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INT CL **E05B**
Other: **EPODOC, WPI, Patent Fulltext**

(54) Title of the Invention: **Vehicle lock control system**
Abstract Title: **Vehicle lock control system based on presence of restricted passengers**

(57) A control system for a lock system on a vehicle, comprising an input configured to receive a restricted passenger signal 61, 71, 98 indicative of a passenger of restricted ability being seated within the vehicle; and a control module 74 configured to control the state of the lock system in dependence on the signal. The lock is preferably a child lock. The system may detect the presence of a passenger based on their weight, the use of a child seat with ISOFIX couplings, biometric data, facial recognition, thermal imaging, images from a camera, previously entered identities or using a learning system which predicts when a passenger may enter the vehicle, e.g. at the right time (including calendar or day of the week data) and location for a school run. The system also unlocks the lock system when the restricted passenger has left the vehicle.

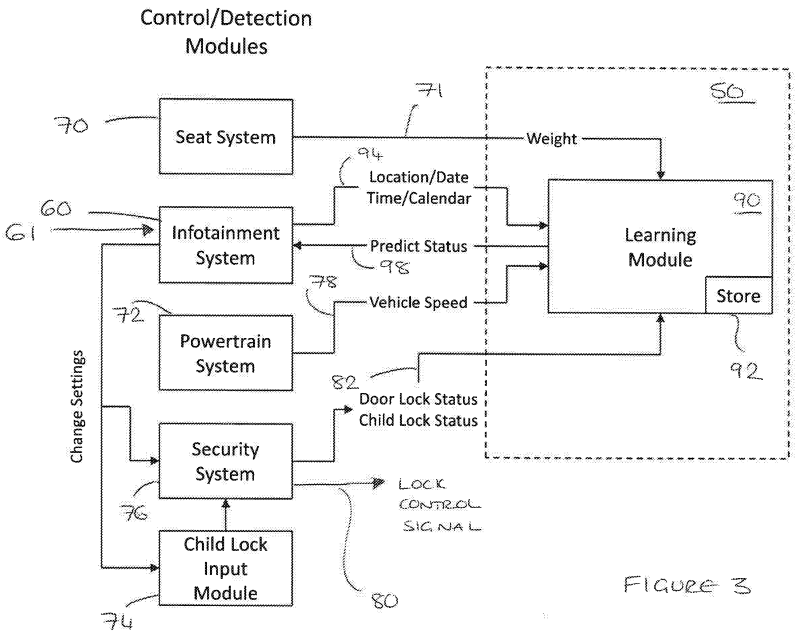

Figure 3

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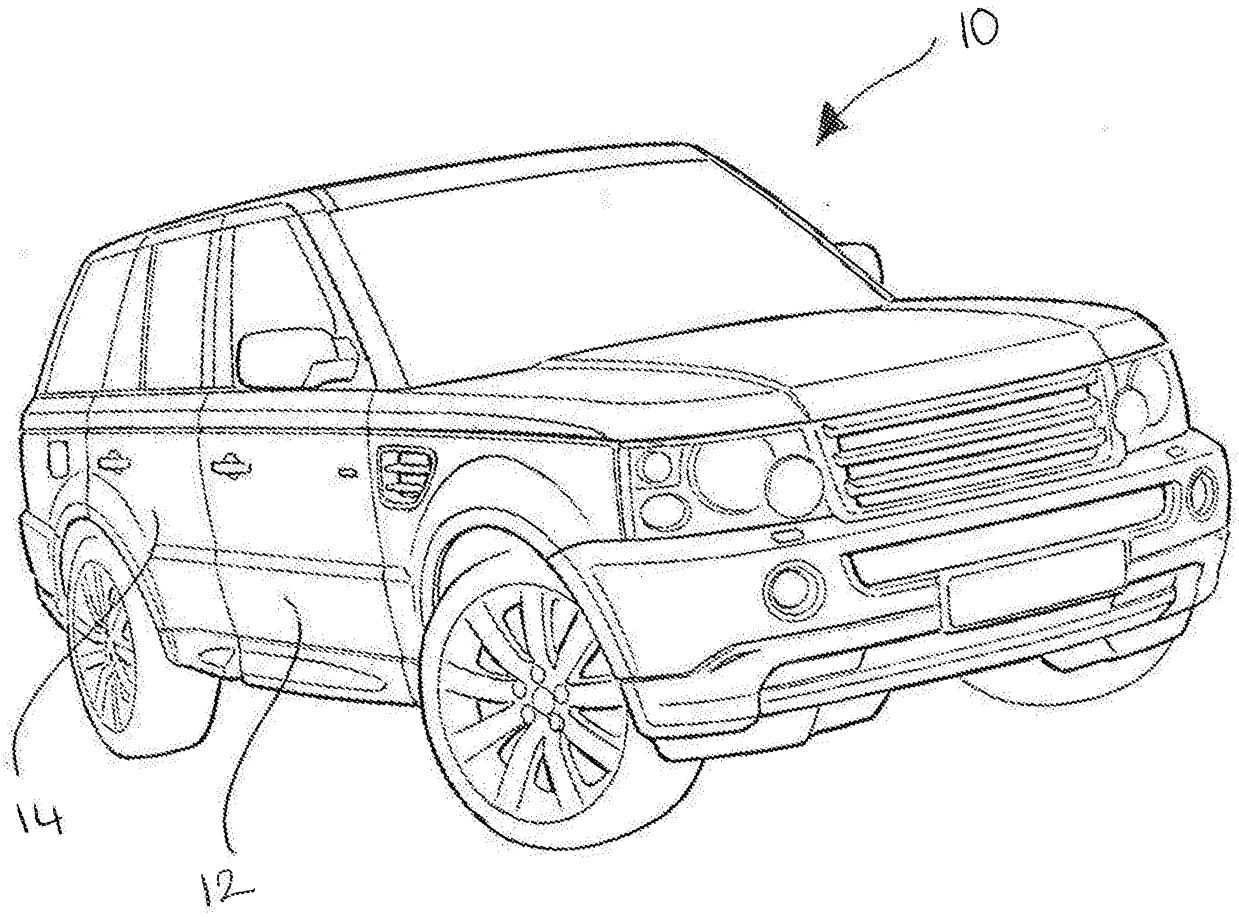

