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(54) Title: IMPLICIT ACTIVATION AND CONTROL OF DRIVER ASSISTANCE SYSTEMS

(57) Abstract: A system, vehicle and method are provided that automatically activate and deactivate a driver assistance system. The automatic activation and deactivation depend on predefined criteria such as brake or gas pedal release, current vehicle velocity, and the presence of a lead vehicle.

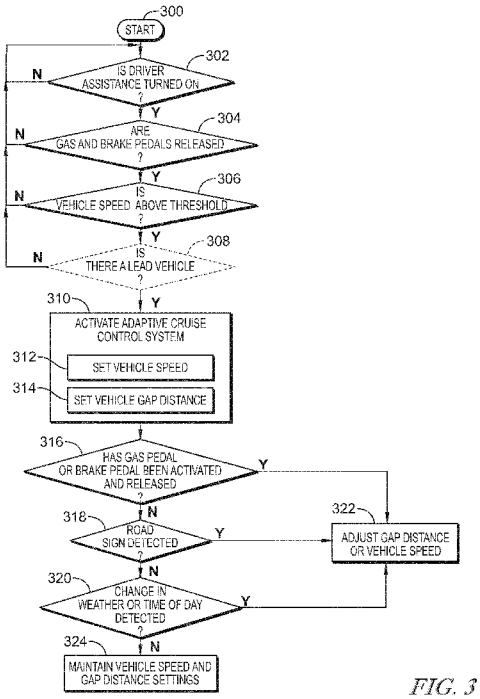


FIG. 3

[Continued on next page]

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IMPLICIT ACTIVATION AND CONTROL OF DRIVER ASSISTANCE SYSTEMS

BACKGROUND

The present disclosure relates to systems, components and methodologies for implicitly controlling driver assistance systems. In particular, the present disclosure relates to systems, components and methodologies for automatically controlling adaptive cruise control systems.

SUMMARY

An adaptive cruise control system may be provided with a switch configured to turn the system on and off; a sensor configured to detect an environmental condition outside a transportation vehicle; and control means for automatically activating the system in response to detection that a transportation vehicle gas pedal and a transportation vehicle brake pedal are released, detection that an environmental condition is detected, and that the current vehicle speed meets a predefined threshold.

According to some embodiments, a transportation vehicle is provided with a gas pedal and a brake pedal, a sensor configured to sense current speed, and an adaptive cruise control processor configured to receive inputs from the gas pedal, the brake pedal, and the sensor, and in response to each determination that the driver has released the gas pedal and the brake pedal, determine whether to activate the adaptive cruise control functionality based on current speed of the vehicle.

In some embodiments, the system and vehicle may automatically set a velocity to be maintained based on sensor inputs. In some embodiments, the adaptive cruise control system, and the transportation vehicle further may be configured to detect a lead vehicle traveling directly in front of the vehicle and automatically set a gap distance to be automatically maintained between the vehicle and the lead vehicle.

In some embodiments, the adaptive cruise control system, and the transportation vehicle further comprise one or more of GPS, navigation, and identification systems. The system and vehicle may further automatically set and adjust vehicle speed and gap distance settings to a lead vehicle directly ahead of the vehicle based on inputs from these systems.

Additional features of the present disclosure will become apparent to those skilled in the art upon consideration of illustrative embodiments exemplifying the best mode of carrying out the disclosure as presently perceived.

BRIEF DESCRIPTIONS OF THE DRAWINGS

Further advantages, features and possibilities of using the present disclosed embodiments emerge from the description below in conjunction with the figures.

Fig. 1A-D	constitute a diagrammatic view of an exemplary process of a vehicle in operation with the adaptive cruise control (ACC) system including turning the ACC system on, activating the ACC system, setting vehicle speed and distance, and adjusting vehicle speed and distance.
Fig. 1A	shows a vehicle having an ACC system and the ACC system being turned on in the vehicle.
Fig 1B	illustrates how the ACC system is automatically activated by the controller in response to the satisfying one or more predefined criteria.
Fig 1C	depicts the ACC system setting an ACC gap between the vehicle and a lead vehicle directly in front of the vehicle in the same lane the vehicle is travelling in and a speed of travel for the vehicle;.

Fig. 1D illustrates the ACC system adjusting the vehicle speed and the ACC gap to new values in response to one or more inputs to the controller.

