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(54) METHOD FOR A VEHICLE RELATED IDENTITY VALIDATION

(57) The invention discloses a method for a vehicle related identity validation as well as a vehicle. The method comprises receiving a vehicle related identity validation request signal (16) associated with a designated vehicle (S1). A specific control signal (20) is then transmitted to a presumed vehicle (26) that is presumably the designated vehicle (S2). The specific control signal (20) contains control data (22) for at least one vehicle component of the designated vehicle and identification data (24). If the received identification data (24) match stored identification data (30), the at least one vehicle component is operated according to the control signal (22) (S4, S5). An off-vehicle sensor device (34) then provides a sensor signal (36) that characterizes the operation of the vehicle component (S6). If the at least one vehicle component has been operated according to the control data (22), the requested vehicle related identity validation is confirmed (S8, S9).

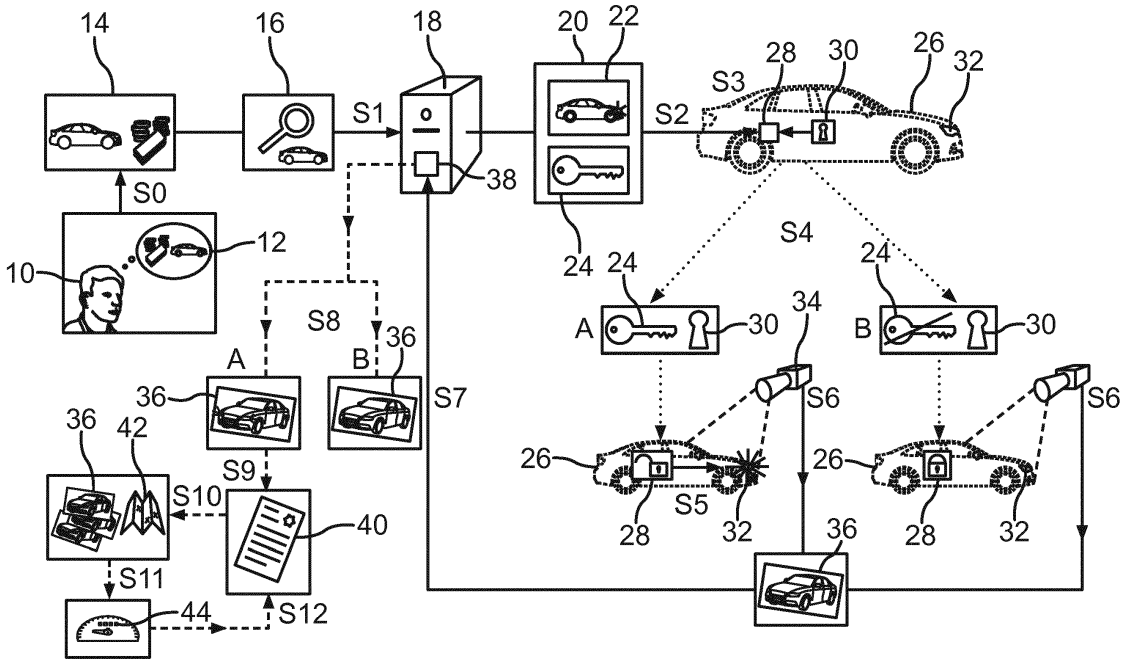

Fig.

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Description

[0001] The invention is concerned with a method for a vehicle related identity validation and a vehicle designed to conduct steps related to the vehicle according to such a method.

[0002] Nowadays, there is a variety of situations where it is critical to validate vehicle identity, vehicle part identity, and/or reliability of vehicle data. This is for example the case when an individual attempts to sell or buy a vehicle. In such a situation, it can be important to be able to accurately state vehicle mileage. Usually, a desired validation of vehicle data such as vehicle mileage can be accomplished via digital certificates or other encryption mechanisms.

[0003] Document US 2002/0072963 A1 discloses a system for collecting and/or disseminating information in relation to traffic. With this system, information about individual persons and/or vehicles can be collected and checked on reliability in such a way that yet sufficient protection can be offered against illegitimate tracing of individual persons and/or vehicles. Hereby, an odometer reading can be verified with help of reliable information supplied from the outside world via a transmitter.

[0004] It is an object of the present invention to provide a reliable validation mechanism for vehicle related identity validation.

[0005] The object is accomplished by the subject matter of the independent claims. Advantageous developments with convenient and non-trivial further embodiments of the invention are specified in the following description, the dependent claims, and the figures.

[0006] The inventive method is based on the understanding that in some cases the value of gaining unauthorized access to a vehicle and/or its vehicle data is high. Therefore, there is a considerable interest in cracking an encryption that is used to prevent unauthorized access to the vehicle and/or its vehicle data. Under such circumstances, it may be desirable to have an additional and redundant validation mechanism to be able to perform a reliable identity validation of vehicle related data. Such an additional redundant validation mechanism can be achieved by making use of a signal transmitted to the vehicle, modifying the transmitted signal in a vehicle or vehicle part specific manner to create a vehicle related signal that could be measured by an off-vehicle device, transmitting a signal externally comprising a request for measuring the vehicle related signal to the off-vehicle device, and then measuring the externally observable vehicle related signal by the off-vehicle device. By conducting the described additional redundant validation mechanism, the authenticity of a particular vehicle, a specific vehicle part of a vehicle, and/or a data stream of vehicle data associated with a specific vehicle can be established resulting in validating a respective vehicle related identity.

[0007] The inventive method for vehicle related identity validation comprises receiving a vehicle related identity validation request signal associated with a designated vehicle. In a first step of the inventive method, it is stated by receiving the validation request signal that one party, e.g., a user of a vehicle selling platform, is interested in performing an identity validation in connection with a specific vehicle. This specific vehicle is referred to as the designated vehicle. The received vehicle related identity validation request signal contains data characterizing the designated vehicle whose identity shall be validated with the help of the inventive method. The request signal can furthermore specify a particular vehicle part of the designated vehicle, e.g., a specific battery that is comprised by the designated vehicle. In order to identify an object such as a vehicle and/or a vehicle part whose identity is requested to be validated, a vehicle identification number (VIN) could be used to identify the vehicle itself and/or the vehicle that is supposed to contain the vehicle part in question. If, however, it is expected that, for example, a specific battery as vehicle part is comprised by a specific vehicle, this information could be comprised by the identity validation request signal. In general, it should be first decided which vehicle related identity is supposed to be validated and afterwards a respective identity validations request signal should be generated and provided. However, details on the identity of the designated vehicle relating to the object of the vehicle related identity validation request should be comprised by the vehicle related identity validation request signal.

