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(54) Title: A SYSTEM FOR SELECTIVELY OPERATING REGENERATIVE BRAKING IN A VEHICLE AND METHOD THEREOF

(57) Abstract: The present invention is directed to a system (100) for selectively operating regenerative braking in a vehicle. The system (100) includes a user-operable input device (110) for selecting a regenerative mode, a motor (120) for driving the vehicle, and a controller (130) coupled with the motor (120) and the user-operable input device (110). The controller (130) is configured to: receive an input signal corresponding to the regenerative mode selected by a user; receive a vehicle parameter; and enable or disable the regenerative braking for controlling operation of the motor (120) based on the regenerative mode selected by the user and the vehicle parameter.

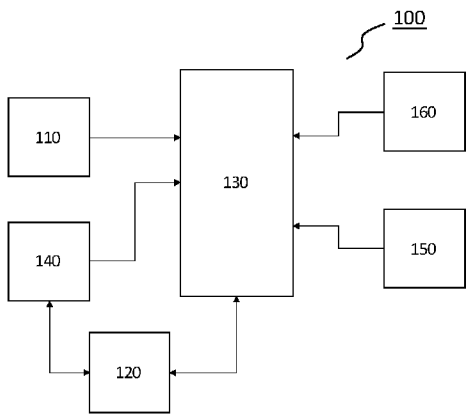


Figure 1

WO 2022/201176 A1

TITLE OF INVENTION

A System for Selectively Operating Regenerative Braking in a Vehicle and Method Thereof

FIELD OF THE INVENTION

[001] The present invention relates to a system for selectively operating regenerative braking in a vehicle and method thereof.

BACKGROUND OF THE INVENTION

[002] Regenerative braking is an energy recovery mechanism that slows down a moving vehicle by converting its kinetic energy into a form that can be either used immediately or stored until needed. In this mechanism, an electric traction motor uses the vehicle's momentum to recover energy that would otherwise be lost to the brake discs as heat energy. This contrasts with conventional braking systems, where the excess kinetic energy is converted to unwanted and wasted heat due to friction in the brakes, or with dynamic brakes, where the energy is recovered by using electric motors as generators but is immediately dissipated as heat in resistors. In addition to improving the overall efficiency of the vehicle, regeneration can significantly extend the life of the braking system as the mechanical parts will not wear out very quickly.

[003] In existing electric or hybrid electric vehicles, regeneration is performed whenever the vehicle is braked or when throttle is stopped. In these vehicles whenever the battery state of charge (SOC) is below a threshold value, the regeneration is allowed to happen, and battery charging occurs with a fixed maximum current while vehicle is coasting. There

is no other means to reduce or increase the regeneration current which will have different drive feel upon changing the same.

[004] Further, in the existing systems, if the regeneration current is high enough to charge the battery, the vehicle may be halted at shorter distance or the distance it can travel without throttle will be short. Moreover, at high current the battery charging does not happen as a predefined charging current has been set. These systems also do not discuss the means to stop or turn OFF the regeneration or even vary the regeneration current intentionally by the user.

[005] Further, the amount of regeneration decides the distance at which the vehicle will be stopped, the rate of deceleration of the vehicle, and the charging rate of the battery. Moreover, based on the route of the vehicle or the trip planned by the user and the terrain during the trip, a high regenerative current or a low regenerative current will be required. For instance, a downward slope of the vehicle may result in higher stopping distance even if the regenerative current is more, however, a plain road may result in shorter stopping distance, if the regenerative current is high. The existing systems do not have any means for adjusting the amount of regeneration.

[006] Thus, there is a need in the art for a system for selectively operating regenerative braking in a vehicle and method thereof which addresses at least the aforementioned problems.

SUMMARY OF THE INVENTION

[007] In one aspect, the present invention is directed to a system for selectively operating regenerative braking in a vehicle. The system includes a user-operable input device for selecting a regenerative mode, a motor for driving the vehicle, and a controller coupled with

the motor and the user-operable input device. The controller is configured to receive an input signal corresponding to the regenerative mode selected by a user; receive a vehicle parameter; and enable or disable the regenerative braking for controlling operation of the motor based on the regenerative mode selected by the user and the vehicle parameter.

[008] In an embodiment of the invention, the regenerative mode includes a high regenerative mode whereby the motor supplies a current more than a predefined regenerative current during the regenerative braking. In another embodiment, the regenerative mode includes a low regenerative mode whereby the motor supplies a current less than the predefined regenerative current during the regenerative braking.

[009] In another embodiment of the invention, the system includes a battery pack for supplying electrical power to the motor to drive the vehicle. The motor is configured to supply electrical power to the battery pack during regenerative braking. In an embodiment, the vehicle parameter includes a state of charge, a temperature, and a fault condition of the battery pack. The controller is configured to: monitor the state of charge, the temperature, and the fault condition of the battery pack; and control operation of the motor to supply a predetermined charging current from the motor to the battery pack during the regenerative braking if: the state of charge is less than a predefined value, the temperature is less than a predefined temperature, and the fault condition is absent. The predefined temperature is 60 degree Celsius. In another embodiment, the predefined regenerative current is equal to the predetermined charging current.