Fig. 2 is a diagrammatic view of a vehicle with an integrated adaptive cruise control system, an adaptive cruise control system controller, and the various vehicle components and systems that may be in communication with the controller.

Fig. 3 is a diagrammatic flow chart of a method provided in accordance with disclosed embodiments.

DETAILED DESCRIPTION

The figures and descriptions provided herein may have been simplified to illustrate aspects that are relevant for a clear understanding of the herein described devices, systems, and methods, while eliminating, for the purpose of clarity, other aspects that may be found in typical devices, systems, and methods. Those of ordinary skill may recognize that other elements and/or operations may be desirable and/or necessary to implement the devices, systems, and methods described herein. Because such elements and operations are well known in the art, and because they do not facilitate a better understanding of the present disclosure, a discussion of such elements and operations may not be provided herein. However, the present disclosure is deemed to inherently include all such elements, variations, and modifications to the described aspects that would be known to those of ordinary skill in the art.

Figs. 1A-1D constitute a diagrammatic view of an exemplary implicit activation and control driver assistance system, in particular, an adaptive cruise control (ACC) system. The ACC system may be automatically activated and automatically set and adjust vehicle operations.

In Fig. 1A, a vehicle 14 is illustrated traveling on a road 12 in the same direction as a lead vehicle 16. A lead vehicle 16 may be any vehicle traveling in the same direction as vehicle 14 and in the same lane of a road 12 as vehicle 14 in front of vehicle 14. A vehicle operator may turn on ACC system so that the ACC system 18 is on, but not yet activated. ACC system 18 may be turned on by one or more of a switch, push button or touchscreen interface within the vehicle 14.

As shown in Fig. 1B, sensors 34 detect one or more conditions, and an ACC controller 22 implicitly, without further operator input, activates the ACC system 20 when the conditions satisfy one or more predefined criteria 24. By way of example, In Fig. 1B, sensors 34 may detect a velocity "V" of the vehicle 14, a pedal release "P" within the vehicle 14, and the presence of a lead vehicle 16 "L" in front of the vehicle 14. Predefined velocity criteria may be, for example, that the vehicle 14 is traveling at a speed above a predefined threshold. Predefined pedal release criteria may be, for example, that the operator of the vehicle has released and is not pressing the gas or brake pedals. Predefined lead vehicle criteria may be for example that a lead vehicle 16 has been identified at a distance "D" directly ahead of the vehicle on the road 12 traveling in the same lane in the same direction.

Fig. 1C depicts that based on the predefined criteria being met in Fig. 1B, the vehicle speed and distance may be set 26. Controller 22 may control the ACC system operations without further input, by setting an ACC gap and a corresponding velocity 28 setting to be maintained. These setting are set so that the acceleration gap D1, or distance, between the vehicle 14 and the lead vehicle 16 is approximately maintained. Fig. 1D depicts automatically adjusting vehicle speed and distance 30 as long as the ACC system 18 remains on and is activated 20. By way of example, between Figs. 1C and 1D, the operator of the vehicle 14 may have engaged the vehicle gas pedal and released it. Based on this action, the controller 22 may automatically determine that the operator has a more aggressive driving style and adjust the ACC gap D2 to be shorter to correspond to this

driving behavior and adjust the velocity V2 to maintain this shorter gap D2 in the settings 32. In another example, between Figs. 1C and 1D, the operator of the vehicle 14 may have engaged the vehicle brake pedal and released it. Based on this action, the controller 22 may automatically determine that the operator would like a larger ACC gap between the vehicle 14 and the lead vehicle 16 and adjust the velocity to maintain a larger gap in the settings 32. Still in a further example, sensors 34 may detect that the lead vehicle 16 has slowed down and automatically adjust the ACC gap distance and vehicle velocity settings 32 based on this detection.

