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program update method, program update system and mobile object

Abstract

A mobile object comprises an acquisition processor acquiring new program from an external apparatus via a network; a rewriting control processor performing a rewriting control of rewriting a program of an electronic control unit equipped with the mobile object, the rewriting being performed by using the acquired new program during drive of the mobile object is disabled; a storage compartment covered by a hood; a hood latch; and a battery stored in the storage compartment and configured to supply electrical power to the rewriting control processor and the electronic control unit. The rewriting control processor locks the hood latch such that the hood may not be opened when performing the rewriting control of rewriting the program of the electronic control unit.

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Background/Summary

BACKGROUND

Technical Field

[0001] The present disclosure relates to a program update method, program update system and mobile object.

Related Art

[0002] An Electronic Control Unit (ECU) which is equipped with a mobile object such as a vehicle provides various functions implemented by executing a software program. The software program is updated by a program update system.

SUMMARY

[0003] In one aspect of the present disclosure, a computer implemented method updating a program of an electronic control unit equipped with a mobile object, wherein the mobile object comprises: [0004] a rewriting control processor performing a rewriting control of rewriting a program of the electronic control unit; [0005] a storage compartment covered by a hood; [0006] a hood latch; and [0007] a battery stored in the storage compartment and configured to supply electrical power to the rewriting control processor and the electronic control unit, [0008] the method comprising: [0009] (i) acquiring new program from an external apparatus via a network; and [0010] (ii) performing the rewriting control of rewriting the program of the electronic control unit, the rewriting being performed by using the acquired new program during drive of the mobile object is disabled; and [0011] wherein the step (ii) further comprises locking the hood latch such that the hood may not be opened when performing the rewriting control of rewriting the program of the electronic control unit.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The advantages of the disclosure will become apparent in the following description taken in conjunction with the following drawings.

[0013] FIG. **1** schematically describe an update system **10** according to one embodiment.

[0014] FIG. **2** schematically shows an example sequence of program update processing.

[0015] FIG. **3** schematically shows an embodiment of configuration of a battery.

[0016] FIG. **4** schematically shows another embodiment of configuration of a battery.

[0017] FIG. **5** schematically shows a system configuration provided to the control system **200**.

[0018] FIG. **6** schematically shows a configuration of a hood open/close system.

[0019] FIG. **7** schematically shows a configuration of the server **70**.

[0020] FIG. **8** schematically shows a configuration of the mobile terminal **30**.

[0021] FIG. **9** shows a processing of a program update method of a mobile object according to one embodiment of the present application.

[0022] FIG. **10** shows a processing of a program update method of a mobile object according to one embodiment of the present application.
[0023] FIG. **11** shows an example of update ready notice screen **400**.
[0024] FIG. **12** shows an example of warning screen **402**.
[0025] FIG. **13** shows a processing of a program update method of a mobile object according to another embodiment of the present application.
[0026] FIG. **14** shows an example of hood open notice screen **404**.
[0027] FIG. **15** shows a processing of a program update method of a mobile object according to another embodiment of the present application.
[0028] FIG. **16** shows an example of key fob warning screen **406**.
[0029] FIG. **17** shows a processing of a program update method of a mobile object according to another embodiment of the present application.
[0030] FIG. **18** shows a processing of a program update method of a mobile object according to another embodiment of the present application.
[0031] FIG. **19** shows an example of update postpone screen **408**.
[0032] FIG. **20** shows an example of a computer **2000** where a plurality of embodiments of the present disclosure may be entirely or partially embodied.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0033] Hereinafter, the present disclosure will be described through embodiments, but the following embodiments do not limit the invention according to the claims. In addition, not all combinations of features described in the embodiments are essential to the solution of the invention. Hereinafter, like elements are described by using like reference numerals and repetitive description of like elements employed in one or more embodiments described herein is omitted.
[0034] FIG. **1** schematically shows an update system **10** according to one embodiment. The update system **10** includes a vehicle **20** and an external apparatus **70** such as a server device. The vehicle **20** includes a control system **200**. The control system **200** is responsible for control of the vehicle **20** and communication with the external apparatus **70** via a communication network **90**. The communication network **90** includes an IP network such as the Internet, a P2P network, a dedicated line including a VPN, a virtual network, a mobile communication network, and the like. A mobile terminal **30** may be also used for a user and connected to the communication network **90**.
[0035] In the vehicle **20**, the control system **200** includes a plurality of ECUs (Electronic Control Units) configured to perform control of the vehicle **20**. The control system **200** is configured to acquire an update program of the ECU provided to the control system **200** from an outside. For example, the control system **200** is configured to receive an update program, which is transmitted from the external apparatus **70**, via the communication network **90** by wireless communication. The control system **200** is configured to reprogram the ECU provided to the control system **200** by rewriting a program, which is executed by the ECU provided to the control system **200**, with the update program. Such reprogramming is performed for upgrade and the like of functions of the ECU provided to the control system **200**. In this way, the control system **200** is configured to update the ECU by reprogramming the ECU by OTA (Over The Air). In the present embodiment, rewriting a program, which is executed by a device such as the ECU, by the update program is referred to as ‘program update’.
[0036] When performing the ‘program update,’ a user of the mobile object is asked to provide a consent. Such a consent from the user is obtained when downloading a new program from the external apparatus **70** and when executing the program update by using the downloaded new program. Here, general flow of program update is described. FIG. **2** schematically shows an example sequence of program update processing. The flow of program update comprises seven steps: (1) configuration synchronization, (2) new program notification, (3) downloading, (4) double bank memory overwrite, (5) single bank memory overwrite, (6) activation, (7) program update confirmation.

[0037] In the (1) configuration synchronization, for example, the vehicle **20** gathers configuration information of the vehicle **20** and sends the information to the external apparatus such as a server **70**. The server updates own information per vehicle by using the received configuration information. In the (2) new program notification, for example, the server **70** determines whether there is any necessity of new program update, and if so, sends a notification of new program update to the vehicle **20**. Upon receiving the notification, the vehicle **20** notifies a user of the necessity of the new program update by, for example, displaying notice and obtains a consent by the user for the new program update. This notice may be performed by using an interface equipped with the vehicle **20** or the mobile terminal **30**. In the (3) downloading, for example, the vehicle **20** sends a request for the new program. In response, the server **70** causes the vehicle **20** to download and save the new program into a memory device equipped with the vehicle **20**. By using the downloaded and saved program, the vehicle **20** overwrites a double bank memory in the (4) double bank memory overwrite. The steps of the (1) configuration synchronization, the (2) new program notification, the (3) downloading, and the (4) double bank memory overwrite are all performed during the IG power supply is on state.

