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(54) Occupation monitoring system

(57) The present invention is related to a system for monitoring the occupation of a group of items. Each item of the group of items is provided with detection means and arranged for transmitting information about the occupation of said item. Each item further comprises an item module arranged for controlling said detection means. The item modules are in connection with a junction module arranged for controlling the item modules. The junction module is controlled by a controller device.

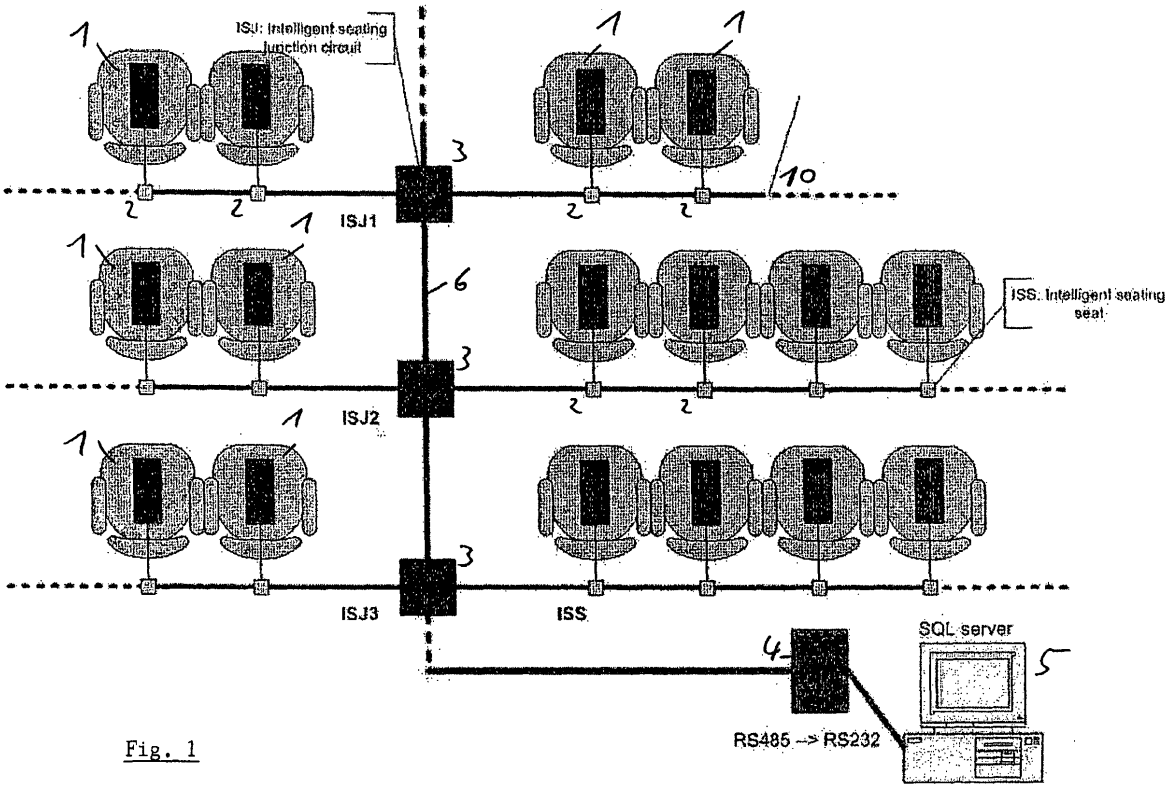

Fig. 1

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Description

Field of the invention

[0001] The present invention relates to the field of systems for monitoring the occupation of seats and beds and the like.

State of the art

[0002] Systems for monitoring the occupation of seats are well known for applications in cars. Such systems are mostly provided with a set of sensors and a control unit (see e.g. WO 03/004318). Patent application EP 1491408 specifically relates to a seat occupation sensor. However, it is clear that in such applications there is a very limited number of seats to be monitored.