Figure 1

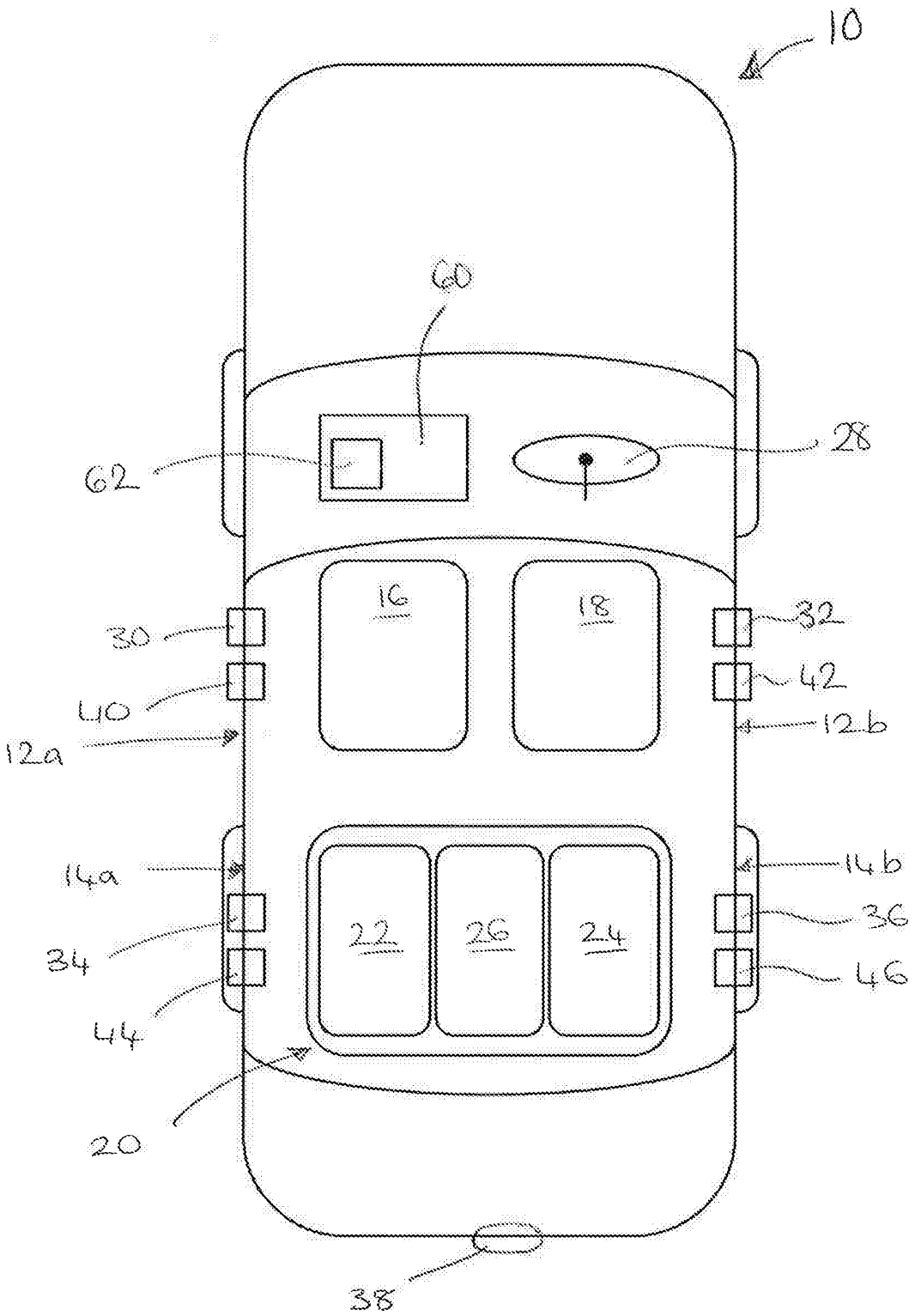
10
60
62
28
16
18
30
32
40
42
12a
12b
14a
14b
22
26
24
34
36
44
46
20
38

Figure 2

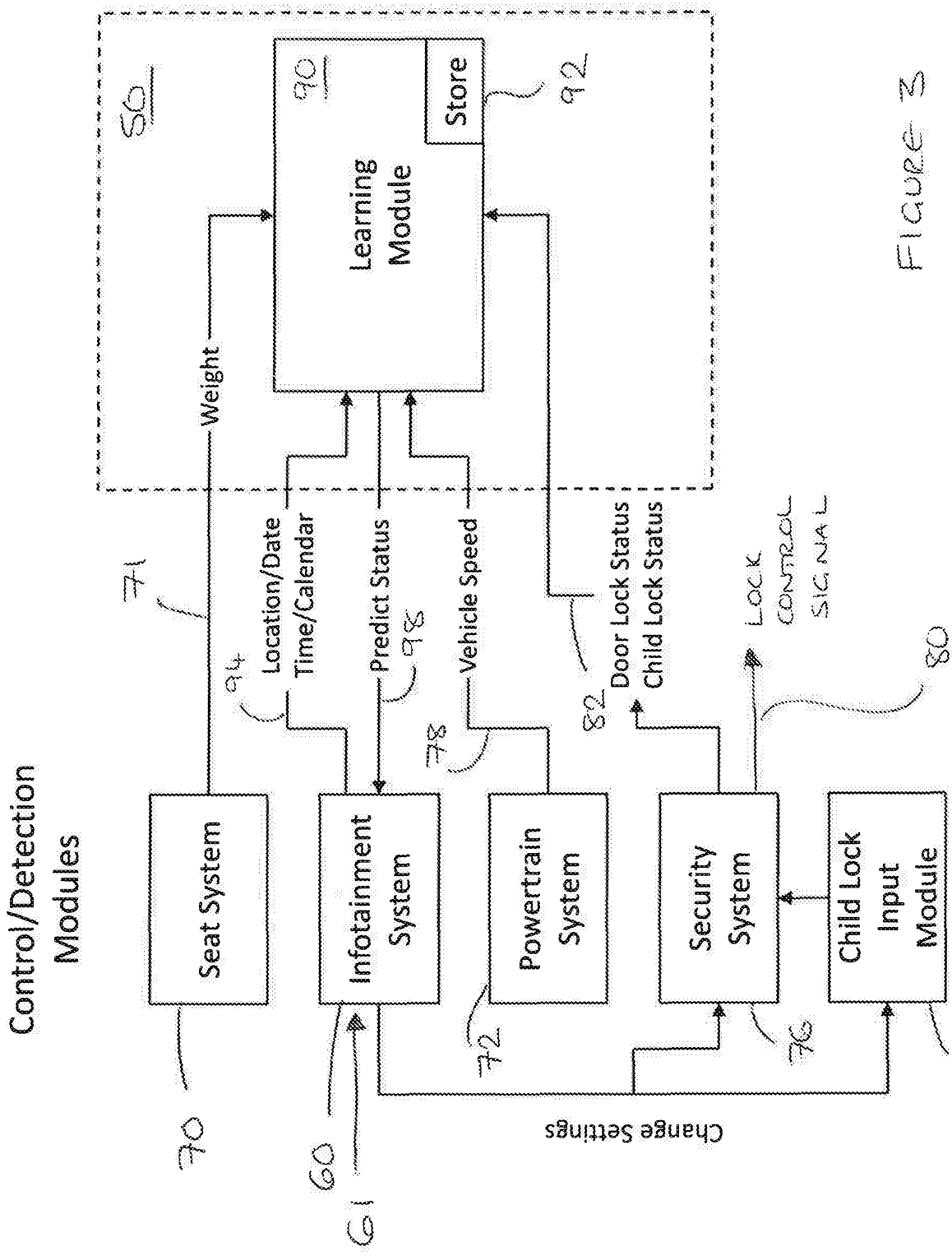
Control/Detection Modules
Seat System
Infotainment System
Powertrain System
Security System
Child Lock Input Module
Learning Module
Store
50
90
92
Weight
Location/Date
Time/Calendar
Predict Status
Vehicle Speed
Door Lock Status
Child Lock Status
Lock Control Signal
Change Settings
70
71
72
74
76
78
80
82
94
98
60
61