[0038] When the IG power supply becomes off, in the (5) single bank memory overwrite, the vehicle **20** informs the user of down time for program update by, for example, displaying information and obtains a consent by the user for the new program update. Then, the vehicle **20** performs the single bank memory overwrite. This may be initiated at the timing scheduled by a user in advance. In the (6) activation, the vehicle **20** activates the updated program.

[0039] When the IG power supply becomes on, the vehicle **20** notifies the user of the completion of the program update and obtains confirmation by the user in the (7) program update confirmation. Also, the vehicle **20** sends configuration information including new program which is now being executed.

[0040] For example, the vehicle **20** may be a vehicle with an internal combustion engine, an electric vehicle such as a Battery Electric Vehicle (BEV), a Hybrid Electric Vehicle (HEV), a Plug-in Hybrid Electric Vehicle (PHEV), an Extended Range Electric Vehicle (EREV). The event in which the IG power supply becomes on is an example of the event that the mobile object is powered on. In another example, the mobile object may be powered on by pressing a brake pedal of the mobile object. In yet another example, the mobile object may be powered on by receiving an instruction from the mobile terminal **30**.

[0041] The update of the ECU by reprogramming the ECU is executed by the control system **200** during drive of the vehicle **20** is disabled such as IG is turned off. Therefore, the required electric power for the program update is supplied by a low-voltage battery. Also, because the vehicle **20** cannot be used during the processing of the program update, execution of the program update may be scheduled at any convenient time when a user does not drive the vehicle **20**. For example, a user may specify a starting time for the execution of the program update by inputting it on HMI device.

[0042] According to study by the inventor, it may possibly occur that the user forgets the scheduled program update time and performs maintenance on the vehicle **20** at the time in which the program update is scheduled. As a result, it may be possible that the low-voltage battery is disconnected and removed from the vehicle **20** for maintenance purpose in the middle of the program update. Especially, when the user uses an auto repair service for maintenance, a maintenance person has no knowledge about the scheduled program update, and thus, it may be possible that the maintenance person disconnects the battery or removes the battery from the vehicle **20** for providing service. Loss of power in the middle of the program update may cause a problem with the program update, and thus, it is desirable to prevent the battery from being disconnected from the vehicle **20** during the program update.

[0043] For example, when performing rewriting control of rewriting the program of the electronic control unit, a hood latch is locked such that the hood may not be opened. According to this configuration, it is possible to prevent the user from disconnecting the battery during performing

the rewriting control.
[0044] The control system **200** which performs the program update is supplied electric power from a low-voltage battery such as 12V lead-acid battery. FIG. **3** schematically shows an embodiment of configuration of a battery. FIG. **4** schematically shows another embodiment of configuration of a battery. For example, as shown by FIG. **3**, the vehicle **20** includes a storage compartment **22** covered by a hood. The storage compartment **22** is a frunk which is located at a front portion of the vehicle **20**. A low-voltage battery **295** is stored in the storage compartment **22**. The low-voltage battery **295** is connected to the control system **200** via a cable and/or a bus. The embodiment is not limited to the above configuration. For example, as shown by FIG. **4**, the vehicle **20** may alternatively or additionally include a storage compartment **24** covered by a hood. The storage compartment **24** is a trunk which is located at a rear portion of the vehicle **20**. The configuration of the battery is not limited to the above embodiments. The low-voltage battery **295** may be stored in a storage compartment provided to any portion of the vehicle **20**.
[0045] FIG. **5** schematically shows a system configuration provided to the control system **200**. The vehicle control system **200** includes a central ECU **2** which performs general control of the vehicle **20** and information processing. The central ECU **2** is connected with communication lines including communication wires B**1** to B**6**. The central ECU **2** realizes a function of a gateway which manages delivery and acceptance of communication data among those communication lines. The central ECU **2** executes writing of programs to be executed by the ECUs for the ECUs which are connected with the central ECU **2** by the communication wires B**1** to B**6** and for the ECUs which are connected with the above ECUs by other communication wires B**7** to B**14**. Writing of a program includes update of a program which is already written in the ECU and newly writing a program in the ECU. The central ECU **2** executes over-the-air (OTA) management, for example. The OTA management includes control about a process of downloading an update program for the ECU included in the vehicle **20** from a server on the outside of the vehicle and about a process of applying a downloaded update program to an in-vehicle device, for example.
[0046] The ECU **2** is configured to function as a program update control apparatus (also referred to as 'OTA manager') configured to control the program update of the ECUs **50**. The ECU **2** includes a rewriting control unit **220**, an acquisition unit **240**, and a storage unit **270**.
[0047] The rewriting control unit **220** is configured to perform control of rewriting a program, which is executed by the ECUs **50**, to a new program. The acquisition unit **240** is configured to acquire a new program from the server **70** and save the downloaded program to the storage unit **270**.
[0048] The vehicle control unit includes a zone-A ECU **11**, a zone-B ECU **13**, and the ECUs **50** illustrated in FIG. **5**, for example. In FIG. **5**, each of various ECUs which are connected with the central ECU **2**, the zone-A ECU **11**, and the zone-B ECU **13** is denoted as ECU **50**. With the central ECU **2**, the zone-A ECU **11** is connected by the communication wire B**1**, and the zone-B ECU **13** is connected by the communication wire B**2**. As described later, in addition, plural ECUs **50** are connected with the zone-A ECU **11** and the zone-B ECU **13**. The zone-A ECU **11** manages delivery and acceptance of communication data between the central ECU **2** and the ECUs **50** which are connected with the zone-A ECU **11**. The zone-B ECU **13** manages delivery and acceptance of communication data between the central ECU **2** and the ECUs **50** which are connected with the zone-B ECU **13**.
[0049] With the central ECU **2**, plural ECUs **50** are connected by the communication wires B**4**, B**5**, and B**6**. Those ECUs **50** include a vehicle-to-everything (V2X) communication device, for example. The V2X communication device is a communication device that includes a communication antenna and a communication circuit, which are not illustrated, and that has a wireless communication function and performs vehicle-to-vehicle communication or road-to-vehicle communication in accordance with control by the central ECU **2**. The ECUs **50** which are connected with the central ECU **2** may include a telematics control unit (TCU). The TCU is a

wireless communication device that includes a communication antenna and a communication circuit, which are not illustrated, and that executes wireless data communication by a cellular communication system such as long-term evolution (LTE) or the fifth-generation mobile communication system (5G). The ECUs **50** which are connected with the central ECU **2** may include an in-vehicle infotainment (IVI) ECU. With the IVI-ECU, in-vehicle apparatuses such as an automotive navigation system, various cameras including a rear camera, an audio player, a monitor, a touch panel, operation elements such as keys and switches, a speaker, and a microphone are connected. The IVI-ECU controls the in-vehicle apparatuses and thereby provides various kinds of information and entertainment for an occupant of the vehicle **20**. For example, the IVI-ECU executes control such as starts and stops of the in-vehicle apparatuses, control for outputting data and so forth, which are detected by a sensor by the other ECU, and so forth. The IVI-ECU may also control HMI device of the vehicle **20**. The V2X communication device and the TCU are one example of a function unit which is controlled by the central ECU **2**.