[0008] The vehicle related identity validation request signal is preferably received by an off-vehicle server unit. The off-vehicle server unit is, for example, designed as a computer such as a network host. The off-vehicle server unit that received the vehicle identity validation request signal then transmits a specific control signal to the vehicle that is presumed to be the designated vehicle. The specific control signal contains control data for at least one vehicle component of the designated vehicle. The at least one vehicle component is for example a headlight of the vehicle that can be dimmed or brightened up according to lightning control specifications given by the control data. The specific control signal contains, additionally to the control data, identification data. The identification data are customized for the designated vehicle and/or a vehicle component whose identity validation is requested according to the received vehicle identity validation request signal. The identification data comprise for example a digital code that can only be decrypted by a component of the designated vehicle and/or the vehicle component whose identity validation is requested according to the received vehicle identity validation request signal. This means that the server unit creates and then transmits a specific signal, i.e., the specific control signal to a vehicle that comprises data with which it is possible to modify for example the intensity of the vehicle headlights. This modification is supposed to be only temporary, meaning that no permanent modification of the respective vehicle component of the designated vehicle is intended based on the control data, such as permanent

dimming of the vehicle headlights. The specific control signal can, for example, be transmitted via a wireless communication connection between the server unit and the presumed vehicle. The wireless communication connection can be established via a wireless local network such as a wireless local area network (WLAN), or via a mobile data network based on mobile radio standard Long Term Evolution (LTE) or Fifth Generation (5G). The vehicle to which the specific control signal is transmitted is referred to as the presumed vehicle because in order to validate the vehicle identity it is in the beginning only assumed that a certain vehicle is the designated vehicle. The presumed vehicle is thus the vehicle that is allegedly the designated vehicle. Until the end of the validation method is reached, the vehicle to which the specific control signal is transmitted is hence referred to as the presumed vehicle.

[0009] In a next step of the method, the presumed vehicle receives the specific control signal. Therefore, the presumed vehicle comprises a communication unit that is capable of receiving the specific control signal from the server unit. Subsequently, it is verified if the identification data of the received specific control signal match with stored identification data stored in the presumed vehicle. This verification step can be performed by a control unit of the presumed vehicle. The control unit is connected with a data storage unit of the presumed vehicle in which the identification data known to the vehicle are stored. But the specific control signal that is received by the presumed vehicle is at first convoluted. This means that the specific control signal is converted into a format in which it is a combined signal comprising the control data as well as the identification data, wherein the identification data is unique to the designated vehicle. The data unique to the designated vehicle, i.e., the identification data, can only be decrypted if corresponding stored identification data is available to the control unit. With the described verification step, it is hence possible to unlock the so far inaccessible control data within the specific control signal. This means that only if the received identification data and the stored identification data correspond to each other it is possible to operate the at least one vehicle component of the presumed vehicle according to the control data of the specific control signal. As a possible result of the matching of the received identification data and the stored identification data as well as the consequent operation of the vehicle component according to the control data, the intensity of the headlights of the presumed vehicle is dimmed by a specific percentage for a specific time interval. As an example, the headlights of the designated vehicle could each be dimmed by 20 percent for a duration of three seconds. If however the transmitted identification data and the stored identification data are no match, the control unit cannot access the control data contained by the specific control signal and therefore the at least one vehicle component, e.g., the headlights of the vehicle are not operated according to the control signal.

[0010] An off-vehicle sensor device can now detect a sensor signal characterizing the operation of the at least one vehicle component of the presumed vehicle according to the control data. The off-vehicle sensor device can be designed as a traffic camera. This means that the sensor signal could be given as a video feed of a road on which the presumed vehicles is driving. In case the at least one vehicle component of the presumed vehicle is operated according to the control signal, this operation should be verifiable by evaluating the detected sensor signal. The next step of the method therefore comprises evaluating the detected sensor signal to validate if the at least one vehicle component has been operated according to the transmitted control data. By performing the evaluation step, it is determined whether the headlights of the presumed vehicle were dimmed according to the control data or if no change in brightness of the headlights of the vehicle can be recognized according to the evaluated sensor signal. The evaluation step is typically performed by the off-vehicle server unit. This means that the detected sensor signal is after its detection transmitted from the off-vehicle sensor device to the off-vehicle server unit.

[0011] If the at least one vehicle component has been operated according to the control data, which can be decided by the server unit based on the evaluation of the sensor signal, the server unit confirms the requested vehicle related identity validation. If the requested vehicle related identity validation is confirmed, it is achieved that the presumed vehicle is identified as the designated vehicle. Confirming the requested vehicle related identity validation can be done by storing confirmation data in the server unit that can serve as a certificate for the vehicle related identity associated with the presumed vehicle. The certificate can be advantageous to have for the vehicle selling platform that first sent out the request signal to the server unit in order to gain prove for a potential customers that a certain vehicle is actually the designated vehicle, wherein details regarding equipment and condition of the designated vehicle are known previous to the request signal. Now the known details are furthermore known to be connected to the presumed vehicle since the identity validation was successful for the presumed vehicle.

[0012] In other words, the server unit, for example, can connect to the off-vehicle sensor device and request transmission of the video feed of a particular traffic camera. It can afterwards evaluate the measured intensity of the vehicle headlights over time and match the thereby calculated light intensity value to the expected light intensity value according to the control signal. Hereby, it is taken into account how the designated vehicle is expected to implement the control data by operating the vehicle headlights. In case of successful validation of the detected sensor signal from the specific traffic camera, it is then confirmed that the vehicle that is presumed to be the designated vehicle is actually the designated vehicle. Because otherwise, the identification data trans-

mitted within the specific control signal would not match with the stored identification data stored in the vehicle resulting in a lack of proof for operating the at least one vehicle component according to the control signal.

[0013] The advantage of the described method is that it can reliably allow for the validation of vehicles, vehicle parts and/or vehicle data. By doing so one can build confidence into a service provided by the vehicle selling platform or another respective platform, wherein the service confirms the vehicle related identity validation. By detecting the operation of the at least one vehicle component with an off-vehicle sensor device a manipulation of the validation result from within the vehicle can be ruled out. This increases trustworthiness and reliability of the described method and especially of the results of the described validation process.

