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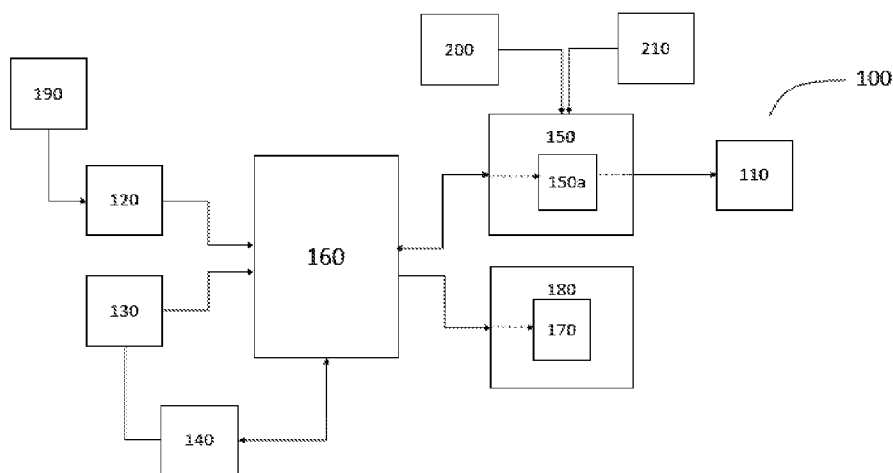


Figure 1

(57) **Abstract:** The present invention is directed to a system (100) for controlling a headlamp (110) of a vehicle includes: an Idle Stop Start (ISS) module (120) configured to: monitor a vehicle stop condition; and generate an engine stop signal when the vehicle stop condition is satisfied; an alternator (130); a headlamp driver module (150) having a PWM signal module (150a) configured to generate one or more PWM signals; and a control unit (160) coupled with the ISS module (120), the alternator (130) and the headlamp driver module (150), configured to: receive the engine stop signal; monitor status of the alternator (130); and generate a headlamp signal upon receipt of the engine stop signal or if a fault is detected in the alternator (130), the headlamp signal allows the headlamp driver module (150) to control the headlamp (110) with the one or more PWM signals.



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TITLE OF INVENTION**A System for Controlling a Headlamp of a Vehicle and Method Thereof****FIELD OF THE INVENTION**

[001] The present invention relates to a system for controlling a headlamp of a vehicle and method thereof.

BACKGROUND OF THE INVENTION

5 [002] Electrical components of a vehicle are generally powered by a battery. In this regard, an alternator is provided in the vehicle to charge the battery. The alternator is coupled with an engine and generates electricity for charging the battery. Accordingly, any malfunction in the alternator inhibits the battery from charging. As a result, certain electrical components such as a headlamp is ideally switched OFF as soon as the malfunction is
10 detected. Such action avoids drainage of the battery. However, particularly during night, such sudden switching OFF the headlamp generally causes inconvenience to a user who may also panic. Also, such action may lead to accidents.

[003] On the other hand in case the headlamp is allowed to remain in an ON state when the alternator malfunctions the headlamp will drain the battery which is undesirable. The
15 headlamp being continuously ON has been noticed even when the vehicle is in idling condition as well as when the vehicle is stationary but ignition is ON. In either of the conditions the battery is drained thereby affecting its lifespan which eventually results in difficulty in starting the vehicle by an electric start switch. This subsequently adds to the rider's inconvenience.

[004] In vehicles which include an Idle Start Stop (ISS) module, the increased load on battery due to malfunction of the alternator may also cause trouble in restarting the vehicle in ISS mode. Moreover, due to drainage of the battery, ISS mode of the vehicle may not be displayed to a user. This may cause inconvenience to the user, who is unaware of the fact that the vehicle is no longer in the ISS mode, and is constantly trying to use the ISS mode to restart the vehicle, thereby wasting his time and efforts in doing so.

[005] Other systems which control headlamp, for instance, by means of a seat switch are also susceptible to failure, particularly while operating the vehicle in harsh driving conditions. There also exist systems wherein a dedicated headlamp switch is used for controlling intensity of the headlamp. However, such dedicated switch has several limitations. For instance, the dedicated switch consumes ample space on handlebar of the vehicle, which might affect the overall aesthetics of the vehicle. Moreover, the dedicated switch would require an additional circuit, thereby increasing the overall cost of the vehicle. Further, installation of the dedicated switch and its corresponding circuit will result in increased assembly time and require maintenance as well.

[006] Thus, there is a need in the art for a system for controlling a headlamp of 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 controlling a headlamp of a vehicle. The system includes an Idle Stop Start (ISS) module, an alternator coupled with an engine, a headlamp driver module connected to the headlamp, and a control unit. The ISS module is configured to: monitor a vehicle stop condition; and

generate an engine stop signal when the vehicle stop condition is satisfied. The headlamp driver module has a PWM signal module configured to generate one or more PWM signals. The control unit is coupled with the ISS module, the alternator, and the headlamp driver module. The control unit is configured to: receive the engine stop signal; monitor status of the alternator; and generate a headlamp signal upon receipt of the engine stop signal or if a fault is detected in the alternator, the headlamp signal allows the headlamp driver module to control the headlamp with one or more PWM signals. The one or more PWM signals are generated by the PWM signal module.

[008] In an embodiment of the invention, the ISS module is configured to generate the engine stop signal for a first predetermined time (t_{PDT1}). The vehicle enters into an ISS mode when the engine stop signal is generated by the ISS module and the engine is stopped.

[009] In another embodiment of the invention, the system also includes an ISS indicator coupled with the control unit. The control unit is configured to illuminate the ISS indicator upon receipt of the engine stop signal. The ISS indicator in an illuminated state indicates that the vehicle is in the ISS mode. The ISS indicator is disposed in a speedometer.

[010] In yet another embodiment of the invention, the ISS module is configured to generate a start signal during the ISS mode if a vehicle start condition is satisfied. The vehicle exits from the ISS mode when the start signal is generated by the ISS module and the engine is started.

[011] In still another embodiment of the invention, the vehicle remains in the ISS mode for the first predetermined time (t_{PDT1}). In one embodiment of the invention, the first predetermined time (t_{PDT1}) includes a first time slot (t_1), and a second time slot (t_2). The

second time slot (t_2) starts after the first time slot (t_1) has elapsed. The sum of the first time slot (t_1) and the second time (t_2) slot is equal to the first predetermined time (t_{PDT1}).