[0050] The ECUs **50** which are connected with the central ECU **2** may include a driving assistance ECU which executes control for automatically parking the vehicle **20** at a parking position or an assistance function in a case where a driver parks the vehicle **20**. Function units as control targets of the driving assistance ECU include various cameras, a monitor, a touch panel, a steering device, a brake mechanism, and an acceleration device, which are installed in the vehicle **20**, for example.

[0051] With the zone-A ECU **11**, plural ECUs **50** are connected by the communication wires B**7** to B**10**. The ECUs **50** which are connected with the zone-A ECU **11** include a fuel injection (FI) control unit, a motor control unit, a battery (BATT) control unit, a shift control unit, a vehicle stability assist (VSA) control unit, and so forth, for example. The ECUs **50** which are connected with the zone-A ECU **11** by the communication wires B**7** to B**10** can be considered to be function units as control targets of the zone-A ECU **11**.

[0052] The FI control unit controls a fuel injection amount and a fuel injection timing in an internal combustion engine which is installed in the vehicle **20**. Function units as control targets of the FI control unit include an electronic control fuel injection device and may include sensors. As sensors, an **02** sensor, a knock sensor, a cam angle sensor, a crank angle sensor, an intake air temperature sensor, an exhaust gas temperature sensor, and so forth can be raised. The motor control unit controls a rotation speed of a motor which is installed in the vehicle **20**. Function units as control targets of the motor control unit include an inverter circuit which supplies a driving current to the motor and may include various sensors.

[0053] The BATT control unit performs charge control, discharge control, and management of a remaining charge amount for a traveling battery which is installed in the vehicle **20**. A battery as a function unit as a control target of the BATT control unit is a battery that is separately provided from a starting battery such as the low-voltage battery **295** which supplies power to each unit of the vehicle control system **200** and is installed in the vehicle **20** for supplying a driving power source for the motor. The traveling battery may be a lithium-ion secondary battery, a lithium polymer battery, a nickel-metal hydride battery, a solid-state battery, another secondary battery, or a capacitor. Function units as control targets of the BATT control unit may include a regenerative mechanism which generates regenerative power by traveling energy of the vehicle **20**. Meanwhile, the starting battery of the vehicle **20** is a secondary battery which supplies power to each unit of the vehicle control system **200** in a state where a power source of the vehicle **20** is turned off and is charged by a generating device installed in the vehicle **20** during travel of the vehicle **20**. For example, the starting battery is formed from a lead-acid battery, another secondary battery, or a capacitor.

[0054] The shift control unit controls a shift mechanism of the vehicle **20** in accordance with a traveling state of the vehicle **20** and an operation by the driver. Function units as control targets of the shift control unit include the shift mechanism of the vehicle **20**, and specifically, a step automatic transmission (AT), a continuously variable transmission (CVT), a dual clutch

transmission (DCT), or the like is raised. The function units as the control targets of the shift control unit may include a shift position sensor, a shift switch, a shift lever, and so forth.
[0055] A function unit as a control target of the VSA control unit is an actuator provided to a brake mechanism of the vehicle **20**, for example. The VSA control unit causes the actuator of the brake mechanism to act in accordance with a posture or the like of the vehicle **20** and thereby stabilizes the posture of the traveling vehicle **20**, and in advance prevents a slip and a spin, for example.
[0056] With the zone-B ECU **13**, plural ECUs **50** are connected by the communication wires B**11** to B**14**. The ECUs **50** which are connected with the zone-B ECU **13** includes a hood latch actuator control unit (HLA-ECU), a hood open sensor ECU and a key sensor ECU, for example. The ECUs **50** which are connected with the zone-B ECU **13** by the communication wires B**11** to B**14** can be considered to be function units as control targets of the zone-B ECU **13**.
[0057] The HLA-ECU may control a hood latch actuator **296**. A function unit as a control target of the hood open sensor ECU is a hood open sensor **298** which detects that the hood of the vehicle **20** is opened and/or the hood of the vehicle **20** is in an open status. A function unit as a control target of the key sensor ECU is a key sensor **297** which detects that a remote key less entry fob or a remote key less entry mobile terminal of the vehicle **20** is present in the storage compartment **22** of the vehicle **20**.
[0058] The communication wires B**1** to B**14** are formed from plural communication transmission paths which conform to various communication standards. Each of the communication wires B**1** to B**14** can be provided as a data transmission path which conforms to a different communication standard. That is, a specific configuration, a transmission band, and a communication standard of a cable that constitutes each of the communication wires B**1** to B**14** are arbitrarily selected. As communication standards which are applicable to the communication wires B**1** to B**14**, for example, a controller area network (CAN), Ethernet®, a universal serial bus (USB), a local interconnect network (LIN), and a low-voltage differential signaling (LVDS) can be raised, but other standards may be used. The communication wires B**1** to B**6** are illustrated, in FIG. **5**, as independent communication lines, but their specific configurations are not restricted, and for example, the communication wires B**1** to B**6** may be bus communication lines, which are connected with plural apparatuses, similarly to the communication wires B**7** to B**14**.
[0059] The above description explains examples of various ECUs **50** which are installed in the vehicle **20** and apparatuses which are controlled by the ECUs **50**. It is not intended that the ECUs **50** included in the vehicle **20** as an application target of the present disclosure are limited to a manner of connection illustrated in FIG. **5**.
[0060] FIG. **6** schematically shows a configuration of a hood open/close system. The hood open/close system may be implemented by using “By-wire” system. The hood latch actuator **296** is communicated with the ECU **50** (HLA-ECU) and receives an instruction such as a hood open instruction and a hood close instruction. In accordance with the received instruction, the hood latch actuator **296** opens or closes the hood. For example, when the hood open instruction is received, the hood latch actuator **296** drives an electric motor to disengage a mechanical latch and moves the hood upward to open the hood. When the hood close instruction is received, the hood latch actuator **296** drives the electric motor to move the hood downward to close the hood and engage the mechanical latch. For emergency purpose, the hood latch actuator **296** is also connected to a switch **11** by a wire. The switch **111** is disposed in an instrument panel of the vehicle. By using the switch **111**, a user may open the hood manually and mechanically.
[0061] A user may input a hood open command and a hood close command by using IVI. For example, the central ECU **2** receives the hood open command or the hood close command from the IVI via the IVI-ECU, determines whether the hood may be opened or may be closed, then sends the hood open command or the hood close command to the HLA-ECU. Then, in accordance with the received command, the HLA-ECU sends the hood open instruction or the hood close instruction to the hood latch actuator **296**.