[010] In a further embodiment of the invention, the vehicle parameter includes a throttle position, the throttle position determined from a throttle signal generated by a throttle sensor. The controller is configured to: receive the throttle signal; and enable the

regenerative braking based on the throttle position corresponding to the throttle signal and the regenerative mode selected by the user.

[011] In another embodiment of the invention, the vehicle parameter comprises a brake position, the brake position determined from a brake signal generated by a brake sensor. The controller is configured to: receive the brake signal; and enable the regenerative braking based on the brake position corresponding to the brake signal and the regenerative mode selected by the user.

[012] In still another embodiment of the invention, the controller is configured to disable regenerative braking when a no regenerative braking mode is selected by the user from the user-operable input device.

[013] In another embodiment of the invention, the user-operable input device is selected from an instrument cluster, a mobile device, and a switch. The controller is configured to display one or more vehicular information on the instrument cluster. The vehicular information selected from a ride mode of the vehicle, a speed of the vehicle, the regenerative mode, multimedia features and a geographical path between a first location and a second location.

[014] In still another embodiment of the invention, the system includes a navigation module for navigating the vehicle from a first location to a second location. The navigation module is coupled with the controller and the controller is configured to: receive, from the navigation module, a navigation signal corresponding to a geographical path between the first location and the second location, and enable the regenerative braking based on the regenerative mode selected by the user, the vehicle parameter, and the geographical path.

[015] In yet another embodiment of the invention, the system includes a ride mode selection switch for selecting a ride mode of the vehicle by the user. The ride mode

selection switch is coupled with the controller and the controller is configured to: receive, from the ride mode selection switch, a ride mode selection signal corresponding to the selected ride mode of the vehicle, and enable the regenerative braking based on the regenerative mode selected by the user, the vehicle parameter, and the selected ride mode of the vehicle.

[016] In another embodiment of the invention, the controller includes a vehicle control unit. In still another embodiment, the controller includes a motor controller.

[017] In another aspect, the present invention is directed to a method for selectively operating regenerative braking in a vehicle. The method includes the steps of: selecting, by a user-operable input device, a regenerative mode; receiving, by a controller, an input signal corresponding to the regenerative mode selected by a user, the controller being coupled with the user-operable input device and a motor for driving the vehicle; receiving, by the controller, a vehicle parameter; and enabling or disabling, by the controller, the regenerative braking for controlling operation of the motor based on the regenerative mode selected by the user and the vehicle parameter.

[018] In an embodiment of the invention, the method includes the step of supplying, by the motor, a current more than a predefined regenerative current during regenerative braking when the regenerative mode comprises a high regenerative mode.

[019] In another embodiment of the invention, the method includes the step of supplying, by the motor, a current more than a predefined regenerative current during regenerative braking when the regenerative mode comprises a high regenerative mode.

[020] In still another embodiment of the invention, the method includes the step of supplying, by the motor, electrical power to a battery pack during regenerative braking.

[021] In yet another embodiment of the invention, the vehicle parameter includes a state of charge, a temperature, and a fault condition of the battery pack. The method includes the steps of: monitoring, by the controller, the state of charge, the temperature, and the fault condition of the battery pack; and controlling operation of the motor, by the controller, to supply a predetermined charging current from the motor to the battery pack during the regenerative braking if the state of charge is less than a predefined value, the temperature is less than a predefined temperature, and the fault condition is absent. The predefined temperature is 60 degree Celsius.

[022] In a further embodiment of the invention, the vehicle parameter includes a throttle position. The method includes the steps of: generating, by a throttle sensor, a throttle signal corresponding to the throttle position; receiving, by the controller, the throttle signal; and enabling, by the controller, the regenerative braking based on the throttle position and the regenerative mode selected by the user.

[023] In a still further embodiment of the invention, the vehicle parameter includes a brake position. The method includes the steps of: generating, by a brake sensor, a brake signal corresponding to the brake position; receiving, by the controller, the brake signal; and enabling, by the controller, the regenerative braking based on the brake position and the regenerative mode selected by the user.

[024] In yet another embodiment of the invention, the method includes the step of disabling, by the controller, regenerative braking when a no regenerative braking mode is selected by the user from the user-operable input device.

[025] In still another embodiment of the invention, the method includes the steps of: receiving, by the controller, a navigation signal from a navigation module coupled with the controller, the navigation signal corresponding to a geographical path between a first

location and a second location; and enabling, by the controller, the regenerative braking based on the regenerative mode selected by the user, the vehicle parameter, and the geographical path.

