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(54) **CHILD SEAT MONITORING SYSTEM**

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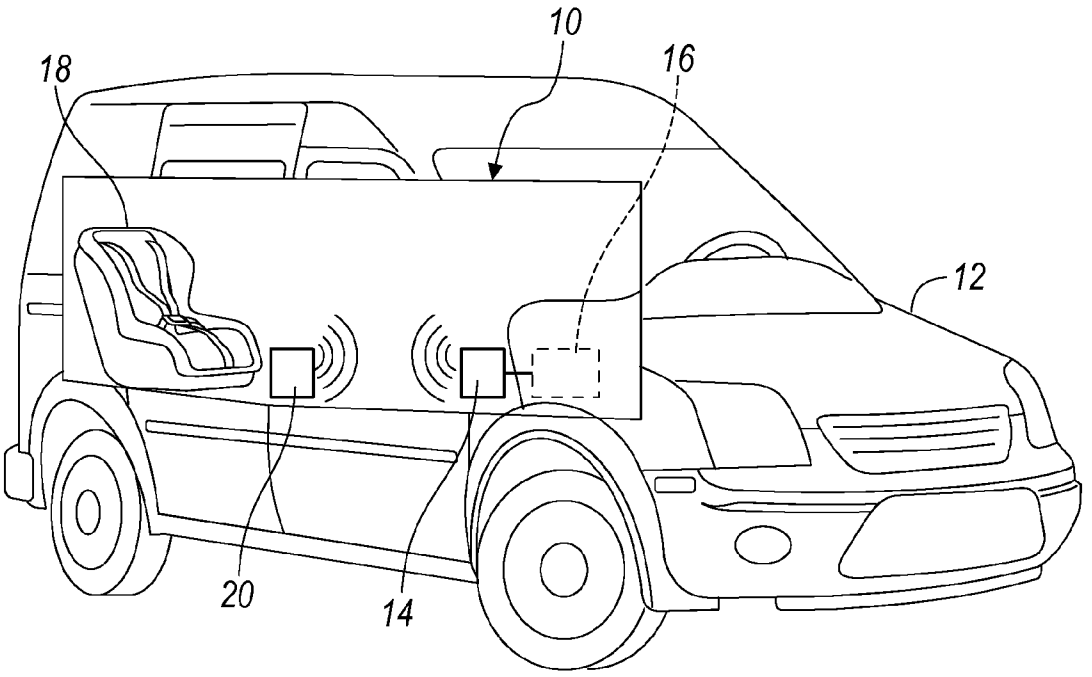
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(57) **ABSTRACT**

A vehicle system for communicating with a child seat is provided with a receiver configured for receiving a seat sensor signal from a child seat controller. A controller is configured for communicating with the receiver for analyzing the seat sensor signal and comparing the seat sensor signal to pre-existing guidelines to determine a status message. A user interface is configured for communicating with the controller for displaying the status message. The child seat is provided with a plurality of seat sensors for measuring different adjustable features of the seat including; a harness sensor for measuring a tension within a harness; a buckle switch for measuring a connection of a buckle; and a level sensor for measuring an inclination of a seat sub-assembly. The seat controller is provided for receiving measurement signals from the seat sensors and transmitting the seat sensor signal.



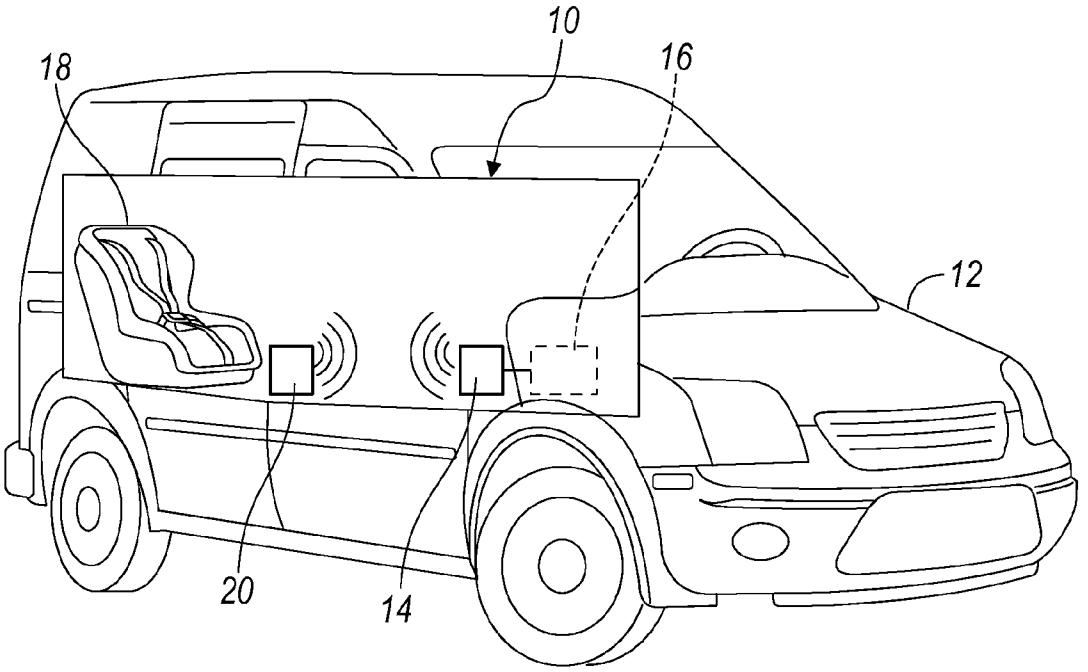


FIG. 1

130

132 FEATURE	134 SEAT STATUS STATUS	136 INSTRUCTION
1. HARNESS	1. NOK	1. TIGHTEN HARNESS
2. ANCHOR	2. OK	2. ---
3. TETHER	3. NOK	3. TIGHTEN TETHER
4. BUCKLE 1	4. OK	4. ---
5. BUCKLE 2	5. NOK	5. CHECK BUCKLE 2
6. LEVEL	6. OK	6. ---
7. DIRECTION	7. NOK	7. REVERSE DIRECTION
8. TEMPERATURE	8. OK	8. ---
9. MOISTURE	9. NOK	9. CHECK COVERING
10. BATTERY	10. NOK	10. CHARGE

