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(54) ON-BOARD TELEMATIC DEVICE FOR ACQUIRING DATA RELATED TO THE STATE AND/OR MOTION AND/OR DRIVING OF A TRANSPORT VEHICLE

(57) An on-board telematic device (1), for acquiring data related to the state and/or motion and/or driving of a transport vehicle, comprising:
- a localization module (10);
- an inertial sensor (11);
- a short-range wireless data communication interface (12) configured to operatively connect the on-board telematic device (1) to an external communication device (100) logically paired to the on-board telematic device (1) and arranged within a coverage area of the short-range wireless data communication interface (12);
- a data acquisition and processing unit (13) operatively connected to the localization module (10), the inertial sensor (11), and the wireless data communication interface (12);
- a container body (2) adapted to support and accommodate the localization module (10), the inertial sensor (11), the wireless data communication interface (12), the data acquisition and processing unit (13);
- at least a first USB connector (3) to receive an electrical power supply signal from the transport vehicle.

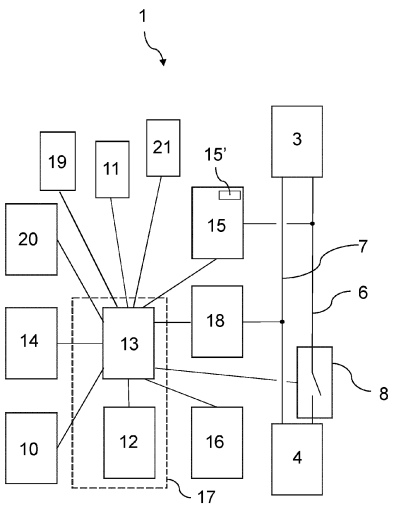

FIG. 2

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Description

[0001] The present invention relates to an on-board telematic device for acquiring data related to the state and/or motion and/or driving of an associable transport vehicle.

[0002] On-board telematic devices are well known and now widely used. Such devices are usually installed on board road transport vehicles, such as, for example, cars, vans, buses, to acquire data related to the state and/or motion and/or driving of the transport vehicles, particularly, road transport vehicles.

[0003] Such telematic devices are generally provided with a satellite localization unit, an inertial accelerometer, a data processing unit, a long-range data communication interface. The latter allows operatively connecting the on-board telematic device by means of a wireless telecommunications network to a remote data acquisition center, for example a center managed by a telematic services provider. The acquired data may be used for various purposes, for example, to recreate the dynamics of a road accident, to monitor the driving style or features of the drivers also in order to parameterize the insurance pricing or in order to educate drivers to a better driving behavior from a safety and/or economic and/or environmental point of view. The wireless communication interface comprises a modem for connection to a cellular radio network, for example, GPRS, 3G, LTE, 4G or 5G.

[0004] An example of an on-board telematic device of the prior art is described in patent application WO201145640A1.

[0005] Despite the widespread use, the on-board telematic devices of the prior art still have numerous drawbacks.

[0006] In particular, the installation of on-board telematic devices is expensive and in some cases complex, because it requires the intervention of a specialized operator and because it requires wiring to connect the telematic devices to the power supply battery of the electrical system of the transport vehicles. In addition, the cost of on-board telematic devices is still high, due to the provision of the long-range communication interface modem. Furthermore, a user who changes a transport vehicle already in his possession with a new transport vehicle will have to bear the burden of uninstalling the on-board telematic device from the discontinued vehicle and of installing it on the new transport vehicle, both with economic and time costs.

[0007] It is the object of the present invention to provide an on-board telematic device which allows solving, or at least partially reducing, the drawbacks affecting the on-board telematic devices of the prior art.

[0008] This and other objects are achieved by an on-board telematic device as defined in claim 1 in its most general form, and some particular embodiments of it in the dependent claims.

[0009] The invention will become more apparent from the following detailed description of the embodiments thereof, given by way of non-limiting examples, with reference to the accompanying drawings, in which:

- Figure 1 shows a three-dimensional diagrammatic view of an exemplary and non-limiting embodiment of a telematic system comprising an on-board telematic device and an external communication device;
- Figure 2 shows a functional block diagram of an exemplary and non-limiting embodiment of the on-board telematic device;
- Figure 3 shows a simplified state diagram of the operation of the on-board telematic device.

[0010] Equal or similar elements will be indicated by the same reference signs in the accompanying Figures.

[0011] With reference to Figure 1, a non-limiting embodiment of a telematic system 1, 100, 200 comprising an on-board telematic device 1, an external communication device 100 and a remote control center 200 has been diagrammatically represented therein. The remote control center 200 is, for example, a remote data acquisition center, for example, a center managed by a telematic services provider. The on-board telematic device 1 in a normal use condition is installed or accommodated or transported on board a transport vehicle. The transport vehicle is, for example, a wheeled road transport vehicle such as, for example, a car, a van, a motorcycle, a bus, a coach, a truck. The transport vehicle is not necessarily a wheeled vehicle, being also possible for it to be, for example, a water vehicle, such as, for example, a boat.