[012] In a further embodiment of the invention, the PWM signal module is configured to generate the one or more PWM signals with variable duty cycles during the first time slot, thereby controlling intensity of the headlamp. The PWM signal module is also configured to generate the one or more PWM signals with decreasing duty cycle during the first time slot (t_1) whereby the intensity of the headlamp decreases during the first time slot (t_1). The decreasing intensity of the headlamp indicates that the first predetermined time (t_{PDT1}) will elapse, and the vehicle will exit the ISS mode.

[013] In still further embodiment of the invention, the headlamp driver module is configured to switch OFF the headlamp during the second time slot (t_2) indicating that the vehicle will exit the ISS mode after the second time slot (t_2) by switching OFF the headlamp.

[014] In still another embodiment of the invention, the ISS module is configured to generate a first signal for a second predetermined time (t_{PDT2}) prior to the engine stop signal. The first signal is generated when the vehicle stop condition is satisfied. The control unit is configured to: receive the first signal; monitor the status of the alternator; and generate the headlamp signal upon receipt of the first signal or if the fault is detected in the alternator. The headlamp signal allows the headlamp driver module to control the headlamp. The one or more PWM signals are generated by the PWM signal module.

[015] In yet another embodiment of the invention, the vehicle enters the ISS mode after the elapse of the second predetermined time (t_{PDT2}).

[016] In a further embodiment of the invention, the control unit is configured to illuminate the ISS indicator upon receipt of the first signal. The ISS indicator in the illuminated state indicates that the vehicle stop condition is satisfied. The control unit is configured to blink the ISS indicator for the second predetermined time (t_{PDT2}) indicating that the vehicle stop condition is satisfied and the vehicle will enter into the ISS mode after the second predetermined time (t_{PDT2}). The ISS indicator blinks at a predetermined frequency.

[017] In another embodiment of the invention, the control unit includes the ISS module and the headlamp driver module.

[018] In yet another embodiment of the invention, the control unit includes an Engine Control Unit (ECU).

[019] In still another embodiment of the invention, the alternator is an Integrated Starter Generator (ISG) machine. The control unit includes an ISG controller coupled with the ISG machine.

[020] In a further embodiment of the invention, the vehicle stop condition includes comparing at least a speed of the vehicle (V_s) from a speed sensor with a predetermined speed of the vehicle (V_1).

[021] In a still further embodiment of the invention, the system also includes a Light Dependent Resistor (LDR) coupled with the headlamp driver module. The LDR activates the headlamp driver module in night conditions and deactivates the headlamp driver module in day conditions.

[022] In another embodiment of the invention, the headlamp driver module is coupled with a speedometer clock. The headlamp driver module is configured to: receive a time of a day

from the speedometer clock; and switch ON the headlamp only if the time falls between a predetermined range of time.

[023] In another aspect, the present invention is directed to a method for controlling a headlamp of a vehicle. The method includes the steps of: monitoring, by an Idle Stop Start (ISS) module, a vehicle stop condition; and generating, by the ISS module, an engine stop signal when the vehicle stop condition is satisfied. The method also includes the steps of: receiving, by a control unit, the engine stop signal; monitoring, by the control unit, status of an alternator; and generating, by the control unit, a headlamp signal upon receipt of the engine stop signal or if a fault is detected in the alternator. The headlamp signal allows a headlamp driver module to control the headlamp with one or more PWM signals. The one or more PWM signals are generated by a PWM signal module.

[024] In an embodiment of the invention, the method also includes the step of generating, by the ISS module, the engine stop signal for a first predetermined time (t_{PDT1}). The vehicle enters into an ISS mode when the engine stop signal is generated by the ISS module and an engine is stopped.

[025] In another embodiment of the invention, the method also includes the step of illuminating, by the control unit, an ISS indicator upon receipt of the engine stop signal. The ISS indicator in an illuminated state indicates that the vehicle is in the ISS mode.

[026] In still another embodiment of the invention, the method further includes the step of generating, by the ISS module, a start signal during the ISS mode if a vehicle start condition is satisfied. The vehicle exits from the ISS mode when the start signal is generated by the ISS module and the engine is started.

[027] In yet another embodiment of the invention, the vehicle remains in the ISS mode for the first predetermined time (t_{PDT1}). The first predetermined time (t_{PDT1}) includes a first time slot ($t1$), and a second time slot ($t2$). The second time slot ($t2$) starts after the first time slot ($t1$) has elapsed. The sum of the first time slot ($t1$) and the second time ($t2$) slot is equal to
5 the first predetermined time (t_{PDT1}).

[028] In still another embodiment of the invention, the method also includes the step of generating, by the PWM signal module, the one or more PWM signals with variable duty cycles during the first time slot ($t1$), thereby controlling intensity of the headlamp.

[029] In a further embodiment of the invention, the method also includes the step of
10 generating, by the PWM signal module, the one or more PWM signals with decreasing duty cycle during the first time slot ($t1$) whereby the intensity of the headlamp decreases during the first time slot ($t1$). The decreasing intensity of the headlamp indicates that the first predetermined time (t_{PDT1}) will elapse, and the vehicle will exit the ISS mode.

[030] In a still further embodiment of the invention, the method includes the step of
15 switching OFF, by the headlamp driver module, the headlamp during the second time slot ($t2$) indicating that the vehicle will exit the ISS mode after the second time slot ($t2$) by switching OFF the headlamp.

[031] In another embodiment, the method also includes the step of generating, by the ISS module, a first signal for a second predetermined time (t_{PDT2}) prior to the engine stop
20 signal. The first signal is generated when the vehicle stop condition is satisfied. The vehicle enters the ISS mode after the elapse of the second predetermined time (t_{PDT2}).

[032] In yet another embodiment of the invention, the method further includes the steps of: receiving, by the control unit, the first signal; monitoring, by the control unit, the status of

the alternator; and generating, by the control unit, the headlamp signal upon receipt of the first signal or if the fault is detected in the alternator. The headlamp signal allows the headlamp driver module to control the headlamp with the one or more PWM signals. The one or more PWM signals are generated by the PWM signal module.

5 [033] In still another embodiment of the invention, the method includes the step of illuminating, by the control unit, the ISS indicator upon receipt of the first signal. The ISS indicator in the illuminated state indicates that the vehicle stop condition is satisfied.