FIGURE 3

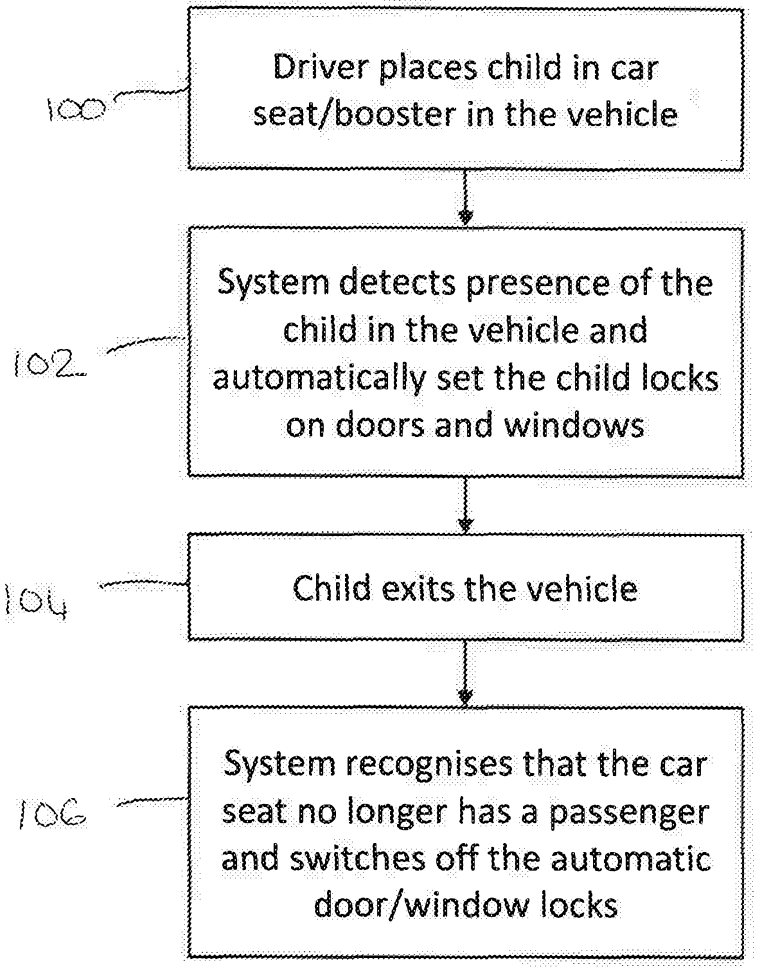

Figure 4

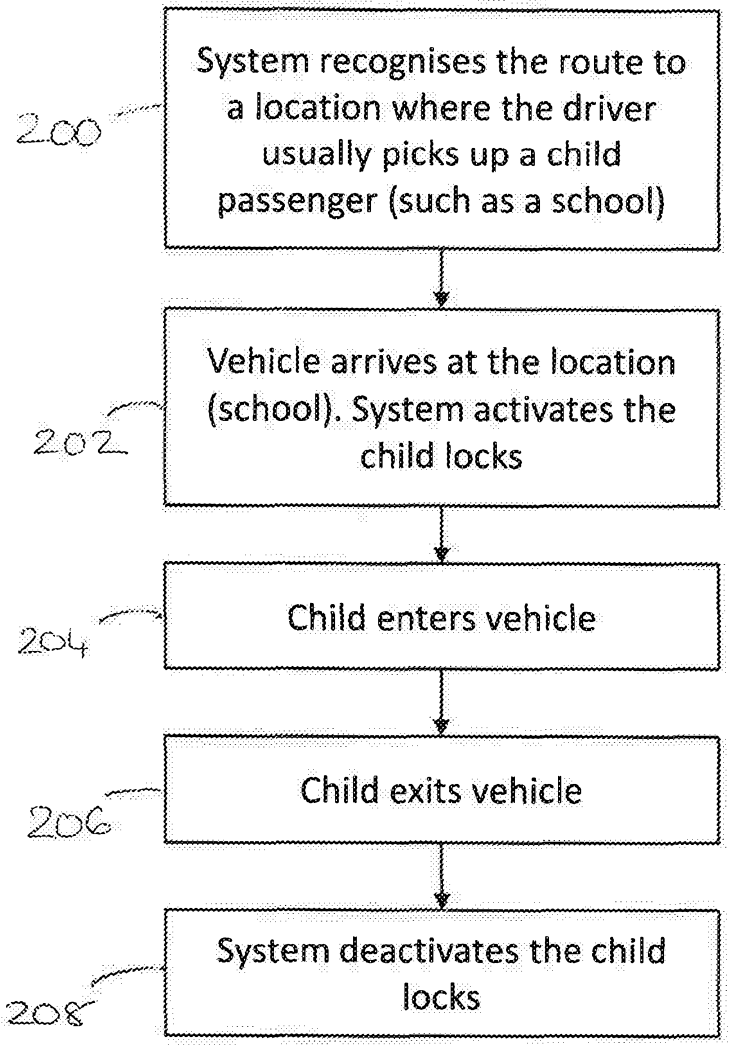

Figure 5

The following terms are registered trade marks and should be read as such wherever they occur in this document:

Google
Microsoft Office

VEHICLE LOCK CONTROL SYSTEM

TECHNICAL FIELD

The present disclosure relates to a vehicle lock control system for a vehicle. Aspects of the invention relate to a control system, a vehicle lock system, a vehicle, and a method of controlling a lock system on a vehicle.

BACKGROUND

It is known in vehicles to provide child locks on a vehicle door as a safety feature to prevent young children travelling in the vehicle from opening the vehicle door in unwanted situations. It is of particular benefit to provide locks on the vehicle doors which prevent a child from opening the doors when the vehicle is in motion. The locks serve to prevent internal opening of the doors, but can be overridden by a passenger opening the door from outside the vehicle.

It is usual for child locks to be provided on the rear doors in a vehicle, and in some vehicles they are also provided in the passenger seat to cater for front-seated children. Typically, the key has to be removed from the vehicle ignition in order for the door to be opened from the outside which provides an additional safety measure.

Whilst such systems are commonplace in vehicles they do not come without disadvantages. For example, some child locks require manual operation whereby it is necessary to operate a switch on the door in order to activate the child lock. The switch is only operable when the vehicle is stationary and the door is open. This is inconvenient and requires the user of the vehicle to plan in advance whether child locks are required for their journey. For family vehicle usage, where many different combinations of passengers may use the vehicle, it is clearly a disadvantage for the driver to have to determine each time a journey is made whether the child locks need to be activated. If the child locks remain activated when children are not being carried, this presents the problem that rear passengers, for example, cannot exit the vehicle themselves without someone external to the vehicle opening the door for them. Another disadvantage arises where a vehicle user forgets to activate the child locks when children are being

transported, which presents the risk of inadvertent opening of the doors in undesirable circumstances.

The present invention has been devised to mitigate or overcome at least one of the above-mentioned problems.

SUMMARY OF THE INVENTION

Aspects and embodiments of the invention provide a control system, a lock system, a vehicle, and a method of controlling a lock system as claimed in the appended claims.

According to an aspect of the present invention there is provided a control system for a lock system on a vehicle, the lock system being operable between a locked state and an unlocked state, the control system comprising: an input arranged to receive a restricted passenger signal indicative of a passenger of restricted ability being located within the vehicle; and a control module configured to control the state of the lock system in dependence on the restricted passenger signal so that, when the passenger of restricted ability is located within the vehicle, the lock system adopts the locked state.

According to an aspect of the present invention there is provided means for controlling a lock system on a vehicle, the lock system being operable between a locked state and an unlocked state, the means for controlling a lock system on a vehicle comprising: means for receiving a restricted passenger signal indicative of a passenger of restricted ability being seated within the vehicle; and means for controlling the state of the lock system in dependence on the restricted passenger signal so that, when the passenger of restricted ability is seated within the vehicle, the lock system adopts the locked state. The means for controlling a lock system on a vehicle may be a control system for a lock system on a vehicle. The means for controlling a lock system on a vehicle may be in the form of a processor. The means for receiving a restricted passenger signal may be an input. The means for controlling the state of the lock system may be a control module.