As illustrated in Figure 2, an ACC system 220 may be incorporated into a transportation vehicle 214. ACC controller 222 may be linked to other systems and sensors of the vehicle 214 via a vehicle communication bus 226. ACC controller 222 may be turned on and/or off via a switch 244, which may include a button, switch knob, touchscreen or other input interface. ACC controller 222 may include memory 228 on which instructions or logic are provided, and a processor 229 to control implicit activation of the ACC system 220. In some embodiments, the ACC controller 222 may include a machine learning model that continuously updates its implicit activation speed and gap distance parameters based on historic driving behavior sensed over time, as well as driving behavior in particular driving situations or road and weather conditions. The ACC controller 222 may be in communication with one or more environmental sensors 230 for sensing outside the vehicle and/or inside the vehicle. By way of example, exterior sensors may include lidar, camera, or other sensors for sensing surroundings including signs, other vehicles, lead vehicles, traffic lights, or other conditions affecting activation and automatic operation of the vehicle. Interior sensors may include biometric, camera, or other sensors used to identify the driver as part of an integrated driver identification system 232 that may be used for setting vehicle driver preference internal comfort settings. Driver identification system 232 can communicate driving style of that driver such as aggressive or cautious, stored in the driver identification system 232, to be used in activating the ACC system 220 and setting speed and gap distance parameters.

Brake pedal 234 and gas pedal 236 may communicate with the ACC controller 222 information about the state of the pedals, including whether or not they are being pressed by the driver and when they are released. Additionally, brake pedal and gas pedal 236 may receive operational inputs from the ACC controller 222 to manage and maintain speeds and gap distances. GPS 238, navigation 240, and speedometer 242 may additionally provide inputs to the ACC controller 22 regarding location, route guidance information and speed. For example, the navigation system 240 may inform on intersections, speed limits, or upcoming turns to the controller ACC 222 to manage changes in speed.

In a method of operation of a driver assistance system 300, the system must be determined to be turned on 302, the gas and brake pedals must be released 304, and the vehicle must be above a predefined threshold speed 306. In some embodiments, the gas and brake pedals being released means no driver or operator force or instruction is acting on them. In some embodiments, the predefined threshold speed 306 is a value between 20-30 mph. If these conditions are met and optionally, if a lead vehicle is also detected 308, then the driver assistance system is activated 310. The method will continuously query conditions 302, 304, 306 during activation either sequentially or in parallel, and if any of these conditions are not met, the driver assistance system is deactivated until the conditions 302, 304, 306 are met again.

Once the adaptive cruise control system is activated 310, a vehicle speed is set 312 to maintain a set 314 vehicle gap distance between the vehicle and an identified lead vehicle. The speed may be constantly adjusted based on changes in gap distance due to changes in velocity of the lead vehicle. If no lead vehicle is detected 308 then vehicle speed may be set 312 based on one or more sensor inputs such as speed limit road signs, navigation system identification of type of road, such as rural country road, highway, or other road type, weather, time of day, and driver style.

Inputs that may cause the ACC system to automatically adjust the gap distance and vehicle speed 322 include activation and subsequent release 316 of the brake pedal or gas pedal or detection 319 of a new road sign. For example, as previously mentioned, activation of the brake or gas pedal will deactivate the ACC system. However, if activation and release are close in time to each other, or within a predefined time, when the ACC system activates again, it may use the previous speed and gap distance settings and set new speed and gap distances informed by those previous settings. In one example, the brake is activated and released, and the system determines the driver would like more distance from a lead vehicle and sets a larger gap distance. In another example, the gas pedal is activated and released, and the system determines the driver would like to drive more aggressively with less distance from the lead vehicle and increases the speed and reduces the gap distance.

In another example, the detection of a new road sign 318 may include a change in speed limit, a stop sign, a construction ahead or other sign and the system will adjust the set speed and/or gap distance accordingly. In another example, the system may detect 320 ambient weather and time of day conditions, detect rain, change from day to night lighting conditions, snow, wind, or another condition that may cause the system to adjust speed. Any of these conditions 316, 318, 320 may be considered individually or in combination in setting and adjusting vehicle speed and vehicle gap distance 322. Conditions 316, 318, 320 are continuously sensed in series or in parallel for changes and otherwise vehicle speed and gap distance are maintained 324. The system will continuously maintain 324 or adjust 322 vehicle speed and gap distance until the system is turned off, the vehicle speed falls below the threshold speed, or the driver resumes operational control of the gas or brake pedal.

Existing driver assistance functions such as an ACC system can improve driver safety and comfort by adjusting vehicle speed to maintain a safe distance. Existing driver

assistance systems use a mix of brake and gas pedals, switches, physical monostable levers and/or buttons and menu based settings. For example, existing systems include a switch that the driver must press to turn the system on and off, as well as a button or monostable lever the driver must manipulate in order to activate the system and set and adjust target speeds. These physical levers and buttons can hinder drivers from discovering and using the system. Additionally, these physical levers and buttons increase the risk of mode confusion, accidental activation, deactivation, and adjustment of the system.