FIG. 8

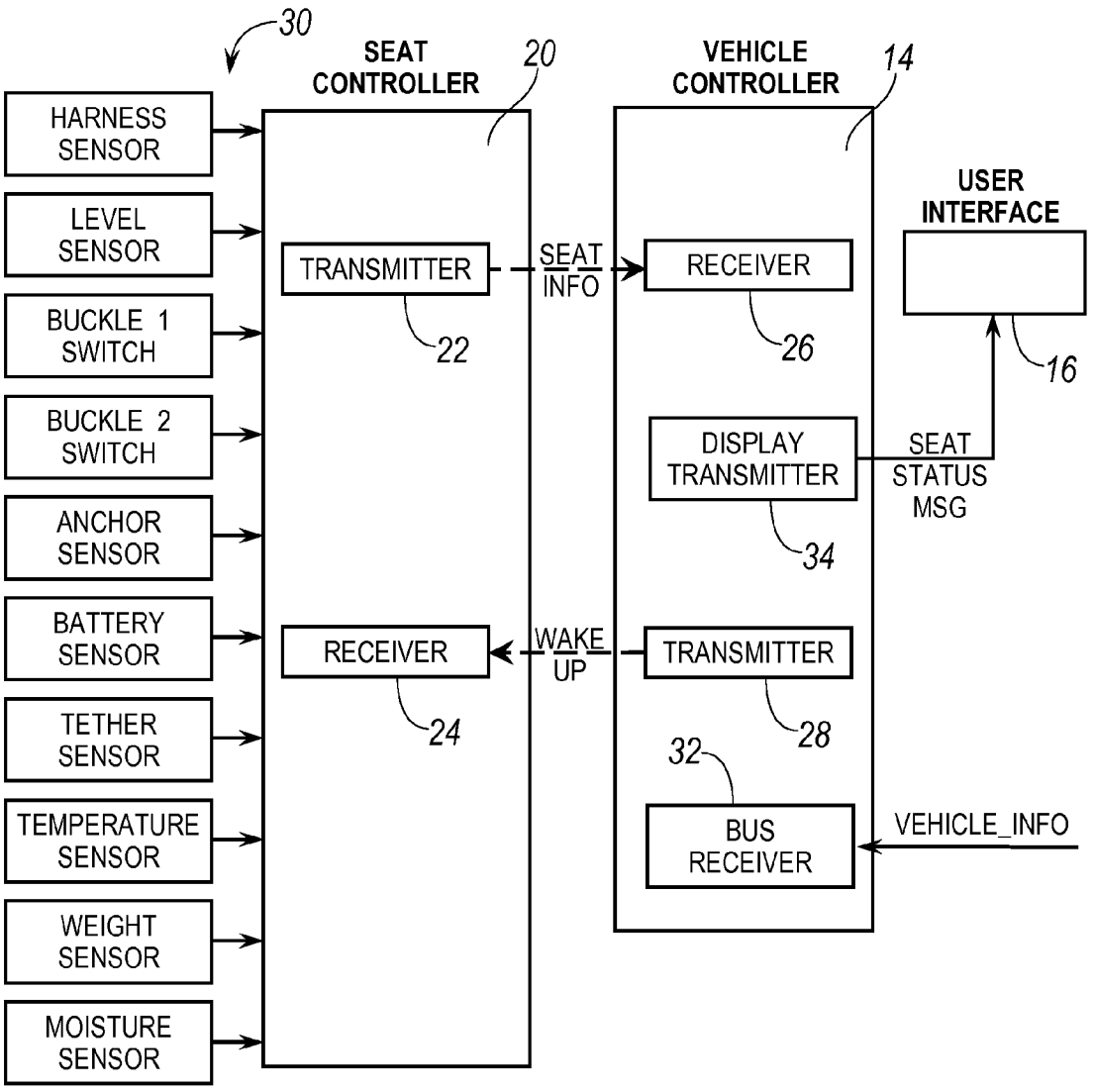

30
SEAT CONTROLLER
20
VEHICLE CONTROLLER
14
HARNESS SENSOR
LEVEL SENSOR
BUCKLE 1 SWITCH
BUCKLE 2 SWITCH
ANCHOR SENSOR
BATTERY SENSOR
TETHER SENSOR
TEMPERATURE SENSOR
WEIGHT SENSOR
MOISTURE SENSOR
TRANSMITTER
22
SEAT INFO
RECEIVER
26
USER INTERFACE
16
DISPLAY TRANSMITTER
34
SEAT STATUS MSG
RECEIVER
24
WAKE UP
TRANSMITTER
28
32
BUS RECEIVER
VEHICLE_INFO

FIG. 2

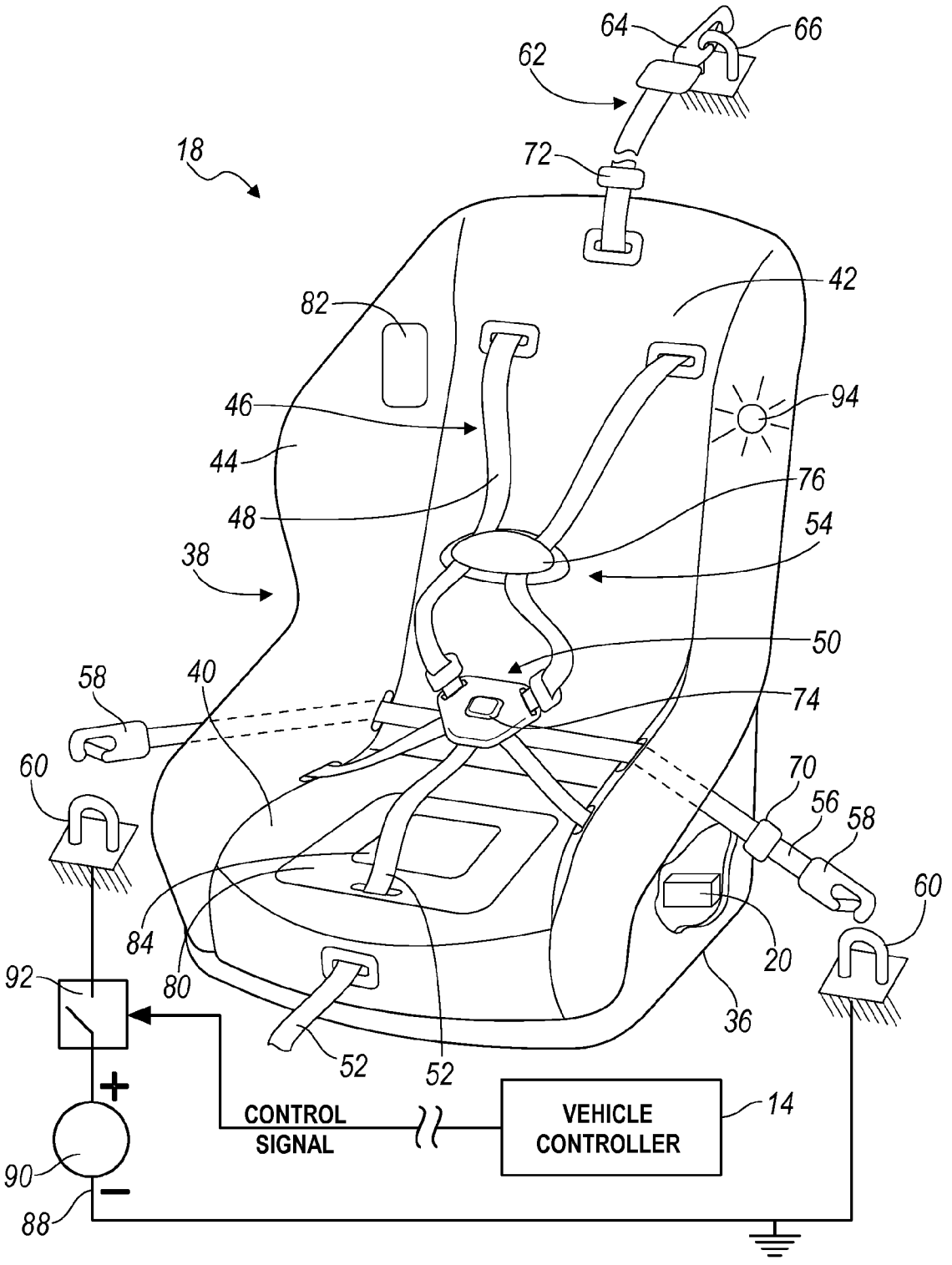

64
66
62
18
72
42
82
46
94
44
76
48
54
38
50
58
40
74
60
70
56
58
60
84
20
92
80
36
52
52
CONTROL SIGNAL
VEHICLE CONTROLLER
14
90
88