[034] In a further embodiment of the invention, the method includes the step of blinking, by the control unit, the ISS indicator for the second predetermined time (t_{PDT2}) indicating
10 that the vehicle stop condition is satisfied and the vehicle will enter into the ISS mode after the second predetermined time (t_{PDT2}). The ISS indicator blinks at a predetermined frequency.

[035] In a still further embodiment of the invention, the method also includes the step of activating, by a Light Dependent Resistor (LDR), the headlamp driver module in night
15 conditions, and deactivating, by the LDR, the headlamp driver module in day conditions.

[036] In another embodiment of the invention, the method includes the step of: receiving, by the headlamp driver module, a time of a day from a speedometer clock; and switching ON, by the headlamp driver module, the headlamp only if the time falls between a predetermined range of time.

20

BRIEF DESCRIPTION OF THE DRAWINGS

[037] 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 controlling a headlamp of a vehicle in accordance
5 with an embodiment of the present invention.

Figure 2 illustrates the system of Figure 1 with a control unit having an Idle Stop Start (ISS) module and a headlamp driver module in accordance with an embodiment of the present invention.

Figure 3 illustrates a method for controlling a headlamp of the vehicle in accordance
10 with an embodiment of the present invention.

Figure 4 shows detail of the steps illustrated in Figure 3 in accordance with an embodiment of the present invention.

Figure 4a illustrates the steps of Figure 4 with a first signal being generated by an Idle Stop Start (ISS) module prior to an engine stop signal in accordance with an
15 embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[038] 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
20 embodiments, the vehicle is a two wheeled 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.

[039] In one aspect, the present invention relates to a system for controlling a headlamp of a vehicle.

[040] As shown in Figure 1, the system 100 includes an Idle Stop Start (ISS) module 120, an alternator 130 coupled with an engine 140, and a headlamp driver module 150. The headlamp driver module 150 includes a PWM signal module 150a. The PWM signal module 150a is configured to generate one or more PWM signals. The headlamp 110 includes a light emitting diode (LED) for illumination purpose.

[041] The ISS module 120 is configured to: monitor a vehicle stop condition; and generate an engine stop signal when the vehicle stop condition is satisfied. In the present context, the vehicle stop condition requires comparing at least a speed of the vehicle V_s from a speed sensor 190 with a predetermined speed of the vehicle V_1 . In addition to the speed of the vehicle V_s , it is also possible that other parameters of the vehicle are considered for determining the vehicle stop condition. These parameters include, but are not limited to, engine temperature from a temperature sensor, and engine speed from an RPM sensor.

[042] The system also includes a control unit 160 coupled with the ISS module 120, the alternator 130, and the headlamp driver module 150. The system further includes an ISS indicator 170 coupled with the control unit 160, a Light Dependent Resistor (LDR) 200 coupled with the headlamp driver module 150, and a speedometer clock 210 coupled with the headlamp driver module 150.

[043] A constant current driver which regulates current through the LED may also be installed in the control unit 160. The constant current driver ensures accurate output current control regardless of the supply-voltage fluctuations effected by the one or more PWM signals. This reduces the occurrence of LED failure.

[044] In an embodiment, the ISS indicator 170 is disposed in a speedometer 180. Further, the ISS indicator 170 is capable of blinking at a predetermined frequency. LDR 200 is a photoresistor, which is an electronic component that is sensitive to light. Accordingly, the LDR 200 activates the headlamp driver module 150 in night conditions and deactivates the headlamp driver module 150 in day conditions. The speedometer clock 210 keeps a record of time and communicates the time to the headlamp driver module 150. Accordingly, in an embodiment, the headlamp driver module 150 is configured to receive a time of a day from the speedometer clock 210; and switch ON the headlamp 110 only if the time falls between a predetermined range of time. For instance, if the speedometer clock 210 records the time in between 7am to 7pm, the headlamp 110 is turned OFF by the headlamp driver module 150. Embodiments pertaining to the manner in which the headlamp driver module 150 controls the headlamp 110 have been described below.

[045] As shown in Figure 2, the control unit 160 includes the ISS module 120 and the headlamp driver module 150. In one embodiment, the control unit 160 is an Engine Control Unit (ECU).

[046] In another embodiment, the alternator 130 is an Integrated Starter Generator (ISG) machine. Accordingly, in an embodiment, the control unit 160 is an ISG controller coupled with the ISG machine.

[047] The present invention allows controlling the headlamp 110 when an ignition switch (not shown in Figures) is in an ON state. Said otherwise, the ignition switch is required to be actuated by a rider for the vehicle to start and for the system 100 to control the headlamp 110. In this regard, in an embodiment of the invention, the control unit 160 is configured to: receive the engine stop signal; monitor status of the alternator 130; and

generate a headlamp signal upon receipt of the engine stop signal or if a fault is detected in the alternator 130. The headlamp signal allows the headlamp driver module 150 to control the headlamp 110 with the one or more PWM signals. The one or more PWM signals are generated by the PWM signal module 150a.

5 [048] The vehicle enters into an ISS mode when the engine stop signal is generated by the ISS module 120 and the engine 140 is subsequently stopped.

[049] In an embodiment, the vehicle remains in the ISS mode for the first predetermined time t_{PDT1} . In another embodiment, the first predetermined time t_{PDT1} includes a first time slot $t1$ and a second time slot $t2$. The second time slot $t2$ starts after the first time slot $t1$
10 has elapsed. Further, the sum of the first time slot $t1$ and the second time $t2$ slot is equal to the first predetermined time t_{PDT1} . Accordingly, at the end of the second time slot $t2$, the vehicle will exit the ISS mode and the rider will no longer be able to restart the vehicle using the ISS module. Said otherwise, after the second time slot $t2$ elapses, the rider will have to kick start the vehicle or use an electric switch for starting the vehicle.

15 [050] The control unit 160 is also configured to illuminate the ISS indicator 170 upon receipt of the engine stop signal.

[051] In an embodiment, the ISS module 120 is also configured to generate a first signal for a second predetermined time t_{PDT2} prior to the engine stop signal. The first signal is generated when the vehicle stop condition is satisfied.