[0062] The user may also input a hood open command and a hood close command by using the mobile terminal **30**. For example, the central ECU **2** receives the hood open command or the hood close command from the mobile terminal **30** via the TCU, determines whether the hood may be opened or may be closed, then sends the hood open command or the hood close command to the HLA-ECU. Then, in accordance with the received command, the HLA-ECU sends the hood open instruction or the hood close instruction to the hood latch actuator **296**. The central ECU **2** may receive the hood open command or the hood close command from the mobile terminal **30** via short range communication described below.

[0063] FIG. **7** schematically shows a configuration of the server **70**. The server **70** includes a control system **100**. The control system **100** is responsible for control of the server **70** and communication with the vehicle **20** and the mobile terminal **30** via the communication network such as a mobile communication network through the communication unit **116** such as a network card. The control system **100** includes a program update control unit **112** and a storage unit **114**.

[0064] The program update control unit **112** maintains current version of program for each vehicle registered in the server **70** by timely updating a program for each ECU. The program update control unit **112** sends and receives information and data to and from the vehicle **20** and the mobile terminal **30** through the communication unit **116**, and save and maintain data stored in the storage unit **114**.

[0065] FIG. **8** schematically shows a configuration of the mobile terminal **30**. The mobile terminal **30** includes a control system **300**. The control system **300** is responsible for control of the mobile terminal **300** and communication with the server **70** via the communication network such as a mobile communication network through the communication unit **316** such as a network card. The control system **300** may be also communication with the vehicle **20** through the short range communication unit (SCU) **318** via short range communication such as Bluetooth®, Wi-Fi®, NearLink, near-field communication (NFC), LPWAN, ultra-wideband (UWB). The control system **300** includes an update communication control unit **312** and a storage unit **314**. The control system **300** also controls an output device of the mobile terminal **30** such as a display device **332** and a speaker **334** to output information, and also control an input device **336** such as a keyboard and a touch panel to receive input information from a user.

[0066] When a new version of a program is released, the program update control unit **112** of the server **70** stores it and identifies a vehicle which is subject to update. In many cases, the program update is directed to a specific model, a specific year, a specific trim or a specific region and so on. The program update control unit **112** assigns a unique identification “UPDATE ID” or “CAMPAIGN ID” to the program update, identifies all vehicles subject to the program update, and save the data with the correlation therebetween. When the subject vehicle is identified, the program update control unit **112** communicates with the vehicle **20** which is subject to the update and causes the vehicle **20** to download and save the new program thereon to update the program by rewriting the program for an ECU. Before starting the download, the program update control unit **112** may obtain an approval for the download from a user of the subject vehicle. For example, the program update control unit **112** sends information such as version information and detailed feature or improvement of the new program to the vehicle **20**. The rewriting control unit **220** displays version information and detailed feature or improvement of the new program on the IVI and/or HMI, and prompts approval by a user. The program update control unit **112** may also send the information such as version information and detailed feature or improvement of the new program to the mobile terminal **30**. The update communication control unit **312** displays version information and detailed feature or improvement of the new program on the display device **332**, prompts approval by a user to be input via the input device **336**.

[0067] Now, a processing of a program update method of a mobile object according to one embodiment of the present application is described. FIG. **9** and FIG. **10** show a processing of a program update method of a mobile object according to one embodiment of the present application.

At step **1020**, the rewriting control unit **220** determines whether a new program has been downloaded by the acquisition unit **240** from the server **70** to the storage unit **270**. When the answer is negative, the process goes to loop. On the other hand, when the answer is affirmative, the rewriting control unit **220** determines whether the vehicle **20** is turned in a disabled state at step **1040**. For example, the vehicle **20** is turned in a disabled state when ignition IG is turned off. In other embodiment, the vehicle **20** may be disabled when the vehicle **20** is turned off by other mechanism. When the answer is negative, the process goes to loop. On the other hand, when the answer is affirmative, the rewriting control unit **220** notifies a user on a display device such as IVI and/or HMI of the vehicle **20** that a new program is ready for update, and that the hood cannot be opened for a predetermined amount of time during performing the program update, and prompts user acceptance for execution of the program update or scheduling of initiation of the program update at step **1060**.

[0068] FIG. **11** shows an example of update ready notice screen **400**. For example, the rewriting control unit **220** may display on the IVI and/or HMI the update ready notice screen **400**. The update ready notice screen **400** includes a status section **424**, an acceptance button **434** and a schedule button **444**. The status section **424** indicates that a new program is ready for update, the hood cannot be opened for a predetermined amount of time during performing the program update, and a user is prompted to accept the program update. By selecting the acceptance button **434**, the user can accept the program update. In this event, the rewriting control unit **220** may initiate the execution of the program update after a predetermined amount of time such as tens of seconds has passed. By selecting the schedule button **444**, the user can designate a specific time and date when the program update should start.

[0069] At step **1080**, the rewriting control unit **220** determines whether the user has accepted the program update or the user has set up the scheduled time for starting the program update. When the answer is negative, the process moves to step **1180** and ceases attempt of the program update on the current cycle. On the other hand, when the answer is affirmative, when the initiation time has come, the rewriting control unit **220** determines the status or the condition of the vehicle **20** at step **1100**. For example, the rewriting control unit **220** determines the state of charge (SOC) of the battery, the position of a gear shifter, vehicle speed, or the hood position. Then, at step **1120**, the rewriting control unit **220** determines whether the hood is in the closed state based on the signal from the hood open sensor **298**.