[0012] The external communication device 100 is in particular a device which is external to the on-board telematic device 1 and is a mobile and wireless communication device. For example, without thereby introducing any limitations, the external communication device 100 is a personal communication device such as, for example, a smartphone, or a smartwatch, or a tablet-PC. In accordance with an embodiment, the external communication device 100 could be a wireless communication device integrated in, or coupled with, the transport vehicle. It is clear that, in any case, the external communication device 100 is adapted to be transported on board the transport vehicle.

[0013] With reference now to the diagram shown in Figure 2, the on-board telematic device 1, which may also be defined as a dedicated telematic On-Board-Unit (OBU), based on an embedded system and therefore not comparable in terms of structure and/or operation to general purpose devices such as smartphones, tablet-PCs, smartwatches, is adapted and configured to acquire data related to the state and/or motion and/or driving of the transport vehicle, and in this regard it comprises:

- a localization module 10;
- an inertial sensor 11;
- a short-range wireless data communication interface 12;

- a data acquisition and processing unit 13 operatively connected to the localization module 10, the inertial sensor 11, and the wireless data communication interface 12.

[0014] With joint reference now to Figures 1 and 2, the on-board telematic device 1 further comprises a container body 2 adapted to support and/or accommodate the localization module 10, the inertial sensor 11, the wireless data communication interface 12, the data acquisition and processing unit 13 and the remaining components of the on-board telematic device 1. The container body 2 is preferably made of an electrically insulating material, for example, plastic. The container body 2 has, for example, approximately the shape of a parallelepiped. Preferably, the container body 2 comprises at least an ergonomic manual gripping element 5, for example, a curved recess 5, or two curved recesses 5 opposite to each other. The container body 2 preferably has the aspect and size of a USB key.

[0015] The localization module 10 is, for example, a satellite geolocation module, for example a GPS, or GLONASS or GALILEO, or BeiDou localization module, or any combination of said localization systems. Such module 10 comprises, for example, a receiver and an antenna which allow signals to be picked up which are useful for identifying the position of the on-board telematic device 1 in a georeferenced coordinate system.

[0016] The inertial sensor 11 comprises, for example, a six-axis sensor and is therefore provided with an accelerometer and a gyroscope. The inertial sensor 11 may however be simpler and may, for example, be a triaxial sensor, for example, an inertial triaxial accelerometer. In some implementations, the inertial sensor 11 may be even more complex and be a nine-axis sensor. In the latter case, for example, the inertial sensor 11 comprises a triaxial accelerometer, a gyroscope and a magnetometer.

[0017] The short-range wireless data communication interface 12 is preferably a bidirectional interface and advantageously comprises a Bluetooth interface, for example, a bidirectional Bluetooth Low Energy interface. Short-range means that the wireless data communication interface 12 has an operating range, i.e., a coverage range, generally less than 15 m, for example a range equal to about 10 m or a range less than 10 m. In an alternative embodiment, the short-range wireless data communication interface 12 comprises a Wi-Fi interface or a ZigBee interface.

[0018] In accordance with a particularly advantageous embodiment, the on-board telematic device 1 does not have a modem for connection to a cellular radio network. In such embodiment, the short-range wireless data communication interface 12 is therefore the only wireless communication interface of the telematic device 1.

[0019] The data acquisition and processing unit 13 is a unit dedicated to carrying out on-board telematic functions, i.e., dedicated to acquiring and/or storing and/or processing and/or transmitting data related to the state and/or to the driving and/or to the motion of the transport vehicle and comprises, for example, a microcontroller. In accordance with an embodiment, the data acquisition and processing unit 13 and the short-range wireless communication interface 12 are integrated in the same System on Chip (SOC) 17. In an alternative embodiment, the data acquisition and processing unit 13 and the short-range wireless communication interface 12 are integrated in separate chips. A preferably dedicated firmware is installed on board the data acquisition and processing unit 13, which allows acquiring, for example from the localization module 10, from the inertial sensor 11 and from any further input modules operatively connected to the data acquisition and processing unit 13, data related to the state and/or motion and/or driving of the transport vehicle. The aforesaid firmware also allows processing acquired data to produce processed data. The aforesaid firmware further allows storing the acquired data and/or the processed data. The aforesaid firmware further allows sending the acquired and/or stored and/or processed data to the communication device 100 by means of the short-range communication interface 12. In accordance with a particularly advantageous embodiment, one or more parameters of the aforesaid firmware may be modified by means of modification requests sent by the remote control center 200 and received by means of the short-range communication interface 12 by means of the communication device 100. Said parameters may include, for example, thresholds, for example thresholds which allow the firmware to detect harsh driving events and/or crash events. Said parameters may, for example, include one or more data acquisition, data processing, data storage, data transmission frequencies.