Thus, disclosed embodiments provide the technical effect of enabling automatic activation of a cruise control system in response to detection that a transportation vehicle gas pedal and a transportation vehicle brake pedal are released, detection that an environmental condition is detected, and that the current vehicle speed meets a predefined threshold. Accordingly, the disclosed embodiments reduce the above identified risks by implicitly controlling activation and adjustment of various functions. The only user input the system relies on apart from a switch to turn the system on and off, are the normal user operation of the gas and brake pedals while operating the vehicle. The system automatically monitors when it should be activated, deactivated, or adjusted. In some embodiments, it also learns over time to differentiate between normal driver behavior and user preferences, and incidents caused by road or traffic conditions. In the disclosed embodiments, the driver no longer has to manually activate or adjust a driver assistance function. This is performed automatically upon release of the gas or brake pedal. Moreover, the driver still has the option to be in control by simply operating the gas or brake pedal as would be done under manual driving operations.

It should be understood that some or all of the methodology explained above may be performed on, utilizing or with access to one or more servers, processors and associated memory. Unless specifically stated otherwise, and as may be apparent from the above description, it should be appreciated that throughout the specification

descriptions utilizing terms such as “processing,” “computing,” “calculating,” “determining,” or the like, refer to the action and/or processes of a computer or computing system, or similar electronic computing device, that manipulate and/or transform data represented as physical, such as electronic, quantities within the computing system’s registers and/or memories into other data similarly represented as physical quantities within the computing system’s memories, registers or other such information storage, transmission or display devices.

In a similar manner, the terms “controller” and “processor” may refer to any device or portion of a device that processes electronic data from registers and/or memory to transform that electronic data into other electronic data that may be stored in registers and/or memory.

References to “one embodiment,” “an embodiment,” “example embodiment,” “various embodiments,” etc., may indicate that the embodiment(s) of the invention so described may include a particular feature, structure, or characteristic, but not every embodiment necessarily includes the particular feature, structure, or characteristic. Further, repeated use of the phrase “in one embodiment,” or “in an exemplary embodiment,” do not necessarily refer to the same embodiment, although they may.

Although certain embodiments have been described and illustrated in exemplary forms with a certain degree of particularity, it is noted that the description and illustrations have been made by way of example only. Numerous changes in the details of construction, combination, and arrangement of parts and operations may be made. Accordingly, such changes are intended to be included within the scope of the disclosure, the protected scope of which is defined by the claims.

CLAIMS

1. An adaptive cruise control system (220) comprising:

a switch (244) configured to turn the system (220) on and off;

a sensor (230) configured to detect an environmental condition outside a transportation vehicle (14, 214); and

control means (222) for automatically activating (310) the system (220) in response to detection (304) that a transportation vehicle gas pedal (236) and a transportation vehicle brake pedal (234) are released, detection that an environmental condition is detected, and detection (306) that the current vehicle speed meets a predefined threshold.

2. The adaptive cruise control system (220) of claim 1, wherein the environmental condition is a detected (308) presence of a lead vehicle (16) in front of the transportation vehicle (14, 214).

3. The adaptive cruise control system (220) of claim 1 or 2, wherein automatically activating (310) the system includes setting (312, 314) and adjusting (322) cruise control settings without operator intervention.

4. The adaptive cruise control system (220) of claim 3, wherein the cruise control settings include a transportation vehicle speed and a distance between a lead vehicle (16) and the transportation vehicle (14, 214).

5. The adaptive cruise control system (220) of claim 4, wherein the control means (222) is configured to adjust (322) the transportation vehicle speed based on one or more inputs of information about navigation maps, road signs, road conditions, weather, and historic operator behavior, or to adjust (322) the distance based on one or more inputs of indicating whether the gas pedal (236) or the brake pedal (234) was released and a speed of a lead vehicle (16).

6. A transportation vehicle (14, 214) comprising:

a gas pedal (236) and a brake pedal (234),

a sensor configured to sense current speed, and

an adaptive cruise control processor (222) configured to receive inputs from the gas pedal (236), the brake pedal (234), and the sensor, and in response to each determination that the driver has released the gas pedal (236) and the brake pedal (234), determine whether to activate (310) the adaptive cruise control functionality based on the current speed of the transportation vehicle (14, 214).