20 [052] During the second predetermined time t_{PDT2} , the control unit 160 is configured to: receive the first signal; monitor the status of the alternator 130; and generate the headlamp signal upon receipt of the first signal or if the fault is detected in the alternator 130. The headlamp signal allows the headlamp driver module 150 to control the headlamp 110 with

the one or more PWM signals. The one or more PWM signals are generated by the PWM signal module 150a.

[053] In an embodiment, the vehicle enters the ISS mode after the elapse of the second predetermined time t_{PDT2} . Thereafter, during the first predetermined time t_{PDT1} , the vehicle
5 remains in the ISS mode and exits the ISS mode after the first predetermined time t_{PDT1} has elapsed.

[054] In another embodiment, the control unit 160 is configured to illuminate the ISS indicator 170 upon receipt of the first signal. For instance, the control unit 160 is configured to glow the ISS indicator 170 during the first predetermined time t_{PDT1} , thereby indicating to
10 the rider that the vehicle will exit the ISS mode after the first predetermined time t_{PDT1} has elapsed.

[055] As described hereinbefore, the control unit 160 is configured to generate the headlamp signal upon receipt of the engine stop signal or if the fault is detected in the alternator 130. The headlamp signal allows the headlamp driver module 150 to control the
15 headlamp 110 with the one or more PWM signals. In this regard, reference is now made to Figures 3, 4 and 4a which illustrate configuration of the system 100 and a method for controlling the headlamp 110 of the vehicle. As shown in Figure 3, at step 401, the ISS module 120 monitors the vehicle stop condition.

[056] When the vehicle stop condition is satisfied, the ISS module 120 generates the
20 engine stop signal, as shown at step 402. Subsequently, the control unit 160 receives the engine stop signal at step 403.

[057] Meanwhile, the control unit 160 is also monitoring the status of the alternator 130 at step 404. If the alternator 130 malfunctions, the control unit detects the fault and generates

the headlamp signal at step 405. The fault detection by the control unit 160 can be understood by way of an example. For instance, the alternator 130 is the ISG machine. In this case, the fault in the ISG machine would include a missing phase or a disconnected stator. Upon detecting this fault, the control unit 160 generates the headlamp signal at step 405. As is known to a person skilled in the art, such fault in the alternator 130, particularly ISG machine, would result in battery charging being disabled, thereby resulting in an increase in the electrical load on battery.

[058] Advantageously, the present invention controls the headlamp 110 with the one or more PWM signals, thereby ensuring battery is not drained quickly. This results in an extended battery life when compared with the conventional systems.

[059] PWM or Pulse Width Modulation or Pulse Duration Modulation is a method for reducing electrical power delivered through electrical signals by turning switches to ON and OFF state between supply and load at a fast rate. Illumination of the headlamp 110 using the one or more PWM signals is based on a duty cycle which is the fraction of one period depicting the time taken for the headlamp signal to complete an ON and OFF cycle. Thus, the PWM signals ensure that the battery is used judiciously.

[060] Alternately, the headlamp signal is also generated by the control unit 160 upon receiving the engine stop signal from the ISS module 120. Thereafter, the headlamp driver module 150 controls the headlamp 110 with the one or more PWM signals.

[061] Referring to Figure 4 which shows details of the method steps for controlling the headlamp 110 in accordance with an embodiment of the invention.

[062] At step 406, the PWM signal module 150a generates the one or more PWM signals with variable duty cycle during the first time slot t1. The variable duty cycle controls the intensity of the headlamp 110.

[063] In an embodiment, the one or more PWM signals can be generated at step 406 with decreasing duty cycle during the first time slot t1. Thus, the intensity of the headlamp 110 decreases during the first time slot t1. This can be understood by way of an example. For instance, if the first time slot t1 is 7 minutes, the headlamp 110 will illuminate with 75% intensity.

[064] Once the first time slot t1 elapses, the second time slot t2 will start. As shown at step 413, the headlamp 110 is switched OFF by the headlamp driver module 150 after the second time slot t2 has elapsed. Therefore, during the second time slot t2, the headlamp 110 is still controlled by the one or more PWM signals from the PWM signal module 150.

[065] In one embodiment, the intensity of the headlamp 110 can also be varied during the second time slot t2 as well. This can be done by generating the one or more PWM signals with decreasing duty cycle, as described above for the first time slot t1. In fact, the intensity of the headlamp 110 during the second time slot t2 can be lower than the intensity of the headlamp 110 during the first time slot t1, thereby indicating to the rider that the headlamp 110 will be switched OFF after the elapse of second time slot t2. For instance, the headlamp 110 will illuminate with 75% intensity during the first time slot t1 and 25% intensity during the second time slot t2.

[066] During the ISS mode, the rider can also restart the vehicle using the ISS module 120 upon a vehicle start condition being satisfied. For this, the ISS module 120 is configured to generate a start signal during the ISS mode if the vehicle start condition is

satisfied, as shown at step 414. In the present context, the vehicle start condition is monitored by the ISS module, which includes monitoring the parameters of the vehicle, such as but not limited to, throttle position, speed of the vehicle V_s and the engine speed.

[067] Meanwhile, at step 407, the control unit 160 illuminates the ISS indicator 170 upon
5 receiving the engine stop signal. The illumination of the ISS indicator 170 indicates to the rider that the vehicle is in the ISS mode and that the vehicle can be restarted using the ISS module 120 itself. For this, the start signal is generated by the ISS module as shown at step 414. Once the start signal is generated, the vehicle exits from the ISS mode and the engine 140 is started.

10 [068] In an embodiment, the headlamp driver module 150 can be controlled using the LDR 200 as shown at step 415. The LDR 200 can activate the headlamp driver module 150 in the night conditions and deactivate the headlamp driver module 150 in the day conditions.

[069] In another embodiment, as shown at step 416, the headlamp driver module 150 can
15 receive the time of the day from the speedometer clock 210 and control the headlamp 110 if the time falls between the predetermined range of time. In one embodiment, the headlamp 110 is switched ON by the headlamp driver module 150 if the time falls between the predetermined range of time. The predetermined range of time is between 7pm to 7am as per local standard time. Similarly, the headlamp 110 is switched OFF by the headlamp
20 driver module 150 if the time falls beyond the predetermined range of time.

