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(54) **DELIRIUM DETECTION SYSTEM AND METHOD**

(71) Applicant: **KONINKLIJKE PHILIPS N.V.**, EINDHOVEN (NL)

(72) Inventors: **Thomas FALCK**, Aachen (DE); **Esther Marjan VAN DER HEIDE**, Hertogenbosch (NL); **Adrienne HEINRICH**, Den Bosch (NL); **Yingrong XIE**, Eindhoven (NL)

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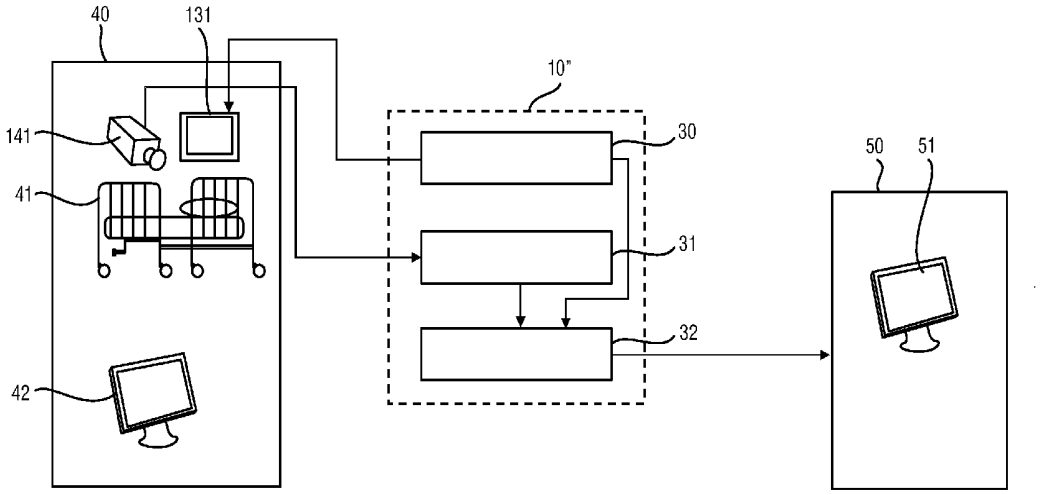
(57) **ABSTRACT**

A delirium detection system for automatic, unobtrusive and reliable detection of delirium of a person comprises a processor and a computer-readable storage medium, wherein the computer-readable storage medium contains instructions for execution by the processor. The instructions cause the processor to perform the steps of controlling a stimulus unit to output a stimulus for stimulating the person, receiving and evaluating one or more reaction signals captured by a reaction unit and reflecting the person's reaction to a stimulus, and determining a delirium score from said evaluation of one or more reaction signals.