[0003] In various applications commercially interesting information can be obtained from an occupation monitoring system. Also from the point of view of security the information provided by such a system can be useful. A desirable feature for a monitoring system is that the information can be gathered in a quick and reliable way and at a relatively low cost.

[0004] In patent EP278717-B1 a system and method are disclosed for polling terminal units provided at passenger seats in a passenger vehicle to obtain an indication of the state of each terminal unit. A sensor is attached to each passenger seat. The sensed information is transmitted as a polling answer signal through a transmission line to a head end apparatus like e.g. a monitor display.

[0005] Patent document FR-2826484-A1 relates to a passenger information device for a vehicle in a public transport means, where a detector hidden in the seat returns information on seat occupation. Each seat is provided with a module for transforming the sensor signal into a signal adapted for processing by a calculation means. The various seats are preferably connected with a bus type communication network that allows multiplexing. The calculation means is among other things capable of detecting the absence of transmitted information from one or more modules.

[0006] Patent document JP5085491 discloses a system controlling in a concentrated way whether or not seat belts are fastened and how seats are occupied. It comprises a load detecting sensor applied to the bottom of the seat. It also provides a seat-occupied status display means being driven by a central control unit.

Aims of the invention

[0007] The present invention aims to provide a system for monitoring the occupation of items like seats, beds, ..., that overcomes the drawbacks of the prior art solutions.

Summary of the invention

[0008] The present invention relates to a system for monitoring the occupation of a group of items. Each item of the group of items is provided with detection means and is arranged for transmitting information about the occupation of said item. Each item is further provided with an item module arranged for controlling said detection means. The item modules are in connection with a junction module arranged for controlling the item modules. The junction module is controlled by a controller device.

[0009] In a preferred embodiment the group of items is divided in a plurality of subgroups, each of said subgroups having its own junction module. The item modules are advantageously connected to the junction module via a one-wire bus.

[0010] Preferably the junction modules are connected to the controller device via an asynchronous serial bus. In an advantageous embodiment data communication between the junction module and the controller device is performed according to a RS-485 protocol.

[0011] In a further embodiment the system further comprises a converter for converting data transferred from the junction modules to the controller device. The controller device is preferably a personal computer.

[0012] In a preferred embodiment the items to be monitored are seats or beds.

[0013] The sensing means is typically a resistive or capacitive load detection sensor.

[0014] In another preferred embodiment the item modules are provided with a memory device. Also the junction module (s) may be provided with a memory device.

[0015] In an alternative embodiment the system for occupation monitoring further comprises a console for test and/or initialisation purposes.

[0016] Optionally the system also comprises visualisation means.

Short description of the drawings

[0017] Fig. 1 represents a block scheme of the occupation monitoring system according to the invention.

Detailed description of the invention

[0018] The present invention discloses a system for monitoring the occupation of a group of items, like seats, beds, ... In the following description the example is used of monitoring the seat occupation in a movie theatre. However, it will be immediately clear to those skilled in the art that the monitoring system as described can directly be applied for monitoring seats in aircrafts, coaches, ..., for beds in hotels, hospitals and so on.

[0019] The block scheme of Fig.1 shows the main building blocks of the system. Each seat (1) disposes of sensing means and a seat module (2). The sensing means, preferably a sensor, is placed on an appropriate place that depends on the envisaged application. Preferably the sensor is placed horizontally on the seat cushion. Depending on the seat type and specific application, a resistive or a capacitive load detection sensor can be used. The sensor response is for example determined by the value of a resistance. When the seat is not occupied, it returns a value in a first predefined range. When the seat is taken, the resistance changes to a value in a second predefined range distinct from said first range. When a sensor is out of order it returns e.g. an extremely high value, indicating its malfunction. A connection with the sensor is provided on the seat module. The sensor is capable of transmitting said resistance value. The information from the sensor is read by the corresponding seat module. The seat module controls the sensor and decides whether or not a seat is taken. The various seat modules are connected with each other via a one-wire bus (10). This bus is used for both data transfer and power supply. It is well known in the state of the art.