[0070] When the answer is negative, the process moves to step **1180** and ceases attempt of the program update on the current cycle. On the other hand, when the answer is affirmative, the rewriting control unit **220** keeps the hood lock state at step **1140** and starts the program update at step **1160**. The hood lock state is a state in which the closed hood is kept closed. The hood lock state may be implemented by ignoring the hood open command which is input by a user. Here, by starting the program update, rewriting the program of the electronic control unit is started. In a single bank memory, the memory is overwritten. In a double bank memory, the memory with older program is switched by the memory with newer program.

[0071] Then, as shown by FIG. **10**, the rewriting control unit **220** determines whether the program update has been completed by successfully rewriting the program at step **1200**. When the answer is affirmative, the process moves to step **1290** and the rewriting control unit **220** releases the hood lock state. On the other hand, when the answer is negative, the rewriting control unit **220** determines whether the program update has been failed due to any problem at step **1220**. When the answer is affirmative, the process moves to step **1290** and the rewriting control unit **220** releases the hood lock state (the hood is unlocked). On the other hand, when the answer is negative, the process continues the program update.

[0072] During the program update, as shown by FIG. **10**, the rewriting control unit **220** determines whether a user tries to open the hood at step **1240**. For example, a user may try to open the hood by inputting the hood open command by using IVI. In this case, the rewriting control unit **220** receives

the hood open command from the IVI via the IVI-ECU. The user may also try to open the hood by inputting the hood open command by using the mobile terminal **30**. In this case, the rewriting control unit **220** receives the hood open command from the mobile terminal **30** via the TCU. When the answer is negative, the process goes to loop. On the other hand, when the answer is affirmative, the rewriting control unit **220** ignores the received hood open command at step **1260**, and the rewriting control unit **220** notifies the user on a display device such as IVI and/or HMI of the vehicle **20** the hood cannot be opened for a predetermined amount of time during performing the program update at step **1280**. When the rewriting control unit **220** receives the hood open command from the mobile terminal **30**, the rewriting control unit **220** notifies the user on the display of the mobile terminal **30**.

[0073] FIG. **12** shows an example of warning screen **402**. For example, the rewriting control unit **220** may display on the IVI and/or HMI the warning screen **402**. The warning screen **402** includes a status section **424**, an acceptance button **434** and a return button **464**. The status section **424** indicates that the program update is in progress and the hood cannot be opened during performing the program update. By selecting the acceptance button **434**, the rewriting control unit **220** ceases the notice on the IVI and/or HMI.

[0074] According to the embodiment, the hood lock state in which the closed hood is kept closed is kept during performing the program update. Thus, it is possible to prevent the user from opening the hood to access the battery stored in the storage compartment and from disconnecting the battery stored in the storage compartment during performing the rewriting control. Moreover, when the program update has been completed, the hood lock state is released. Thus, it becomes possible for the user to access the storage compartment without causing a trouble in the program update.

[0075] Moreover, when prompting a user consent to execution of the program update, the user may be notified that the hood cannot be opened for a predetermined amount of time during performing the program update. By providing advance notice, it is possible to prevent the user from encountering unexpected inconvenient situations in which the user cannot access stuff such as a personal item stored in the storage compartment.

[0076] Moreover, when the user tries to open the hood during performing the program update, the user may be notified that the hood cannot be opened for a predetermined amount of time during performing the program update. Thus, it is possible to improve entire usability of the program update system together with the storage compartment.

Second Embodiment

[0077] Now, the second embodiment is described below. In the embodiment described above, when it is determined that the hood is not in the closed state based on the signal from the hood open sensor **298** at step **1120**, the rewriting control unit **220** ceases attempt of the program update on the current cycle at step **1180**. The second embodiment has a different processing. In the description below, processing steps which are different from the previous embodiment are described.

[0078] FIG. **13** shows a processing of a program update method of a mobile object according to another embodiment of the present application. As shown by FIG. **13**, at step **1122**, the rewriting control unit **220** determines whether the hood is in the closed state based on the signal from the hood open sensor **298**. When the answer is negative, the process goes to loop. That is, the rewriting control unit **220** waits until the hood is closed. Then, when the answer is affirmative at step **1122**, the rewriting control unit **220** keeps the hood lock state at step **1140** and starts the program update at step **1160**.

[0079] In the present embodiment, different from the previous embodiment, the program update may be started even though the hood is once in an opened state by waiting the closure of the hood. Thus, execution of program update may be facilitated by increasing the number of opportunity.

[0080] In another embodiment, at step **1122**, the rewriting control unit **220** may notify a user on a display device such as IVI and/or HMI of the vehicle **20** that after the hood is closed, the hood latch is locked and the rewriting of the program is started. FIG. **14** shows an example of hood open

notice screen **404**. For example, the rewriting control unit **220** may display on the IVI and/or HMI the hood open notice screen **404**. The hood open notice screen **404** includes a status section **424**, an acceptance button **434** and a return button **464**. The status section **424** indicates that the hood is open, and after the hood is closed, the hood is locked and the program update is started. By selecting the acceptance button **434**, the rewriting control unit **220** ceases the notice on the IVI and/or HMI.

[0081] In the present embodiment, the user may be notified in advance that after the hood is closed, the hood is locked and the program update is started, that is, the user is notified that the user cannot open the hood for a while during the program update. Thus, it is possible to improve entire usability of the program update system together with the storage compartment.

[0082] The present application is not limited to the above-described embodiments. Now, another embodiment is described below. In the description below, processing steps which are different from the previous embodiments are described.

[0083] FIG. **15** shows a processing of a program update method of a mobile object according to another embodiment of the present application. As shown by FIG. **15**, step **1110** is added after step **1100**. As shown by FIG. **15**, the rewriting control unit **220** determines the status or the condition of the vehicle **20** at step **1100**. Then, the rewriting control unit **220** determines whether a remote key less entry fob or a remote key less entry mobile terminal is present in the storage compartment **22**. The key sensor **297** detects that a remote key less entry fob or a remote key less entry mobile terminal of the vehicle **20** is present in the storage compartment **22** of the vehicle **20**. The rewriting control unit **220** receives a key detection signal from the key sensor **297** via the key sensor ECU and determines whether a remote key less entry fob or a remote key less entry mobile terminal is present in the storage compartment **22** at step **1110**.

[0084] When the answer is negative, the process proceeds to step **1122**. On the other hand, when the answer is affirmative, the rewriting control unit **220** may notify a user on a display device such as IVI and/or HMI of the vehicle **20** that the program update may not be started because the remote key less entry fob or mobile terminal is present in the storage compartment **22**. FIG. **16** shows an example of key fob warning screen **406**. For example, the rewriting control unit **220** may display on the IVI and/or HMI the key fob warning screen **406**. The key fob warning screen **406** includes a status section **424**, an acceptance button **434** and a return button **464**. The status section **424** indicates that the key fob is present in the storage compartment such as a frunk, the program update may not be started, and requests the user to remove the key fob from the storage compartment **22**. By selecting the acceptance button **434**, the rewriting control unit **220** ceases the notice on the IVI and/or HMI.

