vehicle M to the destination according to one approval.

(69) At the position (7), the lane change of the host vehicle M to the third lane L**3** is completed. When the host vehicle M reaches the position (7), the control manager **180** causes an image X**1** to be displayed in the first area of the display, causes an image not to be displayed in the second area, and causes an image X**3** to be displayed in the third area. The image X**1** is an example of "an image showing that the controller can cause the host vehicle to perform the lane change without relying on driving of the driver on the basis of an operation according to an intention of the driver, which is not an image showing that the controller presents or proposes the lane change".

(70) When the host vehicle M reaches the position (8), which is an end position of the branch, the control manager **180** ends the driving assistance. Accordingly, the speed control and the steering control in the driving assistance device **100** end. After the end, the driver operates the driving operator **80** to drive the host vehicle M.

(71) When the host vehicle M gives up before the lane change is completed in the route guidance recommendation, the image X**1** is displayed in the first area, and an image showing that the lane change and the steering assistance are suspended is displayed in the second area, and the image X**3** is displayed in the third area. "Gives up" means that the steering assistance cannot be continued, the operation assistance is suspended, and the lane change cannot be completed. The host vehicle M gives up the lane change according to the route guidance recommendation when the host vehicle M cannot complete the lane change until a desired position in each lane change. When the host vehicle M gives up, the driver operates the operator for operating the direction indicator to cause the host vehicle M to perform the lane change, or the driver drives and causes the host vehicle M to perform the lane change.

(72) For example, when the host vehicle M cannot start the lateral movement before the host vehicle M reaches the desired position, the steering assistance is given up and suspended. "The host vehicle M cannot perform the lateral movement" means, for example, that the driver does not grip the steering wheel, that the host vehicle M cannot start lane change according to a situation of surrounding vehicles (for example, that the host vehicle M would interfere with other vehicles if a lane change were performed), that driving assistance device **100** has determined that recognition of the position of the host vehicle M is indefinite, that the lanes cannot be recognized, that traffic congestion is occurring ahead, and that conditions on which another lane change cannot be started are satisfied. Further, operation assistance is also stopped when conditions for interrupting the vehicle change after the lateral movement has been started are satisfied. The interrupting conditions are, for example, conditions that are the same as or similar to conditions in which the host vehicle M cannot start the lateral movement.

(73) As described above, the driving assistance device **100** performs the road recommendation, stopping of the road recommendation, and the route guidance recommendation, thereby improving the convenience for the user, as described in comparison with comparative examples 1 and 2 that will be described below.

(74) [Flowchart]

(75) FIG. **4** is a flowchart showing an example of a flow of processing that is executed by the driving assistance device **100**. First, the control manager **180** of the driving assistance device **100** determines whether or not the destination of the host vehicle M is set (step S**100**). When the destination is not set, processing of one routine of this flowchart ends. When the destination is set, the control manager **180** determines whether or not the road recommendation is being made (step S**102**). When the road recommendation is not being made, the processing of the one routine of this flowchart ends.

(76) When the road recommendation is being made, the control manager **180** determines whether or not the host vehicle M is scheduled to enter a branch lane at a predetermined distance ahead

(step S**104**). When the host vehicle M is scheduled to enter the branch lane, the control manager **180** sets a position at which the route guidance recommendation starts (step S**106**). The position at which the route guidance recommendation starts is, for example, a position at which the host vehicle M can perform a lane change and enter the branch lane with a margin. For example, when the host vehicle M needs to perform the lane change a plurality of times to enter a branch lane, the position at which the route guidance recommendation starts is set so that the route guidance recommendation starts earlier than when the host vehicle M performs the lane change once and enters the branch lane.

(77) The control manager **180** sets a stop section of the road recommendation on the basis of the position determined in step S**106** (step S**108**). The control manager **180** determines, for example, a position at a predetermined distance before the position at which the route guidance recommendation starts to be a position at which the road recommendation starts.

(78) Next, the control manager **180** determines whether or not the host vehicle M has reached the stop section of the road recommendation (step S**110**). When the host vehicle M reaches the stop section of the road recommendation, the control manager **180** stops the road recommendation (step S**112**). Next, the control manager **180** determines whether or not the stop section of the road recommendation has ended and the host vehicle M has reached the start point of the route guidance recommendation (step S**114**). When the host vehicle M has reached the start point of the route guidance recommendation, the control manager **180** starts the route guidance recommendation (step S**116**). Processing regarding the route guidance recommendation is the processing described with reference to FIG. **3**. Accordingly, processing of one routine in the present flowchart ends.