[0014] The invention also comprises embodiments that provide features which afford additional technical advantages.

[0015] In one embodiment of the inventive method, it is comprised that the vehicle related identity validation request signal requests identity validation of a vehicle, a vehicle part and/or vehicle data. The vehicle part whose identity validation is requested can be for example a particular battery or another exchangeable vehicle part that is integrated in the vehicle. The vehicle data could be a current odometer reading value, i.e., a mileage in kilometers or miles of a specific vehicle. Depending on the vehicle related identity validation request signal the identification data of the specific control signal fit the stored identification data associated with the vehicle, the vehicle part and/or the vehicle data. The specific control signal is created in a way that the identification data that is added to the specific control signal contains the specific identification data that is correlated to the stored identification data that is related to the vehicle related object or data comprised within the validation request signal. For example, a potential buyer of a vehicle is interested in making sure that the vehicle that is expected to be the offered vehicle shown at a vehicle selling platform comprises a specific battery, that is for example relatively new and therefore in good condition. The potential buyer then sends a corresponding vehicle related identity validation request signal to the server unit. The sent vehicle identity validation request signal comprises the information, that the identity that is supposed to be validated refers to a specific battery comprised by a specific vehicle. The specific control signal that is then created contains identification data for the specific vehicle itself but also for the specific battery that is presumably integrated into the specific vehicle. Therefore the operation according to the control data takes place if both the battery related identification data match corresponding stored identification data as well as the identification data associated with the designated vehicle itself matches stored identification data associated with the vehicle itself in the presumed vehicle. In general the identification data of the specific control signal can contain multiple identification data elements each associated with either the designated vehicle itself, a particular vehicle part, specific vehicle data, and/or vehicle data elements. This allows for a nuanced and accurate identity validation of the vehicle related object or data which are of interest due to the received vehicle related validation request signal. This makes the described method particularly effective and furthermore guarantees a reliable result of the method as it is guaranteed that all requested identities are actually validated.

[0016] According to another embodiment of the invention, the control data comprise at least one activation data element. The activation data element characterizes a specific time and/or a specific location at which the at least one vehicle component of the presumed vehicle is operated. It is therefore possible to predefine a point in time in the future as well as a particular place where operating the at least one vehicle component according to the control signal takes place. This allows, for example, choosing a location in a predefined surrounding area of a specific off-vehicle sensor device, for example the traffic camera located at a specific location alongside a particular road. Under consideration of details on a current driving route of the vehicle, it is hence possible to estimate an approximate arrival time within the surveillance area of the specific traffic camera meaning that it is known at which specific time the vehicle reaches the specific location. The specific control signal comprises the information on time and location at which the presumed vehicle is supposed to be in the surveillance area of the specific traffic camera. At that time and location the operation of the at least one vehicle component of the designated vehicle is performed. If the right vehicle received the specific control signal and was able to access the control data, the expected operation actually happens at the expected point in time and location and can be detected by the specific off-vehicle sensor device. The specific time and specific location is preferably determined based on a current vehicle location, the known driving route of the vehicle and the availability of off-vehicle sensor devices, such as one or multiple public traffic camera with an available video feed. By specifying time and place of the operation of the at least one vehicle component, it is furthermore possible to achieve quick and fail-safe finding of the detected sensor signal within a large amount of sensor signals provided by a particular off-vehicle sensor device that provides the sensor signal. Because if no specific time and no specific location is comprised within the control data extensive effort is expected to find the sensor signal corresponding to the designated vehicle.

[0017] An additional embodiment comprises that if the requested vehicle related identity validation is confirmed the location where the operation of the at least one vehicle component was detected is stored in an off-vehicle memory device. Every time the requested vehicle related identity validation is confirmed meaning every time it is detected, that the presumed vehicle was operated according to the transmitted control data of the specific con-

trol signal this event is saved as a respective specific data element. In addition to the simple information that the vehicle related identity validation was successful it is therefore furthermore stored where the respective identity validation event took place. The stored data thus allows for tracking a driving route of the designated vehicle if the described method to validate a vehicle related identity is preformed multiple times, preferably continuously, for example every ten minutes or once an hour when the vehicle is in action. The multiple performed identity validations can beneficially support the accuracy of the confirmation of the vehicle, the vehicle part and/or the vehicle data.

[0018] According to another embodiment, it is intended that if several locations are stored in the off-vehicle memory device for the designated vehicle, a total length of a driving distance of the designated vehicle is estimated. By doing so, an approximated odometer reading is calculated for the designated vehicle. It is thus possible to track a distance the designated vehicle has travelled by determining the sum of all distances between the individual locations where the operation of the at least one vehicle component was detected. This is possible due to the fact that all these different locations are stored in the off-vehicle memory device. Additionally it is possible to also store driving routes prepared by a navigation system of the designated vehicle in the off-vehicle memory device if those driving route details are transmitted to the off-vehicle memory device. By additionally considering these details on the driving route of a designated vehicle by estimating the total lengths of the driving distance of the designated vehicle, it is possible to make sure that also details of the driving route are considered that are for example not accessible due to lack of an available off-vehicle sensor device or due to a predetermined time gap between individual validation procedures according to the described method. This is possible because successful validation of the control data from a specific traffic camera can confirm both the identity and the position of the vehicle. The storage of such data can over time be used to validate the approximate number of kilometers and/or miles the designated vehicle should have been driven in total.

[0019] The reason for the approximation of the odometer reading value of the designated vehicle is that this value is often manipulated with, e.g., by resetting a vehicle electric control unit that record the odometer reading value. The advantage of the described method to estimate the odometer reading value is that the designated vehicle has been proven physically localized at each specific stored location so that the driven distance of the vehicle can be estimated reliably. Since data provided by the off-vehicle sensor device is available for the public, it is easily possible to verify a given odometer reading of a vehicle if the individual locations where the operation of the at least one vehicle component of this vehicle was detected is stored in the off-vehicle memory device. The estimation of the total lengths of the driving distance of the designated vehicle is typically not performed in the designated vehicle itself due to fear of manipulation of data but by the off-vehicle server unit. This reduces the risk of tempering with individual steps of the method but also guarantees a reliable estimated odometer reading value, e.g., to convince a potential buyer or seller of the vehicle of the validity its odometer reading value.