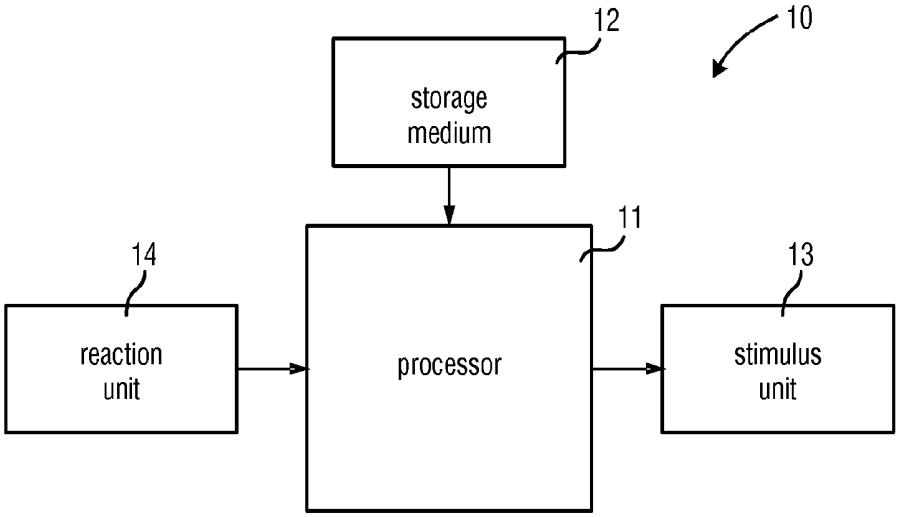

12
10
storage medium
11
14
13
reaction unit
processor
stimulus unit

FIG.1

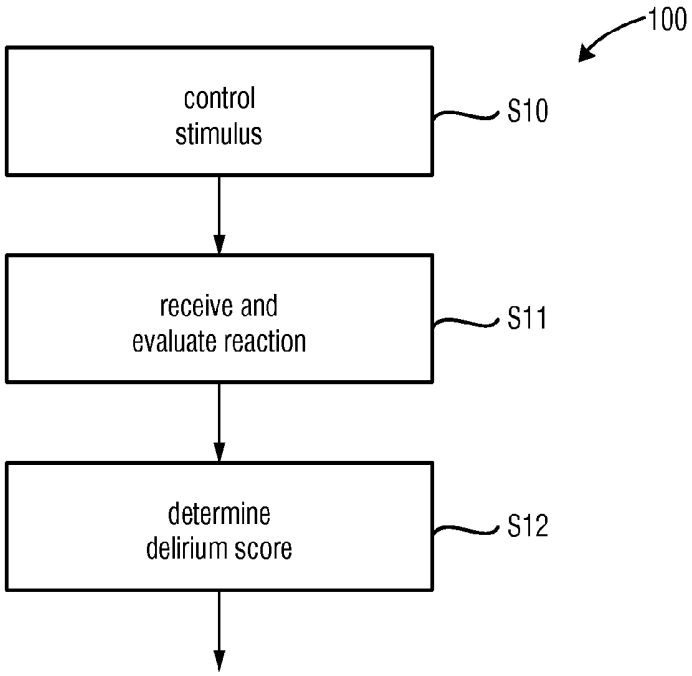

100
control stimulus
S10
receive and evaluate reaction
S11
determine delirium score
S12