[0020] In accordance with a particularly advantageous embodiment, the data acquisition and processing unit 13 is configured to periodically interrogate, for example once a day, the external communication device 100 to detect if a firmware update is available. If an update is available, the data acquisition and processing unit 13 is configured to receive the update from the external communication device 100.

[0021] In accordance with an advantageous embodiment, the firmware of the data acquisition and processing unit 13 is a firmware dedicated to perform data acquisition and/or data storage and/or data processing and/or data transmission functions in an autonomous manner, i.e., without the aid of a software comparable to an application program executable on board a processing device of the general purpose type. Thereby, in fact, it is not possible to state that the on-board telematic device 1 is comparable to, or may be confused with, the communication device 100 and that it is therefore itself comparable to a smartphone or to a tablet-PC.

[0022] In accordance with an advantageous embodiment, the on-board telematic device 1 further comprises a watchdog module 16 operatively connected to, or integrated in, the data acquisition and processing unit 13.

The watchdog module 16 is programmed to detect a vitality state of the data acquisition and processing unit 13 and to reset the data acquisition and processing unit 13 when the vitality state is not detected.

[0023] The wireless data communication interface 12 is adapted and configured to operatively connect the on-board telematic device 1 to the external communication device 100 logically paired to the on-board telematic device 1 when the external communication device 100 is arranged within the coverage area of the short-range wireless data communication interface 12. Logically paired means that the connection between the on-board telematic device 1 and the external communication device 100 may be established by virtue of a prior logical pairing process which allows each of the two entities to know the identity of the other entity.

[0024] By virtue of the short-range wireless data communication interface 12, it is possible to transmit data acquired and processed by the data acquisition and processing unit 13 to the external communication device 100. This data may include speed data, acceleration data, driving trajectory data, localization data, data containing information on the state of the transport vehicle, data indicative of the driving style of the driver, data indicative of a distracted driving by the driver, data representative of a crash event involving the transport vehicle, data relating to the state of the telematic device 1, etc. These data transmitted to the external communication device 100 are transmitted, as they are or following a post-processing carried out by the external communication device 100, from the external communication device 100 to the remote control center 200 preferably by means of a cellular radio network. In accordance with an advantageous embodiment, the data transmission from the external communication device 100 to the remote control center 200 is managed by an application program 101, such as, for example, an APP, installed on board the external communication device 100. By means of the application program 101, these data may be used to provide information to the driver of the vehicle, for example, by showing all or part of this data, or data related thereto, on a display of the external communication device 100, for example to inform the driver if the driving style thereof is virtuous or risky and/or anti-ecological and therefore needs to be improved. In accordance with a particularly advantageous embodiment, the application program 101 is configured to check and validate the data provided by the on-board telematic device 1. For example, the application program 101 may check whether the acceleration and/or speed and/or position data provided by the telematic device 1 are consistent with other data which may be acquired by the communication device 100 directly by means of sensors and/or interfaces provided on board the communication device 100.

[0025] The on-board telematic device 1 comprises at least a first USB connector 3 to receive an electrical power supply signal from the transport vehicle. Thereby, the installation of the on-board telematic device 1, for example in the passenger compartment of a car, is particularly simple and may be carried out directly by the end user.

[0026] Preferably but not necessarily, the first USB connector 3 is a USB plug connector and can be plugged into a USB socket connector integral with the transport vehicle, for example, integrated in the dashboard of the transport vehicle.

[0027] In accordance with a particularly advantageous and non-limiting embodiment, the first USB connector 3 is integral with the container body 2 of the telematic device 1 so that when the USB plug connector is inserted into the USB socket connector, the container body 2 is also mechanically supported in a position which is fixed and stable with respect to the transport vehicle. However, it is possible to provide an alternative embodiment in which the on-board telematic device 1 comprises a flexible connection cable operatively interposed between the container body 2 and the first USB connector 3.

[0028] In accordance with a particularly advantageous embodiment, the on-board telematic device 1 further comprises a second USB connector 4, preferably a USB socket connector, connected in parallel and in particular in a through manner to the first USB connector 3 to provide an electrical and/or USB data connection to a user device provided with a USB interface which may be connected to the second USB connector 4. Thereby, the on-board telematic device 1 is a pass-through device which allows a user to use, in any case, the USB port of the transport vehicle even if it is physically occupied by the on-board telematic device 1. For example, the on-board telematic device 1 comprises a power bus 6 and a data bus 7 which extend, preferably in a straight manner, between the first USB connector 3 and the second USB connector 4 and which are operatively connected, on the one side, to the first USB connector 3 and, on the other side, to the second USB connector 4. In accordance with a particularly advantageous embodiment, the first USB connector 3 and the second USB connector 4 are arranged on two faces opposite to each other of the container body 2.

[0029] In the present description, when reference is made to a USB connector, it means any type of USB connector currently known, or to be developed in the future, including 1.0 or 2.0 USB connectors of the A, B, mini A, mini B, micro A, micro B type and 3.0 or 3.1 USB connectors including A, B, Micro-B and C connectors.