[0020] In a further embodiment of the invention, it is disclosed that the received vehicle related identity validation request signal associated with the designated vehicle is sent by a server unit of a vehicle selling platform and/or a manufacturer of the designated vehicle. The vehicle related validation request signal is particularly sent by this server unit as a reaction to a validation request made by a potential buyer and/or a potential seller of the designated vehicle. The validation request can be made for example via activating a predefined request option of an application on a mobile communication device or a website that is respectively accessed by the potential buyer and/or the potential seller. For a potential buyer it can be interesting to have proof that, for example, a particular battery is actually built into a vehicle that the designated potential buyer would like to purchase. For the potential seller it is advantageous to have a confirmation of the identity of the vehicle, the vehicle part of the vehicle or the vehicle data he provides to show a potential customer. With help of this proof, the potential customer would trust information about the designated vehicle stated on the vehicle selling platform. For the manufacturer of the designated vehicle, it can be beneficial to be informed if any manipulations were performed on a vehicle that was produced by the manufacturers, e.g., in order to estimate the vehicle's reselling value on a used-vehicle market.

[0021] Alternatively or additionally to the described sending of the validation request signal to the server unit upon a validation request made in the end by a person, i.e., the potential seller or buyer of the designated vehicle, it is also possible to provide an automatically generated validation request. Such an automatically generated validation request could be transmitted to the server unit or be created by the server unit. A particular automatically generated validation request could be generated after a predetermined time interval and/or for a randomly chosen designated vehicle in order to get an estimation of the general dimension of attempts to manipulate vehicle identity, vehicle part identity and/or vehicle data identity.

[0022] According to another embodiment the specific control signal is transmitted and/or the detected sensor signal is respectively evaluated by an off-vehicle server unit. To make sure that the presumed vehicle is the designated vehicle the specific control signal is created and transmitted to the presumed vehicle by a device that is definitively not positioned within the designated vehicle itself so that the transmittance of the specific control signal is independent from the presumed as well as the designated vehicle. This part of the method is thus independent of potential manipulations of the control unit of the

presumed and/or designated vehicle. Analogously, also the verification step during which the detected sensor signals are validated and correlated with the control data of the specific control signal is performed by the off-vehicle server unit. This guarantees a high probability that if the requested vehicle related identity validation is confirmed this result is highly trustworthy and cannot be manipulated by performing manipulation steps on the vehicle, vehicle parts and/or vehicle data.

[0023] Another embodiments comprises that one or multiple vehicle components of the presumed vehicle are operated in such a way that the operation is physically detectable by the off-vehicle sensor device. This means that any vehicle component or combination of vehicle components could be operated that is designed to be altered so as to be physically detected by a sensors device as off-vehicle sensor device that responds to, for example, an electromagnetic signal, sound, i.e., an acoustic signal, a physical movement of the respective vehicle component or components, and/or a mass of the respective vehicle component or components. Therefore, multiple vehicle components could be operated, particularly an interior or exterior light of the vehicle that sends out an electromagnetic signal. In case a sound is detected by the off-vehicle sensor device, a horn of the vehicle could be operated as vehicle component. Furthermore, the vehicle could be operated according to a specific driving routine so that the resulting physical movement could be detectable. Alternatively or additionally, the vehicle could be operated according to the specific driving routine so that the vehicle is at a specific point in time positioned on a specific road segment with an integrated mass sensor as off-vehicle sensor device that then detects the presence of the vehicle. Depending on the reliability and the availability of the operable vehicle component within the vehicle as well as the availability of a corresponding off-vehicle sensor device a respective physically detectable operation is performed by the at least one vehicle component according to the control data of the specific control signal. This makes the vehicle related identity validation versatile applicable.

[0024] Moreover, another embodiment comprises that as vehicle component of the presumed vehicle at least one of following vehicle components is operated: at least one headlight, at least one rear light, at least one sidelight, at least one vehicle interior light, a light detection and ranging (LIDAR) device, a horn, a communication device with a predefined limited communication range, i.e., a transmitter, a drive system, a brake system, and/or a steering system. The control signal can therefore for example include an operation rule for the vehicle headlights, the vehicle sidelights and/or the rear lights comprising a rapid dimming or rapid brightening of these lights, respectively. It is also possible to introduce a rapid changing of the corresponding headlights, sidelights and/or rear lights, e.g., a blinking of the corresponding light for three times in a predefined time interval. Alternatively or additionally, changing the intensity of the corresponding lights, particularly the vehicle interior lights, by a predefined percentage for a predefined time duration can be intended as operation. Additionally or alternatively another transmission device can be used for such intensity changes like for example the LIDAR device or the communication device that transmits, for example, a predefined radio signal to a nearby cell tower. Alternatively or additionally, sound can be used as an operation, such as the sound of the horn of the vehicle. Alternatively or additionally to that, a particular motion pattern of the vehicle can be introduced by for example changing the speed of a vehicle causing the car to stutter or to temporarily drop speed at a predefined speed dropping rate. Another movement of the vehicle that could be used as specific operation of a vehicle component involves steering the vehicle according to a predefined trajectory routine performed by operating the steering system according to respective control data.

[0025] All these examples would each result in an operation of the presumed vehicle that is recognizable by analyzing the sensor signal provided by the off-vehicle sensor device, such as analyzing the video stream of the traffic camera as described in detail above. A static picture of the vehicle at a certain time as sensor signal is therefore often not sufficient to determine whether the control data were used to operate the vehicle or not. In total, there is a large variety of components of the vehicle that can be operated. The more of these different components are operated the higher is the reliability of the received confirmation of the requested vehicle related identity validation. This is especially the case if the different components are operated in a specific operation routine, i.e., if they are operated one after the other in a specific order or simultaneously within a predefined time window. Depending on the reliability and availability of the off-vehicle sensor device, one or more of the described components can be operated according to the control data of the specific control signal. This makes the vehicle related identity validation versatile applicable.