[0020] In case beds are to be monitored it can be advantageous to provide more than one sensor on the bed. Moreover in an application wherein beds in a hospital are to be monitored a wireless implementation may be preferable in order to avoid electromagnetic interference caused by cables.

[0021] The plurality of seats to be monitored is advantageously divided in a number of groups, e.g. of 20 units. Each group is connected to a junction module (3) being connected to the same one-wire bus connecting the seat modules belonging to that group. The junction modules can read out the information from the corresponding set of seat modules. The junction modules are capable of communicating with a controller device (5) controlling the monitoring process. The controller device is typically a personal computer. The individual junction modules are connected with each other and with the controller device by means of an asynchronous serial bus comprising four wires, two of which supply power while the other two are meant for data transfer. Data communication over this serial bus can for example be based on the RS-485 protocol. Optionally a converter (4) can be provided for converting the asynchronous serial bus into a USB or RS232 port to ease the communication with the controller device (5).

[0022] Moving a part of the system's complexity from the level of the seat modules to that of the junction modules allows speeding up significantly the monitoring process. This feature makes the system also very suitable for monitoring a large number of items. The monitoring system according to the invention is capable to detect the state of hundreds of seats in a matter of seconds. In the case of a wired implementation of the system a further advantage is that the number of wires can be limited drastically. Between the seat modules only three wires are required and between the various junction modules four wires are sufficient.

[0023] The various parts of the system are discussed more in detail in the subsequent paragraphs.

[0024] The seat module (2) comprises a small micro-controller for interpreting the information from the corresponding sensor and for communication on the one-wire bus. The micro-controller comprises flash memory for the software that interprets the sensor signal and stores the seat status, as well as some EEPROM for storing information (e.g. the seat identification). Further connection is provided for the one-wire bus and for a supply bus.

[0025] Each junction module is arranged for communication with the controller device over the asynchronous serial bus as well as for communication with the seat modules over the one-wire bus. The junction module can be positioned anywhere on the one-wire bus. The junction module continuously monitors the state of the seat modules connected to the same one-wire bus. On request of the controller device it transmits the status of the seat modules connected. A table comprising a list of seats (seat modules) connected to the junction module and their status is kept. The necessary connectors are provided. A junction module further comprises a micro-controller and memory means (e.g. of the flash-EPROM type) to render the module programmable.

[0026] For data communication over the asynchronous serial bus the already mentioned RS-485 protocol is particularly suitable, as it uses differential signals (it compares the voltage difference over the two wires). Due to the reduced noise levels higher bit rates and much longer communication distances can be achieved and more robustness is provided. It further allows using a bus with several transmitters and receivers.

[0027] The logical protocol is designed to optimise the efficiency of the data transport and to reduce as much as possible the required micro-controller software. The first three bytes of any data packet sent always have the same meaning : the first byte identifies the sender of the message (i.e. either the controller device or a junction module), the

second byte contains the identification of the destination and the third byte comprises some control bits : an indication of the data packet size, indication of an *'acknowledge'* message, ... The last byte of the data packet is a cyclic redundancy check (CRC) sum.

[0028] As there is only one bus, the communication between the junction modules and the controller device is in half duplex mode. Messages sent over the bus are to be acknowledged to the transmitter by sending either an acknowledge message or a reply comprising a new message. When the transmitter does not receive any message back from the destination address, an error has occurred. The original message then needs to be sent again.

[0029] The controller device, typically a personal computer, is the master in the communication over the serial bus. The junction modules only communicate in reply to a message previously sent by the controller. When, for example, the controller has sent a message asking information on the status of a certain seat or number of seats, the junction module replies by sending the desired status information. The controller device keeps a table comprising the status of all items to be monitored. The table is continuously updated while new status information of a seat is received. Each junction module on the asynchronous serial bus must clearly have a unique address in order to be addressable by the controller device.