[026] In a further embodiment of the invention, the method includes the steps of: generating, from a ride mode selection switch for selecting a ride mode of the vehicle by the user, a ride mode selection signal, the ride mode selection switch coupled with the controller; receiving, by the controller, the ride mode selection signal corresponding to the selected ride mode of the vehicle, and enabling, by the controller, the regenerative braking based on the regenerative mode selected by the user, the vehicle parameter, and the selected ride mode of the vehicle.

[027] In a still further embodiment of the invention, the user-operable input device is selected from an instrument cluster, a mobile device, and a switch.

[028] In another embodiment of the invention, the method includes the step of displaying, by the controller, one or more vehicular information on the instrument cluster, the vehicular information selected from a ride mode of the vehicle, a speed of the vehicle, the regenerative mode, multimedia features and a geographical path between a first location and a second location.

BRIEF DESCRIPTION OF THE DRAWINGS

[029] Reference will be made to embodiments of the invention, examples of which may be illustrated in accompanying figures. These figures are intended to be illustrative, not limiting. Although the invention is generally described in context of these embodiments, it should be understood that it is not intended to limit the scope of the invention to these particular embodiments.

Figure 1 illustrates a system for selectively operating a regenerative braking in a vehicle in accordance with an embodiment of the present invention.

Figure 2 illustrates the system of Figure 1 with a controller having a vehicle control unit and a motor controller in accordance with an embodiment of the present invention.

Figure 3 shows a method for selectively operating a regenerative braking in a vehicle in accordance with an embodiment of the present invention.

Figures 3a, 3b and 3c show details of the steps illustrated in Figure 3 in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[030] Various features and embodiments of the present invention here will be discernible from the following further description thereof, set out hereunder. In the ensuing exemplary embodiments, the vehicle is a two wheeled vehicle, particularly an electric vehicle. However, it is contemplated that the disclosure in the present invention may be applied to any automobile capable of accommodating the present subject matter without defeating the spirit of the present invention.

[031] In one aspect, the present invention relates to a system for selectively operating regenerative braking in a vehicle.

[032] As shown in Figure 1, the system 100 includes a user-operable input device 110 for selecting a regenerative mode, and a motor 120 for driving the vehicle. The user-operable input device 110 is selected from an instrument cluster 110a, a mobile device 110b, and a switch 110c in the vehicle.

[033] The system 100 also includes a battery pack 140 for supplying electrical power to the motor 120 to drive the vehicle. The motor 120 is configured to supply electrical power to the battery pack 140 during regenerative braking.

[034] The system also includes a throttle sensor 150, a brake sensor 160, a navigation module 170 (shown in Figure 2), and a ride mode selection switch 180 (shown in Figure 2). The throttle sensor 150 is configured to generate a throttle signal corresponding to a throttle position. The brake sensor 160 is configured to generate a brake signal corresponding to a brake position.

[035] The navigation module 170 (shown in Figure 2) is configured to generate a navigation signal for navigating the vehicle from a first location to a second location. The navigation signal corresponds to a geographical path between the first location and the second location. The navigation module typically uses satellite navigation to get its position data which is then correlated to a position on a road.

[036] The ride mode selection switch 180 (shown in Figure 2) is configured to generate a ride mode selection signal corresponding to a ride mode selected by a user.

[037] The system also includes a controller 130. The controller 130 is coupled with the motor 120, the user-operable input device 110, the battery pack 140, the throttle sensor 150, and the brake sensor 160.

[038] In an embodiment, as shown in Figure 2, the controller 130 includes a vehicle control unit 130a. In another embodiment, the controller 130 includes a motor controller 130b.

[039] As shown in Figure 2, the vehicle control unit 130a and the motor controller 130b are capable of performing the function of the controller without deviating from their routine function. Said otherwise, the controller 130 is replaceable with either or both the vehicle

control unit 130a and the motor controller 130b. It is also possible that the vehicle control unit 130a replaces the controller 130 for some functions of the controller 130, while the motor controller 130b replaces the controller 130 for the remaining functions of the controller 130.

[040] Accordingly, as shown in Figure 2, the vehicle control unit 130a is coupled with the motor 120, the user-operable input device 110, the battery pack 140, the motor controller 130b, the navigation module 170, and the ride mode selection switch 180. Similarly, the motor controller 130b is coupled with motor 120, the battery pack 140, the vehicle control unit 130a, the throttle sensor 150, and the brake sensor 160.

[041] In an embodiment, the control unit 130 is configured to receive an input signal corresponding to the regenerative mode selected by the user; receive a vehicle parameter; and enable or disable the regenerative braking for controlling operation of the motor 120 based on the regenerative mode selected by the user and the vehicle parameter.

[042] In the present context, the vehicle parameter includes a state of charge, a temperature, and a fault condition of the battery pack 140, the throttle position from the throttle sensor 150, and the brake position from the brake sensor 160.

[043] In an embodiment, the present invention allows the user to select between a high regenerative mode, a low regenerative mode, and a no regenerative mode using the user-operable input device 110.