According to an aspect of the present invention there is provided a control system for a lock system on a vehicle, the lock system being operable between a locked state and an unlocked state, the control system comprising: an input configured to receive a

restricted passenger signal indicative of a passenger of restricted ability being seated within the vehicle; and a control module configured to control the state of the lock system in dependence on the restricted passenger signal so that, when the passenger of restricted ability is seated within the vehicle, the lock system adopts the locked state.

The invention is applicable to door lock systems in vehicles, which determine whether vehicle doors can be opened or whether they are locked to prevent opening, and also window locks which determine whether the opening of vehicle windows is possible. The invention may also be extended to a lock system associated with a rear tailgate or other opening to the vehicle boot.

Reference to a restricted passenger, or a passenger of restricted ability, is intended to mean a person who is not able to take responsibility for judging in which circumstances it is appropriate to open, for example, a vehicle door or vehicle window. Typically, a passenger of restricted ability may be a child passenger, or an elderly, disabled or infirm passenger, or a passenger who has impaired cognitive or intellectual ability.

In one embodiment, the control system comprises a user input module configured to receive a manual user input of the restricted passenger signal.

The user input module may be configured to allow a user to select the seat position of the passenger of restricted ability, and wherein the control system is configured to determine the seat in which the passenger of restricted ability is seated in dependence on the user selection.

This provides the user with the ability to select the most appropriate circumstances in which the lock system should be activated (locked) as they have first-hand knowledge of the nature and seating positions of the passengers in the vehicle.

In another embodiment the control system comprises a determination module configured to determine whether the passenger (or passengers) of restricted ability is seated in the vehicle and to generate the restricted passenger signal in dependence on the determination.

By way of example, the determination module may be configured to determine in which seat in the vehicle the passenger of restricted ability is seated.

In one example of the invention, the vehicle with which the control system is used includes a plurality of lock systems, each lock system being associated with a door of the vehicle and each door being associated with a seat of the vehicle. In this case the control module may be configured to control each lock system of each door independently of the other lock systems, depending on the seat in which the passenger (or passengers) of restricted ability is determined to be seated.

For example, the determination module may be configured to determine in which seat in the vehicle the passenger of restricted ability is seated, and to control the state of the lock system associated with the door associated with the determined seat, so that the lock system adopts the locked state if the passenger of restricted ability is seated in the associated seat.

In another embodiment, the determination module may comprise a learning module configured to generate a restricted passenger signal in dependence on a prior vehicle usage profile. For example, the learning module may comprise a data store configured to store data relating to a prior vehicle usage profile, and at least one input configured to receive data relating to a current vehicle usage. The learning module may be configured to compare the current vehicle usage with the prior vehicle usage profile and to generate the restricted passenger signal in dependence on the comparison being indicative of the passenger of restricted ability being seated in the vehicle.

The use of the learning module provides the advantage that the user need not input manually any signal to indicate that a passenger of restricted ability is present in the vehicle, but the habits of vehicle usage may be used to make a determination of when it is most likely that a passenger of restricted ability is travelling in the vehicle, and where they may be seated. For example at different times of day, and on different days, a family vehicle may be used quite differently, so that over time this profile of use is learnt and the system responds automatically to adjust the status of the lock system(s) in dependence on the predicted usage.

The data relating to a prior vehicle usage profile may include one or more of the following: location data; time data; day of week data; passenger data; and calendar data. Data relating to prior vehicle usage may be updated continuously as the vehicle is used (i.e. on each vehicle journey) or may be updated only when a user selects that it is appropriate to do so, thus allowing unusual or unique journeys to be ignored by the learning module.

In one embodiment the determination module may be configured to determine that the passenger of restricted ability has exited the vehicle, and whereby the control system is operable to move the lock system from the locked state to the unlocked state in the event that the determination module provides an output indicative of the passenger of restricted ability no longer being in the vehicle.

This provides the advantage that the lock system is automatically updated to the required lock state, without the user having to update the system that the passenger of restricted ability is no longer in the vehicle.

The control system may, for example, be configured to control operation of a lock system associated with a vehicle door and/or of a lock system associated with a window of a vehicle door.

In one embodiment, the lock system may be a child lock system of the vehicle and the locked state is a child locked state in which a door and/or window associated with the child lock system cannot be opened from inside the vehicle, but can be opened from outside the vehicle.

According to another aspect of the invention there is provided a vehicle lock system for a vehicle comprising at least one lock system and a control system as described in the previous aspect of the invention and configured to control the at least one lock system in dependence on the restricted passenger signal.

According to another aspect of the invention there is provided a vehicle comprising the vehicle lock system of the previous aspect of the invention.

According to another aspect of the invention there is provided a method for controlling a lock system on a vehicle, the lock system being operable between a locked state and an unlocked state, the method comprising receiving a restricted passenger signal indicative of a passenger of restricted ability being seated within the vehicle; and controlling the state of the lock system in dependence on the restricted passenger signal so that, when the passenger of restricted ability is present seated within the vehicle, the lock system adopts the locked state.

The method may comprise determining whether the passenger of restricted ability is seated in the vehicle and generating the restricted passenger signal in dependence on the determination.

The method may comprise determining whether the passenger of restricted ability is seated in the vehicle by receiving a manual user input of the restricted passenger signal.

For example, the method may comprise receiving a seat position signal to indicate the seat position of the passenger of restricted ability and determining the seat in which the passenger of restricted ability is seated in dependence on the seat position signal.

The method may be used in a vehicle comprising a plurality of lock systems, each lock system being associated with a respective vehicle door. The method may comprise controlling each lock system of each door independently of the other lock systems, depending on the seat in which the passenger of restricted ability is determined to be seated.

The method may comprise determining in which seat of the vehicle the passenger of restricted ability is seated, and controlling the state of the lock system associated with the door associated with the determined seat, so that the lock system adopts the locked state if the passenger of restricted ability is seated in the associated seat.

The method may comprise generating a restricted passenger signal in dependence on a prior vehicle usage profile.

In this embodiment, the method may comprise storing data relating to a prior vehicle usage profile, receiving data relating to a current vehicle usage; comparing the prior vehicle usage profile with the current vehicle usage and generating the restricted passenger signal in dependence on the comparison being indicative of the passenger of restricted ability being seated in the vehicle.

In any embodiment, the method may comprise determining that the passenger of restricted ability has exited the vehicle, and controlling the lock system to move from the locked state to the unlocked state in the event that it is determined that the passenger of restricted ability has exited the vehicle.

Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

BRIEF DESCRIPTION OF THE DRAWINGS

One or more embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a view of a vehicle with which the vehicle lock control system of the invention may be used;

Figure 2 is a plan view of a typical interior layout in the vehicle of Figure 1; and

Figure 3 is a schematic diagram of an embodiment of the vehicle lock control system of the invention, for use with the interior layout in Figure 2;

Figure 4 is a flow diagram of one embodiment of the process which may be implemented by the vehicle lock control system in Figure 3; and

Figure 5 is a flow diagram of another embodiment of the process which may be implemented by the vehicle lock control system in Figure 3.

DETAILED DESCRIPTION

Referring to Figure 1, a vehicle 10 is provided with a lock system (not shown) to control access for passengers to and from the vehicle via the front 12 and rear 14 vehicle doors (only the right hand doors are shown in Figure 1). The lock system also includes a lock (not shown) on the rear tailgate, or other boot opening of the vehicle, to control access to the vehicle boot.