[0030] An example of a message from controller device to junction module is given. The controller device can send an 'acknowledge' after having received a message from a junction module. The controller may also send a standard message to provoke a reply from a junction module. In the latter case a typical message from the controller to a given junction module can look like this (byte-per-byte):

source - dest.- 33h - comm1 - comm2 - CRC

whereby the first three bytes and the last one have a meaning as already explained before and *comm1* and *comm2* comprise a message requesting the status of the seat modules.

[0031] A further explanation on the operation of the occupation monitoring system is now provided. Still the same example of a movie theatre is used for this purpose. Suppose the seats in the theatre are divided in subgroups on a row-per-row basis and the seat modules of all seats of a same row are connected to one junction module. This junction module is the master for the communication over the one-wire bus connecting all seat modules of the row in question.

[0032] In normal operation each junction module constantly interrogates its slaves (i.e. the seat modules). A seat module typically returns the following information :

- whether or not a seat (with a given number) is present or not,
- if the seat is present, whether it is occupied or not,
- whether an error is detected at the sensor (open circuit or short circuit)

The information from all seats is stored in the memory provided in the corresponding junction module. The junction module is capable of scanning the one-wire bus two to three times per second, so the stored information is updated at the same rate.

[0033] At the installation of the system (or at start-up) a learning procedure must be carried out in order to assign a unique sequence number to each item of the group of items to be monitored. This is performed for each junction module in turn in the following way. The junction module sends a signal to the seat modules connected with it to indicate the learning mode is entered. All seat modules set their sequence number to 0. Then numbers are assigned from 1 to N by consecutively occupying each seat to be numbered. By occupying the seat the next number to be attributed goes to that seat.

[0034] During the set-up procedure as described the monitoring system may advantageously also employ an (optional) console. The console can be considered as an extension of the junction modules without any intelligence of its own. It only allows a more practical way of operating the junction modules and of getting feedback from the junction modules. It can e.g. display which number is assigned during the learning procedure. The console takes over some of the functionalities provided by the junction modules. Alternatively the initialisation procedure can also be performed by using a personal computer device.

[0035] The console may also be useful for test purposes. In such a test one can for example request the sequence number of a certain item to be monitored. The junction module connected to the same one-wire bus is then switched into a test mode. The console then takes over some of the functionality of the console. In other words, a check on the item sequence numbers can already be performed during the installation of the system, when the controller device still has to be installed.

Claims

1. System for monitoring the occupation of a group of items, each item of said group of items being provided with detection means and arranged for transmitting information about the occupation of said item, each item further being provided with an item module arranged for controlling said detection means, **characterised in that** said item modules are in connection with a junction module arranged for controlling said item modules, said junction module being controlled by a controller device.

2. System for occupation monitoring as in claim 1, wherein said group of items is divided in a plurality of subgroups, each of said subgroups having its own junction module.

3. System for occupation monitoring as in claim 1 or 2, wherein said item modules are connected to said junction module via a one-wire bus.

4. System for occupation monitoring as in any of claims 1 to 3, wherein said junction modules are connected to said controller device via an asynchronous serial bus.

5. System for occupation monitoring as in any of the previous claims, wherein data communication between said junction module and said controller device is performed according to a RS-485 protocol.

6. System for occupation monitoring as in any of the previous claims, further comprising a converter for converting data transferred from said junction modules to said controller device.

7. System for occupation monitoring as in any of the previous claims, wherein said controller device is a personal computer.

8. System for occupation monitoring as in any of the previous claims, wherein said items are seats or beds.

9. System for occupation monitoring as in any of the previous claims, wherein said sensing means is a resistive or capacitive load detection sensor.

10. System for occupation monitoring as in any of the previous claims, wherein said item module and/or said junction module is provided with a memory device.

11. System for occupation monitoring as in any of the previous claims, further comprising a console for test and/or initialisation purposes.