[0026] According to another embodiment, the off-vehicle sensor device detects an electromagnetic signal, an acoustic signal, a force signal, an acceleration signal, a deceleration signal and/or a mass signal as sensor signal. As electromagnetic signal a signal of a specific wavelength range can be detected, which is for example the wavelength range of ultraviolet light, visible light, infrared light and/or a radio wave. If, for example, at least one light of the vehicle, and/or the LIDAR device are operated, this can be detected as an electromagnetic signal by a respective off-vehicle sensor device. If, for example, the drive system, the brake system, and/or the steering system are operated, this can be detected as a force signal, an acceleration signal, a deceleration signal and/or a mass signal by a respective off-vehicle sensor device. In case of the detected mass signal, the sensor device could be a mass sensor positioned in a road segment on which the vehicle can be positioned. Depending on its availability along the current route of the vehicle, the ideal sen-

sor device or even multiple sensor devices can be chosen to detect the operation of the presumed vehicle by detecting at least one of the mentioned signal types as sensor signal. This leads to a particularly diverse applicability of the validation method described.

[0027] Furthermore, another embodiment provides that as the off-vehicle sensor device at least one of following devices is operated: a camera device, a light detection device, a communication device with a predefined limited communication range, i.e., a receiver, a motion sensor device, and/or an acoustic sensor device. If for example the at least one headlight, the at least one rear light, the LIDAR device, the drive system, the brake system, and/or the steering system are operated, this can be detected by using the camera device, i.e., a traffic camera, as off-vehicle sensor device. If a light detection device is used it is also possible to use for example an infrared or LIDAR device signal to detect the operation of the designated vehicle. In case a communication signal is sent with the vehicle communication device that has a predefined limited communication range, the communication signal can be detected by a corresponding communication device that has also a limited communication range but is positioned outside of the vehicle as the off-vehicle sensor device. Communication can be done via a wireless technology for short distance data exchange, such as a Bluetooth communication. The motion sensor device is for example included into a road. This sensor is then also designed to detect operations of the drive system, the brake system and/or the steering system of the vehicle that result in a specific driving pattern of the designated vehicle. If an acoustic sensor device is used as an off-vehicle device, the horn of the presumed vehicle should be operated or another sound making device of the presumed vehicle, e.g., a multimedia system of the designated vehicle. Depending on its availability along the current route of the vehicle the ideal sensor device or even multiple sensor devices can be chosen to detect the operation of the presumed vehicle. This also leads to a diverse applicability of the validation method described.

[0028] The invention also discloses a vehicle with a control unit and at least one vehicle component that can be operated according to control data of a specific control signal. The vehicle is designed to conduct corresponding steps related to the vehicle of a method as described above. The invention also comprises embodiments of the inventive vehicle that comprise features that correspond to features as they have already been described in connection with the embodiments of the inventive method. For this reason, the corresponding features of the embodiments of the inventive vehicle are not described here again.

[0029] The inventive vehicle is preferably designed as a motor vehicle, in particular as a passenger vehicle or a truck, or as a bus or a motorcycle.

[0030] The invention also discloses a system comprising a vehicle as described above, an off-vehicle sensor device as well as an off-vehicle server unit. The off-vehicle server unit is, for example, designed as a computer such as a network host. The system is designed to conduct a method as it was described above. The invention also comprises embodiments of the inventive system that comprise features that correspond to features as they have already been described in connection with the embodiments of the inventive method. For this reason, the corresponding features of the embodiments of the inventive system are not described here again.

[0031] In order to perform the inventive method, the invention also provides a processing unit for a server unit and/or a vehicle control unit comprising at least one processor and a data memory coupled to the at least one processor, wherein the processing unit is designed to perform corresponding steps for the server unit and/or the vehicle control unit of an embodiment of the inventive method. The at least one processor may each be based on one of a microprocessor and a microcontroller and an ASIC (application specific integrated circuit). For performing the inventive method, the data memory may comprise computer readable instructions that -when executed by the at least one processor- cause the at least one processor to perform the embodiment of the inventive method. The processing unit may comprise one or more microprocessors and/or one or more microcontrollers. Further, the processing unit may comprise program code that is designed to perform the described method when executed by the processing unit. The program code may be stored in a data storage of the processing unit.

[0032] The invention also comprises the combinations of the features of the different embodiments.

[0033] In the following an exemplary implementation of the invention is described. The only Fig. shows a schematic illustration of a method for vehicle related identity validation.

[0034] The embodiment explained in the following is a preferred embodiment of the invention. However, in the embodiment, the described components of the embodiment each represent individual features of the invention which are to be considered independently of each other and which each develop the invention also independently of each other and thereby are also to be regarded as a component of the invention in individual manner or in another than the shown combination. Furthermore, the described embodiment can also be supplemented by further features of the invention already described.

[0035] In the figure identical reference signs indicate elements that provide the same function.

[0036] The only Fig. shows different steps S1 to S11 that are performed to validate the identity of a vehicle related item. This method starts once a person 10, who can be a potential buyer and/or a potential seller of a vehicle, makes a validation request 12. The person 10 could, alternatively or additionally, be a vehicle rental company operator, a vehicle fleet operator and/or a vehicle manufacturer. The vehicle manufacturer as person 10 could make a validation request 12 because it intends

to offer a warranty certificate for one of the vehicles produced by the vehicle manufacturer. The validation request 12 states that the person 10 is interested in the performance of a vehicle related identity validation. The validation request 12 can be made via a respective application installed on a mobile communication device of the person 10 and/or by using a corresponding application on a website. Providing the validation request 12 and transmitting it to a vehicle selling platform 14 is considered as a pre-step S0. Alternatively or additionally to the vehicle selling platform 14 the validation request 12 can be sent to a manufacturer of a vehicle of interest. The vehicle selling platform 14 then sends a vehicle related identity validation request signal 16 that is associated with the designated vehicle to a server unit 18. This is done within step S1. This means that the server unit 18 that is preferably not situated within a vehicle receives the vehicle related identity validation request signal 16 that is based on the validation request 12 made by the person 10 in advance.

[0037] The server unit 18 then creates a specific control signal 20 for the designated vehicle. The specific control signal 20 comprises control data 22 for at least one vehicle component of the designated vehicle and identification data 24 for the designated vehicle and/or the vehicle component whose identity validation is requested according to the received vehicle related identity validation request signal 16. The server unit 18 transmits the specific control signal 20 in step S2 to the vehicle that is presumed to be the designated vehicle. This vehicle is allegedly the designated vehicle and in the following referred to as the presumed vehicle 26.