[044] During the high regenerative mode, the motor 120 is configured to supply a current more than a predefined regenerative current during the regenerative braking. Similarly, during the low regenerative mode, the motor 120 is configured to supply a current less than the predefined regenerative current during the regenerative braking.

[045] As described hereinbefore, the controller 130 is configured to enable or disable the regenerative braking for controlling operation of the motor 120 based on the regenerative mode selected by the user and the vehicle parameter. In this regard, reference is now made to Figures 3, 3a, 3b and 3c which illustrate configuration of the system 100 and a method for selectively operating the regenerative braking in the vehicle. As shown in Figure 3, at step 301, the user-operable input device 110 is configured to select the regenerative mode. Said otherwise, the user selects the regenerative mode from the available options of high regenerative mode, low regenerative mode and no regenerative mode.

[046] Subsequently, at step 302, the controller 130 receives the input signal corresponding to the regenerative mode selected by the user.

[047] Meanwhile, at step 303, the controller 130 receives the vehicle parameter. Thereafter, at step 304, the controller 130 enables or disables the regenerative braking for controlling operation of the motor 120 based on the regenerative mode selected by the user and the vehicle parameter.

[048] Referring to Figure 3a, at step 304c, the controller 130 disables regenerative braking when the no regenerative braking mode is selected by the user from the user-operable input device 110.

[049] Otherwise, at step 304b, the motor 120 supplies current more than the predefined regenerative current during regenerative braking when the regenerative mode is the high regenerative mode. If the user selects the low regenerative mode, the motor 120 supplies current less than the predefined regenerative current. This is shown at step 304a.

[050] Subsequently, the motor 120 supplies the electrical power to the battery pack 140 during the regenerative braking, i.e. as per the regenerative mode selected by the user.

[051] Referring to Figure 3b, when the vehicle parameter includes the state of charge, the temperature, and the fault condition of the battery pack (140), as shown at step 307, the controller 130 monitors the state of charge, the temperature, and the fault condition of the battery pack (140). Thereafter, at step 308, the controller 130, controls the operation of the motor 120 to supply a predetermined charging current from the motor 120 to the battery pack 140 during the regenerative braking if the state of charge is less than a predefined value, the temperature is less than a predefined temperature, and the fault condition is absent.

[052] The predefined value of the state of charge corresponds to the battery pack 140 being sufficiently charged. Similarly, the predefined temperature of the battery pack 140 is 60 degree Celsius.

[053] Referring to Figure 3c, when the vehicle parameter includes the throttle position, as shown at step 309, the throttle sensor 150 generates the throttle signal corresponding to the throttle position. At step 310, the controller 130 receives the throttle signal. Thereafter, at step 311, the controller 130 enables the regenerative braking based on the throttle position and the regenerative mode selected by the user.

[054] Similarly, when the vehicle parameter includes the brake position, as shown at step 312, the brake sensor 160 generates the brake signal corresponding to the brake position. At step 313, the controller 130 receives the brake signal from the brake sensor 160. Thereafter, at step 314, the control unit 130 enables the regenerative braking based on the brake position and the regenerative mode selected by the user.

[055] At step 315, the ride mode selection switch 180 generates the ride mode selection signal. The ride mode selection signal corresponds to the selected ride mode of the vehicle. The controller 130 receives the ride mode selection signal at step 316.

Subsequently, at step 317, the controller 130 enables the regenerative braking based on the regenerative mode selected by the user, the vehicle parameter, and the selected ride mode of the vehicle.

[056] In an embodiment, based on the ride mode selected by the user, for instance power mode or economy mode, the options to select the regenerative mode may be restricted by the controller 130. For example, in case of power mode, the regenerative mode allowed for the user selection may be no regenerative braking mode and high regenerative braking mode. Similarly, for economy mode, the regenerative mode allowed for the user selection may be no regenerative braking mode, high regenerative braking mode, and low regenerative braking mode.

[057] At step 318, the controller 130 is also configured to receive the navigation signal from the navigation module 170. The navigation signal corresponding to the geographical path between the first location and the second location.

[058] Subsequently, at step 319, the controller 130 enables the regenerative braking based on the regenerative mode selected by the user, the vehicle parameter, and the geographical path.

[059] In an embodiment, based on the geographical path between the first location and the second location, the regenerative modes are enabled by the controller 130 to ensure that the vehicle performance is as expected by the user.

[060] At step 306, the controller 130 is configured to display one or more vehicular information on the user-operable input device 110, particularly the instrument cluster 110a. The vehicular information can be selected from the ride mode of the vehicle, a speed of the vehicle, the regenerative mode, multimedia features and the geographical path between the first location and the second location.

[061] When the user-operable input device 110 is the mobile device 110b, the controller 130 is configured to communicate with the mobile device 110b using a short-range wireless communication. The short-range wireless communication includes, but is not limited to, Bluetooth. The mobile device 110b includes an application, for instance a mobile application. The user can create a profile in the mobile application basis which the regenerative modes are enabled by the controller 130.