FIG.2

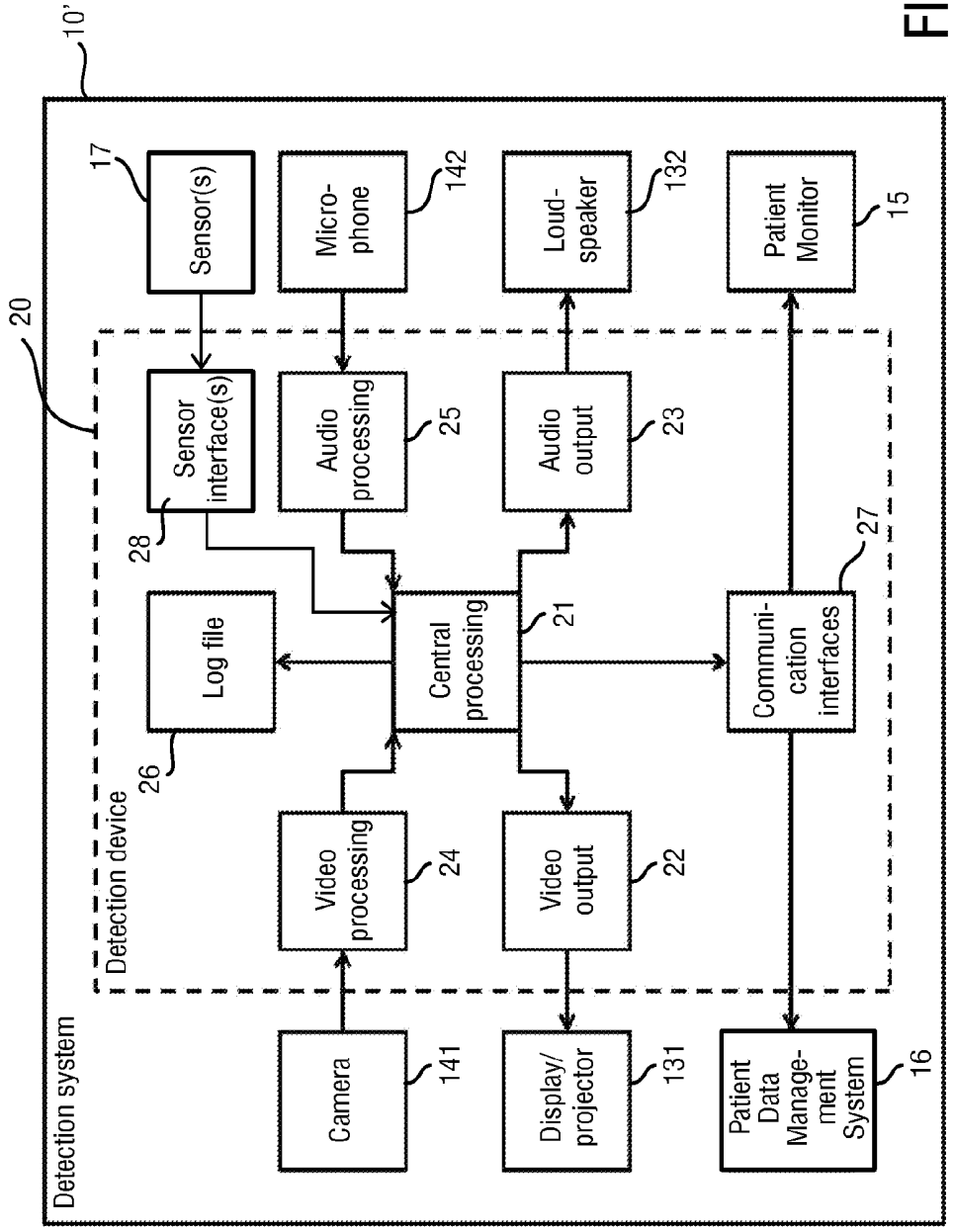

10'
Detection system
20
Detection device
17
Sensor(s)
Micro-phone
142
Loud-speaker
132
Patient Monitor
15
Sensor interface(s)
28
Audio processing
25
Audio output
23
Log file
26
Central processing
21
Communi-cation interfaces
27
Video processing
24
Video output
22
Camera
141
Display/ projector
131
Patient Data Manage-ment System
16