Referring to Figure 2, a typical seat layout in the vehicle includes two front seats (front-left 16 and front-right 18) and a rear bench seat 20 which provides three seat locations for three different passengers (rear-left 22, rear-right 24 and central 26).The vehicle shown is a right-hand drive vehicle where the driver of the vehicle would be seated on the front-right seat 18 in front of the steering wheel 28. Each seat is provided with a seat system including an occupant detection system (ODS) (not shown). Each seat system provides a signal to indicate whether a passenger is seated in the seat, as determined by the ODS, and whether that passenger is a child passenger.

For family usage, it may be common for an adult passenger to be seated in the front left seat 16 of the vehicle, with child passengers to be seated in the rear of the vehicle, either one, two, or three children being seated on the rear bench seat 20. In other scenarios, a child passenger may be seated in the front left seat 16. Depending on the age and weight of the child passenger, the child may sit directly upon the cushion of the seat on which they are seated, or may be seated in a child seat, such as a booster cushion or a baby or toddler chair, which is mounted on the actual vehicle seat 16, 22, 24 or 26. Regardless of whether the child is seated directly on the seat cushion or not, for the purpose of the following description the child passenger will be considered to be seated on the seat.

The dynamics of family life mean that other passengers may also need to be transported, including the elderly or infirm, and in some scenarios there is a requirement to transport other restricted ability passengers for whom it is not appropriate for them to determine when a vehicle door can be opened.

As mentioned previously, reference herein to a restricted passenger, or a passenger of restricted ability, is intended to mean a person who is not able to take responsibility for judging in which circumstances it is appropriate to open, for example, a vehicle door or vehicle window.

This is particularly important where opening the vehicle door could be a precursor to attempting to disembark from the vehicle. The mere fact a vehicle is stationary does not imply that it is therefore safe for occupants to leave the vehicle. For example, the vehicle may have come to a temporary halt at a road junction or at traffic lights, in which case other road users may present a significant risk to passengers trying to alight from the vehicle. Alternatively, the vehicle may have come to a halt as part of a parking manoeuvre, in which case opening doors of the vehicle injudiciously could cause damage to adjacent parked vehicles.

Typically, a passenger of restricted ability may be a child passenger, or an elderly, disabled or infirm passenger, or a passenger who has impaired cognitive or intellectual ability.

For the purpose of the following description, family vehicle usage which requires a passenger of restricted ability to be carried in the vehicle shall be discussed with specific reference to a child passenger being carried in the vehicle. However, it will be evident to the skilled reader that the same principles apply to passengers of restricted ability other than children (albeit using indicators of restricted ability other than, or in addition to, merely weight of the seat occupant / presence of a child seat in the vehicle).

Referring again to Figure 2, the vehicle is provided with a lock system which includes a door lock assembly 30, 32, 34, 36 associated with each door of the vehicle, and a further lock assembly 38 associated with a rear tailgate of the vehicle. The front left door 12a has an associated front left door lock assembly 30, the front right door 12b has an

associated front right door lock assembly 32, the rear left door 14a has an associated rear left door lock assembly 34 and the rear right door 14b has an associated rear left door lock assembly 36. The lock system of each door controls the status of an associated door opening mechanism (not shown) to determine whether or not a passenger is able to open the door to exit from or enter the vehicle. Each door lock assembly 30, 32, 34, 36 has three states of operation. In a first state, the door lock assembly is locked and the door cannot be opened from inside or outside the vehicle without a key to deactivate the lock. In a second state, the door lock assembly is unlocked and the door can be opened either from inside or outside the vehicle even without a key. The door lock assembly further includes a child lock function which defines a third, child locked state of the assembly. When in the child locked state the associated door cannot be opened from the inside of the vehicle, but can be opened from the outside.

The child lock function allows an adult user of the vehicle to put the door lock assembly into a locked state so that a passenger of restricted ability, in this case a child passenger, in the associated seat is unable to open the door from the inside of the vehicle, whilst still permitting the door to be opened by an adult outside the vehicle, without the need for key access. In order to open the door, the adult passenger therefore has to exit the vehicle and open the child's door from the outside of the vehicle. Once activated (locked), the child lock function remains active (locked) until such time as the adult passenger deactivates the child lock feature.

As described previously, whilst such features are essential on vehicles where children are being transported, they pose an inconvenience in known vehicles as the adult driver has to anticipate each time the vehicle is used whether or not the child lock feature of the door lock assembly has to be activated (locked). Sometimes the vehicle may be used with the child lock function activated when it is not required, because the driver of the vehicle has forgotten to deactivate it. A passenger in the seat associated with the child lock function that has been activated is then unable to exit the vehicle without someone external to the vehicle opening the door. In some vehicles, the child lock function is typically a manually-operable switch on the associated door, which is accessible only when the door is open. In the present invention the child lock function is activated through a child lock module which will be described in further detail later.

Each door 12, 14 of the vehicle also has an associated window opening mechanism (not shown), the status of which is determined by an associated window lock assembly. The front left door 12a is associated with a front left window lock assembly 40, the front right door 12b is associated with a front right window lock assembly 42, the rear left door 14a is associated with a rear left window lock assembly 44, and the rear right door 14b is associated with a rear right window lock assembly 46. The window opening mechanism may be manually operable by means of a handle of the vehicle door, or may be electronically controlled by a user activating a button or switch on the associated door.

The vehicle 10 further includes a control system 50 to control various vehicle functions including the lock state of the door lock assemblies 30, 32, 34, 36 and/or the lock state of the window lock assemblies 40, 42, 44, 46 and/or the lock state of the rear tailgate lock assembly 38. For the purpose of the following description of the invention, only the control of the door lock assemblies 30, 32, 34, 36 by the control system 50 will be described in detail.

The control system includes an infotainment system 60 including a human machine interface (HMI) 62, which enables a user to input various commands, information and parameters relating to vehicle usage, thereby to enable control of various vehicle functions by the control system. The infotainment system 60 includes a satellite navigation system (not shown) which outputs various signals indicative of the location of the vehicle, journey information and various other vehicle data and parameters. The infotainment system 60 may also comprise a telematics control unit (TCU) arranged to communicate with one or more personal, electronic, on-line / internet based calendars (Google, Microsoft Office etc.) associated with habitual users of the vehicle. The HMI 62 includes a display screen which allows a user to input commands and information to the infotainment system 60, including information relating to the desired state of the door lock assemblies and information to indicate the locked/unlocked status of the door lock assemblies.

Figure 3 shows the control system of the invention in further detail, including the seat system 70 (the seat system 70 indicated here represents the seat system for all of the vehicle seats), the vehicle infotainment system 60, a vehicle power train system 72, a

vehicle child lock module 74, a vehicle security system 76 and a passenger determination module 50.

The seat system 70 is configured to provide a signal indicative of a child passenger being seated within the vehicle to the passenger determination module 50. The seat system 70 does this by providing a weight signal 71 to the passenger determination module 50 to indicate the weight of the passenger associated with the relevant vehicle seat 16, 18, 22, 24, 26. By virtue of the reduced weight of a child passenger, the weight signal 71 can be used to determine whether the seated passenger is a child or an adult through comparison with a threshold weight level. The seat system 70 may also, or alternatively, incorporate an ISOFIX detection system so that the detection of an ISOFIX coupling between the vehicle and a child seat, in combination with a seated passenger in the seat, is indicative of a child passenger being present.