(79) As described above, the driving assistance device **100** can improve convenience for the driver by setting a section in which the road recommendation is stopped.

Comparative Example 1

(80) FIG. **5** is a diagram for explaining comparative example 1. In comparative example 1, the road recommendation continues without providing a road recommendation stop section, and switching from the road recommendation to the route guidance recommendation is performed. For example, in the road recommendation, when the host vehicle is traveling in a first lane L**1**, a lane change to an overtaking lane is recommended, and when the host vehicle is traveling in a second lane L**2**, which is an overtaking lane, a lane change to the first lane L**1** is recommended.

(81) When the host vehicle instructs the road recommendation at a position (1) and performs the lane change to the second lane L**2**, the route guidance is recommended when the host vehicle reaches a position (2), the host vehicle performs the lane change to the first lane L**1**, also performs the lane change from the first lane L**1** to the third lane L**3**, and enters a branch lane.

(82) As described above, when the road recommendation stop section is not provided, the host vehicle performing lane change to a lane farther from the branch lane may be recommended. When the host vehicle performs the lane change in response to the recommendation, an amount of lateral movement of the host vehicle increases when the host vehicle performs a lane change to the branch lane, the burden on an occupant may increase or smooth lane change may be difficult.

(83) On the other hand, in the present embodiment, the driving assistance device **100** can suppress the burden on an occupant or realize smooth lane change by providing the road recommendation stop section as described above.

Comparative Example 2

(84) FIG. **6** is a diagram for explaining comparative example 2. In comparative example 2, the road recommendation is continued without providing the road recommendation stop section, and switching from the road recommendation to the route guidance recommendation is performed. It is assumed that the continued road recommendation (road recommendation executed instead of the road recommendation stop section) is a lane change to the third lane L**3** near the branch lane.

(85) For example, an image Y**1** is displayed in the first area, and an image Y**3** (the same image as the image A**3**) is displayed in the third area. The image Y**1** is an image recommending the lane

change to the third lane L**3**.

(86) For example, in the road recommendation, in principle, the lane change to an overtaking lane is recommended when the host vehicle is traveling in a first lane L**1**, and lane change to the first lane L**1** is recommended when the host vehicle is traveling in a second overtaking lane L**2**, as in FIG. **5**. Such recommendation is made until the host vehicle reaches a position (1).

(87) Thereafter, for example, when the host vehicle reaches the position (1), a lane change to a third lane L**3** is recommended until a position (2). In this case, the driver may feel uncomfortable. This because the lane change to the second lane L**2**, which is an overtaking lane, is recommended until the position (1), but the lane change to the third lane L**3**, which is a traveling lane, is suddenly recommended when the host vehicle reaches the position (1).

(88) On the other hand, in the present embodiment, the driving assistance device **100** can suppress the driver feeling uncomfortable by providing the road recommendation stop section as described above.

(89) (Others)

(90) It is preferable for the road recommendation stop section shown in FIG. **3** described above is provided on the basis of a position at a predetermined distance from a connection point P between the branch lane and the third lane L**3**. The position at the predetermined distance may be, for example, a position at which the driver can recognize that there is a branch lane ahead or a position based on the position at which the driver can recognize that there is the branch lane ahead (for example, a position after the position at which the driver can recognize that there is the branch lane ahead, which is a position at which the lane change to the branch lane based on the route guidance recommendation can be performed with a margin). For example, the position at the predetermined distance is set on the basis of a position at which a marking, signboard, sign, or the like indicating that there is the branch lane a predetermined distance ahead is provided.

(91) For example, when the map information includes the position at which the marking, signboard, sign, or the like is provided, the control manager **180** specifies the position at the predetermined distance on the basis of the position of the host vehicle M and the map information. The control manager **180** may specify the position at the predetermined distance on the basis of a recognition result of the recognizer **110**. For example, the control manager **180** may determine the position at which the marking, signboard, sign, or the like recognized by the recognizer **110** is provided, or a predetermined distance before this position, to be the position at the predetermined distance.

(92) According to the embodiment described above, the driving assistance device **100** can improve the convenience for the user by providing the road recommendation stop section. Although a case in which the road recommendation stop section is provided in the road recommendation has been described in the present embodiment, the route guidance recommendation stop section may be instead provided in the route guidance recommendation, and the recommendation by the vehicle system **1** may be stopped in this stop section.