[0030] In accordance with an advantageous embodiment, the data acquisition and processing unit 13 is adapted and configured to selectively allow or inhibit a connection between the first USB connector 3 and the second USB connector 4. In this regard, the on-board telematic device 1 comprises an electronically controlled switch 8 operatively interposed between the first USB connector 3 and the second USB connector 4 and operatively connected to the data acquisition and processing unit 13 to be controlled by the latter so as to selectively assume a conduction state and an interruption state. For example, the electronically controlled switch 8 allows es-

tablishing/interrupting the connection of the second USB connector 4 to/from the power bus 6. This function may for example be used to control the switching on and off of an external user device operatively connected to the second USB connector 4. In accordance with an embodiment, the aforesaid connection may be established/interrupted on the basis of a control signal transmitted by the external communication device 100 to the telematic device 1.

[0031] In accordance with an advantageous embodiment, the on-board telematic device 1 comprises an electrical power supply distribution module 15, adapted to supply an electrical power supply to the modules and/or components of the on-board telematic device 1 which require for the operation thereof an electrical power supply signal.

[0032] The electrical power supply distribution module 15 preferably performs the functions of regulating and conditioning the electrical power supply signal provided to the on-board telematic device 1 by means of the first USB connector 3 so as to adapt the voltage and/or current values of such signal to the levels required by the various modules which require an electrical power supply. In the particular example shown in the Figures, the electrical power supply distribution module 15 is operatively interposed between the data acquisition and processing unit 13 and the USB power bus 6. In order not to compromise the clarity of Figure 2, in such Figure the other connections which form the electrical power supply distribution network, from the distribution module 15 to the various modules and/or components of the on-board telematic device 1, have not been shown.

[0033] In accordance with a particularly advantageous embodiment, the on-board telematic device 1 comprises a serial data communication interface 18, for example an FTDI interface, which allows the data acquisition and processing unit 13 to receive and/or transmit data by means of the first USB connector 3. In the example, the serial data communication interface 18 is operatively interposed between the data bus 7 and the data acquisition and processing unit 13.

[0034] By virtue of the presence of the serial data communication interface 18, the on-board telematic device 1 may for example use user interface functions offered by the transport vehicle by means of a display, for example a touchscreen display, installed on board the transport vehicle or integrated in the transport vehicle. These functions may be used, for example, when the transport vehicle supports functions such as Apple CarPlay or Android Auto. In practicing the invention, by means of the serial data communication interface 18, the on-board telematic device 1 would appear to the transport vehicle as if it were a smartphone connected to the USB port, and may therefore delegate user interface functions to the on-board display of the transport vehicle.

[0035] In accordance with an advantageous embodiment, the on-board telematic device 1 further comprises at least one non-volatile memory 14 adapted to store data acquired and/or processed by the data acquisition and processing unit 13. Conveniently, such non-volatile memory 14 has a capacity from 4 Mbyte to 64 Mbyte and, for example, equal to 32Mbyte, and is for example a Flash memory.

[0036] In accordance with a particularly advantageous embodiment, the data acquisition and processing unit 13, upon detecting an interruption in the electrical power supply signal, is programmed to save in the non-volatile memory 14 acquired and/or processed data, not yet saved, and preferably also auxiliary data, such as, for example, the date and time in which the interruption of the power supply signal was detected, so as to know the duration of the time period in which the on-board telematic device 1 was not powered. In accordance with a particularly advantageous embodiment, the on-board telematic device 1 comprises an energy storage or reserve device 15' adapted to supply power to the data acquisition and processing unit 13 at least for a period of time required to carry out said saving.

[0037] In addition or as an alternative to what has been described in the previous paragraph, the data acquisition and processing unit 13 is adapted and configured to periodically save in the non-volatile memory 14 data to be transmitted to the communication device 100 by means of the short-range wireless communication interface 12.

[0038] To optimize the duration of the useful life of the non-volatile memory 14, the aforesaid periodic saving is carried out, for example, with a period of time greater than one minute, for example, of the order of 5 minutes or 10 minutes.

[0039] With regard to the energy storage or reserve device 15', in Figure 2 this is shown as included in the electrical power supply distribution module 15. This embodiment is not limiting and the energy storage or reserve device 15' may be external to the electrical power supply distribution module 15.

[0040] The energy storage or reserve device 15' is particularly advantageous since, usually, the power supply voltage to the USB port of a transport vehicle is automatically cut off after a certain time (conventionally, a few minutes) after the transport vehicle is switched off, and is provided again when the vehicle is turned on again or shortly before (e.g., when the doors are unlocked). Therefore the on-board telematic device 1 cannot rely on a permanent power supply voltage. The energy storage or reserve device 15' serves to ensure that the data acquisition and processing unit 13 remains powered at least for a short period of time (conventionally, a fraction of a second) after the external power supply is cut off, and that the data which are to be kept between a power supply cycle and the next one, and which have not been previously saved, may be saved in the non-volatile memory 14. In a basic implementation of the on-board telematic device 1, the energy storage or reserve device 15' comprises one or more simple capacitors of adequate capacity. In addition or alternatively, it is however also possible to use primary or rechargeable batteries, or one or more

supercapacitors.