FIG. 3

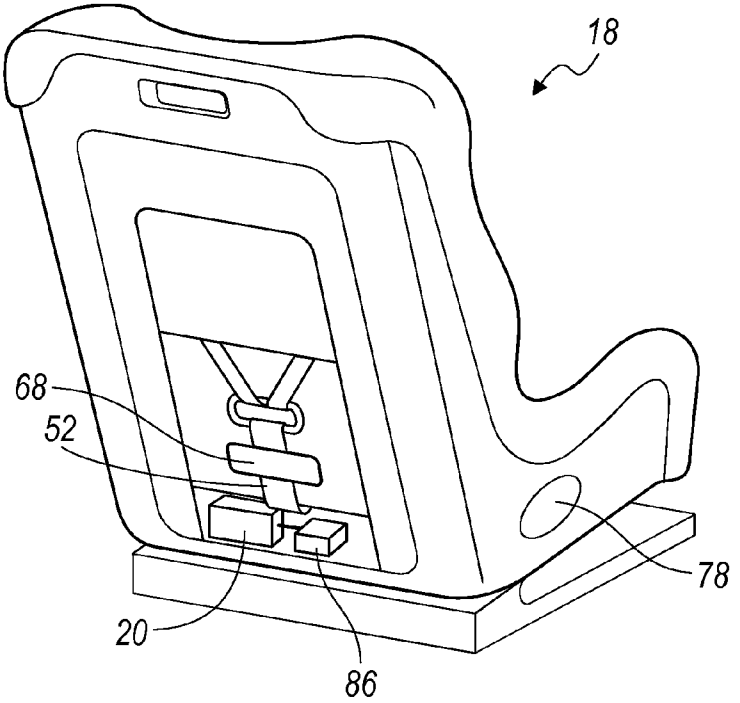

18
68
52
78
20
86

FIG. 4

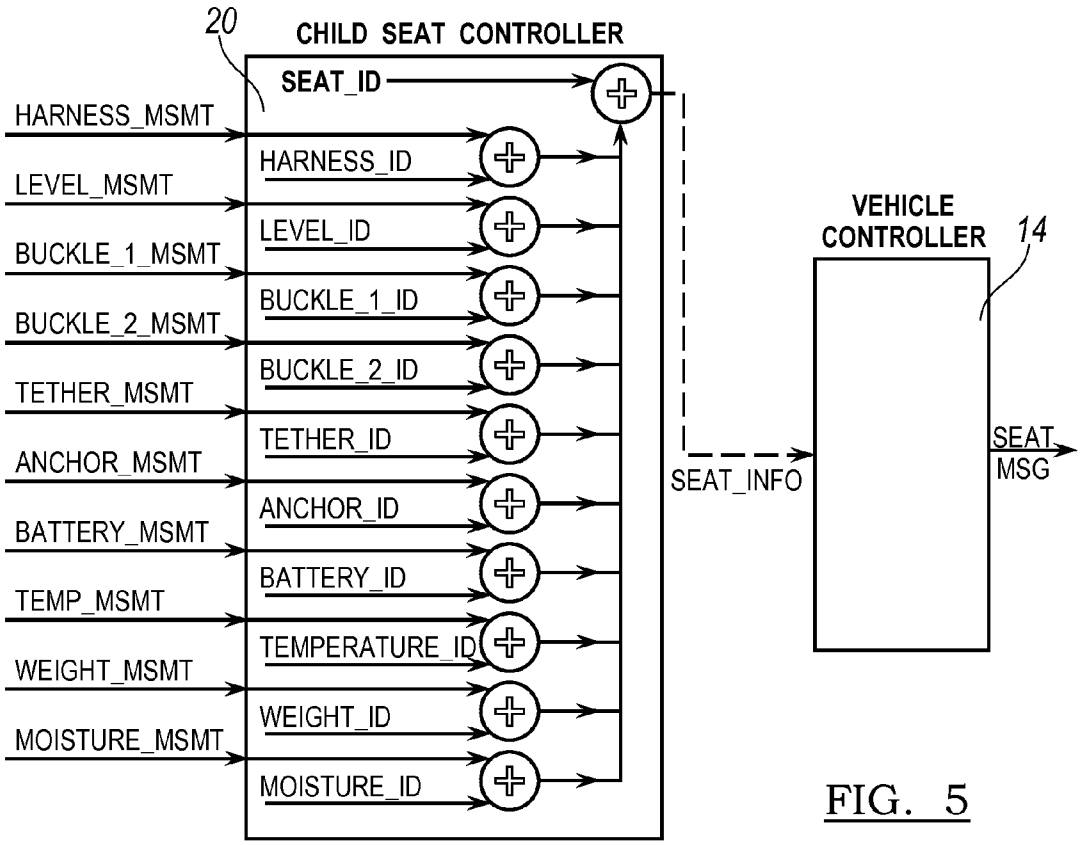

20
CHILD SEAT CONTROLLER
SEAT_ID
HARNESS_MSMT
HARNESS_ID
LEVEL_MSMT
LEVEL_ID
BUCKLE_1_MSMT
BUCKLE_1_ID
BUCKLE_2_MSMT
BUCKLE_2_ID
TETHER_MSMT
TETHER_ID
ANCHOR_MSMT
ANCHOR_ID
BATTERY_MSMT
BATTERY_ID
TEMP_MSMT
TEMPERATURE_ID
WEIGHT_MSMT
WEIGHT_ID
MOISTURE_MSMT
MOISTURE_ID
SEAT_INFO
VEHICLE CONTROLLER
14
SEAT MSG