7. The transportation vehicle (14, 214) of claim 6, further comprising an environmental sensor (230), wherein the adaptive cruise control processor (222) determines whether to activate (310) the adaptive cruise control functionality based on one or more sensed environmental conditions of the transportation vehicle (14, 214).

8. The transportation vehicle (14, 214) of claim 7, wherein the one or more environmental conditions comprises the detection of a lead vehicle (16) in front of the transportation vehicle (14, 214) or a speed of a detected lead vehicle (16).

9. The transportation vehicle (14, 214) of any of claims 6 to 8, wherein the adaptive cruise control processor (222) is further configured to automatically adjust (322) a transportation vehicle speed or a distance between the transportation vehicle (14, 214) and a detected lead vehicle (16) while the adaptive cruise control functionality is activated.

10. The transportation vehicle (14, 214) of any of claims 6 to 9, further comprising one or more of a global positioning system (238), driver identification system (232), clock, and navigation system (240) configured to provide inputs to the adaptive cruise control processor (222), wherein the adaptive cruise control processor (222) is

configured to determine whether to activate (310) or adjust (322) the adaptive cruise control based on the one or more inputs.

11. The transportation vehicle (14, 214) of any of claims 6 to 10, wherein the adaptive cruise control processor (222) includes a model that is configured to learn driver's behavior and adapt speed and distance settings based on the learned driving behavior.

12. An adaptive cruise control device (222) for a transportation vehicle (14, 214), comprising a processor (229) and software stored in a memory (228) that, when executed, causes the processor (229) to:

determine (304) whether a gas pedal (236) and a brake pedal (234) is released, and

in response to a determination (304) that the gas pedal (236) and the brake pedal (234) are released, activate (310) adaptive cruise control functionality when a predetermined vehicle speed threshold is met (306) and a lead vehicle (16) is detected (308).

13. The adaptive cruise control device (222) of claim 12, wherein the adaptive cruise control functionality includes automatically adjusting (322) vehicle speed or distance between the transportation vehicle (14, 214) and the lead vehicle (16).

14. The adaptive cruise control device (222) of claim 12 or 13, wherein the processor (229) is further configured to automatically adjust (322) vehicle speed or distance based on one or more of navigation map, road sign, road conditions, weather, time of day, and historic driver behavior inputs.

15. The adaptive cruise control device (222) of any of claims 12 to 14, wherein in response to a gas pedal (236) pressed (316) and a lead vehicle (16) detected (308), the processor (229) automatically reduces (322) the distance in response to release (316) of

the gas pedal (236), or wherein in response to a brake pedal (234) pressed (316) and a lead vehicle (16) detected (308), the processor (229) automatically increases (322) the distance in response to release (316) of the brake pedal (234).