[0041] In accordance with a particularly advantageous embodiment, the data acquisition and processing unit 13 is adapted and configured to distinguish whether an interruption of the electrical power supply signal is due to a switching-off of the transport vehicle or to a disconnection of the first USB connector 3 from the transport vehicle. To make such distinction, for example, the data acquisition and processing unit 13 constantly monitors the USB power bus 6. Alternatively or in addition, if the serial data communication interface 18 is present, the data acquisition unit 13 constantly monitors the USB data bus 7. For example, if the data acquisition and processing unit 13 detects that one or more electrical parameters of the USB power bus 6 and/or the USB data bus 7, such as the electrical resistance, are indicative of the fact that said buses 6 and/or 7 are open, then it establishes that the on-board telematic device 1 has been physically disconnected from the USB port of the transport vehicle. Conversely, if the data acquisition and processing unit 13 detects an that an interruption of the electrical power supply has occurred, but that the buses 6 and/or 7 are closed, it establishes that the on-board telematic device 1 is physically connected to the USB port of the transport vehicle and that the vehicle has been switched off and/or that the battery on-board the vehicle is flat.

[0042] In accordance with an advantageous embodiment, the data acquisition and processing unit 13 is programmed and configured to detect an on or off state of a traction motor of the transport vehicle and/or to uniquely identify the transport vehicle.

[0043] In accordance with a particularly advantageous embodiment, the on-board telematic device 1 comprises a microphone 19 operatively connected to the data acquisition and processing unit 13, preferably a solid-state microphone. Technically, a solid-state microphone is akin to an accelerometric sensor. However, it is convenient to use this component to detect signals in the audio band. In the on-board telematic device 1 these signals may be analyzed and processed by the data acquisition and processing unit 13 for various purposes, including:

- the detection of a crash event of the transport vehicle; and/or
- the unique recognition of the vehicle by means of the characteristic audio imprint thereof, such as, for example, the frequency spectrum of the noise with the traction engine at idle speed;
- recognition of the on or off state of the traction motor.

[0044] In accordance with a preferred embodiment, the on-board telematic device 1 further comprises an acoustic and/or optical signaling device 20 operatively connected to the data acquisition and processing unit 13 to be driven thereby. For example, the acoustic signaling device 20 is or comprises a buzzer. For example, the optical signaling device 20 is or comprises a LED. The acoustic and/or optical signaling device allows, for example, informing the user about the correct operating state and/or connection of the on-board telematic device 1.

[0045] In accordance with a particularly advantageous embodiment, the on-board telematic device 1, when driving the transport vehicle, is adapted and configured to receive, through the short-range wireless data communication interface 12 and from the external communication device 100, data representative of a usage by the user of the external communication device 100. These data allow the data acquisition and processing unit 13 to determine if the driver of the transport vehicle is distracted while driving. Such data allow, for example, obtaining information on whether the user, while driving, is reading or editing a text, or is making or answering a phone or video call, consulting a website or a social network or an address book, writing an email or a text message or an instant message. Preferably such data are provided by the operating system of the external communication device 100, preferably by means of the application program 101.

[0046] In accordance with a particularly advantageous embodiment, the representative usage data are saved by the data acquisition and processing unit 13 as they are, or after a processing, in the non-volatile memory 14, alone or associated with other data acquired by the unit 13, such as, for example, speed, acceleration, localization data, etc. In accordance with a particularly advantageous embodiment, such representative usage data saved in the non-volatile memory 14 are transmitted as they are or after a processing to the external communication device 100 by means of the wireless communication interface 12 for a subsequent transmission to the remote control center 200.

[0047] In accordance with a particularly advantageous embodiment, the on-board telematic device 1 comprises a tamper sensor 21 fixed to or integrated in the container body 2. The tamper sensor 21 is operatively connected to the data acquisition and processing unit 13 and allows the latter to detect a breaking of the telematic device 1 and/or a disconnection of the telematic device 1 from the USB connector integral with the transport vehicle. In accordance with an advantageous embodiment, upon detecting a breaking and/or disconnection of the telematic device 1, the data acquisition and processing unit 13 is configured to bring the telematic device 1 in a deactivated state. In the deactivated state, the device 1 may not acquire and/or process data related to the state and/or motion and/or driving of the transport vehicle and/or generally it may not transmit such data by means of the short-range wireless communication interface 12. Advantageously, the data acquisition and processing unit 13 is configured to directly or indirectly bring back the telematic device 1 to an activated state upon receiving an activation signal transmitted by the communication device 100. Such activation signal is preferably transmitted by the communication device 100 with prior authorization from the remote control center 200.