FIG. 5

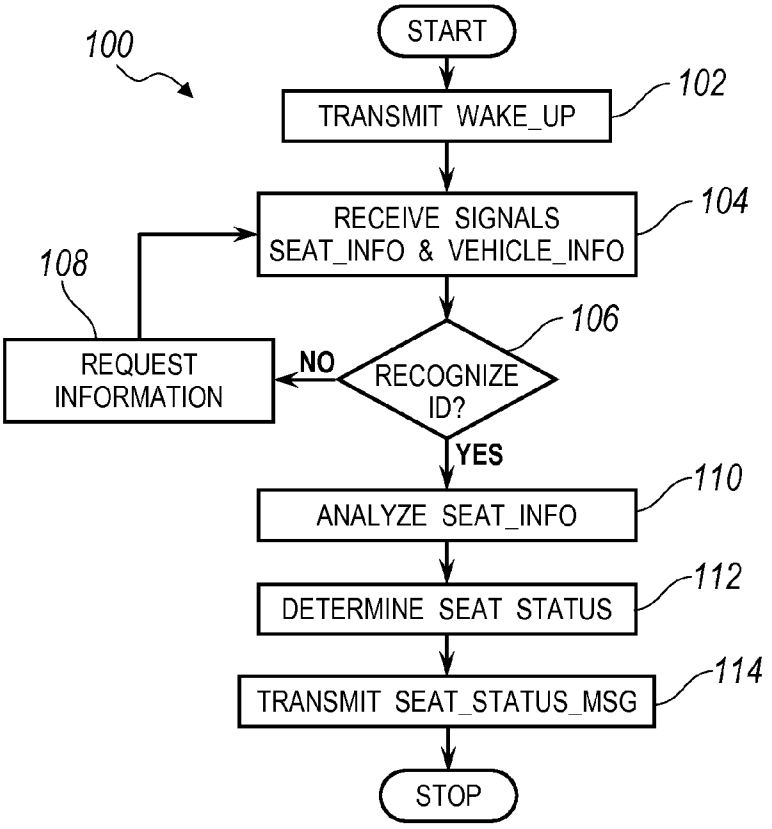

100
START
TRANSMIT WAKE_UP
102
RECEIVE SIGNALS
SEAT_INFO & VEHICLE_INFO
104
108
106
REQUEST
INFORMATION
NO
RECOGNIZE
ID?
YES
ANALYZE SEAT_INFO
110
DETERMINE SEAT STATUS
112
TRANSMIT SEAT_STATUS_MSG
114
STOP

FIG. 6

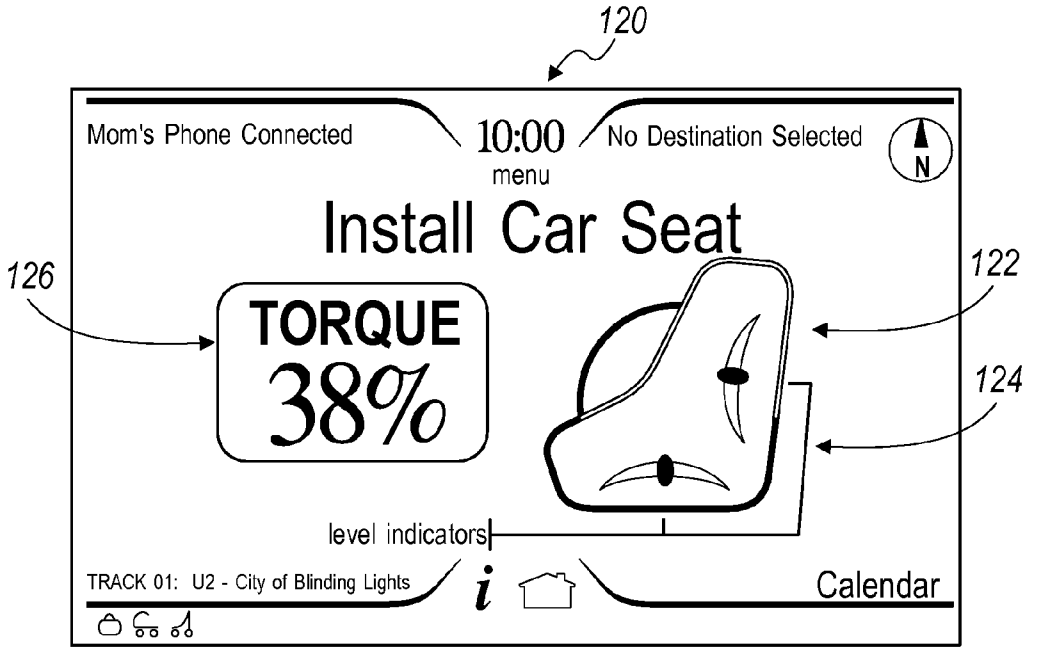

120
Mom's Phone Connected
10:00
menu
No Destination Selected
N
Install Car Seat
126
TORQUE
38%
122
124
level indicators
TRACK 01: U2 - City of Blinding Lights
i
Calendar

FIG. 7

CHILD SEAT MONITORING SYSTEM

BACKGROUND

[0001] 1. Technical Field

[0002] One or more embodiments of the present invention generally relate to vehicle child seating and vehicle communications.

[0003] 2. Background Art

[0004] A plurality of adjustable features are provided for conventional child seats for automotive vehicles. The adjustable features allow a user to secure a child to the seat and to secure the seat to the vehicle. Adjustment guidelines are typically provided in a child seat manual. The user adjusts the features of the child seat according to their understanding of the guidelines.

SUMMARY

[0005] In at least one embodiment a vehicle system for communicating with a child seat is provided. The vehicle system comprises a receiver. The receiver is configured for receiving at least one seat sensor signal from a child seat controller. The vehicle system further comprises a controller that is configured for communicating with the receiver for analyzing the at least one seat sensor signal and comparing the seat sensor signal to pre-existing guidelines to determine a status message. The vehicle system further comprises a user interface that is configured for communicating with the controller for displaying the status message.

[0006] In yet another embodiment a child seat system for use in an automobile is provided. The child seat system comprises a base for resting upon an underlying surface. The system includes a seat sub-assembly for supporting a child; wherein the seat sub-assembly is pivotally connected to the base. The system further comprises a harness for securing a child to the seat sub-assembly. The system includes a harness sensor for measuring a tension within the harness. The system further comprises at least one buckle for connecting multiple portions of the harness together. The system includes a buckle switch for measuring a connection of the buckle. The system further comprises a level sensor for measuring an inclination of the seat sub-assembly. Additionally the system includes a seat controller that is configured for receiving measurement signals from the harness sensor, the buckle switch and the level sensor; wherein the seat controller transmits an information signal indicative of the measurement signals.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a schematic view of a vehicle system for monitoring a child seat system according to embodiments of the present invention;

[0008] FIG. **2** is a schematic diagram further illustrating the vehicle system of FIG. **1**;

[0009] FIG. **3** is a front perspective view of the child seat system of FIG. **1**;

[0010] FIG. **4** is a rear perspective view of the child seat system of FIG. **3**;

[0011] FIG. **5** is another schematic diagram illustrating the vehicle system of FIG. **1**;

[0012] FIG. **6** is a flow chart illustrating a method for monitoring the child seat system of FIG. **1**;

[0013] FIG. **7** is a schematic diagram of a user interface of the vehicle system of FIG. **1**, illustrating a pictorial display; and

[0014] FIG. **8** is another schematic diagram view of the user interface of the vehicle system of FIG. **1**, illustrating a tabular display.

DETAILED DESCRIPTION

[0015] As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. The figures are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for the claims, and/or as a representative basis for teaching one skilled in the art to variously employ the present invention.

[0016] In general, a user subjectively adjusts the features of a child seat in a vehicle according to their understanding of the adjustment guidelines for the child seat. Many users are confused by the guidelines and are unsure if they have properly secured the child. A vehicle system is provided whereby sensors take measurements of the adjustable features of the child seat, as the user adjusts the features. A vehicle controller compares the measurements to predetermined guidelines to objectively determine the status of the child seat. The controller then conveys this status to the user, so that the user can properly secure the child.