[070] Referring to Figure 4a which shows an embodiment of the present invention in which the first signal is generated prior to the engine stop signal. In one embodiment, the first signal is generated at step 408. As a pre-requisite for generating the first signal, the

vehicle stop conditions should be satisfied, as shown at step 401. The first signal is generated for the second predetermined time t_{PDT2} and the vehicle enters the ISS mode after the second predetermined time t_{PDT2} has elapsed.

[071] Said otherwise, once the second predetermined time t_{PDT2} has elapsed, the ISS
5 module generates the engine stop signal, as shown at step 402.

[072] Similar to the engine stop signal, upon generating the first signal by the ISS module 120, the control unit 160 receives the first signal at step 409. Thereafter, at step 410, the status of the alternator 130 is monitored by the control unit 160.

[073] At step 412, the headlamp signal is generated upon receiving the first signal or if the
10 fault is detected in the alternator 130. The embodiments pertaining to the fault in the alternator 130 and the headlamp signal being generated consequently as in steps 404 and 405 are applicable here as well.

[074] Upon generating the headlamp signal, the headlamp driver module 150 controls the headlamp 110 with the one or more PWM signals generated by the PWM signal module
15 150a.

[075] In an embodiment, at step 411, the ISS indicator 170 illuminates upon receiving the first signal. The illumination of the ISS indicator 170 indicates the rider that the vehicle stop condition is satisfied and the vehicle will enter the ISS mode after the elapse of the second predetermined time t_{PDT2} .

[076] In another embodiment, at step 411a, the control unit 160 blinks the ISS indicator
20 170 for the second predetermined time t_{PDT2} indicating that the vehicle stop condition is satisfied and that the vehicle will enter the ISS mode after the second predetermined time

t_{PDT2} has elapsed. In an embodiment, the control unit 160 is configured to blink the ISS indicator 170 for the predetermined frequency.

[077] Advantageously, the present invention provides for a more efficient controlling of the headlamp 110 using the one or more PWM signals. More importantly, since the headlamp
5 110 intensity can be controlled by varying the duty cycle, the battery discharging rate is reduced.

[078] The present invention also overcomes the requirement of a dedicated headlamp control device or switch and a corresponding circuit for controlling the headlamp 110.

[079] Also, since the ISS indicator 170 illuminates during the engine stop signal as well as
10 the first signal, the rider is kept informed about the ISS mode. Further, the present invention also overcomes the requirement of manually adjusting the intensity of the headlamp 110 by way of the one or more PWM signals which operate on pre-configured intensity based on the duty cycles.

[080] While the present invention has been described with respect to certain
15 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 controlling a headlamp (110) of a vehicle comprising:
an Idle Stop Start (ISS) module (120) configured to: monitor a vehicle stop condition;
and generate an engine stop signal when the vehicle stop condition is satisfied;
5 an alternator (130) coupled with an engine (140);
a headlamp driver module (150) connected to the headlamp (110), the headlamp driver
module (150) having a PWM signal module (150a) configured to generate one or more
PWM signals;
a control unit (160) coupled with the ISS module (120), the alternator (130) and the
10 headlamp driver module (150), the control unit (160) configured to:
receive the engine stop signal;
monitor status of the alternator (130); and
generate a headlamp signal upon receipt of the engine stop signal or if a fault is
detected in the alternator (130), the headlamp signal allows the headlamp driver
15 module (150) to control the headlamp (110) with the one or more PWM signals being
generated by the PWM signal module (150a).
2. The system as claimed in claim 1, wherein the ISS module (120) is configured to
generate the engine stop signal for a first predetermined time (t_{PDT1}), the vehicle enters
20 into an ISS mode when the engine stop signal is generated by the ISS module (120)
and the engine (140) is stopped.
3. The system as claimed in claim 2, comprising an ISS indicator (170) coupled with the
control unit (160) wherein the control unit (160) is configured to illuminate the ISS

indicator (170) upon receipt of the engine stop signal, the ISS indicator (170) in an illuminated state indicates that the vehicle is in the ISS mode.

4. The system as claimed in claim 3, wherein the ISS indicator (170) is disposed in a speedometer (180).
5. The system as claimed in claim 2, wherein the ISS module (120) is configured to generate a start signal during the ISS mode if a vehicle start condition is satisfied, the vehicle exits from the ISS mode when the start signal is generated by the ISS module (120) and the engine (140) is started.
6. The system as claimed in claim 2, wherein the vehicle remains in the ISS mode for the first predetermined time (t_{PDT1}).
7. The system as claimed in claim 6, wherein the first predetermined time (t_{PDT1}) comprises: a first time slot ($t1$); and a second time slot ($t2$), the second time slot ($t2$) starts after the first time slot ($t1$) has elapsed, such that the sum of the first time slot ($t1$) and the second time ($t2$) slot is equal to the first predetermined time (t_{PDT1}).
8. The system as claimed in claim 7, wherein the PWM signal module (150a) is configured to generate the one or more PWM signals with variable duty cycles during the first time slot, thereby controlling intensity of the headlamp (110).
9. The system as claimed in claim 7 and 8, wherein the PWM signal module (150a) is configured to generate the one or more PWM signals with decreasing duty cycle during the first time slot ($t1$) whereby the intensity of the headlamp (110) decreases during the

first time slot (t_1), the decreasing intensity of the headlamp (110) indicates that the first predetermined time (t_{PDT1}) will elapse, and the vehicle will exit the ISS mode.

10. The system as claimed in claim 9, wherein the headlamp driver module (150) is
5 configured to switch OFF the headlamp (110) during the second time slot (t_2) indicating that the vehicle will exit the ISS mode after the second time slot (t_2) by switching OFF the headlamp (110).

11. The system as claimed in claim 1, wherein the ISS module (120) is configured to
10 generate a first signal for a second predetermined time (t_{PDT2}) prior to the engine stop signal, the first signal generated when the vehicle stop condition is satisfied.

12. The system as claimed in claim 11, wherein the control unit (160) is configured to:

receive the first signal;

15 monitor the status of the alternator (130); and

generate the headlamp signal upon receipt of the first signal or if the fault is detected in the alternator (130), the headlamp signal allows the headlamp driver module (150) to control the headlamp (110) with the one or more PWM signals being generated by the PWM signal module (150a).

20 13. The system as claimed in claim 11, wherein the vehicle enters the ISS mode after the elapse of the second predetermined time (t_{PDT2}).