[0048] The tamper sensor 21 is, for example, a force

sensor, for example a load cell, or an electromechanical switch. For example, the electromechanical switch may be integral with the container body 2 and comprise a movable button. The electromechanical switch assumes an interruption or conduction state (or vice versa) depending on whether the button is respectively abutting or not against a contact surface placed at or on the USB connector of the transport vehicle.

[0049] Figure 3 shows a possible simplified and non-limiting state diagram of the on-board telematic device 1. The initial state S0 is a state in which the telematic device 1 is uninstalled. For example, the telematic device 1 is supplied to a user in the initial state S0. In the initial state S0, after connecting the telematic device 1 to the USB connector of the transport vehicle, the device 1 may be logically paired to the communication device 100. After the logical pairing, starting from the initial state S0, preferably upon receiving an installation signal from the communication device 100, the telematic device 1 assumes an activation state S1, in which it is preferably periodically checked whether a firmware update is available. For example, the check is carried out once a day. If an update is available, the telematic device 1 assumes an update state S2. In this state S2, by means of the external communication device 100, the firmware update is downloaded and installed. Subsequently, the telematic device 1 re-assumes the activation state S2. Starting from the state S2, if the transport vehicle is switched on, the telematic device 1 passes to the on state S3, in which data related to the state and/or motion and/or driving of the transport vehicle are acquired. Starting from the on state S3, if the transport vehicle is switched off, the telematics device 1 assumes the off state S5.

[0050] If an energy storage device is provided on board the telematic device 1, in the off state S5 the telematic device 1 may be preferably limited to detect and store any alarms preferably in the non-volatile memory unit 14, for example, relating to an abnormal shock detected when the transport vehicle is turned off.

[0051] Furthermore, again starting from the on state S3, if abnormal or intense accelerations/decelerations are detected (for example, higher than 2G or 2.5G), the telematic device 1 assumes the crash state S4 which is representative of a potential accident or collision. For example, in the crash state S4 the acquired data, even in a time interval prior to the passage to the crash state (for example, equal to 5s or 10s), is immediately saved in the non-volatile memory unit 14 and possibly immediately transmitted to the external communication device 100. Once the detected accelerations return to normal (for example, lower than 2G or 2.5G), starting from the crash state S4, the telematic device 1 re-assumes the on state S3. Starting from any state, for example from the activation state S2 or starting from the off state S5, if a breaking or tampering of the on-board telematic device 1 is detected, the device assumes the deactivation state S6, where it preferably remains as long as it does not receive an authorization signal, for example, from the communication device 100. Preferably, upon receiving the authorization signal, the telematic device 1 re-assumes the initial deinstallation state S0 and, starting from this state, it may assume the activation state S1 preferably after a new logic pairing with the communication device 100 and upon receiving a new installation signal.

[0052] Based on the above, it is thus possible to understand how an on-board telematic device 1 of the type described above allows fully achieving the purposes indicated above with reference to the prior art.

[0053] Without prejudice to the principle of the invention, the embodiments and the manufacturing details may be broadly varied with respect to the above description disclosed by way of a non-limiting example, without departing from the scope of the invention as defined in the appended claims.

Claims

1. An on-board telematic device (1), for acquiring data related to the state and/or motion and/or driving of a transport vehicle, comprising:

   - a localization module (10);
   - an inertial sensor (11);
   - a short-range wireless data communication interface (12) configured to operatively connect the on-board telematic device (1) to an external communication device (100) logically paired to the on-board telematic device (1) and arranged within a coverage area of the short-range wireless data communication interface (12);
   - a data acquisition and processing unit (13) operatively connected to the localization module (10), the inertial sensor (11), and the wireless data communication interface (12);
   - a container body (2) adapted to support and accommodate the localization module (10), the inertial sensor (11), the wireless data communication interface (12), the data acquisition and processing unit (13);
   - at least a first USB connector (3) to receive an electrical power supply signal from the transport vehicle;

   characterized in that:

   - the first USB connector (3) is a USB plug connector and can be plugged into a USB socket connector which is integral with the transport vehicle, wherein the first USB connector is integral with the container body (2) so that when said plug connector is plugged into said socket connector, the container body (2) is also mechanically supported in a fixed and stable position with respect to the transport vehicle;
   - the on-board telematic device (1) compris-

es a non-volatile memory (14) adapted to store data acquired and/or processed by the data acquisition and processing unit (13).

2. An on-board telematic device (1) according to any one of the preceding claims, further comprising a second USB connector (4), preferably a USB socket connector, connected in parallel to the first USB connector (3) to provide an electrical and/or USB data connection to a user device provided with a USB interface which is connectable to said second USB connector (4).

3. An on-board telematic device (1) according to claim 2, wherein the data acquisition and processing unit (13) is adapted and configured to selectively allow or inhibit a connection between the first USB connector (3) and the second USB connector (4).