FIG.3

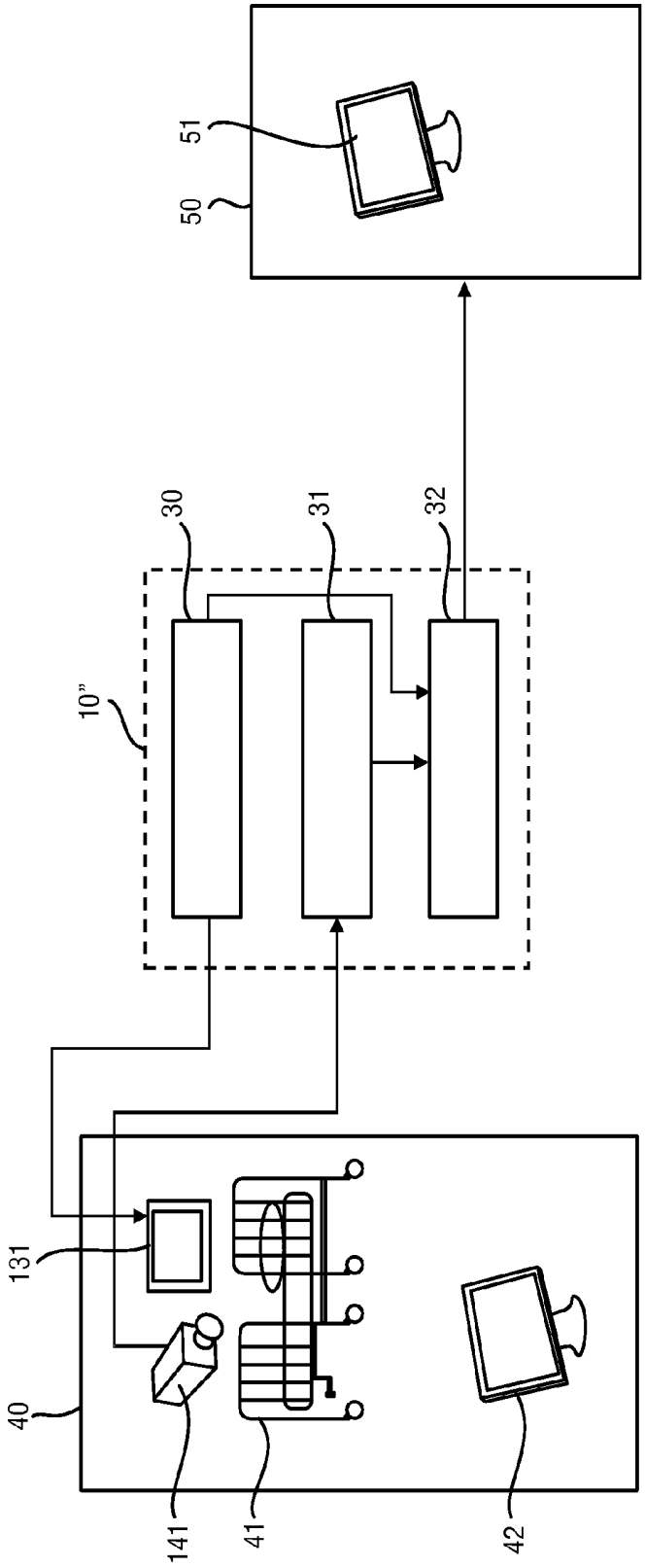


FIG.4

DELIRIUM DETECTION SYSTEM AND METHOD

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. provisional application Ser. No. 62/013,030 filed Jun. 17, 2014, which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to a delirium detection system and method.

BACKGROUND OF THE INVENTION

[0003] Delirium is a neuropsychiatric syndrome with a multifactorial etiology that occurs in a majority of ICU (Intensive Care Unit) patients. Delirium is associated with increased mortality, prolonged hospital stay, and long term effects such as decreased independent living, increased rate of institutionalization and increased risk to develop long-term cognitive impairment. Longer hospital stay and complications associated with delirium in the ICU lead to significantly higher costs of care. The prevalence rates of delirium in an ICU range from 11% to 87%. Delirium affects up to 80% ICU patients, doubles ICU mortality, triples 6-month mortality, increases length of stay by 5-10 days, involves a 9 times higher risk of permanent cognitive impairment, and attributes to $145 billion estimated annual costs in the US alone. Accurate and early detection and treatment of delirium is the key to improving patient outcome and curbing delirium-related health care costs.

[0004] Currently, for the diagnosis of delirium in ICU patients a number of validated screening questionnaires (such as the Confusion Assessment Method for ICUs (CAM-ICU)) are used. With these methods patients are checked at most three times a day, i.e. at most once per shift of caregivers. With the fluctuating character of delirium the delirious episodes are easily missed. Although it is a serious problem, delirium in patients (or persons in general) is commonly under-detected. Besides, under-detection of delirium is still the case even if screening instruments are used. Accurate and early detection methods may lead to more effective application of appropriate clinical interventions, leading to better outcome and reduced induced mortality.

[0005] WO 2013/050912 A1 discloses a monitoring system and a corresponding monitoring method for monitoring a patient and detecting delirium of the patient in an unobtrusive manner without the need of on-body sensors. The proposed monitoring system comprises a monitoring unit for obtaining image data of the patient over time, an image analysis unit for detecting motion events of the patient from the obtained image data, an evaluation unit for classifying the detected motion events into delirium-typical motion events and non-delirium-typical motion events, and a delirium determination unit for determining a delirium score from the duration, intensity, type, location and/or occurrence of delirium-typical motion events, said delirium score indicating the likelihood and/or strength of delirium of the patient.

[0006] There is a need for a continuous, objective and sensitive way for detecting delirium of persons, e.g. of ICU patients, without necessarily requiring the detection of delirium-typical motion events.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide delirium detection systems and methods for detecting delirium of persons, such as ICU-patients, in a more continuous, objective and sensitive way.