[0085] In the present embodiment, the user may be notified in advance that the key fob is present in the storage compartment, and the program update may not start until the key fob is removed from the storage compartment. Thus, it is possible to avoid inconvenient situation in which the program update starts and the user cannot open the hood until the completion of the program update even though the key fob is left in the storage compartment by mistake. Thus, it is possible to improve entire usability of the program update system together with the storage compartment.

[0086] The present application is not limited to the above-described embodiments. Now, another embodiment is described below. In the description below, processing steps which are different from the previous embodiments are described.

[0087] FIG. **17** shows a processing of a program update method of a mobile object according to another embodiment of the present application. Different from the above-described embodiment, when it is determined that a remote key less entry fob or a remote key less entry mobile terminal is present in the storage compartment **22** at step **1112**, the process moves to step **1180** and ceases attempt of the program update on the current cycle.

[0088] In the present embodiment, the program update may not start until the key fob is removed from the storage compartment. Thus, it is possible to avoid inconvenient situation in which the

program update starts and the user cannot open the hood until the completion of the program update even though the key fob is left in the storage compartment by mistake. Thus, it is possible to improve entire usability of the program update system together with the storage compartment.
[0089] The present application is not limited to the above-described embodiments. Now, another embodiment is described below. In the description below, processing steps which are different from the previous embodiments are described.
[0090] FIG. **18** shows a processing of a program update method of a mobile object according to another embodiment of the present application. As shown by FIG. **18**, step **1114** is added after step **1100**. As shown by FIG. **18**, the rewriting control unit **220** determines the hood was opened in a predetermined cycle of driving of the vehicle **20**. When the answer is affirmative, the process moves to step **1180** and ceases attempt of the program update on the current cycle. On the other hand, when the answer is negative, the process moves to the step **1122**.
[0091] For example, by checking history of driving of the vehicle **20**, the rewriting control unit **220** may determine the possibility in which the storage compartment was used for storing stuff such as a personal item. This indicates the possibility that the personal item is still stored in the storage compartment and the user may desire to access it. Therefore, it may be better to delay performing the program update. For example, the central ECU **2** receives a hood open signal from the hood open sensor **298** via the hood open sensor ECU and saves the hood open event in association with the time and date as a history in a memory device. The hood open event may be saved in association with destination information of the user such as a shopping center just before the hood was opened. Such destination information may be obtained from a navigation system.
[0092] Also, at step **1114**, the rewriting control unit **220** may notify a user on a display device such as IVI and/or HMI of the vehicle **20** that the program update is postponed due to possibility of usage of the storage compartment, please check the storage compartment, and please execute the program update without using the storage compartment. FIG. **19** shows an example of update postpone screen **408**. For example, the rewriting control unit **220** may display on the IVI and/or HMI the update postpone screen **408**. The update postpone screen **408** includes a status section **424**, an acceptance button **434** and a return button **464**. The status section **424** indicates that the storage compartment might be used, please check the storage compartment, and please execute the program update without using the storage compartment. By selecting the acceptance button **434**, the rewriting control unit **220** ceases the notice on the IVI and/or HMI.
[0093] In the present embodiment, the program update may not start and the hood is not locked when there is a possibility that the storage compartment was used for storing stuff such as a personal item. Thus, it is possible to surely avoid inconvenient situation in which the program update starts and the user cannot access the stuff until the completion of the program update. Thus, it is possible to improve entire usability of the program update system together with the storage compartment.
[0094] The above embodiments are described by using the display device of the vehicle **20** as an example. However, the present application is not limited to this configuration. For example, the rewriting control unit **220** may notify a user by using the display device **332** of the mobile terminal **30** to display screens **400**, **402**, **404**, **406** and **408**.
[0095] FIG. **20** shows an example of a computer **2000** where a plurality of embodiments of the present disclosure may be entirely or partially embodied. A program that is installed in the computer **2000** can cause the computer **2000** to function as a system such as the control system of the embodiment or each unit of the system or as an apparatus such as an information processing apparatus or each unit of the apparatus, to execute operations associated with the system or each unit of the system or the apparatus or each unit of the apparatus, and/or to execute the process of the embodiment or steps thereof. Such a program may be executed by a CPU **2012** so as to cause the computer **2000** to execute a specific operation associated with some or all of the processing procedures and the blocks in the block diagrams described herein.

[0096] The computer **2000** according to the present embodiment includes the CPU **2012** and a RAM **2014**, which are mutually connected by a host controller **2010**. The computer **2000** also includes a ROM **2026**, a flash memory **2024**, a communication interface **2022**, and an input and output chip **2040**. The ROM **2026**, the flash memory **2024**, the communication interface **2022**, and the input and output chip **2040** are connected to the host controller **2010** via an input and output controller **2020**.
[0097] The CPU **2012** is configured to operate according to programs stored in the ROM **2026** and the RAM **2014**, thereby controlling each unit.
[0098] The communication interface **2022** is configured to communicate with other electronic devices via a network. The flash memory **2024** is configured to store a program and data that are used by the CPU **2012** in the computer **2000**. The ROM **2026** is configured to store a boot program or the like that is executed by the computer **2000** at boot-up, and/or a program depending on hardware of the computer **2000**. The input and output chip **2040** may also be configured to connect various input and output units such as a keyboard, a mouse, and a monitor, to the input and output controller **2020** via input and output ports such as a serial port, a parallel port, a keyboard port, a mouse port, a monitor port, a universal serial bus (USB) port and a high-definition multimedia interface (HDMI (registered trademark)) port.
[0099] A program is provided via a computer-readable storage medium such as a CD-ROM, a DVD-ROM, or a memory card, or a network. The RAM **2014**, the ROM **2026**, or the flash memory **2024** is an example of the computer-readable storage medium. The program is installed in the flash memory **2024**, the RAM **2014** or the ROM **2026** and is executed by the CPU **2012**. Information processing described in these programs is read into the computer **2000**, resulting in cooperation between the programs and the various types of hardware resources described above. An apparatus or a method may be constituted by realizing an operation or processing of information according to a use of the computer **2000**.
[0100] For example, when communication is performed between the computer **2000** and an external device, the CPU **2012** may be configured to execute a communication program loaded onto the RAM **2014** to instruct communication processing to the communication interface **2022**, based on processing described in the communication program. The communication interface **2022** is configured, under control of the CPU **2012**, to read transmission data stored on a transmission buffer processing area provided in a recording medium such as the RAM **2014** and the flash memory **2024**, to transmit the read transmission data to the network, and to write reception data received from the network to a reception buffer processing area or the like provided on the recording medium.
[0101] In addition, the CPU **2012** may be configured to cause all or a necessary portion of a file or a database, which has been stored in a recording medium such as the flash memory **2024**, to be read into the RAM **2014**, thereby executing various types of processing on the data on the RAM **2014**. Next, the CPU **2012** is configured to write the processed data back to the recording medium.
[0102] Various types of information, such as various types of programs, data, tables, and databases, may be stored in the recording medium and may be subjected to information processing. The CPU **2012** may be configured to execute, on the data read from the RAM **2014**, various types of processing including various types of operations, processing of information, conditional judgment, conditional branching, unconditional branching, search and replacement of information, and the like described in the present specification and specified by instruction sequences of the programs, and to write a result back to the RAM **2014**. The CPU **2012** may also be configured to search for information in a file, a database, etc., in the recording medium. For example, when a plurality of entries, each having an attribute value of a first attribute associated with an attribute value of a second attribute, is stored in the recording medium, the CPU **2012** may be configured to search for an entry having a designated attribute value of the first attribute that matches a condition from the plurality of entries, and to read the attribute value of the second attribute stored in the entry, thereby