(93) The embodiment described above can be expressed as follows.

(94) A control device including a storage device that stores a program, and a hardware processor, wherein the hardware processor executes the program stored in the storage device to execute: processing for recognizing a situation of surroundings of a host vehicle; processing for automatically controlling at least steering of the host vehicle to cause the host vehicle to perform the lane change on the basis of the recognized situation of the surroundings; first processing for presenting a lane change to an adjacent lane adjacent to a lane in which the host vehicle travels to a driver without considering of guiding the host vehicle to a set destination, and causing the host vehicle to perform the lane change on the basis of an instruction of the driver; second processing for proposing a lane change required for guidance of the host vehicle to the destination to the driver and causing the host vehicle to perform a lane change on the basis of approval of the proposal by the driver; and third processing for stopping presenting and proposing the lane change in a set

period between the first processing and the second processing when a plan is to execute the second processing after the first processing.

(95) As described above, the mode for carrying out the present invention has been described using the embodiments, but the present invention is not limited to such embodiments at all, and various modifications and replacements can be made without departing from the gist of the present invention.

Claims

1. A vehicle system comprising: a storage medium configured to store computer-readable instructions; and one or more processors connected to the storage medium, wherein the one or more processors execute the computer-readable instructions to: recognize a situation of surroundings of a host vehicle, automatically control at least steering of the host vehicle to cause the host vehicle to perform a lane change on the basis of the recognized situation of the surroundings of the host vehicle, a first operation of presenting, to a driver, a lane change to a second lane adjacent to a first lane in which the host vehicle travels without considering of guiding the host vehicle to a destination, and causing the host vehicle to perform the lane change on the basis of an instruction of the driver when the host vehicle travels in the first lane, based on a determination that the driver does not instruct the lane change to the second lane and the host vehicle reaches a first position that is a first distance before a reference position, stopping the presenting of the lane change to the second lane to the driver and presenting information to the driver that indicates the road recommendation is not being made, and a second operation of proposing, to the driver, a lane change to a third lane adjacent to the first lane required for guidance of the host vehicle to the destination and causing the host vehicle to perform the lane change to the third lane on the basis of an approval of the proposal by the driver when the host vehicle travels in the first lane and the host vehicle reaches a second position that is a second distance before the reference position, the second position is closer to the reference position than the first position, the third lane is a lane that connects to a branch lane in which the host vehicle is scheduled to travel toward the destination.
2. The vehicle system according to claim 1, wherein the one or more processors execute the computer-readable instructions to cause the host vehicle to perform a lane change a plurality of times to guide the host vehicle to the destination according to one approval when the driver performs one approval of the proposal in a case in which a plurality of lane changes are required to guide the host vehicle to the destination in the second operation.
3. The vehicle system according to claim 1, wherein the instruction or the approval is one or both of the driver operating a predetermined button and the driver gripping a steering wheel.
4. The vehicle system according to claim 1, wherein the second operation is an operation of proposing a lane change to a branch lane to the driver when the host vehicle is traveling in a lane different from a branch lane in which the host vehicle is scheduled to travel toward the destination, and causing the host vehicle to perform the lane change to the branch lane without relying on driving of the driver on the basis of the approval of the proposal by the driver.
5. The vehicle system according to claim 1, wherein in the first operation, presenting the lane change from the lane in which the host vehicle travels to an adjacent lane in which lane change is possible is repeated, and the host vehicle is caused to perform the lane change to the adjacent lane on the basis of an instruction of the driver.
6. The vehicle system according to claim 1, wherein the one or more processors execute the computer-readable instructions to cause a first image recommending a lane change to be displayed on the display in the first operation, cause a second image recommending a lane change to be displayed on the display after the second operation is started, and cause a third image different from the first image and the second image to be displayed on the display during the stopping of the presenting of the lane change to the second lane and before the second operation is started.

7. The vehicle system according to claim 6, wherein the third image is not an image showing presenting or proposing the lane change, but is an image showing that causing the host vehicle to perform the lane change is possible without relying on driving of the driver on the basis of an operation according to an intention of the driver.

8. The vehicle system according to claim 7, wherein the third image is an image showing that causing the host vehicle to perform the lane change by a driving operator operating a direction indicator is possible.