[0008] In a first aspect of the present invention a delirium detection system is presented, the system comprising a processor and a computer-readable storage medium, wherein the computer-readable storage medium contains instructions for execution by the processor, wherein the instructions cause the processor to perform the steps of:

[0009] controlling a stimulus unit to output a stimulus for stimulating the person,

[0010] receiving and evaluating one or more reaction signals captured by a reaction unit and reflecting the person's reaction to a stimulus, and

[0011] determining a delirium score from said evaluation of one or more reaction signals.

[0012] In a further aspect of the present invention a delirium detection method is presented, the method comprising the steps of:

[0013] controlling a stimulus unit to output a stimulus for stimulating the person,

[0014] receiving and evaluating one or more reaction signals captured by a reaction unit and reflecting the person's reaction to a stimulus, and

[0015] determining a delirium score from said evaluation of one or more reaction signals.

[0016] In still a further aspect of the present invention another delirium detection system is presented, the system comprising:

[0017] a controller configured to control a stimulus unit to output a stimulus for stimulating the person,

[0018] an evaluator configured to receive and evaluate one or more reaction signals captured by a reaction unit and reflecting the person's reaction to a stimulus, and

[0019] a scoring unit configured to determine a delirium score from said evaluation of one or more reaction signals.

[0020] In yet further aspects of the present invention, there are provided a computer program which comprises program code means for causing a computer to perform the steps of the method disclosed herein when said computer program is carried out on a computer as well as a non-transitory computer-readable recording medium that stores therein a computer program product, which, when executed by a processor, causes the method disclosed herein to be performed.

[0021] Preferred embodiments of the invention are defined in the dependent claims. It shall be understood that the claimed method, computer program and medium have similar and/or identical preferred embodiments as the claimed system and as defined in the dependent claims.

[0022] The presented systems and method have the advantage that they can be used to detect delirium of a person automatically. In particular, no manual execution of the screening (e.g. according to CAM-ICU) by caregivers is required. Further, the present invention enables close meshed delirium monitoring of all patients, provides a more standardized and objective procedure, represents an assessment of delirium that is less awkward for nurses, reduces the

workload of caregivers, and addresses the problem that caregivers are often reluctant to execute a screening (e.g. because they "feel silly and stupid" to ask these questions over and over again). The detected delirium score indicates the likelihood and/or strength of delirium of the patient and can be used to issue an alarm or notification, e.g. to a caregiver or a central monitoring station, if e.g. the delirium score exceeds a predetermined threshold or an individual threshold set or learned for a particular person over time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter. In the following drawings

[0024] FIG. **1** shows a schematic diagram of a first embodiment of a system according to the present invention,

[0025] FIG. **2** shows a schematic diagram of a first embodiment of a method according to the present invention,

[0026] FIG. **3** shows a schematic diagram of a second embodiment of a system according to the present invention, and

[0027] FIG. **4** shows a schematic diagram of a third embodiment of a system according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0028] FIG. **1** shows a schematic diagram of a first embodiment of a delirium detection system **10** according to the present invention and FIG. **2** shows a schematic diagram of a first embodiment of a corresponding a delirium detection method **100** according to the present invention. The system **10** comprises a processor **11** and a computer-readable storage medium **12**, wherein the computer-readable storage medium **12** contains instructions for execution by the processor **11**. The instructions cause the processor **11** to perform the steps of the method **100** shown in FIG. **2**. In a first step S**10** a stimulus unit **13** is controlled to output a stimulus for stimulating a person. In a second step S**11** one or more reaction signals captured by a reaction unit **14** and reflecting the person's reaction to a stimulus are received and evaluated. In a third step S**12** a delirium score is determined from said evaluation of one or more reaction signals.

[0029] It shall be noted in this context that according to the first embodiment the system **10** comprises the computer-readable storage medium **12** and the processor **11**, which outputs signals to an external stimulus unit **13** and receives signals from an external reaction unit **14**. In other embodiments the system includes the stimulus unit **13** and/or the reaction unit **14**. Further, whenever reference is made to a patient herein, it shall be understood that the same steps or means can be used with respect to any person and not just a patient.