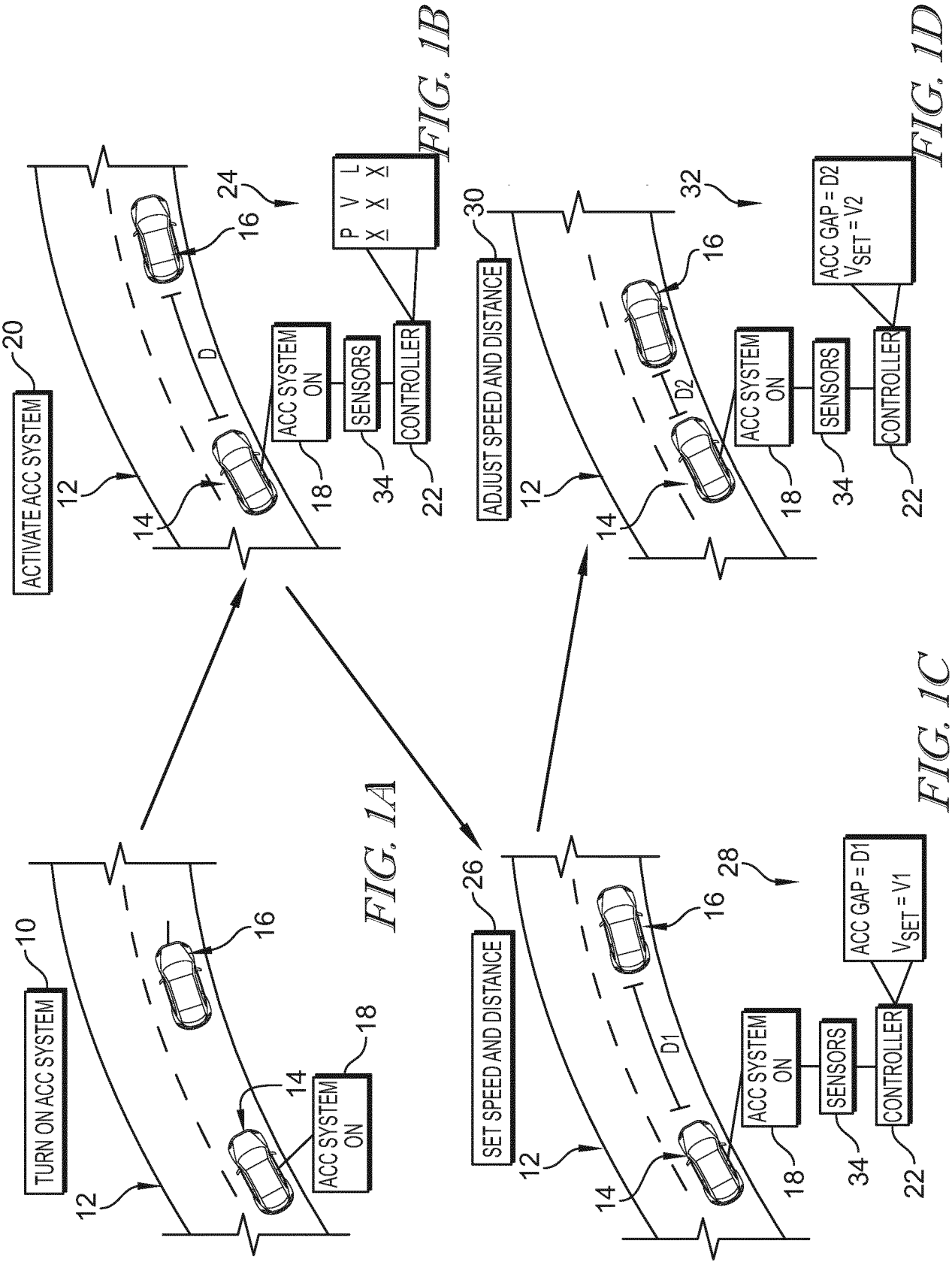


FIG. 1A

FIG. 1B

FIG. 1C

FIG. 1D

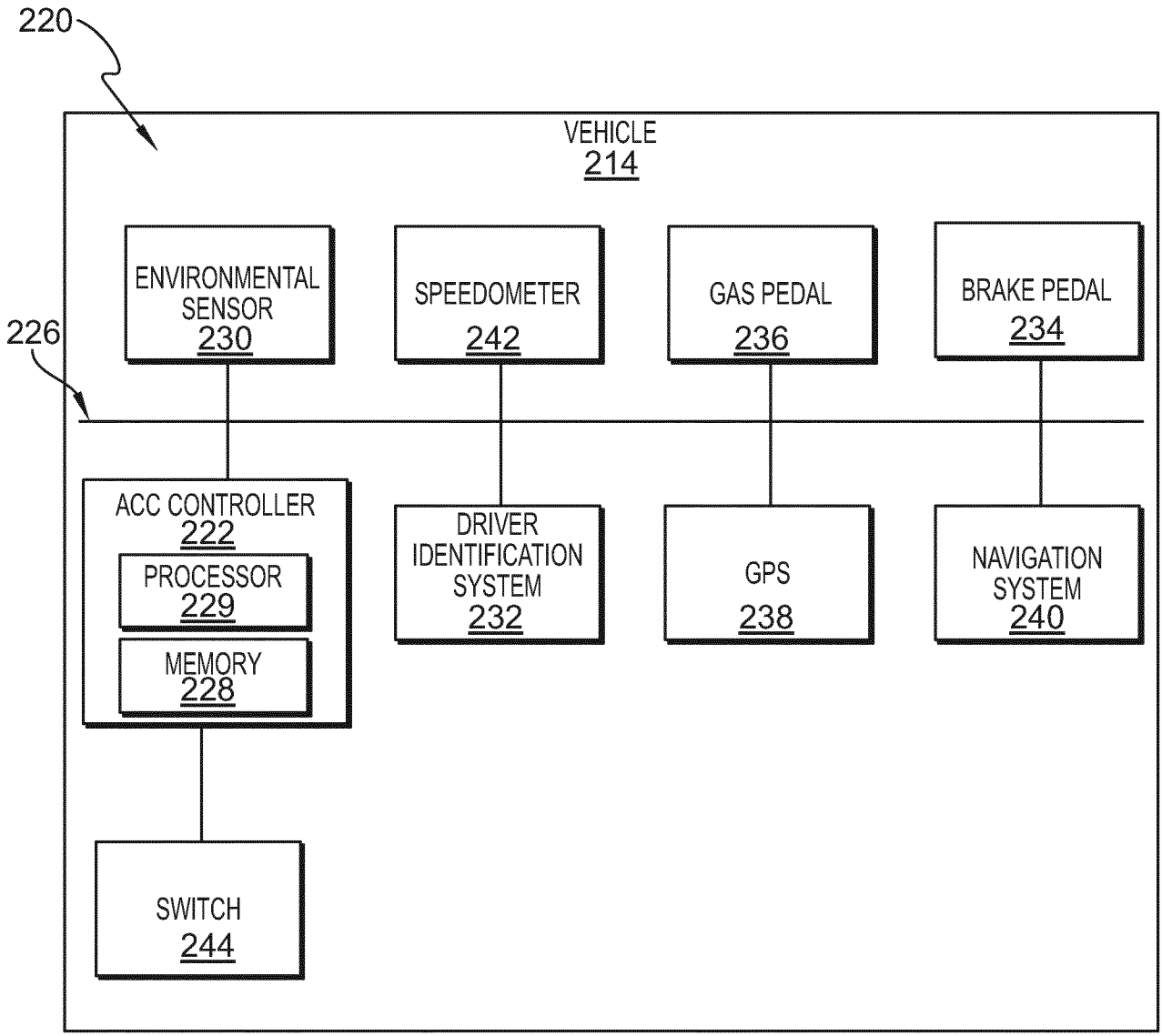

220
VEHICLE
214
ENVIRONMENTAL SENSOR
230
SPEEDOMETER
242
GAS PEDAL
236
BRAKE PEDAL
234
226
ACC CONTROLLER
222
PROCESSOR
229
MEMORY
228
DRIVER IDENTIFICATION SYSTEM
232
GPS
238
NAVIGATION SYSTEM
240
SWITCH
244