obtaining the attribute value of the second attribute associated with the first attribute that satisfies a predetermined condition.

[0103] The programs or software modules described above may be stored in a computer-readable storage medium on or near the computer **2000**. A recording medium such as a hard disk or a RAM provided in a server system connected to a dedicated communication network or the Internet can be used as a computer-readable storage medium. The program stored in the computer-readable storage medium may be provided to the computer **2000** via the network.

[0104] A program that is installed in the computer **2000** and causes the computer **2000** to function as the control system **200** may work on the CPU **2012** and the like to cause the computer **2000** to function as each unit of the control system **200**, respectively. Information processing described in these programs are read into the computer **2000** to cause the computer to function as each unit of the control system **200**, which is a specific means realized by cooperation of software and the various types of hardware resources described above. Then, with these specific means, by realizing computing or processing of information according to an intended use of the computer **2000** in the present embodiment, the specific control system **200** is constructed according to the intended use.

[0105] Similarly, a program that is installed in the computer **2000** and causes the computer **2000** to function as the control system **100** may work on the CPU **2012** and the like to cause the computer **2000** to function as each unit of the control system **100**, respectively. Information processing described in these programs are read into the computer **2000** to cause the computer to function as each unit of the control system **100**, which is a specific means realized by cooperation of software and the various types of hardware resources described above. Then, with these specific means, by realizing computing or processing of information according to an intended use of the computer **2000** in the present embodiment, the specific control system **100** is constructed according to the intended use.

[0106] Similarly, a program that is installed in the computer **2000** and causes the computer **2000** to function as the control system **300** may work on the CPU **2012** and the like to cause the computer **2000** to function as each unit of the control system **300**, respectively. Information processing described in these programs are read into the computer **2000** to cause the computer to function as each unit of the control system **300**, which is a specific means realized by cooperation of software and the various types of hardware resources described above. Then, with these specific means, by realizing computing or processing of information according to an intended use of the computer **2000** in the present embodiment, the specific control system **300** is constructed according to the intended use.

[0107] Various embodiments have been described with reference to the block diagrams and the like. In the block diagrams, each block may represent (1) a step of a process in which an operation is executed, or (2) each unit of an apparatus having a role in executing the operation. Certain steps and each unit may be implemented by dedicated circuitry, programmable circuitry supplied with computer-readable instructions stored on computer-readable storage media, and/or processors supplied with computer-readable instructions stored on computer-readable storage media. The dedicated circuitry may include a digital and/or analog hardware circuit, or may include an integrated circuit (IC) and/or a discrete circuit. The programmable circuitry may include a reconfigurable hardware circuit including logical AND, logical OR, logical XOR, logical NAND, logical NOR, and other logical operations, a memory element such as a flip-flop, a register, a field programmable gate array (FPGA) and a programmable logic array (PLA), and the like.

[0108] Computer-readable storage media may include any tangible device that can store instructions to be executed by a suitable device, and as a result, the computer-readable storage medium having the instructions stored thereon constitutes at least a part of an article of manufacture including instructions that can be executed to provide means for performing operations specified in the processing procedures or block diagrams. Examples of the computer-readable storage media may include an electronic storage medium, a magnetic storage medium, an

optical storage medium, an electromagnetic storage medium, a semiconductor storage medium, and the like. More specific examples of the computer-readable storage media may include a floppy (registered trademark) disk, a diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or flash memory), an electrically erasable programmable read-only memory (EEPROM), a static random access memory (SRAM), a compact disk read-only memory (CD-ROM), a digital versatile disk (DVD), a Blu-ray (registered trademark) disk, a memory stick, an integrated circuit card, and the like.

[0109] Computer-readable instructions may include assembler instructions, instruction-set-architecture (ISA) instructions, machine instructions, machine dependent instructions, microcode, firmware instructions, state-setting data, or either source code or object code described in any combination of one or more programming languages, including an object oriented programming language such as Smalltalk (registered trademark), JAVA (registered trademark) and C++, and a conventional procedural programming language such as a 'C' programming language or similar programming languages.

[0110] Computer-readable instructions may be provided to a processor of a general purpose computer, a special purpose computer, or other programmable data processing apparatus, or to programmable circuitry, locally or via a local area network (LAN), wide area network (WAN) such as the Internet, etc., and the computer-readable instructions may be executed to provide means for performing operations specified in the described processing procedures or block diagrams. Examples of processors include computer processors, processing units, microprocessors, digital signal processors, controllers, microcontrollers, and the like.

[0111] Although a specific form of embodiment has been described above and illustrated in the accompanying drawings in order to be more clearly understood, the above description is made by way of example and not as limiting the scope of the invention defined by the accompanying claims. The scope of the invention is to be determined by the accompanying claims. Various modifications apparent to one of ordinary skill in the art could be made without departing from the scope of the invention. The accompanying claims cover such modifications. In the accompanying claims, a processor is not limited to a single processor, a processor may be implemented by one or more processor. Also, multiple processes or functions may be implemented by a single processor.