[0017] With reference to FIG. **1**, a vehicle system for communicating with a child seat system is illustrated in accordance with an embodiment of the present invention and is generally referenced by numeral **10**. The vehicle system **10** is depicted within a vehicle **12**. The system **10** includes a controller **14** and a user interface **16** that communicate with one another. The controller **14** is configured for communicating with a child seat system **18** for gathering information indicative of a status of the child seat system **18**. The controller **14** analyzes the information received from the child seat system **18** and relays a corresponding message to the user interface **16**, so that the status of the child seat may be conveyed to an operator of the vehicle **12**.

[0018] The child seat system **18** includes a seat controller **20** and a plurality of measuring devices for receiving and conditioning information indicative of the status of the seat system **18**. The measuring devices take measurements of various features of the seat system **18** and transmit corresponding input signals to the seat controller **20**. The seat controller **20** includes signal conditioning equipment (not shown) for modifying any such received signals for analysis. For example, the signal conditioning equipment of the seat controller **20**, may include an analog-to-digital converter (not shown), for converting the measured voltage signals into corresponding signals having digital data (e.g. two hexadecimal digits representing eight bits of data).

[0019] With reference to FIG. **2**, the vehicle controller **14** and the seat controller **20** communicate with each other using RF communication (as indicated by dashed signal lines). The seat controller **20** includes a seat transmitter **22** and a seat receiver **24** that are configured for communicating with other electronic devices, such as the vehicle controller **14**. The seat transmitter **22** transmits signals and the seat receiver **24** receives signals. The vehicle controller **14** includes a receiver **26** and a transmitter **28** that are configured for communicating with other electronic devices, such as the seat controller **20**. Both the vehicle controller **14** and the seat controller **20** are

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configured for communicating with each other via RF waves. Alternate embodiments of the vehicle system **10**, contemplate the controllers **14** and **20** communicating over a hardline vehicle connection using a common bus protocol (e.g. CAN). Additional alternate embodiments of the vehicle system **10**, envision controllers having transceivers configured for both receiving and transmitting signals.

[0020] The vehicle controller **14** and the seat controller **20**, generally includes any number of microprocessors, ASICs, ICs, memory (e.g., FLASH, ROM, RAM, EPROM and/or EEPROM) and software code to co-act with one another to perform a series of operations.

[0021] The controller **14** may be configured to communicate with a plurality of systems/networks that are external to the vehicle. For example the controller **14** may include transceivers for communicating with satellites (e.g. GPS), and computers (via cellular networks, hardwire connections or radio frequency (RF) waves) (not shown). Such networks are described in detail in co-pending U.S. application 61/005,279 to Pleet et al., which is hereby incorporated by reference.

[0022] The vehicle controller **14** may initiate communication with the seat controller **20**. The vehicle controller **14** may instruct the transmitter **28** to transmit a WAKE_UP activation signal to the seat receiver **24**. Upon receipt of the WAKE_UP signal, the seat controller **20** will "wake up", if the seat controller **20** is presently in a "sleep" mode, by energizing appropriate circuitry. The seat controller **20** prepares a response for the vehicle controller **14** by collecting updated information from the measuring devices of the seat system **18**. The measuring devices of the seat system **18** are generally referenced by numeral **30**, in FIG. **2**. Alternate embodiments of the vehicle system **10** contemplate that the seat controller **20** initiates communication with the vehicle controller **14** by periodically transmitting information or by transmitting whenever the seat controller **20** indicates a state change of one of the measuring devices **30**.

[0023] The seat controller **20** receives input signals from the measuring devices **30**, and transmits corresponding digital data to the vehicle controller **14**. Each measuring device **30** provides an input signal to the seat controller **20** that is indicative of the status of a feature measured by the respective device **30**. The input signals may be analog or digital signals. The seat controller **20** converts the input signals into corresponding digital data (e.g. eight bits of hexadecimal "hex" data). The seat controller combines the digital data from the measuring devices **30** into a single packet of data, which is generally referred to as SEAT_INFO. The seat controller **20** instructs the seat transmitter **22** to transmit the SEAT_INFO to the receiver **26** of the vehicle controller **14**, via RF communication. The SEAT_INFO data is sized according to the desired sensitivity of an application. For example, each input may be converted into a two digit hex value (e.g., A5) representing 8 bits of data, or the input may be converted into a three digit hex value (e.g., AF3), representing 12 bits of data, for more sensitive readings.

[0024] The vehicle controller **14** receives the SEAT_INFO data in addition to vehicle data. The receiver **26** is configured to receive the SEAT_INFO from the seat transmitter **22**. The vehicle controller **14** also includes a BUS receiver **32** that is configured for receiving hardwired signals from a vehicle BUS communication network (e.g. CAN) containing information indicative of the status of other vehicle systems (VEHICLE_INFO). For example, the VEHICLE_INFO signal received by the controller **14** may include signals indicative of the current angle of inclination of the vehicle **12**. Such inclination signals may be measured by vehicle accelerometers (not shown), which are well known in the art. The invention contemplates that the vehicle controller **14** may acquire any signal available on the vehicle BUS for comparison to the SEAT_INFO data.

[0025] The vehicle controller **14** compares the SEAT_INFO and VEHICLE_INFO to a set of predetermined data to determine the status of the vehicle seat system **18** and transmits a corresponding status message to the user interface **16**. The predetermined data includes acceptable ranges for each measurement made by the measuring devices **30**. The vehicle controller **14** determines whether each measurement is within the corresponding acceptable range. The vehicle controller **14** generates an overall seat status message (SEAT_STATUS_MSG). The controller **14** includes a display transmitter **34** for transmitting the SEAT_STATUS_MSG to the user interface **16**.

[0026] The user interface **16** receives the SEAT_STATUS_MSG and communicates a corresponding message to the operator of the vehicle **12**. The message communicated by the user interface **16** may be audio, visual or a combination of both audio and visual messages.

[0027] With reference to FIGS. **3-4**, the seat system **18** that is depicted includes a base **36** and a seat sub-assembly **38**, operatively coupled together for supporting a child (not shown). The base **36** includes a generally planar bottom surface for resting upon a seat of a vehicle **12** (FIG. **1**). The seat sub-assembly **38** is formed by a seat bottom **40** and a seat back **42**, that are coupled to each other. The seat bottom **40** provides a generally flat surface for a child to sit upon. The seat back **42** provides an upright surface for a child to rest its back upon. The seat sub-assembly **38** includes a padded covering **44** disposed over the seat bottom **40** and the seat back **42**.

[0028] The seat sub-assembly **38** is pivotally connected to the base **36** for selectively adjusting the seat sub-assembly **38** to a desired angular position. The angular adjustment of the seat system **18** allows the system **18** to be mounted to vehicle seats having varying shapes and sizes. Typical child seat systems **18** are designed such that they may be mounted either in a "forward facing" position (child facing forward in vehicle), or in a "rearward facing" position (child facing rearward in vehicle). The angular adjustment of the seat system **18** allows a seat bottom **40** to be adjusted to a desired angular position in both a forward facing and a rearward facing position.