14. The system as claimed in any of the preceding claims, wherein the control unit (160) is
25 configured to illuminate the ISS indicator (170) upon receipt of the first signal, the ISS

indicator (170) in the illuminated state indicates that the vehicle stop condition is satisfied.

15. The system as claimed in claim 11 and 14, wherein the control unit (160) is configured
5 to blink the ISS indicator (170) for the second predetermined time (t_{PDT2}) indicating that the vehicle stop condition is satisfied and the vehicle will enter into the ISS mode after the second predetermined time (t_{PDT2}).

16. The system as claimed in claim 15, wherein the ISS indicator (170) blinks at a
10 predetermined frequency.

17. The system as claimed in claim 1, wherein the control unit (160) comprises the ISS module (120) and the headlamp driver module (150).

18. The system as claimed in claim 1, wherein the control unit (160) comprises an Engine
15 Control Unit (ECU).

19. The system as claimed in claim 1, wherein the alternator (130) is an Integrated Starter
Generator (ISG) machine.

20. The system as claimed in claim 19, wherein the control unit (160) comprises an ISG
20 controller coupled with the ISG machine.

21. The system as claimed in claim 1, wherein the vehicle stop condition comprises
25 comparing at least a speed of the vehicle (V_s) from a speed sensor (190) with a predetermined speed of the vehicle (V_1).

22. The system as claimed in claim 1, comprises a Light Dependent Resistor (LDR) (200) coupled with the headlamp driver module (150), the LDR (200) activates the headlamp driver module (150) in night conditions and deactivates the headlamp driver module (150) in day conditions.

23. The system as claimed in claim 1, wherein the headlamp driver module (150) is coupled with a speedometer clock (210), the headlamp driver module (150) configured to receive a time of a day from the speedometer clock (210); and switch ON the headlamp (110) only if the time falls between a predetermined range of time.

24. A method for controlling a headlamp (110) of a vehicle, said method comprising the steps of:

monitoring (401), by an Idle Stop Start (ISS) module (120), a vehicle stop condition;

generating (402), by the ISS module (120), an engine stop signal when the vehicle stop condition is satisfied,

receiving (403), by a control unit (160), the engine stop signal;

monitoring (404), by the control unit (160), status of an alternator (130); and

generating (405), by the control unit (160), a headlamp signal upon receipt of the

engine stop signal or if a fault is detected in the alternator (130), the headlamp signal allows a headlamp driver module (150) to control the headlamp (110) with one or more PWM signals being generated by a PWM signal module (150a).

25. The method as claimed in claim 24, comprising the step of generating (402), by the ISS module (120), the engine stop signal for a first predetermined time (t_{PDT1}), the vehicle

enters into an ISS mode when the engine stop signal is generated by the ISS module (120) and an engine (140) is stopped.

26. The method as claimed in claim 25, comprising the step of illuminating (407), by the control unit (160), an ISS indicator (170) upon receipt of the engine stop signal, the ISS indicator (170) in an illuminated state indicates that the vehicle is in the ISS mode.

27. The method as claimed in claim 25, comprising the step of generating (414), by the ISS module (120), a start signal during the ISS mode if a vehicle start condition is satisfied, the vehicle exits from the ISS mode when the start signal is generated by the ISS module (120) and the engine (140) is started.

28. The method as claimed in claim 25, wherein the vehicle remains in the ISS mode for the first predetermined time (t_{PDT1}).

29. The method as claimed in claim 28, wherein the first predetermined time (t_{PDT1}) comprises a first time slot ($t1$); and a second time slot ($t2$), the second time slot ($t2$) starts after the first time slot ($t1$) has elapsed, such that the sum of the first time slot ($t1$) and the second time ($t2$) slot is equal to the first predetermined time (t_{PDT1}).

30. The method as claimed in claim 29, comprising the step of generating (406), by the PWM signal module (150a), the one or more PWM signals with variable duty cycles during the first time slot ($t1$), thereby controlling intensity of the headlamp (110).

31. The method as claimed in claim 29 and 30, comprising the step of generating (406), by the PWM signal module (150a), the one or more PWM signals with decreasing duty

cycle during the first time slot (t_1) whereby the intensity of the headlamp (110) decreases during the first time slot (t_1), the decreasing intensity of the headlamp (110) indicates that the first predetermined time (t_{PDT1}) will elapse, and the vehicle will exit the ISS mode.

5 32. The method as claimed in claim 31, comprising the step of switching OFF (413), by the headlamp driver module (150), the headlamp (110) during the second time slot (t_2) indicating that the vehicle will exit the ISS mode after the second time slot (t_2) by switching OFF the headlamp (110).

10 33. The method as claimed in claim 24, comprising the step of generating (408), by the ISS module (120), a first signal for a second predetermined time (t_{PDT2}) prior to the engine stop signal, the first signal generated when the vehicle stop condition is satisfied, wherein the vehicle enters the ISS mode after the elapse of the second predetermined
15 time (t_{PDT2}).

34. The method as claimed in claim 33, comprising the steps of:
receiving (409), by the control unit (160), the first signal;
monitoring (410), by the control unit (160), the status of the alternator (130); and
20 generating (412), by the control unit (160), the headlamp signal upon receipt of the first signal or if the fault is detected in the alternator (130), the headlamp signal allows the headlamp driver module (150) to control the headlamp (110) with the one or more PWM signals being generated by the PWM signal module (150a).

35. The method as claimed in any of the preceding claims, comprising the step of illuminating (411), by the control unit (160), the ISS indicator (170) upon receipt of the first signal, the ISS indicator (170) in the illuminated state indicates that the vehicle stop condition is satisfied.

5 36. The method as claimed in 33 and 35, comprising the step of blinking (411a), by the control unit (160), the ISS indicator (170) for the second predetermined time (t_{PDT2}) indicating that the vehicle stop condition is satisfied and the vehicle will enter into the ISS mode after the second predetermined time (t_{PDT2}),

10 wherein the ISS indicator (170) blinks at a predetermined frequency.

37. The method as claimed in claim 24, comprising the step of activating (415), by a Light Dependent Resistor (LDR) (200), the headlamp driver module (150) in night conditions, and deactivating, by the LDR (200), the headlamp driver module (150) in day
15 conditions.

38. The method as claimed in claim 24, comprising the step of receiving (416), by the headlamp driver module (150), a time of a day from a speedometer clock (210); and switching ON (416), by the headlamp driver module (150), the headlamp (110) only if
20 the time falls between a predetermined range of time.