[0112] The operations, procedures, steps, stages and the like of each process performed by an apparatus, system, program, and method shown in the claims, embodiments, or diagrams can be performed in any order as long as the order is not indicated by "prior to," "before," or the like and as long as the output from a previous process is not used in a later process. Even if the process flow is described using phrases such as "first" or "next" in the claims, embodiments, or diagrams, it does not necessarily mean that the process must be performed in this order.

Claims

1. A computer implemented method updating a program of an electronic control unit equipped with a mobile object, wherein the mobile object comprises: a rewriting control processor performing a rewriting control of rewriting a program of the electronic control unit; a storage compartment covered by a hood; a hood latch; and a battery stored in the storage compartment and configured to supply electrical power to the rewriting control processor and the electronic control unit, the method comprising: (i) acquiring new program from an external apparatus via a network; and (ii) performing the rewriting control of rewriting the program of the electronic control unit, the rewriting being performed by using the acquired new program during drive of the mobile object is disabled; and wherein the step (ii) further comprises locking the hood latch such that the hood may not be opened when performing the rewriting control of rewriting the program of the electronic control unit.

2. The method according to claim 1, further comprising: (iii) unlocking the hood latch after

performing the rewriting control of rewriting the program of the electronic control unit.

3. The method according to claim 1, further comprising: before performing the rewriting control of rewriting the program of the electronic control unit, providing a notice to a user that the hood cannot be opened for a predetermined amount of time during performing the rewriting control, and obtaining a consent from a user to performing the rewriting control.

4. The method according to claim 1, wherein the step (ii) further comprises determining whether a user tries to open the hood during performing the rewriting control of rewriting the program of the electronic control unit, and when it is determined that the user tries to open the hood, providing a notice to the user that the hood cannot be opened for a predetermined amount of time during performing the rewriting control.

5. The method according to claim 1, wherein the step (ii) further comprises determining whether the hood is open, and when it is determined that the hood is open, waiting until the hood is closed, and when it is determined that the hood is closed, locking the hood latch such that the hood may not be opened and starting the rewriting control of rewriting the program.

6. The method according to claim 1, wherein the step (ii) further comprises determining whether the hood is open, and when it is determined that the hood is open, providing a notice to a user that after the hood is closed, the hood latch is locked and the rewriting of the program is started.

7. The method according to claim 1, wherein the hood latch is locked such that the hood may not be opened by ignoring a command from a user to open the hood.

8. The method according to claim 1, further comprising: before performing the rewriting control of rewriting the program of the electronic control unit, determining whether a remote key less entry fob or mobile terminal is present in the storage compartment, and when it is determined that the remote key less entry fob or mobile terminal is present in the storage compartment, providing a notice to a user that the rewriting control may not be started because the remote key less entry fob or mobile terminal is present in the storage compartment.

9. The method according to claim 1, further comprising: before performing the rewriting control of rewriting the program of the electronic control unit, determining whether a remote key less entry fob or mobile terminal is present in the storage compartment, and when it is determined that the remote key less entry fob or mobile terminal is present in the storage compartment, suspending scheduled program update.

10. The method according to claim 1, further comprising: before performing the rewriting control of rewriting the program of the electronic control unit, checking history of driving of the mobile object to determine whether the hood was opened in a predetermined cycle of driving of the mobile object, and when it is determined that the hood was opened, suspending scheduled program update.

11. A mobile object comprising: an acquisition processor acquiring new program from an external apparatus via a network; a rewriting control processor performing a rewriting control of rewriting a program of an electronic control unit equipped with the mobile object, the rewriting being performed by using the acquired new program during drive of the mobile object is disabled; a storage compartment covered by a hood; a hood latch; and a battery stored in the storage compartment and configured to supply electrical power to the rewriting control processor and the electronic control unit, wherein the rewriting control processor: locks the hood latch such that the hood may not be opened when performing the rewriting control of rewriting the program of the electronic control unit.

12. The mobile object according to claim 11, wherein the rewriting control processor further unlocks the hood latch after performing the rewriting control of rewriting the program of the electronic control unit.

13. The mobile object according to claim 11, wherein the rewriting control processor: before performing the rewriting control of rewriting the program of the electronic control unit, provides a notice to a user that the hood cannot be opened for a predetermined amount of time during performing the rewriting control, and obtains a consent from a user to performing the rewriting

control.

14. The mobile object according to claim 11, wherein the rewriting control processor: determines whether a user tries to open the hood during performing the rewriting control of rewriting the program of the electronic control unit, and when it is determined that the user tries to open the hood, provides a notice to the user that the hood cannot be opened for a predetermined amount of time during performing the rewriting control.

15. The mobile object according to claim 11, wherein the rewriting control processor: determines whether the hood is open, and when it is determined that the hood is open, waits until the hood is closed, and when it is determined that the hood is closed, locks the hood latch such that the hood may not be opened and starts the rewriting control of rewriting the program.

16. A program update system comprising: a server device; a mobile object; and a mobile terminal, wherein the mobile object comprises: an acquisition processor acquiring new program from the server deice via a network, and a rewriting control processor performing a rewriting control of rewriting a program of an electronic control unit equipped with the mobile object, the rewriting being performed by using the acquired new program during drive of the mobile object is disabled; a storage compartment covered by a hood; a hood latch; and a battery stored in the storage compartment and configured to supply electrical power to the rewriting control processor and the electronic control unit, wherein the rewriting control processor: locks the hood latch such that the hood may not be opened when performing the rewriting control of rewriting the program of the electronic control unit.

17. The program update system according to claim 16, wherein the rewriting control processor further unlocks the hood latch after performing the rewriting control of rewriting the program of the electronic control unit.

18. The program update system according to claim 16, wherein the rewriting control processor: before performing the rewriting control of rewriting the program of the electronic control unit, provides a notice to a user that the hood cannot be opened for a predetermined amount of time during performing the rewriting control, and obtains a consent from a user to performing the rewriting control.

19. The program update system according to claim 16, wherein the rewriting control processor: determines whether a user tries to open the hood during performing the rewriting control of rewriting the program of the electronic control unit, and when it is determined that the user tries to open the hood, provides a notice to the user that the hood cannot be opened for a predetermined amount of time during performing the rewriting control.

20. The program update system according to claim 16, wherein the rewriting control processor: determines whether the hood is open, and when it is determined that the hood is open, waits until the hood is closed, and when it is determined that the hood is closed, locks the hood latch such that the hood may not be opened and starts the rewriting control of rewriting the program.