[0029] The child seat system **18** includes a restraint system **46** for securing a child to the seat sub-assembly **38**. The restraint system **46** includes a harness **48**, such as a five-point harness. The harness **48** includes a plurality of straps that pass through slotted apertures of the covering **44** to connect to each other at a common point. A lap-buckle ("first buckle") **50** provides the common point for connecting the straps of the harness **48**. The first buckle **50** is positioned at a lap of the child. The harness **48** includes a pair of generally upright straps, a pair of lap straps and a pull strap **52**, each of which are operatively coupled to the first buckle **50**. The first buckle **50** is configured such that by pulling/cinching the pull strap **52**, the tension throughout the harness **48** increases for securing the child to the seat sub-assembly **38**. The seat system **18** also includes a release (not shown) for releasing the tension in the harness **48**. A chest buckle **54** ("second buckle") laterally connects the pair of upright straps to each other. The chest buckle **54** is generally positioned at a child's chest.

[0030] The restraint system **46** also includes an anchor strap **56** for securely mounting the seat system **18** to a vehicle **12**. The anchor strap **56** includes a pair of anchor connectors **58** that are connected to each other by an adjustable strap. The anchor strap **56** laterally extends across a lower portion of the seat back **42** and exits the seat system **18** through a pair of apertures (not shown) positioned on opposing lateral edges of the seat back **42**. The anchor connectors **58** are attached/latched to a pair of vehicle anchors **60**. The vehicle anchors **60** are rigidly mounted to a structure of the vehicle **12** and extend upwards through a rear seat of the vehicle **12**. The anchor strap **56** is tightened/cinched to securely mount the seat system **18** to the vehicle **12**.

[0031] The restraint system **46** also includes a tether **62** to further secure the seat system **18** to the vehicle **18**. The tether **62** includes a tether connector **64** that is connected to an upper portion of the seat sub-assembly **38** by an adjustable strap. The tether connector **64** is attached to a vehicle tether anchor **66**. The vehicle tether anchor **66** may be positioned in a plurality of vehicle locations depending on the type of vehicle **12** and direction that the seat system **18** is facing. For example, for a van application where the seat system **18** is facing forward, as depicted in FIG. **1**, the vehicle tether anchor **64** may be positioned on the floor of the vehicle behind a row of seats that the seat system **18** is mounted to. Alternate vehicle locations for the tether anchor **64** positions are envisioned and are known in the art.

[0032] The seat system **18** includes a plurality of measuring devices **30** for monitoring the status of the components of the seat system **18** and transmitting corresponding signals to the seat controller **20**. The measuring devices include, but are not limited to, a harness sensor **68**, an anchor sensor **70**, a tether sensor **72**, a first buckle switch **74**, a second buckle switch **76**, a level sensor **78**, a weight sensor **80**, a temperature sensor **82**, a moisture sensor **84**, and a battery sensor **86**. The particular type of measuring device **30** that is implemented may vary based on the desired criteria of a particular implementation. Although specific locations of the measuring devices **30** are described below, alternate embodiments of the seat system **18** contemplate different locations of the devices **30**.

[0033] The harness sensor **68** is provided for measuring force/tension within the harness **48** as the harness **48** is tightened to secure a child to a seat sub-assembly **38**. The harness sensor may be positioned inline along one of the straps of the harness **48**. For example, as illustrated in FIG. **4**, the harness sensor **68** may be positioned inline along a portion of the pull strap **52** that is connected to both upright straps along a rear portion of the seat sub-assembly **38**. The harness sensor **68** transmits an input signal (HARNESS_MSMT) to the seat controller **20** that is indicative of the tension measured in the harness **48**. As mentioned above, the straps of the harness **48** are coupled to each other at the first buckle **50**, and simultaneously tightened by pulling on the pull strap **52**. Therefore, alternate embodiments of the vehicle system **10** envision positioning the harness sensor at alternate locations, inline along the harness **48**. Additional alternate embodiments of the harness sensor, contemplate a torque sensor, for measuring a torque value of the harness **48** about the first buckle **50**.

[0034] The anchor sensor **70** is provided for measuring tension within the anchor strap **56** as the strap **56** is tightened to secure the seat system **18** to the vehicle **12**. The anchor sensor **70** may be positioned inline along the anchor strap **56**. For example, as illustrated in FIG. **3**, the anchor sensor **70** may be positioned external to the seat sub-assembly **38**. The anchor sensor **70** transmits an input signal (ANCHOR_MSMT) to the seat controller **20** that is indicative of the tension measured in the anchor strap **56**. Alternate embodiments of the vehicle system **10**, envision positioning the anchor sensor **70** internal of the seat sub-assembly **38**, (e.g., along the portion of the anchor strap **56** that spans the seat back **42**).

[0035] The tether sensor **72** is provided for measuring tension within the tether **62** as the tether is tightened to secure the seat system **18** to the vehicle **12**. The tether sensor **72** may be positioned inline along the strap of the tether **62**, as illustrated in FIG. **3**. The tether sensor **72** transmits an input signal (TETHER_MSMT) to the seat controller **20** that is indicative of the tension measured along the strap of the tether **62**.

[0036] The first buckle switch **74** is provided for measuring continuity within the first buckle **50**, which is used to secure a child to a seat sub-assembly **38**. The first buckle switch **74** may be positioned within the first buckle **50**. The first buckle switch **74** transmits an input signal (Buckle_**1**_MSMT) to the seat controller **20** that is indicative of the continuity within the first buckle **50**. For example, when the first buckle **50** is connected, the switch **74** may transmit a "high" analog voltage signal, such as 4.5-5.0 Volts. Conversely when the first buckle **50** is not connected the switch **74** may transmit a "low" analog voltage signal, such as 0.0-0.5 Volts. Alternate embodiments of the vehicle system **10** contemplate using a sensor rather than a switch **74** for indicating whether or not the first buckle **50** is connected.

[0037] The second buckle switch **76** is provided for measuring continuity within the second buckle **54**, which is used to secure a child to a seat sub-assembly **38**. The second switch **76** may be positioned within the second buckle **54**. The second buckle switch **76** transmits an input signal (Buckle_**2**_MSMT) to the seat controller **20** that is indicative of the continuity within the second buckle **54**. Alternate embodiments of the vehicle system **10** envision using a sensor rather than a switch **76** for indicating whether or not the second buckle **54** is connected.

[0038] The level sensor **78** is provided for measuring an angle of inclination of the seat sub-assembly **38** relative to ground. The level sensor **78** may be positioned on the side of the base **36**, as illustrated in FIG. **4**. The level sensor **78** transmits an input signal (LEVEL_MSMT) to the seat controller **20** that is indicative of the angle of inclination of the seat sub-assembly **38**. An embodiment of the level sensor **78** includes a dual axis accelerometer.

[0039] The weight sensor **80** is provided for measuring a weight of a child that is secured to the seat sub-assembly **38**. The weight sensor **80** may be positioned within the covering **44** that is disposed over the seat bottom **40** as illustrated in FIG. **3**. The weight sensor **80** transmits an input signal (WEIGHT_MSMT) indicative of the weight of the child.