[062] Advantageously, the present invention provides for selectively operating the regenerative braking by allowing the user to enable or disable the regenerative braking. Therefore, the user can select the suitable regenerative mode as per his requirement and make his drive comfortable.

[063] Further, the present invention also allows enabling the regenerative braking as per the ride mode or the geographical path set by the user, thereby providing an additional room for the user to utilize the features more efficiently.

[064] Moreover, the present invention also ensures no sudden jerk or change in driving comfort is experienced by the user while making the selection between the regenerative modes.

[065] While the present invention has been described with respect to certain embodiments, it will be apparent to those skilled in the art that various changes and modification may be made without departing from the scope of the invention as defined in the following claims.

CLAIMS:

1. A system (100) for selectively operating regenerative braking in a vehicle, the system comprising:

   a user-operable input device (110) for selecting a regenerative mode;

   a motor (120) for driving the vehicle; and

   a controller (130) coupled with the motor (120) and the user-operable input device (110), the controller (130) configured to:

   receive an input signal corresponding to the regenerative mode selected by a user;

   receive a vehicle parameter; and

   enable or disable the regenerative braking for controlling operation of the motor (120) based on the regenerative mode selected by the user and the vehicle parameter.

2. The system as claimed in claim 1, wherein the regenerative mode comprises a high regenerative mode whereby the motor (120) supplies a current more than a predefined regenerative current during the regenerative braking.

3. The system as claimed in claim 2, wherein the regenerative mode comprises a low regenerative mode whereby the motor (120) supplies a current less than the predefined regenerative current during the regenerative braking.

4. The system as claimed in claim 1, comprising a battery pack (140) for supplying electrical power to the motor (120) to drive the vehicle, the motor (120) configured to supply electrical power to the battery pack (140) during regenerative braking.

5. The system as claimed in claim 4, wherein the vehicle parameter comprises a state of charge, a temperature, and a fault condition of the battery pack (140), the controller (130) configured to: monitor the state of charge, the temperature, and the fault condition of the battery pack (140); and

control operation of the motor (120) to supply a predetermined charging current from the motor (120) to the battery pack (140) during the regenerative braking if: the state of charge is less than a predefined value, the temperature is less than a predefined temperature, and the fault condition is absent; wherein the predefined temperature is 60 degree Celsius.

6. The system as claimed in claims 2 to 5, wherein the predefined regenerative current is equal to the predetermined charging current.

7. The system as claimed in claim 1, wherein the vehicle parameter comprises a throttle position, the throttle position determined from a throttle signal generated by a throttle sensor (150).

8. The system as claimed in claim 7, wherein the controller (130) is configured to:

receive the throttle signal; and

enable the regenerative braking based on the throttle position corresponding to the throttle signal and the regenerative mode selected by the user.

9. The system as claimed in claim 1, wherein the vehicle parameter comprises a brake position, the brake position determined from a brake signal generated by a brake sensor (160).

10. The system as claimed in claim 9, wherein the controller (130) is configured to:

receive the brake signal; and

enable the regenerative braking based on the brake position corresponding to the brake signal and the regenerative mode selected by the user.

11. The system as claimed in claim 1, wherein the controller (130) is configured to disable regenerative braking when a no regenerative braking mode is selected by the user from the user-operable input device (110).

12. The system as claimed in claim 1, wherein the user-operable input device (110) is selected from an instrument cluster (110a), a mobile device (110b), and a switch (110c).

13. The system as claimed in claim 12, wherein the controller (130) is configured to display one or more vehicular information on the instrument cluster (110a), the vehicular information selected from a ride mode of the vehicle, a speed of the vehicle, the regenerative mode, multimedia features and a geographical path between a first location and a second location.

14. The system as claimed in claim 1, comprising a navigation module (170) for navigating the vehicle from a first location to a second location, the navigation module (170) coupled with the controller (130) and the controller (130) configured to:
receive, from the navigation module (170), a navigation signal corresponding to a geographical path between the first location and the second location, and
enable the regenerative braking based on the regenerative mode selected by the user, the vehicle parameter, and the geographical path.

15. The system as claimed in claim 1, comprising a ride mode selection switch (180) for selecting a ride mode of the vehicle by the user, the ride mode selection switch (180) coupled with the controller (130) and the controller (130) configured to:
receive, from the ride mode selection switch (180), a ride mode selection signal corresponding to the selected ride mode of the vehicle, and
enable the regenerative braking based on the regenerative mode selected by the user, the vehicle parameter, and the selected ride mode of the vehicle.

16. The system as claimed in any of the preceding claims, wherein the controller (130) comprises a vehicle control unit (130a).

17. The system as claimed in claims 1 to 15, wherein the controller (130) comprises a motor controller (130b).

18. A method for selectively operating regenerative braking in a vehicle, said method comprising:

selecting (301), by a user-operable input device (110), a regenerative mode;

receiving (302), by a controller (130), an input signal corresponding to the regenerative mode selected by a user, the controller (130) being coupled with the user-operable input device (110) and a motor (120) for driving the vehicle;

receiving (303), by the controller (130), a vehicle parameter; and

enabling or disabling (304), by the controller (130), the regenerative braking for controlling operation of the motor (120) based on the regenerative mode selected by the user and the vehicle parameter.