By way of example, the ISOFIX detection system optionally comprises sensors which monitor the ISOFIX anchor points at the base of the vehicle seat to provide an output signal in dependence on the presence and / or absence of a child seat docked with said ISOFIX anchor points. Alternatively, or in addition, the child seat may comprise a wireless electronic transponder or tag (for example an RFID, Bluetooth® or Wi-Fi® enabled tag) arranged in communication with a transmitter / receiver / transceiver disposed within the vehicle and configured to detect the presence or absence of the tag (and hence the child seat) within the vehicle (and optionally the location of the same within the vehicle).

The powertrain system 72 includes a control unit (not shown) for the vehicle powertrain and provides signals to the passenger determination module 50 with information relating to the state of the powertrain system 72. For example, the powertrain system 72 may provide a speed signal 78 to indicate the speed at which the vehicle is travelling, and whether the vehicle is stationary or moving.

The child lock module 74 is a control unit which is configured to receive information about whether or not a child passenger is seated within the vehicle.

For example, in one embodiment the system is configured so that a user may input an information signal 61 to the HMI 62 of the infotainment system 60 regarding the presence of a child in the vehicle, and the seat in which they are seated. More specifically, the HMI 62 of the infotainment system may comprise a graphical user interface (GUI) arranged in use to provide an image of the seats within the vehicle cabin, and from which a user may select any seats within which a child is seated. The HMI 62 may comprise a touch-screen interface, a joystick, a rotary input device, a touch pad, discrete buttons adjacent the GUI, or any other suitable input means. Alternative to manual seat selection, a visual interface (gaze or point of regard tracker) or an audible interface (such as a voice command system) may be used to provide the signals indicative of a child being seated in the vehicle and the seat position occupied by the child.

Alternatively, or in addition, other parameters or factors are used to determine if an occupant of the vehicle is a child; for example, but not limited to, physical / biometric characteristics (height, facial appearance) and / or the identity of an occupant. The physical / biometric characteristics may be determined from image data captured by at least one imager disposed within the vehicle cabin, such as an in-vehicle camera, infrared camera, thermal imager etc.

Without limitation, the identity of an occupant may be determined from biometric data, preferred vehicle settings (e.g. seat settings, media settings, cabin comfort settings etc., and in particular receipt of a request to recall a saved setting for any of the foregoing). The presence of one or more personal mobile device associated with a known user of the vehicle (e.g. smartphone, tablet, smart wearable device etc.) within the vehicle may also act as a primary or secondary indicator of the identity or identities of vehicle occupants and also the relative seat positions of occupants within the vehicle.

The seat system 70 is therefore arranged in use to provide a signal indicative of a child passenger being seated within the vehicle to the passenger determination module 50 in dependence on one or more of physical / biometric characteristics (height, facial appearance) and / or the identity of an occupant.

Furthermore, in embodiments where the infotainment system 60 comprises a telematics control unit (TCU) arranged to communicate with one or more personal, electronic, on-

line / internet based calendars, the identity of an occupant may be predicted or inferred from personal calendar appointments associated with habitual users of the vehicle.

By way of specific example, the infotainment system 60 is arranged in use to interrogate one or more personal electronic calendars associated with habitual users of the vehicle at a prevailing time to determine any calendar events or appointments which would require use of the vehicle by the habitual user. For instance, the infotainment system may determine a calendar event or appointment associated with a child user of the vehicle in temporal proximity to the prevailing time and inform the seat system 70 accordingly.

For example, if the prevailing time is 08:30 on a weekday, and the infotainment system determines that one or more habitual child users of the vehicle has a calendar appointment to travel to school between 08:30 and 08:45, or attend school at 09:00, then the seat system may infer that at least one passenger using the vehicle between 08:30 and 09:30 may be a child. A confidence rating may be applied to the inference, optionally in dependence on secondary information such as route destination / navigation data (e.g. route destination is school).

Signals indicative of a child being seated in the vehicle, and the seat position, are then sent from the infotainment system 60 to the child lock module 74. The child lock module 74 then provides signals 75 to the security system 76 which determines whether the various locks of the system should be locked or unlocked, according to whether and where the child passenger is seated. The security system 76 outputs a child lock control signal 80 to control the associated lock systems accordingly, and provides a door lock status signal 82 to the passenger determination module 50, depending on the lock status.

The determination module 50 includes a learning module 90 which is configured to receive various input signals, namely those from the seat system 70, the infotainment system 60, the powertrain system 72, the security system 76 and the child lock module 74. The learning module 50 includes a memory or data store 92 configured to store data relating to vehicle usage, including signals 94 received from the infotainment system 60 relating to journey data, location data, calendar data and passenger data, including the

passenger count and the type of passenger. Data relating to many other aspects of vehicle usage may also be stored in the data store 92 of the learning module 90, as will be apparent from the following description.

The learning module 90 stores the data relating to vehicle usage and updates the data store each time the vehicle is used, thereby creating a profile of vehicle use which can be accessed later to predict vehicle usage, e.g. which passengers are using the vehicle and when, and which seats are carrying child passengers for which journeys, depending on the relevant conditions at the time. The predicted data signal 98 is output to the infotainment system 60 which then outputs the information to the child lock module 74. The child lock module 74 is configured to output signals to the security system 76 for controlling the various lock assemblies so that the lock assemblies associated with the seats in which child passengers are seated adopt the necessary child lock status. In one embodiment the predicted data signal 98 is used as a prompt to the user, via the infotainment system 60, to confirm whether or not they wish the child lock to be activated for the predicted seat (i.e. the seat in which it has been predicted that a child is seated in). In other embodiments, the predicted data signal 98 may be used directly to activate the child lock of the relevant seat, without the requirement for a user to confirm that child lock activation is required.

There are various ways in which the system of the invention can be utilised with benefits, to provide a vehicle lock system with enhanced functionality compared to prior systems, and specific non-limiting examples will now be described in further detail.

In one embodiment, the determination module 50 is configured to control the status of the door lock assemblies 30, 32, 34, 36 depending on whether a child passenger is detected within the vehicle, and where it is detected that the child passenger is seated. If the seat system 70 sends a signal 71 to the determination module 50 which indicates that a child passenger is in the rear left seat 22, the learning module 90 is updated with this information together with the relevant vehicle data relating to time, day, location, and satellite navigation data etc. In addition, a signal 98 is routed via the infotainment system 60 to the child lock module 74 to update the status of the rear left door lock assembly 34 to the child locked state so that the child passenger in the rear left seat 22 is unable to open the door 14a from inside the vehicle. Control of the state of the child lock module

74 automatically, in response to detecting the presence of a child passenger in the vehicle, provides the advantage that the user does not need to remember to prepare the child locks of the vehicle in advance of a journey.

In another embodiment, if it is determined from the seat system 70 that a child passenger is seated in the rear left seat, a corresponding signal may be sent directly to the child lock module 74 from the determination module 50 to update that the associated rear left door lock assembly 34 should be in the child locked state for the ensuing journey due to the presence of a child in the rear left seat 22. The flow diagram in Figure 4 illustrates this method of operation. In block 100, the driver places a young child in the rear left seat 22 (or in a baby chair located on the rear left seat). In block 102, the determination module 50 determines from the weight signal 71 that the occupant of the seat is a child passenger, and a signal is sent to the child lock module 74 accordingly (as discussed above). As a consequence, the associated rear left door lock assembly 34 is controlled so that it adopts the child locked state to prevent the child from opening the door during the ensuing journey.

Once the journey has been completed, the child exits the vehicle at block 104. At block 106, it is determined from the weight signal 71 from the seat system 70 that the child passenger is no longer present in the rear left seat 34, and the child lock module 74 is updated accordingly so that the child lock for the rear left seat 34 is returned to the unlocked state.