FIG. 2

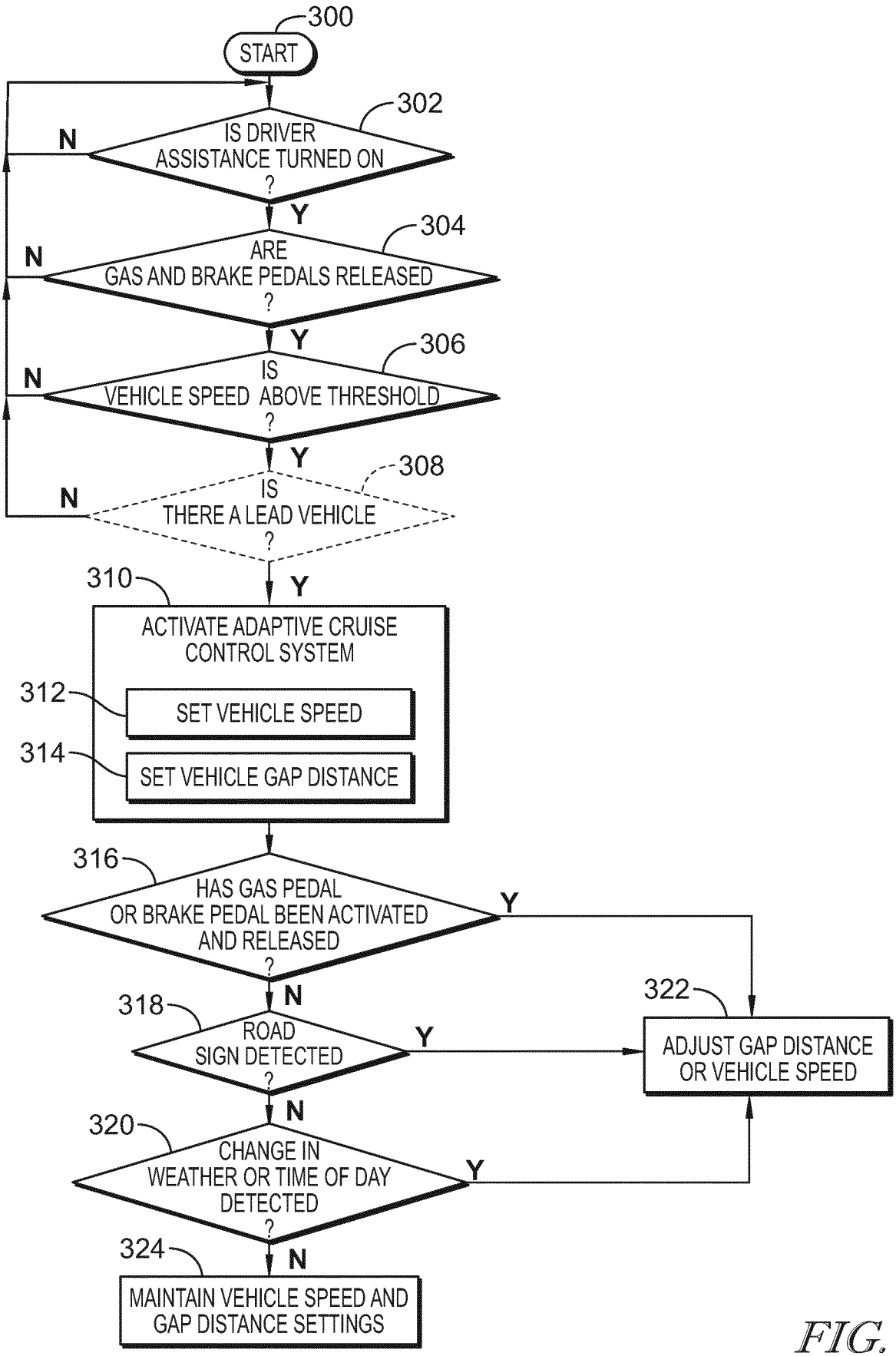

300
START
302
IS DRIVER ASSISTANCE TURNED ON ?
N
Y
304
ARE GAS AND BRAKE PEDALS RELEASED ?
N
Y
306
IS VEHICLE SPEED ABOVE THRESHOLD ?
N
Y
308
IS THERE A LEAD VEHICLE ?
N
Y
310
ACTIVATE ADAPTIVE CRUISE CONTROL SYSTEM
312
SET VEHICLE SPEED
314
SET VEHICLE GAP DISTANCE
316
HAS GAS PEDAL OR BRAKE PEDAL BEEN ACTIVATED AND RELEASED ?
Y
N
318
ROAD SIGN DETECTED ?
Y
N
320
CHANGE IN WEATHER OR TIME OF DAY DETECTED ?
Y
N
322
ADJUST GAP DISTANCE OR VEHICLE SPEED
324
MAINTAIN VEHICLE SPEED AND GAP DISTANCE SETTINGS

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/083101

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60W30/14 B60W30/16 B60W40/09 B60W40/02 B60W40/105
B60W50/04 B60W50/00
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)
EPO-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 Y	US 2018/319402 A1 (MILLS AARON L [US] ET AL) 8 November 2018 (2018-11-08) paragraphs [0004], [0005], [0017] - [0026], [0043], [0065]; figure 1	1-10, 12-15 11
A	US 9 296 368 B2 (GM GLOBAL TECH OPERATIONS INC [US]) 29 March 2016 (2016-03-29) column 1, lines 21-24	1-15
Y	EP 1 997 705 A1 (UNIV NAGOYA NAT UNIV CORP [JP]; EQUOS RES CO LTD [JP]) 3 December 2008 (2008-12-03) paragraphs [0055] - [0061]	11
X Y	US 8 583 341 B2 (STAEHLIN ULRICH [DE]; SWOBODA ADAM [DE] ET AL.) 12 November 2013 (2013-11-12) column 3, line 6 - column 5, line 27	1-10, 12-15 11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 March 2020	02/04/2020

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Vena, Gianpiero

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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