[0038] Presumed vehicle 26 comprises a control unit 28 and a memory device in which stored identification data 30 is stored. In step S3 the presumed vehicle 26, in particular its control unit 28, receives the specific control signal 20. Afterwards in step S4 the control unit 28 verifies if the identification data 24 of the received specific control signal 20 match the stored identification data 30 stored in the presumed vehicle 26. The data transmission that takes place in the vehicle is indicated by dotted lines in the only Fig. Due to verifying if the identification data 24 matches the stored identification data 30 either one of the resulting situations A and B is possible. If the received identification data 24 matches the stored identification data 30, as it is the case in situation A, in a step S5 the at least one vehicle component of the presumed vehicle 26 is operated according to the control data 22. This means that with the help of the received identification data 24 the control unit 28 of the presumed vehicle 26 is unlocked so that a wanted operation of the presumed vehicle 26 can be performed by the control unit 28, wherein this operation is performed according to the control data 22. The operation could be a temporarily dimming of the headlights 32 of the presumed vehicle 26. For example the headlights 32 could be dimmed by a factor of 10 percent of the usual intensity for in total 3 seconds or for three times of a duration of 1 second each within 10 seconds.

[0039] The control data 22 comprise at least one activation data element which characterizes a specific time and/or a specific location at which the at least one vehicle component of the presumed vehicle 26 is operated. The dimming of the headlights 32 of the presumed vehicle 26 therefore takes place at a specific location and/or presumably also at a specific point in time in the future.

[0040] In a next step S6, an off-vehicle sensor device 34, that is a camera along a road the presumed vehicle 26 is currently driving on, detects a sensor signal 36. The detected sensor signal 36 characterizes the operation of the at least one vehicle component of the presumed vehicle 26 according to the control data 22. In this case, the camera as sensor device 34 takes a short video feed of the presumed vehicle 26 while driving on the road while the headlights 32 are dimmed three times for 1 second each within 10 seconds according to the control data 22. Alternatively or additionally to the camera as sensor device 34, a light detection device, a communication device with a predefined limited communication range, a motion sensor device and/or an acoustic sensor device could be used for detecting the operation of the at least one component of the presumed vehicle 26. Alternatively to the described headlights 32, the at least one vehicle component could be at least one rear light, a light detection ranging (LIDAR) device, a horn, a communication device with a predefined limited communication range, a drive system, a brake system and/or a steering system.

[0041] Alternatively to situation A, the received identification data 24 does not match the stored identification data 30 stored in the presumed vehicle 26 in situation B. This results in the situation B in which the control unit 28 of the presumed vehicle 26 stays locked so that no operating of he at least one vehicle component of the presumed vehicle 26 according to the control data 22 is performed. Therefore, there is no detection of a sensor signal 36 by the off-vehicle sensor device 34 in step S6 in situation B.

[0042] In the next step S7 the sensor signal 36 is transmitted to the server unit 18, particularly to an analysis subunit 38 of the sever unit 18. The next steps S8 to S12 all take place in the server unit 18 and this is indicated by using dashed lines within the only Fig. In step S8 the detected and transmitted sensor signal 36 is evaluated. This is done to validate if the at least one vehicle component was operated according to transmitted control data 22. This results again in two possible situations, i.e., in situation A or situation B. In case the headlights 32 were not operated in situation B due to the mismatch of the received control data 24 and the stored control data 30, there is no operation according to the control data 24 that can be observed according to the sensor signal 36 in step S8. This results in a failed identity validation. This means that the presumed vehicle 26 does not seem to be the designated vehicle the person 10 is interested in.

[0043] However in situation A that resulted in operating the headlights 32 of the presumed vehicle 26 according

to control data 22, the validation step S8 has a positive result. If this is the case, meaning that if the at least one vehicle component was operated according to the control data 22, it is in step S9 confirmed that the requested vehicle related identity validation was successful. If, for example, the person 10 was only interested in finding out if the presumed vehicle 26 is really the designated vehicle of which details on for example total lengths of a driven distance of the vehicle are known, the identity of the presumed vehicle 26 as the designated vehicle is now verified.

[0044] If the requested vehicle related identity validation is confirmed in step S9 some sort of digital certificate 40 is created for the presumed vehicle 26 that states, that the presumed vehicle 26 is the designated vehicle, that a certain vehicle part of the presumed vehicle 26 is actually located within the designated vehicle or that vehicle data received from the presumed vehicle 26 or are stored within the presumed vehicle 26 are valid.

[0045] The vehicle related identity validation request signal 16 can request identity validation of a vehicle itself, a vehicle part, e.g., a battery, and/or vehicle data. Depending on the vehicle related identity validation request signal 16, the identification data 24 of the specific control signal 20 fit the stored identification data 30 associated with the vehicle, the vehicle part and/or the vehicle data. Meaning that the specific control signal 20 is designed in a way, that depending on the actual validation request signal 16 the identification data 24 is included into the specific control signal 20 that is necessary to make sure that corresponding stored identification data 30 is stored in the vehicle, wherein the stored identification data 30 can be related to a specific vehicle component, vehicle data and/or the vehicle.

[0046] If the requested vehicle related identity validation is confirmed in step S9 for the presumed vehicle 26, the location, where the operation of the at least one vehicle component has been detected, is stored in an off-vehicle memory device, meaning here the server unit 18. The storage of location data 42 characterizing the location, where the operation of the at least one vehicle component has been detected, takes place in a step S10. Once several locations are stored in the off-vehicle memory device for the designated vehicle, it is possible to calculate an estimation of a total lengths of driven distance of the designated vehicle. Thereby an approximated odometer reading value 44 is calculated in step S11.

[0047] The approximate odometer reading value 44 is thus generated based on multiple sensor signals 36 from different locations described by the stored location data 42 that are combined to calculate the estimation of the total distance the presumed vehicle 26, that has been validated as the designated vehicle, has driven so far. This information referring to the odometer reading value 44 can be included into the certificate 40 in a step S12.

[0048] In general, transmitting the specific control signal 20, detecting the sensor signal 36, and evaluating the sensor signal 36 is all performed by the off-vehicle server unit 18.

[0049] A vehicle that is designed to perform the described method comprises the control unit 28 and the at least one vehicle component that can be operated according to the control data 22. In this case these are the headlights of the presumed vehicle 26. The vehicle is designed to conduct the corresponding steps related to the vehicle as described above, meaning steps S3, S4 and S5.