In another embodiment (not shown), instead of automatically detecting that a child is seated in the vehicle, the infotainment system 60 enables the driver of the vehicle to input information about whether a child passenger is present in the vehicle 10 and where that child passenger is seated, and controls the door lock assemblies accordingly in response to the input information. For example, a driver may input, via the HMI 62, that a child passenger is seated in both the rear left and rear right seats, 22, 24, adjacent to the rear left and rear left doors 14a, 14b respectively, and signals are sent to the child lock module 74 to ensure the rear left and rear right door lock assemblies 34, 36 adopt the child locked states for the ensuing journey.

As described previously, in more sophisticated embodiments of the invention, data that is input by the user regarding where child passengers are seated, or the data that is detected relating to where child passengers are seated, may be provided to the learning module 90 to update the data store 92 so that this data can be used later to determine in which circumstances child passengers are likely to be transported in the vehicle. In other words, on the basis of the stored information, together with current vehicle data, the learning module 90 is configured to learn patterns of vehicle usage so as to predict with some accuracy when a child passenger is likely to be carried, and in which seat they are likely to be carried, and to update the status of the door locks automatically in response to the prediction.

By way of further example, in a given week, family vehicle usage may follow a particular pattern whereby, for example, every weekday morning two children are seated in the rear left and rear right vehicle seats 22, 24 and are driven to a school location for drop-off. Once at school, the children exit the vehicle 10 and the vehicle 10 is driven home, or to another location where an adult passenger is picked up (for example, for a lift to an onward place of work). At the end of the day the return journey may occur where the vehicle is driven to the school location, with no passengers on board (or with one adult passenger having a lift), and then having stopped at the school two child passengers are picked up and seated in the rear left and right seats 22, 24 once again. On the weekends, particular journeys may be conducted at the same time each weekend, for example taking a child passenger to a particular sports or activity club. Data relating to the journeys is recorded together with the child passenger information, as derived from the infotainment system 60 and the seat system 70.

A situation such as this is illustrated in the method of operation shown in Figure 5. At block 200 the system receives time, date, location and journey data from the infotainment system 60. For example, on the basis of the vehicle usage data in the store 92, the learning module determines that at 15:00 on a Monday afternoon the vehicle is typically used to drive to a school location to collect a child passenger who is then placed in the rear left seat 34 for transport back home. As the vehicle is driven to the school location on a Monday afternoon, no child passenger is detected in the vehicle 10 and the child input module 74 is controlled so as to keep the rear left door 14a unlocked. At block 202, on arrival at the school, which is determined from the satellite navigation data,

the learning module 90 anticipates that a child passenger is about to be collected, in accordance with the learnt behaviour, and controls the child lock module 74 so that the rear left door lock 34 adopts the child locked state, thereby preventing inadvertent opening of the rear left door 14a by the child passenger from inside the vehicle.

At block 204 the child enters the vehicle. Weight signals from the seat system 70 may be used at this time to confirm the presence of the child passenger in the rear left seat 22 and to confirm that the child locked state of the child lock associated with rear left door 14a is appropriate. At block 206, when the vehicle arrives at the next destination (e.g. home), the child exits the vehicle 10. At block 208 the system deactivates the child lock on the rear left door 14a ready for the next vehicle journey. Again, automatic deactivation of the rear left child lock in such circumstances may be confirmed by the weight signal 71 from the seat system to indicate that the child is no longer present in the vehicle.

In an alternative version of the embodiment in Figure 5, it may be beneficial for the child lock status to remain locked even after the vehicle has stopped, to ensure that the child passenger cannot exit the vehicle before it is safe to do so. Only once the driver has opened the door from the outside of the vehicle, and the child has left the vehicle, is the child lock module 74 updated so that the associated child lock adopts the unlocked state.

The learning module 90 is configured to record and learn an abundance of other vehicle usage patterns in addition to those described previously. For example, if the driver of the vehicle adjusts the child lock settings at different times of day, or for different types of journey, this may be recorded within the learning module 90 and hence anticipated when similar circumstances arise again. For example, it may be that on a Friday evening at 19:00, the driver always activates the rear right child lock assembly 36 due to the presence of a child passenger in the rear right seat 24. Thus, for any subsequent journey at 19:00 on a Friday, the predict signal 98 proceeds via the infotainment system 60 to cause the child lock module 74 to activate the child lock of the rear right lock 36 automatically. Other inputs may also be provided to the learning module to influence the prediction about whether a child passenger is likely to be carried within the vehicle.

In practice, for every journey that a vehicle makes, various different vehicle journey parameters are recorded in the learning module 90, which may be used to control various other vehicle settings, as is known in the art. However, a particular benefit of the present invention, not foreseen previously in the prior art, is that the vehicle usage pattern relating to the carrying of child passengers is recorded and the learnt behaviour is then used to determine, in advance, when it is appropriate to activate the child locks on the vehicle doors.

In practice the system may be provided with both the means to allow a user to input a selection of the position of a child passenger within the vehicle, via the infotainment system 60, and the means for the presence and seating position of a child passenger to be determined automatically based on other vehicle data, either through the seat system 70 providing a weight signal 71 or other signal (physical / biometric characteristics, e.g. height, facial appearance and / or the identity of an occupant) to the determination module 50 which determines whether or not a child is seated in the vehicle, or through the use of the learning module 90 to predict where and when a child passenger is likely to be carried. It will be appreciated that either of the aforementioned methods may be used to derive a child passenger signal for the purpose of controlling the child locks, either alone or in appropriate combination.

In a further embodiment of the invention, the predict signal 98 sent to the infotainment system 60 may be presented to the driver of the vehicle who may be asked to verify, via the HMI 62, that the prediction is correct. This serves as a prompt to the driver that the status of the child locks needs to be considered, rather than relying on driver awareness.

In a still further embodiment, the system may be configured so that it is not just the door lock assembly associated with the child passenger being detected that has the child lock activated to the locked state, but the detection or prediction of a child passenger in the rear of the vehicle may result in the child locks on the door lock assemblies of both rear doors 14a, 14b being activated to the child locked state.

Although the embodiments described above refer to controlling the status of the door locks on the vehicle doors, the invention can be extended to control, in addition or as an alternative, the window lock systems also, in dependence on whether a child passenger

is present in the associated seat, or is likely to be transported in the associated seat, for a particular journey. In other embodiments, the invention extends to a system suitable for use in detecting any passenger of restricted ability, with reference to ability being in the context of a passenger having the ability to determine when it is appropriate to open and close a door and/or window in a vehicle.

If weight cannot be used solely as a determining factor of the ability of a passenger to take responsibility for door/window opening, as it is in the case of child passenger detection, the system may be configured so as to request that the driver enters information, via the HMI 62, relating to where passengers of restricted ability are seated. Alternatively, or in addition, other parameters or factors are used to determine if an occupant of the vehicle is a passenger of restricted ability; for example, but not limited to, physical / biometric characteristics (height, facial appearance) and / or the identity of an occupant. The physical / biometric characteristics may be determined from image data captured by at least one imager disposed within the vehicle cabin, such as an in-vehicle camera, infrared camera, thermal imager etc. Without limitation, the identity of an occupant may be determined from biometric data, preferred vehicle settings (e.g. seat settings, media settings, cabin comfort settings etc., and in particular actively recalling a saved setting for any of the foregoing). The presence of one or more personal mobile device (e.g. smartphone, tablet, smart wearable device etc.) within the vehicle may also act as a primary or secondary indicator of the identity or identities of vehicle occupants and also relative seat positions of occupants within the vehicle.