9. The vehicle system according to claim 6, wherein the second operation is an operation of proposing a lane change to a branch lane to the driver when the host vehicle is traveling in a lane different from a branch lane in which the host vehicle is scheduled to travel toward the destination, and causing the host vehicle to perform the lane change to the branch lane without relying on driving of the driver on the basis of the approval of the proposal by the driver, and the one or more processors execute the computer-readable instructions to cause an image, the image being not an image showing presenting or proposing the lane change but being an image showing that causing the host vehicle to automatically perform the lane change is possible without relying on driving of the driver on the basis of an operation according to an intention of the driver, to be displayed on a display, when the host vehicle has performed lane change to the branch lane.

10. The vehicle system according to claim 1, wherein the one or more processors execute the computer-readable instructions to cause the host vehicle to perform the lane change in response to a predetermined operation when the driver performs the predetermined operation with respect to an operator for operating a direction indicator in a case in which the stopping the presenting of the lane change to the second lane to the driver and the presenting information that indicates the road recommendation is not being made is being performed.

11. The vehicle system according to claim 1, wherein when the host vehicle is traveling in a first lane on a road having the first lane, the second lane serving as an overtaking lane adjacent to the first lane, and the third lane adjacent to the first lane connecting to a branch lane, the one or more processors execute the computer-readable instructions to cause the host vehicle to perform a lane change to the second lane serving as an overtaking lane in the first operation, and make a proposal to cause the host vehicle to perform a lane change to the third lane in the second operation after the stopping the presenting of the lane change to the second lane to the driver.

12. The vehicle system according to claim 1, wherein the stopping the presenting of the lane change to the second lane to the driver is a third operation, wherein the one or more processors execute the computer-readable instructions to cause a first image recommending a lane change to be displayed on the display in the first operation, cause a second image recommending a lane change to be displayed on the display after the third operation ends and the second operation is started, and cause a third image different from the first image and the second image to be displayed on the display in the third operation, wherein the third image is not an image showing presenting or proposing the lane change, but is an image showing that causing the host vehicle to perform the lane change is possible without relying on driving of the driver on the basis of an operation according to an intention of the driver.

13. A control method comprising: processing for recognizing, by a control device, a situation of surroundings of a host vehicle; processing for automatically controlling, by the control device, at least steering of the host vehicle to cause the host vehicle to perform the lane change on the basis of the recognized situation of the surroundings of the host vehicle; first processing for presenting, by the control device, a lane change to a second lane adjacent to a first lane in which the host vehicle travels to a driver without considering of guiding the host vehicle to a destination, and causing the host vehicle to perform the lane change on the basis of an instruction of the driver when the host vehicle travels in the first lane; based on a determination that the driver does not instruct the lane change to the second lane and the host vehicle reaches a first position that is a first distance before a reference position, stop presenting the lane change to the second lane to the driver and present

information to the driver that indicates the road recommendation is not being made; and second processing for proposing, by the control device, lane change to a third lane adjacent to the first lane required for guidance of the host vehicle to the destination to the driver and causing the host vehicle to perform a lane change to the third lane on the basis of an approval of the proposal by the driver when the host vehicle travels in the first lane and the host vehicle reaches a second position that is a second distance before the reference position, the second position is closer to the reference position than the first position, the third lane is a lane that connects to a branch lane in which the host vehicle is scheduled to travel toward the destination.

14. A non-transitory computer storage medium having a program stored therein, the program causing a control device to execute: processing for recognizing a situation of surroundings of a host vehicle; processing for automatically controlling at least steering of the host vehicle to cause the host vehicle to perform the lane change on the basis of the recognized situation of the surroundings of the host vehicle; first processing for presenting lane change to a second lane adjacent to a first lane in which the host vehicle travels to a driver without considering of guiding the host vehicle to a destination, and causing the host vehicle to perform the lane change on the basis of an instruction of the driver when the host vehicle travels in the first lane; based on a determination that the driver does not instruct the lane change to the second lane and the host vehicle reaches a first position that is a first distance before a reference position, stop presenting the lane change to the second lane to the driver and present information to the driver that indicates the road recommendation is not being made; and second processing for proposing a lane change to a third lane adjacent to the first lane required for guidance of the host vehicle to the destination to the driver and causing the host vehicle to perform a lane change to the third lane on the basis of an approval of the proposal by the driver when the host vehicle travels in the first lane and the host vehicle reaches a second position that is a second distance before the reference position, the second position is closer to the reference position than the first position, the third lane is a lane that connects to a branch lane in which the host vehicle is scheduled to travel toward the destination.