[0030] FIG. **3** shows a more detailed embodiment of a delirium detection system **10'** according to the present invention comprising a delirium detection device **20**, which may be implemented as one or more processors (e.g. as a single processor **11** shown in FIG. **1**) or one or more computers carrying about a corresponding computer program. The delirium detection device **20** interfaces with external components of the system **10'**.

[0031] The central processing unit **21** executes a test for detecting delirium, e.g. a test similar or identical to the CAM-ICU test. For each test it creates a stimulus for the patient and evaluates the patient's reaction. It uses a video output unit **22** and external display(s) **131** or projector(s) (not shown), representing a visual stimulus unit, for rendering graphical content such as text, graphics, pictures or videos. Similarly it uses an audio output unit **23** and external loudspeaker(s) **132** or a headphone (not shown), representing an audio stimulus unit, for rendering audio content such as human speech, sounds or music. The reaction of the patient to these audio-visual stimuli are received by means of a video processing unit **24** and an audio processing unit **25** coupled to an external camera **141**, representing a video reaction unit, and an external microphone **142**, representing an audio reaction unit, respectively.

[0032] The central processing device **20** calculates based on the performance of the patient a delirium score which is preferably stored in a log file **26**. In addition, via wired or wireless communication interfaces **27**, it preferably notifies a patient monitor **15** and a patient data management system **16** about the result which in turn will notify a caregiver in case the patient turned into delirium, i.e. the delirium score indicates that the patient shows delirium or that there is a high likelihood that the patient shows delirium.

[0033] The proposed delirium detection system can e.g. be used to test the features "inattention" and "disorganized thinking" of the CAM-ICU test in an automatic way.

[0034] One example of an inattention test procedure is as follows. The central processing unit **21** instructs the audio output unit **23** to play the following recorded instruction: "I am going to read you a series of 10 letters. Whenever you hear the letter 'A', indicate by raising your hand. Please raise your hand if you are ready to start." The central processing unit **21** waits until the video processing unit **24** has detected that the patient has raised his hand. Then it instructs the audio output unit **23** to read the following recorded letters at a rate of one letter every **3** seconds: "S" "A" "V" "E" "H" "A" "A" "R" "T". The video processing unit **24** informs the central processing unit **21** whenever it has detected that the patient has raised his hand. The central processing unit **21** counts the errors, i.e. when a patient did not raise his hand on the letter "A" and when the patient raised his hand on any letter other than "A". From these counts inattention of the patient and a delirium score can be determined, e.g. by use of a threshold for the number of counts of wrongly raising the hand or not raising the hand.

[0035] Another example of an inattention test procedure is as follows. The central processing unit **21** instructs the audio output unit **23** to play the following recorded instruction: "I am going to show you pictures of some common objects. Watch carefully and try to remember each picture because I will ask what pictures you have seen. Let me know when you saw a picture before by raising your hand. Please raise your hand if you are ready to start." The central processing unit **21** waits until the video processing unit **24** has detected that the patient has raised his hand. Then it instructs the video output unit **22** to show 5 pictures randomly selected from a picture database for three seconds each and in parallel the audio output unit **23** to name each item, e.g. dog, boot, knife, brush, pants, etc. Then the central processing unit **21** instructs the audio output unit **23** to play the following recorded instructions: "Now I am going to show you some more pictures. Some of these you have already seen and some are new. Let me know when you saw a picture before by raising your hand. Please raise your hand if you are ready

to start." The central processing unit **21** waits until the video processing unit **24** has detected that the patient has raised his hand. Then it instructs the visual output unit **22** to show 10 pictures (5 new +5 repeat) in random order from a picture database for three seconds each and in parallel the audio output unit **23** to name each item, e.g. dog, boot, knife, brush, pants, etc. The video processing unit **24** informs the central processing unit **21** whenever it has detected that the patient has raised his hand. The central processing unit **21** counts the errors, i.e. when a patient did not raise his hand on a repeated picture and when the patient raised his hand on any new picture.