19. The method as claimed in claim 18, comprising the step of supplying (304b), by the motor (130), a current more than a predefined regenerative current during regenerative braking when the regenerative mode comprises a high regenerative mode.

20. The method as claimed in claim 19, comprising the step of supplying (304a), by the motor (130), a current less than the predefined regenerative current during regenerative braking when the regenerative mode comprises a low regenerative mode.

21. The method as claimed in claim 18, comprising the step of supplying (305), by the motor (130), electrical power to a battery pack (140) during regenerative braking.

22. The method as claimed in claim 21, wherein the vehicle parameter comprises a state of charge, a temperature, and a fault condition of the battery pack (140), and the method comprises the steps of:

monitoring (307), by the controller (130), the state of charge, the temperature, and the fault condition of the battery pack (140); and

controlling (308) operation of the motor (120), by the controller (130), to supply a predetermined charging current from the motor (120) to the battery pack (140) during the regenerative braking if the state of charge is less than a predefined value, the temperature is less than a predefined temperature, and the fault condition is absent, wherein the predefined temperature is 60 degree Celsius.

23. The method as claimed in claim 18, wherein the vehicle parameter comprises a throttle position, and the method comprises the steps of:

generating (309), by a throttle sensor (150), a throttle signal corresponding to the throttle position;

receiving (310), by the controller (130), the throttle signal; and

enabling (311), by the controller (130), the regenerative braking based on the throttle position and the regenerative mode selected by the user.

24. The method as claimed in claim 18, wherein the vehicle parameter comprises a brake position, and the method comprises the steps of:

generating (312), by a brake sensor (160), a brake signal corresponding to the brake position;

receiving (313), by the controller (130), the brake signal; and

enabling (314), by the controller (130), the regenerative braking based on the brake position and the regenerative mode selected by the user.

25. The method as claimed in claim 18, comprising the step of disabling (304c), by the controller (130), regenerative braking when a no regenerative braking mode is selected by the user from the user-operable input device (110).

26. The method as claimed in claim 18, comprising the steps of:

receiving (318), by the controller (130), a navigation signal from a navigation module (170) coupled with the controller (130), the navigation signal corresponding to a geographical path between a first location and a second location; and

enabling (319), by the controller (130), the regenerative braking based on the regenerative mode selected by the user, the vehicle parameter, and the geographical path.

27. The method as claimed in claim 18, comprising the steps of:

generating (315), from a ride mode selection switch (180) for selecting a ride mode of the vehicle by the user, a ride mode selection signal, the ride mode selection switch (180) coupled with the controller (130);

receiving (316), by the controller (130), the ride mode selection signal corresponding to the selected ride mode of the vehicle, and

enabling (317), by the controller (130), the regenerative braking based on the regenerative mode selected by the user, the vehicle parameter, and the selected ride mode of the vehicle.

28. The method as claimed in claim 18, wherein the user-operable input device (110) is selected from an instrument cluster (110a), a mobile device (110b), and a switch (110c).

29. The method as claimed in claim 28, comprising the step of displaying (306), by the controller (130), one or more vehicular information on the instrument cluster (110a), the vehicular information selected from a ride mode of the vehicle, a speed of the vehicle, the regenerative mode, multimedia features and a geographical path between a first location and a second location.