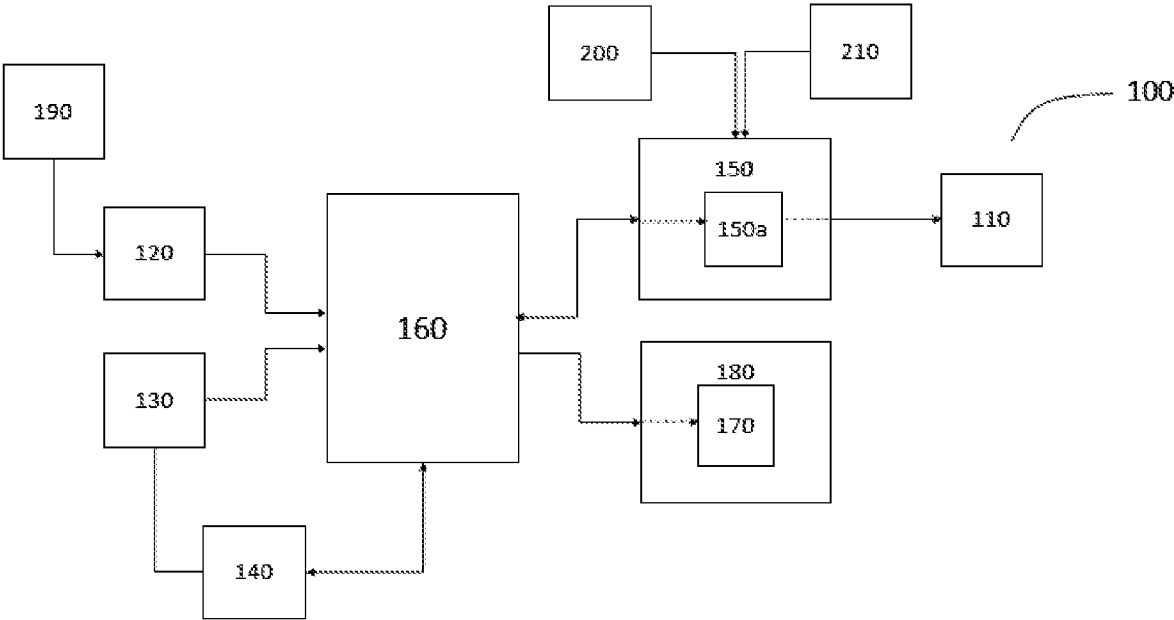


Figure 1

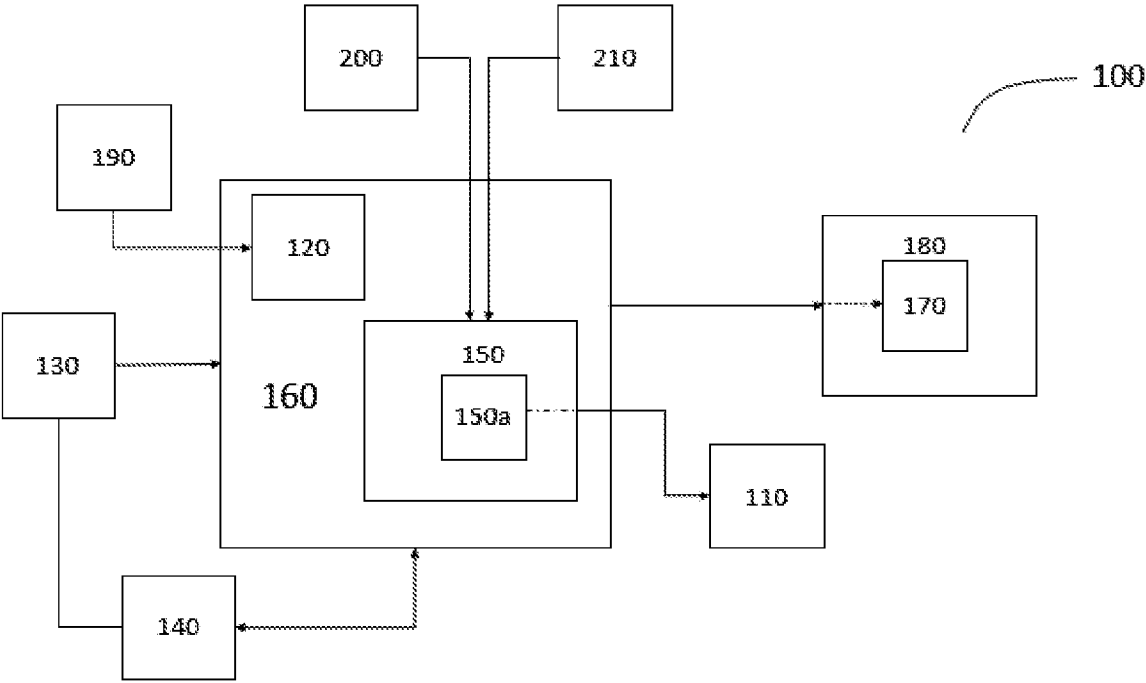


Figure 2

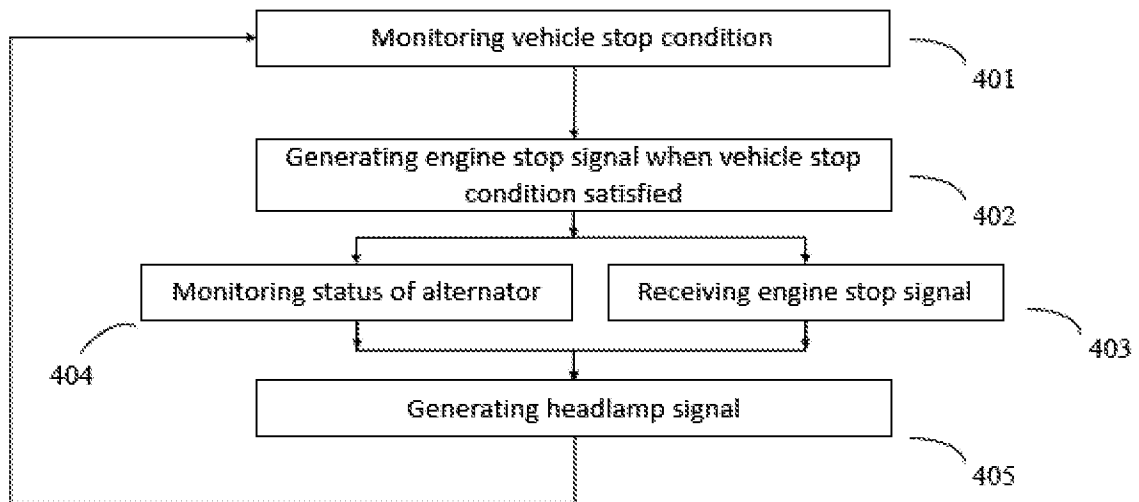


Figure 3

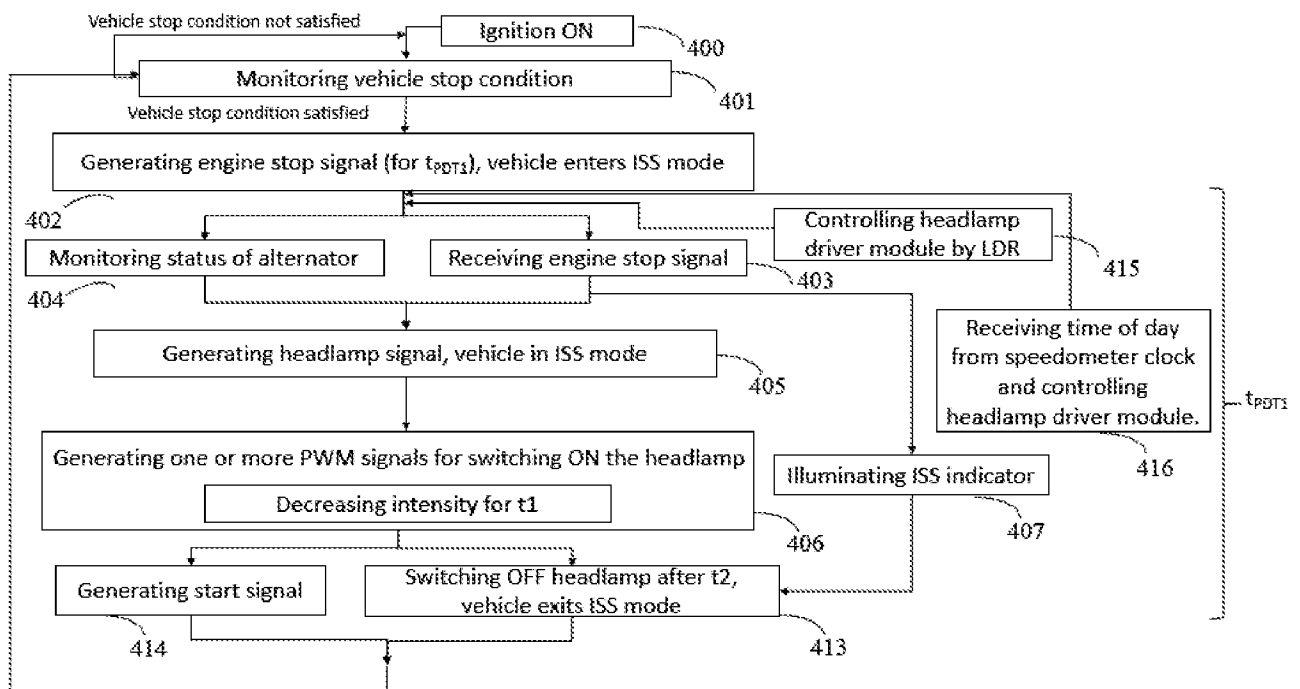


Figure 4

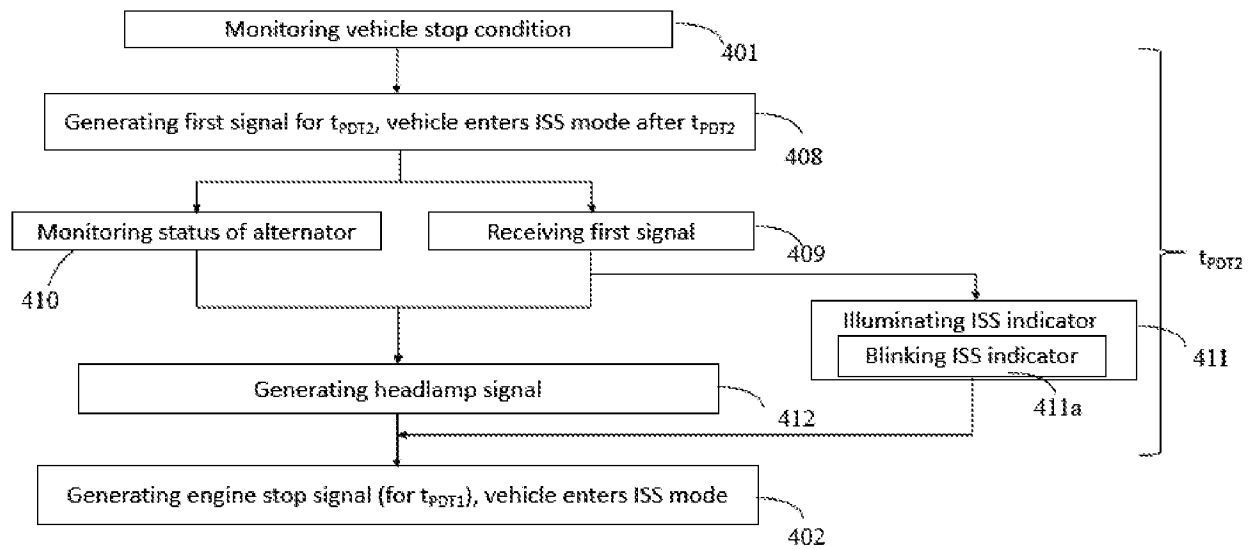


Figure 4a

International application No
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A. CLASSIFICATION OF SUBJECT MATTER INV. F21S41/00 B60W30/18 B60L15/20 F02D29/06 H02J7/14 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) F21S B60R B60W B60L B60Q F02D H02J		
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.
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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "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 27 May 2022		Date of mailing of the international search report 09/06/2022
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Kyriakides, Leonidas

INTERNATIONAL SEARCH REPORT

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