4. An on-board telematic device (1) according to claim 1, wherein the data acquisition and processing unit (13), upon detecting an interruption in the electrical power supply signal, is programmed to save acquired and/or processed data not yet saved in the non-volatile memory (14) .

5. An on-board telematic device (1) according to claim 4, comprising an energy storage device (15') adapted to power the data acquisition and processing unit (13) for a period of time required to carry out said saving.

6. An on-board telematic device (1) according to any one of the preceding claims, wherein the data acquisition and processing unit (13) is adapted and configured to distinguish whether an interruption of the electrical power supply signal is due to a switching-off of the transport vehicle or to a disconnection of the first USB connector (3) from the transport vehicle.

7. An on-board telematic device (1) according to any one of the preceding claims, further comprising a watchdog module (16) operatively connected to, or integrated in, the data acquisition and processing unit (13), programmed to detect a vitality state of the data acquisition and processing unit (13) and to reset the data acquisition and processing unit (13) upon failure to detect said vitality state.

8. An on-board telematic device (1) according to any one of the preceding claims, wherein the short-range wireless communication interface (12) is a Bluetooth interface, preferably a Bluetooth Low Energy interface.

9. An on-board telematic device (1) according to any one of the preceding claims, wherein the on-board device (1) has no modem for the radio connection to a cellular radio data network.

10. An on-board telematic device (1) according to any one of the preceding claims, comprising a tamper sensor (21) fixed to or integrated in the container body (2), wherein the tamper sensor (21) is operatively connected to the data acquisition and processing unit (13) and allows the latter to detect a breaking of the telematic device (1) and/or a disconnection of the telematic device (1) from the USB connector integral to the transport vehicle wherein, upon detecting a breaking and/or a disconnection of the telematic device (1), the data acquisition and processing unit (13) is configured to bring the telematic device (1) into a deactivated state (S6).

11. An on-board telematic device (1) according to any one of the preceding claims, further comprising a microphone (19) operatively connected to the data acquisition and processing unit (13).

12. An on-board telematic device (1) according to claim 11, wherein the data acquisition and processing unit (13) is programmed and configured, also or exclusively, according to audio signals picked up by the microphone (19) :

- to detect an on or off state of a traction motor of the transport vehicle; and/or
- to uniquely identify the transport vehicle; and/or
- to identify a crash event in which the transport vehicle was involved.

13. An on-board telematic device (1) according to any one of the preceding claims, wherein the on-board telematic device (1), when driving the transport vehicle, is adapted and configured to receive, through the short-range wireless data communication interface (12) and from the external communication device (100), data representative of a usage by the user of the external communication device (100), to determine whether the driver of the transport vehicle is distracted while driving.

14. An on-board telematic device (1) according to claim 13, wherein said representative usage data are saved by the data acquisition and processing unit (13) as such, or after processing, in the non-volatile memory (14), to be preferably transmitted to the external communication device (100) through the short-range wireless communication interface (12).

15. A kit of parts comprising an on-board telematic device (1) according to any one of the preceding claims and a computer application program (101) which can be installed on board said communication device (100), wherein the computer application program is adapted and configured to receive data acquired

and/or processed by the data acquisition and processing unit (13) and to transmit said data to a remote control center (200) through a connection over a long-range wireless network.