[0040] The temperature sensor **82** is provided for measuring a temperature at a location of the seat system **18**. The temperature sensor **82** may be positioned on an upper portion of the seat back **42** as illustrated in FIG. **3**. The temperature sensor **82** transmits an input signal (TEMP_MSMT) to the seat controller **20** that is indicative of the temperature measured by the sensor **82**. Alternate embodiments of the seat system **18** contemplate a seat sub-assembly having a cup holder (not shown). For such an embodiment a temperature sensor may be positioned within the cup holder for measuring a temperature that is indicative of the temperature of a fluid within a child's cup.

[0041] The moisture sensor **84** is provided for measuring a moisture level at a location of the seat sub-assembly **38**. The moisture sensor **84** may be positioned within the covering **44** that is disposed over the seat bottom **40** as illustrated in FIG. **3**. The moisture sensor **84** transmits an input signal (MOISTURE_MSMT) to the seat controller that is indicative of the moisture level that is measured by the sensor **84**.

[0042] The battery sensor **86** is provided for measuring an electrical power level of a seat controller battery (not shown). The battery sensor **86** may be positioned within or in proximity to the seat controller **20**, as illustrated in FIG. **4**. The battery sensor **86** transmits a signal (BATTERY_MSMT) to the seat controller **20** that is indicative of the electrical power of the battery. One embodiment of the battery sensor envisions a sensor for measuring the voltage potential of the battery. Another embodiment of the battery sensor contemplates a sensor for measuring the current level stored in the battery. For example a current shunt or an inductive current clamp may be used for measuring the current level in the battery.

[0043] As mentioned above the seat controller **20** includes the seat system battery for providing electrical power to the seat system **18**. The seat system battery may include a single use (disposable) battery, or a rechargeable battery.

[0044] An embodiment of the seat controller **20** includes a MOTE controller. A MOTE is generally an inexpensive controller, capable of sensory collection, basic processing, and wireless communication, that consumes a low amount of electrical power. Therefore the MOTE may operate for a prolonged period of time with a disposable battery or on a single battery charge.

[0045] Referring to FIG. **3**, the seat controller **20** may include a rechargeable battery that is charged by the vehicle. An embodiment of the vehicle system **18** includes a charging circuit **88** for charging the seat controller battery. The circuit **88** includes a power supply **90** and a switch **92**. The power supply **90** may be the vehicle battery. The switch **92** is provided for controlling the direction of current flow within the charging circuit **88**. The vehicle controller **14** may be hardwired connected to the switch **92**, such that the vehicle controller **14** may selectively transmits a signal (CONTROL_SIGNAL) to the switch **92** to command the switch to open or close, thereby altering the direction of the current flow within the circuit **88**. A seat circuit (not shown) may be formed by the anchor strap **56**, the vehicle anchors **60** and the seat battery. The anchor strap **56** may include a wire harness (not shown), embedded in the strap, that extends from an anchor connector **58** through the seat battery and continues to the other anchor connector **58**. Thus when the anchor connectors **58** are both attached to the corresponding vehicle anchors **60**, the vehicle controller **14** may selectively close the switch **92**, thereby allowing current to flow from the charging circuit **88** to the seat circuit to charge the seat battery.

[0046] An alternate embodiment of the charging circuit envisions a circuit that inductively charges the seat battery. The charging circuit is placed in proximity to the seat battery, such as within a rear seat of the vehicle **12**. The charging circuit may be activated by the vehicle controller to generate an electromagnetic field that inductively charges the seat battery.

[0047] The seat system **18** may also include an environmental lighting device **94** that is capable of emitting different colors depending on the vehicle application. As mentioned above, the vehicle controller **14** receives vehicle information (VEHICLE_INFO) from the vehicle BUS. This VEHICLE_INFO may include information regarding an interior lighting color or trim color of the vehicle **12**. Additionally as mentioned above the vehicle controller **14** transmits information (e.g., the WAKE_UP signal) to the seat controller **20**. The vehicle controller **14** may also transmit information regarding an interior lighting color or trim color to the seat controller **20**, which may be used by the seat controller **20** to adjust the environmental lighting device **94**. Alternate embodiments of the vehicle system **10** envision the user selecting a color to be emitted by the lighting device **94** through the user interface **16**.

[0048] Referring to FIG. **5**, the seat controller **20** receives a plurality of input voltage signals and converts them into a packet of digital data. Additionally the seat system **18** and each measuring device **30** include a identification tag that is also included in the packet of digital data. The identification tags identify a specific seat system **18**, having specific measuring devices **30**, within a vehicle **12**. By identifying the system **18** the vehicle controller **14** can compare the measurements taken by a seat system **18** against predetermined data that was configured for that specific seat system **18**.

[0049] For example a seat system **18** may have a digital identification tag (SEAT_ID) of A1. A harness sensor **68** may include a digital identification (HARNESS_ID) of B2. The harness sensor **68** may measure a harness tension of 3.2 volts, which the seat controller **20** digitizes into a corresponding value of C3. The seat controller may group this digital data into a packet (SEAT_INFO). Of course, the SEAT_INFO signal can also include ID tags and measurements from the other measuring devices **30**. The SEAT_INFO signal that is sent by the seat controller **20** and received by the vehicle controller **14** may be an RF signal corresponding to a signal of A1B2C3.

[0050] Upon receipt of the SEAT_INFO signal the vehicle controller **14** analyzes the data, and transmits a corresponding SEAT_STATUS_MSG to the user interface **16**.

[0051] FIG. **6** illustrates a method **100** for evaluating the status of the vehicle seat system **18**. The vehicle controller **14** generally includes any number of microprocessors, ASICs, ICs, memory (e.g., FLASH, ROM, RAM, EPROM and/or EEPROM) which co-act with software code to perform the operations of the method **100**.

[0052] In operation **102**, the vehicle controller **14** transmits a WAKE_UP signal to the seat controller **20**. Upon receipt of the WAKE_UP signal the seat controller **20** energizes appropriate circuitry to collect measurements from the corresponding measuring devices **30**.

[0053] In operation **104**, the vehicle controller **14** receives the SEAT_INFO signal from the seat controller **20** and the VEHICLE_INFO from the vehicle BUS. The SEAT_INFO signal includes the identification tags for the seat system **18** (SEAT_ID) and each measuring device **30**, as well as signals indicative of the measurements made by each measuring device **30**.

[0054] In operation **106** the vehicle controller **14** determines whether or not the controller recognizes a SEAT_ID and corresponding identification tags for the measuring devices **30**.

[0055] In operation **108** if the vehicle controller **14** determines that it did not recognize an identification tag, the controller **14** may request information. The controller **14** may request the information via an external network (e.g., via a

cell phone network). Alternatively the controller **14** may request the information from the operator of the vehicle, via the user interface **16**.

[0056] In operation **110**, once the vehicle controller **14** recognizes the identification tags of a seat system **18**, then the controller **14** analyzes the measured values included in the SEAT_INFO. The controller locates a predetermined acceptable range for a particular measurement and compares the measured value to the range. For example, for a particular harness sensor **68**, the predetermined data may indicate that the acceptable range for a harness tension is between ten Newtons and twenty Newtons which may correspond to a digital range of C1-C9. The vehicle controller **14** compares a measured harness tension value of C3 (from the digitized data representing the HARNESS_MSMT) to the acceptable range to determine that the status of the harness **48** is within the range and therefore acceptable.