Although the embodiments described above refer to the status of a passenger of restricted ability within the vehicle in terms of a seated condition of the passenger of restricted ability and/or in terms of the seat position in which the person of restricted ability is seated, it will be appreciated that in other embodiments the status of the passenger of restricted ability within the vehicle may be defined in terms of the position of the person of restricted ability within the vehicle. The position of the person of restricted ability within the vehicle may be defined by at least one of; the person of restricted ability being located at and/or near a particular seat position; and the person of restricted ability being located at and/or near a particular door and/or window of the vehicle, wherein the particular door and/or window may be associated with a particular seat position within the vehicle. The lock system may be associated with a particular

door and/or window of the vehicle, which may be associated with a particular seat position within the vehicle. The location of the passenger of restricted ability may be determined in dependence on a manual user input or from automated sensor input, such as from an internal camera, or internal camera system of the vehicle.

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It will be appreciated that many modifications may be made to the above examples without departing from the scope of the present invention as defined in the accompanying claims.

CLAIMS

1. A control system for a lock system on a vehicle, the lock system being operable between a locked state and an unlocked state, the control system comprising:

an input arranged to receive a restricted passenger signal indicative of a passenger of restricted ability being seated within the vehicle; and

a control module configured to control the state of the lock system in dependence on the restricted passenger signal so that, when the passenger of restricted ability is seated within the vehicle, the lock system adopts the locked state.

2. The control system as claimed in claim 1, comprising a user input module configured to receive a manual user input of the restricted passenger signal.

3. The control system as claimed in claim 2, wherein the user input module is configured to allow a user to select the seat position of the passenger of restricted ability, and wherein the control system is configured to determine the seat in which the passenger of restricted ability is seated in dependence on the user selection.

4. The control system as claimed in claim 1, comprising a determination module configured to determine whether the passenger of restricted ability is seated in the vehicle and to generate the restricted passenger signal in dependence on the determination.

5. The control system as claimed in claim 4, wherein the determination module is configured to determine in which seat in the vehicle the passenger of restricted ability is seated.

6. The control system as claimed in claim 5, wherein the determination module comprises a learning module configured to generate a restricted passenger signal in dependence on a prior vehicle usage profile.

7. The control system as claimed in claim 6, wherein the learning module comprises a data store configured to store data relating to a prior vehicle usage profile, and at least one input configured to receive data relating to a current vehicle usage; the learning module being configured to compare the current vehicle usage with the prior vehicle usage profile and to generate the restricted passenger signal in dependence on the comparison being indicative of the passenger of restricted ability being seated in the vehicle.

8. The control system as claimed in claim 7, wherein the data relating to a prior vehicle usage profile includes one or more of the following: location data; time data; day of week data; passenger data; and calendar data.

9. The control system as claimed in any of claims 4 to 8, for a vehicle comprising a plurality of lock systems, each lock system being associated with a door of the vehicle and each door being associated with a seat of the vehicle, wherein the control module is configured to control each lock system of each door independently of the other lock systems, depending on the seat in which the passenger of restricted ability is determined to be seated.

10. The control system as claimed in claim 9, wherein the determination module is configured to determine in which seat in the vehicle the passenger of restricted ability is seated, and to control the state of the lock system associated with the door associated with the determined seat, so that the lock system adopts the locked state if the passenger of restricted ability is seated in the associated seat.

11. The control system as claimed in any one of claims 4 to 10, wherein the determination module is configured to determine that the passenger of restricted ability has exited the vehicle, and whereby the control system is operable to move the lock system from the locked state to the unlocked state in the event that the determination module provides an output indicative of the passenger of restricted ability no longer being in the vehicle.

12. The control system as claimed in any of claims 1 to 11, configured to control operation of a lock system associated with a vehicle door and/or of a lock system associated with a window of a vehicle door.

13. The control system as claimed in any of claims 1 to 12, wherein the lock system is a child lock system of vehicle and the locked state is a child locked state in which a door and/or window associated with the child lock system cannot be opened from inside the vehicle, but can be opened from outside the vehicle.

14. A vehicle lock system for a vehicle comprising at least one lock system and a control system as claimed in any of claims 1 to 13 configured to control the at least one lock system in dependence on the restricted passenger signal.

15. A vehicle comprising the control system as claimed in any of claims 1 to 13 or the vehicle lock system as claimed in claim 14.

16. A method for controlling a lock system on a vehicle, the lock system being operable between a locked state and an unlocked state, the method comprising:

receiving a restricted passenger signal indicative of a passenger of restricted ability being seated within the vehicle; and

controlling the state of the lock system in dependence on the restricted passenger signal so that, when the passenger of restricted ability is seated within the vehicle, the lock system adopts the locked state.

17. The method as claimed in claim 16, comprising determining whether the passenger of restricted ability is seated in the vehicle and generating the restricted passenger signal in dependence on the determination.

18. The method as claimed in claim 17, wherein determining whether the passenger of restricted ability is seated in the vehicle comprises receiving a manual user input of the restricted passenger signal.

19. The method as claimed in claim 17 or claim 18, comprising receiving a seat position signal to indicate the seat position of the passenger of restricted ability and determining the seat in which the passenger of restricted ability is seated in dependence on the seat position signal.

20. The method as claimed in claim 17, comprising generating a restricted passenger signal in dependence on a prior vehicle usage profile.

21. The method as claimed in claim 20, comprising storing data relating to a prior vehicle usage profile, receiving data relating to a current vehicle usage; comparing the prior vehicle usage profile with the current vehicle usage and generating the restricted passenger signal in dependence on the comparison being indicative of the passenger of restricted ability being seated in the vehicle.

22. The method as claimed in any of claims 16 to 21, for use in a vehicle comprising a plurality of lock systems, each being associated with a respective vehicle door, the method comprising controlling each lock system of each door independently of the other lock systems, depending on the seat in which the passenger of restricted ability is determined to be seated.

23. The method as claimed in claim 22, comprising determining in which seat of the vehicle the passenger of restricted ability is seated, and controlling the state of the lock system associated with the door associated with the determined seat, so that the lock system adopts the locked state if the passenger of restricted ability is seated in the associated seat.

24. The method as claimed in any one of claims 16 to 23, comprising determining that the passenger of restricted ability has exited the vehicle, and controlling the lock system to move from the locked state to the unlocked state in the event that it is determined that the passenger of restricted ability has exited the vehicle.

Intellectual Property Office

Application No: GB1808725.4 **Examiner:** Mr Philip Lawrence

Claims searched: 1-24 **Date of search:** 16 November 2018

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-5, 9-19, 22-24	GB2340174 A (ROVER), see whole document.
X	1-5, 9-19, 22-24	US9244576 B1 (CYPRESS SEMICONDUCTOR), see especially Col. 8 lines 29-52.
X	1-5, 9-19, 22-24	US2016/0177614 A (ROBERT BOSCH), see Paras [0021] and [0022].
X	1-5, 9-19, 22-24	US2006/0044124 A1 (SIEMENS), see Paras [0027]-[0045].
X	1-5, 9-19, 22-24	JP2015183417 A (DAIHATSU), see WPI Abstract Accession No. 2015-63680B and Figures.
X	1-5, 9-19, 22-24	KR1020150015052 A (HYUNDAI), see WPI Abstract Accession No. 2015-13433T and Figures.

Categories:

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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

E05B

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI, Patent Fulltext

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International Classification:

Subclass	Subgroup	Valid From
E05B	0077/24	01/01/2014
E05B	0077/26	01/01/2014
E05B	0077/54	01/01/2014