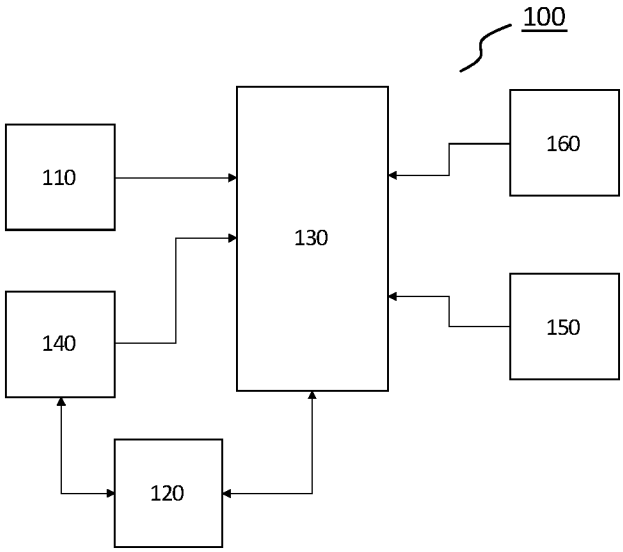


Figure 1

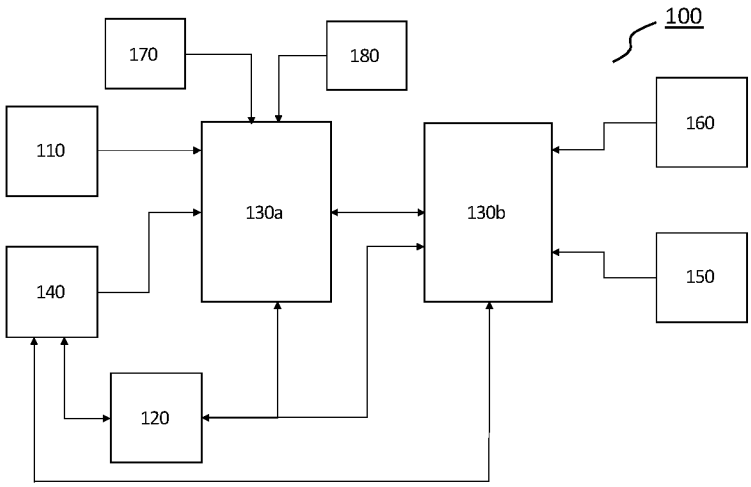


Figure 2

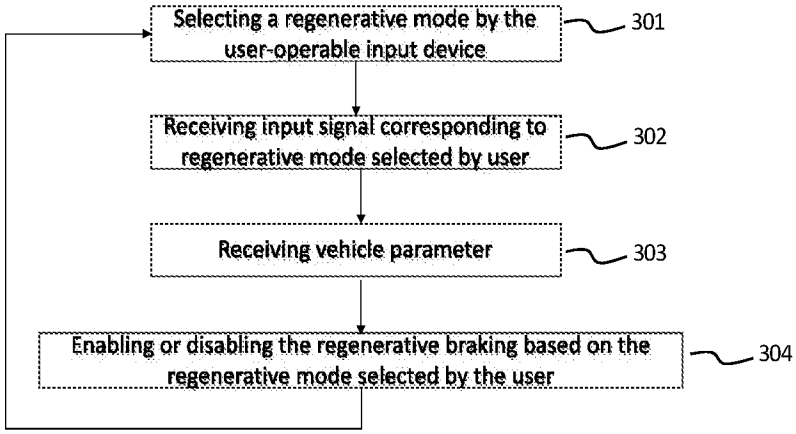

Selecting a regenerative mode by the user-operable input device
301
Receiving input signal corresponding to regenerative mode selected by user
302
Receiving vehicle parameter
303
Enabling or disabling the regenerative braking based on the regenerative mode selected by the user
304

Figure 3

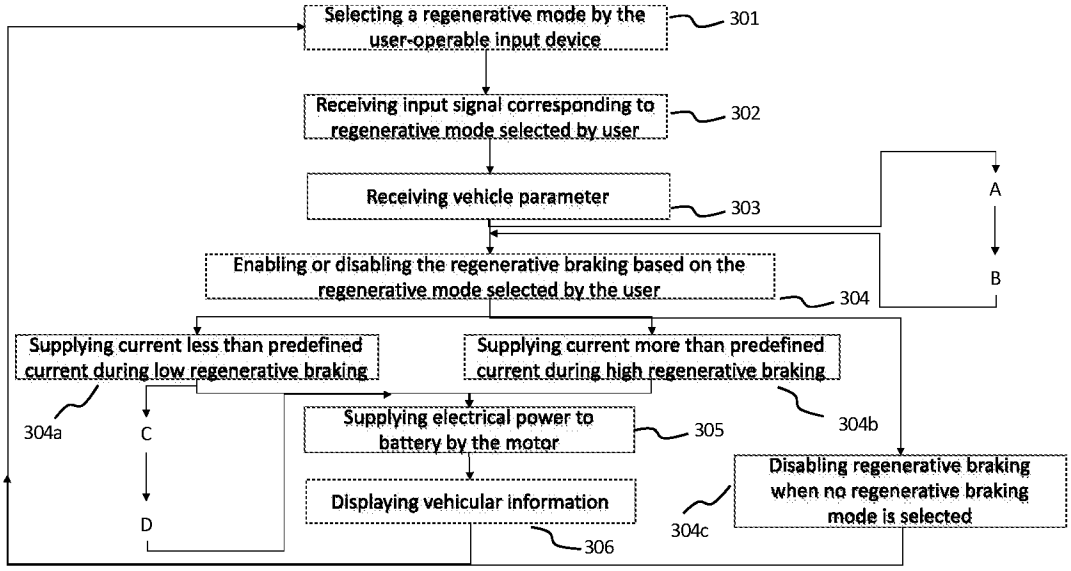

Selecting a regenerative mode by the user-operable input device
301
Receiving input signal corresponding to regenerative mode selected by user
302
Receiving vehicle parameter
303
A
B
Enabling or disabling the regenerative braking based on the regenerative mode selected by the user
304
Supplying current less than predefined current during low regenerative braking
304a
C
D
Supplying current more than predefined current during high regenerative braking
304b
Supplying electrical power to battery by the motor
305
Displaying vehicular information
306
Disabling regenerative braking when no regenerative braking mode is selected
304c