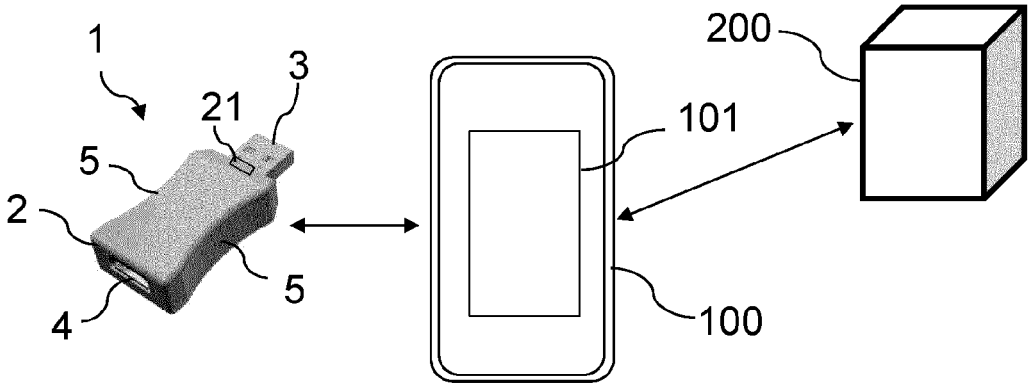

FIG. 1

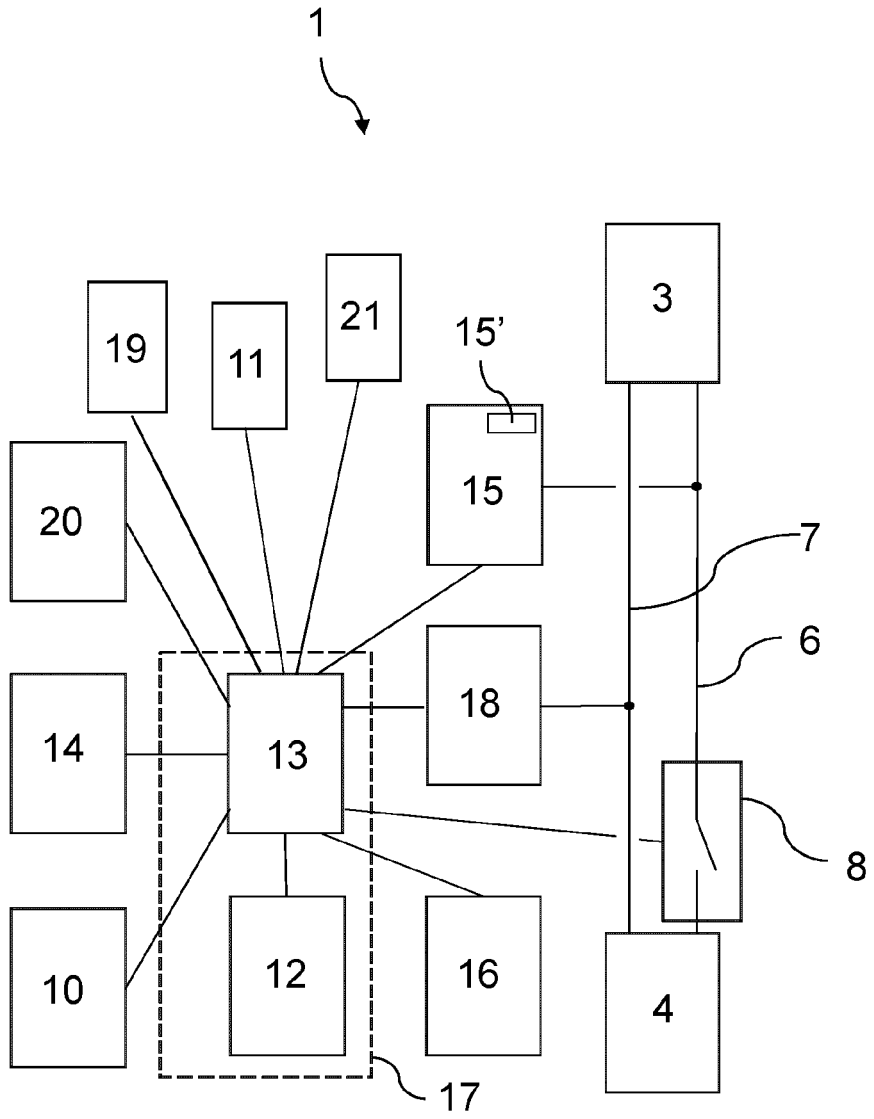

FIG. 2

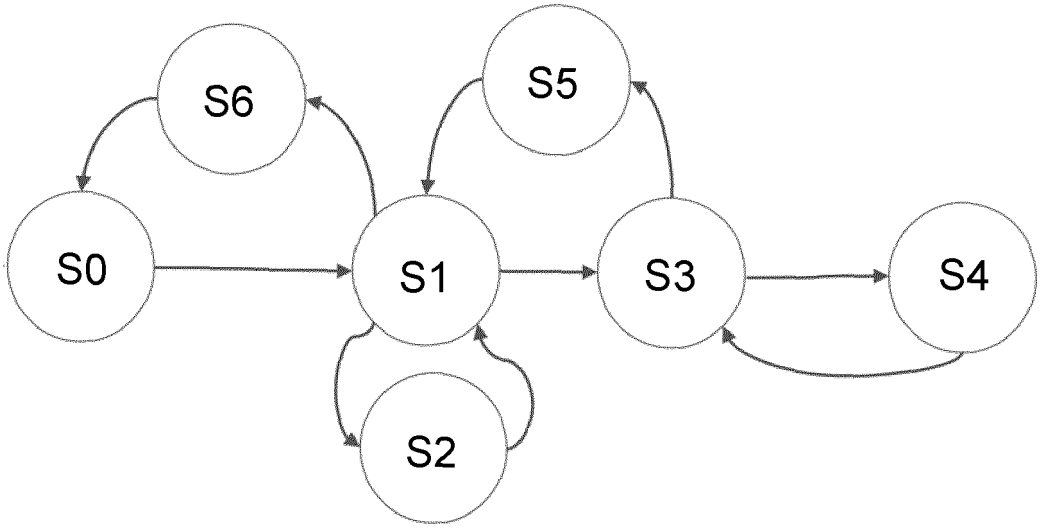

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 5838

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 June 2022	Harder, Sebastian

CATEGORY OF CITED DOCUMENTS

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