12. System for occupation monitoring as in any of the previous claims, further comprising visualisation means.

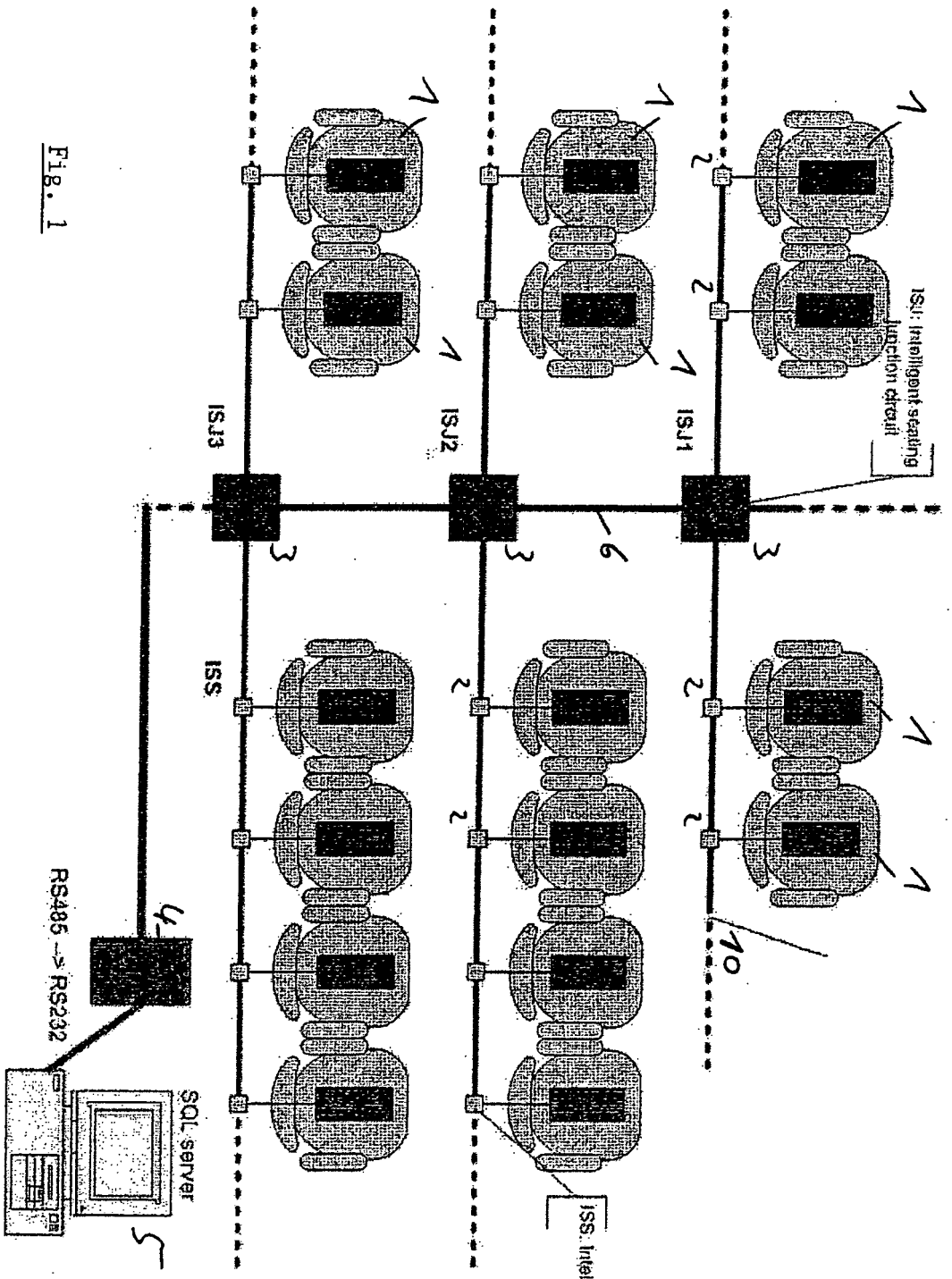
ISJ: Intelligent seating junction circuit
ISJ1
ISJ2
ISJ3
ISS
ISS: Intelligent seating seat
RS485 -> RS232
SQL server
1
2
3
4
5
6
7
10

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 05 44 7227

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 March 2006	Meister, M

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 44 7227

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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