Figure 3a

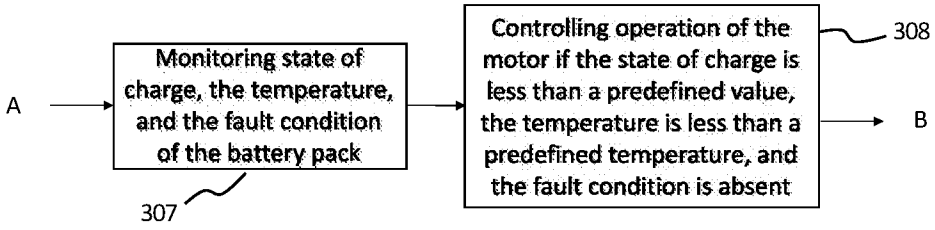

A
Monitoring state of charge, the temperature, and the fault condition of the battery pack
307
Controlling operation of the motor if the state of charge is less than a predefined value, the temperature is less than a predefined temperature, and the fault condition is absent
308
B

Figure 3b

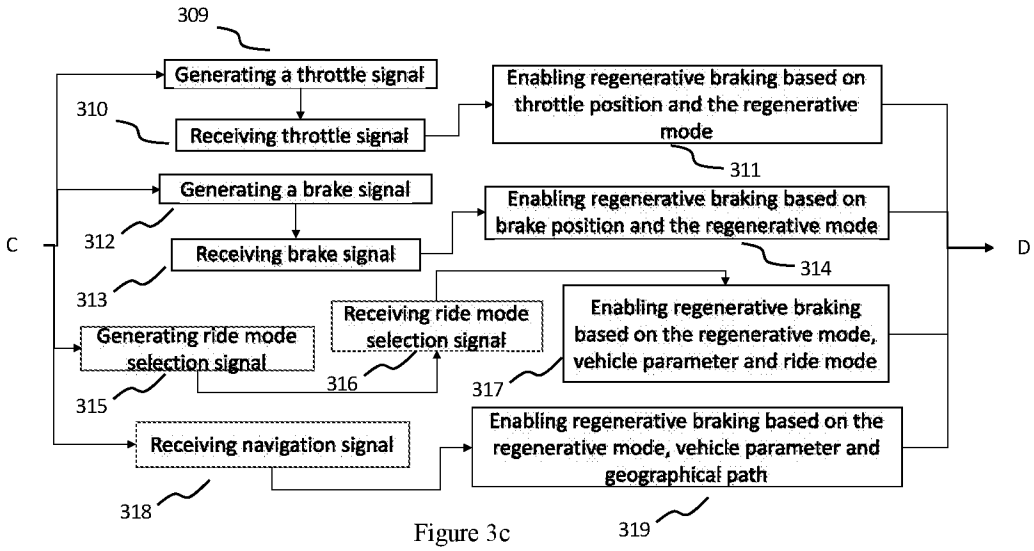

309
Generating a throttle signal
310
Receiving throttle signal
Enabling regenerative braking based on throttle position and the regenerative mode
311
Generating a brake signal
312
Receiving brake signal
Enabling regenerative braking based on brake position and the regenerative mode
314
C
D
313
Receiving ride mode selection signal
Generating ride mode selection signal
315
316
317
Enabling regenerative braking based on the regenerative mode, vehicle parameter and ride mode
Receiving navigation signal
318
Enabling regenerative braking based on the regenerative mode, vehicle parameter and geographical path
319

Figure 3c

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2022/050127

A. CLASSIFICATION OF SUBJECT MATTER
B60L7/10,B60W10/04,B60L15/20 Version=2022.01

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)

B60L,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)

DATABASES: PatSeer, IPO Internal Database, Google Patents.
KEYWORDS:regenerative,braking,input,throttle,SOC,parameters,user,sensor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US20120138375A1 (GP TECHNOLOGY AND INNOVATION LTD) 07 JUNE 2012 (07-06-2012) (ABSTRACT; FIGURES 1C-5B; PARAGRAPHS [0024], [0029], [0031], [0036]-[0038], [0041]-[0043], [0059]; CLAIMS 1-12.	1-29
A	US20180244249A1 (HYUNDAI MOTOR CO ET AL.) 30 AUGUST 2018 (30-08-2018) ABSTRACT; FIGURES 3-6; PARAGRAPHS [0028]-[0046], [0059]-[0063]; CLAIMS 1, 6.	1-29
A	US20170151876A1 (SUBARU CORP) 01 JUNE 2017 (01-06-2017) ABSTRACT; FIGURES 1-11; PARAGRAPHS [0036]-[0041], [0053]-[0054]; CLAIMS 1-14.	1-29

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18-05-2022	18-05-2022
Name and mailing address of the ISA/ Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Authorized officer Rahul Dhakad Telephone No. +91-1125300200

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IN2022/050127

Citation	Pub.Date	Family	Pub.Date
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