[0050] The described invention describes a validation of a vehicle related identity through multi-factor authentication of convoluted events. The convoluted events here refer to the combination of the control data 22 with the identification data 24 in the convoluted and therefore combined specific control signal 20. Above, this was exemplarily described in the context of approximating an odometer reading value 44. However, the described method could be applied to approximate other vehicle data to provide, for example, confidence in one of various vehicle parts and/or vehicle data elements of the vehicle. This could, for example, be achieved by integrating other transmitted control signals over time when performing multi-factor authentication of convoluted events. The verifying procedure performed to check if the identification data 24 and the stored identification data 30 match, can, for example, be based on the principle of a transaction authentication number (TAN) method that is typically used for online banking services.

Claims

1. Method for a vehicle related identity validation, the method comprising:

   - receiving a vehicle related identity validation request signal (16) associated with a designated vehicle (S1);
   - transmitting a specific control signal (20) to a vehicle that is presumed to be the designated vehicle, wherein the specific control signal (20) contains control data (22) for at least one vehicle component of the designated vehicle and identification data (24) for the designated vehicle and/or a vehicle component whose identity validation is requested according to the received vehicle related identity validation request signal (16) (S2);
   - receiving the specific control signal (20) by the presumed vehicle (26) (S3);
   - verifying if the identification data (24) of the received specific control signal (20) match with stored identification data (30) stored in the presumed vehicle (26) (S4);
   - only if the received identification data (24) match the stored identification data (30), operating the at least one vehicle component of the presumed vehicle (26) according to the control

signal (S5);
- detecting a sensor signal (36) characterizing the operation of the at least one vehicle component of the presumed vehicle (26) according to the control data (22) by an off-vehicle sensor device (34) (S6);
- evaluating the detected sensor signal (36) to validate if the at least one vehicle component was operated according to the transmitted control data (22) (S8);
- if the at least one vehicle component was operated according to the control data (22), confirming the requested vehicle related identity validation. (S9)

2. Method according to claim 1, wherein the vehicle related identity validation request signal (16) requests identity validation of a vehicle, a vehicle part and/or vehicle data and depending on the vehicle related identity validation request signal (16) the identification data (24) of the specific control signal (20) fit the predetermined identification data (30) associated with the vehicle, the vehicle part and/or the vehicle data.

3. Method according to any of the preceding claims, wherein the control data (22) comprise at least one activation data element that characterizes a specific time and/or a specific location (42) at which the at least one vehicle component of the presumed vehicle (26) is operated.

4. Method according to any of the preceding claims, wherein if the requested vehicle related identity validation is confirmed the location (42) where the operation of the at least one vehicle component was detected is stored in an off-vehicle memory device. (S10)

5. Method according to the preceding claim, wherein if several locations (42) are stored in the off-vehicle memory device for the designated vehicle, a total length of a driving distance of the designated vehicle is estimated, so that an approximated odometer reading (44) is calculated (S11).

6. Method according to any of the preceding claims, wherein the received vehicle related identity validation request signal (16) associated with the designated vehicle is sent by a server unit (18) of a vehicle selling platform (14) and/or a manufacturer of the designated vehicle, particularly as a reaction to a validation request (12) made by a potential buyer and/or a potential seller. (S0)

7. Method according to any of the preceding claims, wherein the specific control signal (20) is transmitted and/or the detected sensor signal (36) is respectively evaluated by an off-vehicle server unit (18).

8. Method according to any of the preceding claims, wherein the at least one vehicle component or multiple of the vehicle components of the presumed vehicle (26) are operated in such a way that the operation is physically detectable by the off-vehicle sensor device (34).

9. Method according to any of the preceding claims, wherein as vehicle component of the presumed vehicle (26) at least one of following components is operated:

- at least one headlight (32);
- at least one sidelight;
- at least one rear light;
- at least one vehicle interior light;
- a light detection and ranging device;
- a horn;
- a communication device with a predefined limited communication range;
- a drive system;
- a brake system; and/or
- a steering system.

10. Method according to any of the preceding claims, wherein the off-vehicle sensor device (34) detects an electromagnetic signal, an acoustic signal, a force signal, an acceleration signal, a deceleration signal and/or a mass signal as sensor signal (36).

11. Method according to any of the preceding claims, wherein as off-vehicle sensor device (34) at least one of following devices is operated:

- a camera device (34);
- a light detection device;
- a communication device with a predefined limited communication range;
- an acoustic sensor device; and/or
- a motion sensor device.

12. Vehicle with a control unit (28) and at least one vehicle component that can be operated according to control data (22), wherein the vehicle is designed to conduct corresponding steps related to the vehicle of a method as described in the preceding claims.

Amended claims in accordance with Rule 137(2) EPC.

1. Method for a vehicle related identity validation, the method comprising:

- receiving a vehicle related identity validation request signal (16) associated with a designated

vehicle (S1);
- transmitting a specific control signal (20) to a vehicle that is presumed to be the designated vehicle, wherein the specific control signal (20) contains control data (22) for at least one vehicle component of the designated vehicle and identification data (24) for the designated vehicle and/or a vehicle component whose identity validation is requested according to the received vehicle related identity validation request signal (16), wherein the control data (22) comprise at least one activation data element that characterizes a specific time and/or a specific location (42) at which the at least one vehicle component of the presumed vehicle (26) is operated, wherein under consideration of details on a current driving route of the vehicle an approximate arrival time within a surveillance area of an off-vehicle sensor device (34) is estimated and the specific time and the specific location (42) is determined based on a current vehicle location, the known driving route of the vehicle and an availability of off-vehicle sensor devices (34) (S2);
- receiving the specific control signal (20) by the presumed vehicle (26) (S3);
- verifying if the identification data (24) of the received specific control signal (20) match with stored identification data (30) stored in the presumed vehicle (26) (S4);
- only if the received identification data (24) match the stored identification data (30), operating the at least one vehicle component of the presumed vehicle (26) according to the control signal at the specific time and/or specific location (S5);
- detecting a sensor signal (36) characterizing the operation of the at least one vehicle component of the presumed vehicle (26) according to the control data (22) by the off-vehicle sensor device (34) (S6);
- evaluating the detected sensor signal (36) to validate if the at least one vehicle component was operated according to the transmitted control data (22) (S8);
- if the at least one vehicle component was operated according to the control data (22), confirming the requested vehicle related identity validation. (S9)

2. Method according to claim 1, wherein the vehicle related identity validation request signal (16) requests identity validation of a vehicle, a vehicle part and/or vehicle data and depending on the vehicle related identity validation request signal (16) the identification data (24) of the specific control signal (20) fit the predetermined identification data (30) associated with the vehicle, the vehicle part and/or the vehicle data.