[0057] For some measurements (e.g., angle of inclination of the seat sub-assembly **38**) the vehicle controller **14** references information from the VEHICLE_INFO in its analysis of the SEAT_INFO. For example the vehicle controller **14** may compare the LEVEL_MSMT indicating the angle of inclination of the seat sub-assembly **38** to measurements made by vehicle accelerometers to determine whether the seat sub-assembly **38** is facing forward or rearward.

[0058] Additionally, the vehicle controller **14** may analyze multiple measurements from the SEAT_INFO together to determine the status of a feature of the seat system **18**. For example, infants are typically seated in a car seat sub-assembly **38** that is facing rearward. The guidelines for when to switch the child to a forward facing seat may be based on the weight of the child (e.g., once the child exceeds 20 pounds (lbs)). The controller **14** might compare the weight of the child (from the digitized data representing the WEIGHT_MSMT) to the direction the child is facing (determined above) to determine whether or not the child is facing in the proper direction. In another embodiment the vehicle controller **14** monitors signals to confirm the seat sub-assembly **38** is currently unoccupied by a child before charging the seat battery via the charging circuit **88**. For example, the vehicle controller may determine that the seat is not occupied by analyzing the digital data representing the WEIGHT_MSMT.

[0059] In operation **112** the vehicle controller **14** determines from the analysis in operation **110** an overall status of the seat system **18**. The overall status includes, but is not limited to, whether the harness **48**, the anchor strap **56** and the tether **62** are tightened to a proper tension; whether the first buckle **50** and the second buckle **54** are connected; whether the seat sub-assembly **38** is adjusted to the proper angular inclination; whether the child is facing the proper direction; whether the temperature is acceptable; whether the covering **44** is moist; and the power level of the seat battery.

[0060] In operation **114** the vehicle controller **14** transmits the SEAT_STATUS_MSG to the user interface **16**.

[0061] With reference to FIGS. **7-8**, the user interface **16** displays the seat system **18** status information to the operator of the vehicle **12**.

[0062] FIG. **7** illustrates a pictorial display **120** of the status of the seat system **18** as displayed by the user interface **16**. The display **120** includes a seat image **122** representing the seat system **18**. The display **120** may include the status of multiple features of the seat system **18**, or each feature individually. For example, as illustrated in FIG. **7**, the current status of an individual feature, the tension of the harness **48**, may be conveyed to the user. The status may be conveyed graphically by level indicators **124**. Additionally this status may be conveyed to the user numerically by the numerical icon **126** illustrating "Tension/Torque thirty-eight percent". Alternate embodiments of the user interface **16** contemplate an audio component in addition to the display. For example, the user may be in the rear of the vehicle adjusting the seat system **18**. The user interface **16** may be difficult to see from the rear of the vehicle, however the user may listen to the audio status as feedback to their adjustment of the seat system **18**.

[0063] FIG. **8** illustrates a tabular display **130** indicating the status of multiple features of the seat system **18** simultaneously. The display **130** includes a feature column **132** listing the features that were analyzed. A status column **134** indicates whether each analyzed feature is "OK" or not OK "NOK". An instruction column **136** instructs the user how they may adjust a particular feature.

[0064] While the best mode for carrying out the invention has been described in detail, those familiar with the art to which this invention relates will recognize various alternative designs and embodiments for practicing the invention as defined by the following claims. Additionally, the features of various implementing embodiments may be combined to form further embodiments of the invention

What is claimed:

1. A vehicle system for communicating with a child seat, the system comprising:

a receiver for receiving at least one seat sensor signal from a child seat controller;

a controller communicating with the receiver for analyzing the at least one seat sensor signal and comparing the seat sensor signal to pre-existing guidelines to determine a status message; and

a user interface communicating with the controller for displaying the status message.

2. The vehicle system of claim **1**, wherein the receiver is configured to receive the at least one seat sensor signal from a wireless transmitter.

3. The vehicle system of claim **1**, further comprising a transmitter for transmitting an activation signal to the child seat for initiating communication between the vehicle system and the child seat controller.

4. The vehicle system of claim **1**, wherein the controller further comprises a network receiver for receiving vehicle information from a vehicle communication network.

5. The vehicle system of claim **1**, wherein the status signal includes at least one harness tension component for indicating a tension within a portion of a child restraint harness.

6. The vehicle system of claim **1**, wherein the status signal includes at least one buckle component for indicating a connection of a buckle that is connected to a child restraint harness.

7. The vehicle system of claim **4**, wherein the seat sensor signal includes a level component for indicating an angular inclination of the child seat.

8. The vehicle system of claim **1**, wherein the seat sensor signal includes a tether component for indicating a tension within a portion of a tether extending from the child seat to the vehicle.

9. The vehicle system of claim **7**, wherein the controller compares the level component to the vehicle information to determine a seat direction of the child seat.

10. The vehicle system of claim **1**, wherein the status signal includes a battery component for indicating a status of a child seat battery.

11. The vehicle system of claim **10**, further comprising a charging circuit for charging a child seat battery.

12. The vehicle system of claim **11**, further comprising a seat circuit formed by an anchor strap and the child seat battery, wherein the seat circuit directly connects to the charging circuit at a pair of vehicle anchors for charging the child seat battery.

13. The vehicle system of claim **11**, wherein the charging circuit is positioned in proximity to the child seat such that the child seat battery may be inductively charged by a field emanating from the charging circuit.

14. The vehicle system of claim **11**, wherein the controller selectively charges the child seat battery when the controller determines that the child seat is not occupied.

15. The vehicle system of claim **1**, wherein the user interface further comprises a pictorial display for displaying the status message.

16. The vehicle system of claim **3** wherein the transmitter also transmits vehicle information to the child seat; and wherein the seat controller adjusts a lighting device of the child seat in response to the vehicle information.

17. The vehicle system of claim **15**, wherein the user interface further comprises an audio component for conveying the status message to the user audibly.

18. The vehicle system of claim **1**, further comprising a child seat for initiating communication with the controller upon detection of a change in the seat sensor signal.

19. A vehicle system for monitoring the status of a child seat and communicating the status to a user, the vehicle system comprising:

a controller configured to:

receive a seat identification signal indicative of the identification of a child seat, a harness signal indicative of a measurement of a tension within a harness of the child seat, a level signal indicative of a measurement of an angular inclination of the child seat, and a buckle signal indicative of a measurement of a buckle connection of the child seat; and

control a user interface to display a seat status message that is generated based on a comparison of the seat identification signal, the harness signal, the level signal and the buckle signal to predetermined data.

20. A child seat system for use in an automobile, the child seat system comprising;

a base for resting upon an underlying surface;

a seat sub-assembly for supporting a child; wherein the seat sub-assembly is pivotally connected to the base;

a harness for securing a child to the seat sub-assembly;

a harness sensor for measuring a tension within the harness;

at least one buckle for connecting multiple portions of the harness together;

a buckle switch for measuring a connection of the buckle;

a level sensor for measuring an inclination of the seat sub-assembly; and

a seat controller configured for receiving measurement signals from the harness sensor, the buckle switch and the level sensor; wherein the seat controller transmits an information signal indicative of the measurement signals.

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