3. Method according to any of the preceding claims, wherein if the requested vehicle related identity validation is confirmed the location (42) where the operation of the at least one vehicle component was detected is stored in an off-vehicle memory device. (S10)

4. Method according to the preceding claim, wherein if several locations (42) are stored in the off-vehicle memory device for the designated vehicle, a total length of a driving distance of the designated vehicle is estimated, so that an approximated odometer reading (44) is calculated (S11).

5. Method according to any of the preceding claims, wherein the received vehicle related identity validation request signal (16) associated with the designated vehicle is sent by a server unit (18) of a vehicle selling platform (14) and/or a manufacturer of the designated vehicle, particularly as a reaction to a validation request (12) made by a potential buyer and/or a potential seller. (S0)

6. Method according to any of the preceding claims, wherein the specific control signal (20) is transmitted and/or the detected sensor signal (36) is respectively evaluated by an off-vehicle server unit (18).

7. Method according to any of the preceding claims, wherein the at least one vehicle component or multiple of the vehicle components of the presumed vehicle (26) are operated in such a way that the operation is physically detectable by the off-vehicle sensor device (34).

8. Method according to any of the preceding claims, wherein as vehicle component of the presumed vehicle (26) at least one of following components is operated:

- at least one headlight (32);
- at least one sidelight;
- at least one rear light;
- at least one vehicle interior light;
- a light detection and ranging device;
- a horn;
- a communication device with a predefined limited communication range;
- a drive system;
- a brake system; and/or
- a steering system.

9. Method according to any of the preceding claims, wherein the off-vehicle sensor device (34) detects an electromagnetic signal, an acoustic signal, a force signal, an acceleration signal, a deceleration signal

and/or a mass signal as sensor signal (36).

10. Method according to any of the preceding claims, wherein as off-vehicle sensor device (34) at least one of following devices is operated:

- a camera device (34);
- a light detection device;
- a communication device with a predefined limited communication range;
- an acoustic sensor device; and/or
- a motion sensor device.

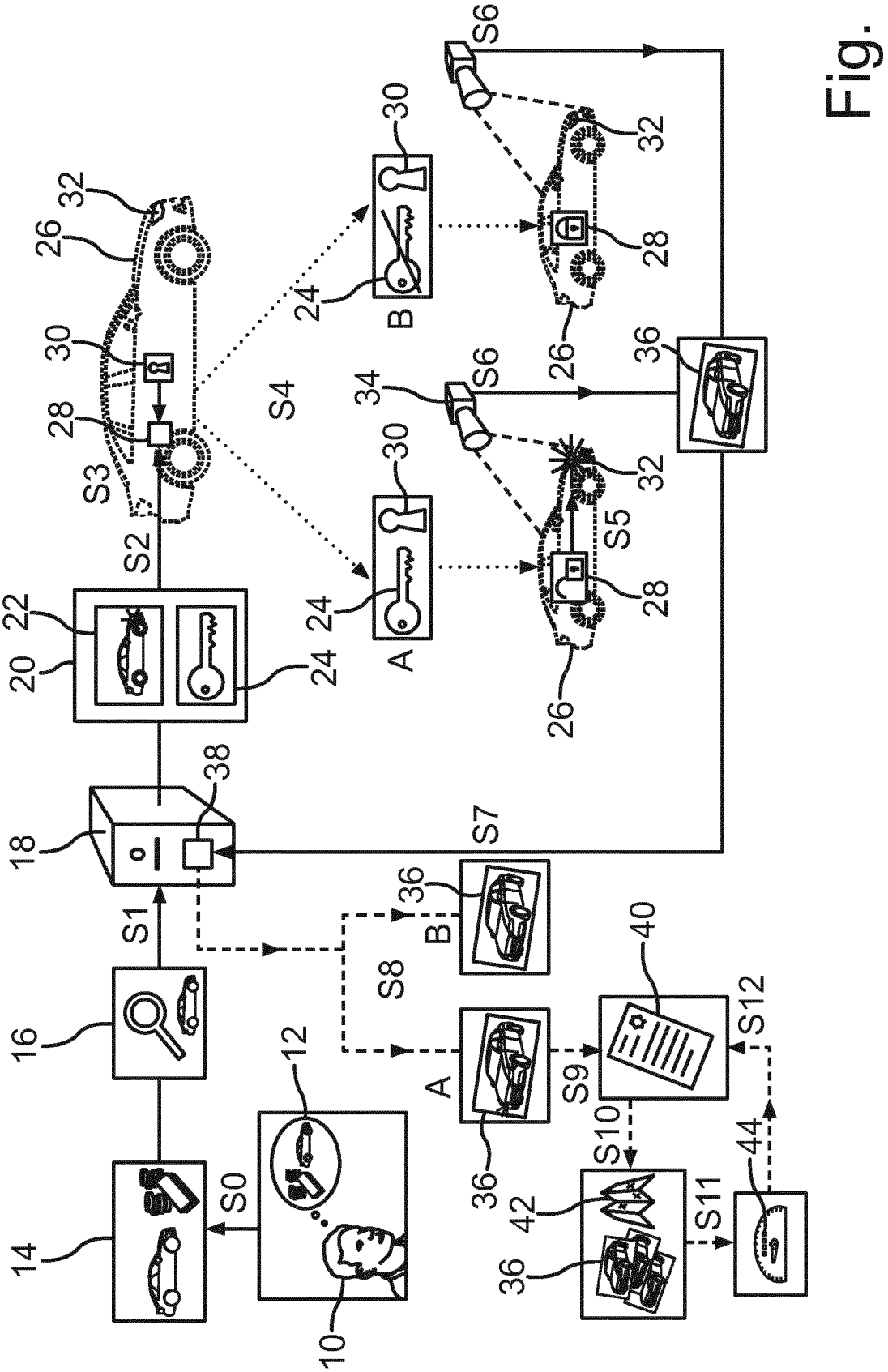
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Fig.

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EUROPEAN SEARCH REPORT

Application Number
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