[0036] One example of a disorganized thinking test procedure is as follows. The central processing unit **21** instructs the audio output unit **23** to play the following recorded instruction: "I am going to ask you four yes/no questions. Let me know the answers by nodding your head yes or no. Please raise your hand if you are ready to start." The central processing unit **21** waits until the video processing unit **24** has detected that the patient has raised his hand. Then it instructs the audio output unit **23** to read the following recorded questions: "Will a stone float on water?", "Are there fish in the sea?", "Does one pound weigh more than two pounds?", and "Can you use a hammer to pound a nail?". The video processing unit **24** informs the central processing unit **21** whenever it has detected that the patient has nodded his head. The central processing unit **21** counts the errors, i.e. when a patient nodded yes on a no question and when the patient nodded no on a yes question.

[0037] Another example of a disorganized thinking test procedure is as follows. The central processing unit **21** instructs the video output unit **22** to show a picture of a hand holding up 2 fingers and the audio output unit **23** to play the following recorded instruction: "Hold up this many fingers". The central processing unit **21** waits until the video processing unit **24** has detected that the patient has raised his hand and counts the number of fingers held up. The video processing unit **24** informs the central processing unit **21** how many fingers the patient held up. The central processing unit **21** counts the errors, i.e. when a patient did not hold up two fingers. Then the central processing unit **21** instructs the audio output unit **23** to play the following recorded instruction: "Now do the same thing with the other hand". The central processing unit **21** waits until the video processing unit **24** has detected that the patient has raised his hand and counts the number of fingers held up. The video processing unit **24** informs the central processing unit **21** how many fingers the patient held up. The central processing unit **21** counts the errors, i.e. when a patient did not hold up two fingers.

[0038] Optionally, caregivers will be notified if the patient is detected as being suspicious for delirium, e.g. have more than two errors in inattention and more than one error is disorganized thinking.

[0039] Various modifications are possible according to further embodiments. In particular:

[0040] Visual output can be replaced by verbal output, and vice versa.

[0041] Visual input can be replaced by verbal input, and vice versa.

[0042] Other gestures can be used for yes/no answers, e.g. eye blinking, nodding, lip moving, etc. Generally, any kinds of gestures or mimics, eye blinking, eye movement, head movement, lip movement and/or movement of one or more other body parts may be monitored and used as input signal for the evaluation and detection if the person has a delirium.

[0043] Instead of letters in an inattention procedure e.g. balls in different colors can be rendered by the video output unit and the patient has to raise his hand (or otherwise signal) whenever he sees e.g. a blue ball on the screen.

[0044] To test inattention the patient can be asked to count the number of balls rendered on the screen.

[0045] To test inattention moving objects can be rendered on the screen and the camera monitors the patient's head movement to detect if the patient is losing track.

[0046] To test inattention moving/travelling sound can be rendered and the system monitors the patient's eye movement to detect if the patient is losing track.

[0047] Inattention can be also tested in combination with EEG sensor or other sensors **17**, whose sensor signals are provided to the central processing unit via a sensor interface **28**. For instance, an oddball object, e.g. a fish suddenly showing up in a sky full of birds, can be rendered. If the patient is attentive, then there will be a peak in the EEG signal when the oddball object appears. If no change in the EEG signal happens when the oddball object appears, then that indicates inattention of the patient.

[0048] Other sensors may be one or more of an ECG sensor, a heart rate sensor, a breathing rate sensor, a blood pressure sensor, a temperature sensor, a skin conductivity sensor and/or a body movement sensor. Generally, any kinds of vital signs may be monitored and used as input signal for the evaluation and detection if the person has a delirium. Vital signs may also be obtained and monitored by a camera recording a sequence of images from which PPG signals are derived and which are used to extract vital signs such as heart rate or breathing rate using the remote photoplethysmography technique.

[0049] An LED screen or other light equipment, as e.g. provided on a ceiling of a patient room, can be used as display for stimulation.

[0050] Generally, a monitor, a TV set, a light apparatus and/or a beamer may be used as visual stimulus unit and a loudspeaker is preferably used as an audio stimulus unit.

[0051] FIG. **4** shows a schematic diagram of a third embodiment of a delirium detection system **10"** according to the present invention. In this embodiment the system **10"** comprises a controller **30** configured to control a stimulus unit **131** (in this embodiment a monitor) to output a stimulus for stimulating the person, in this embodiment a patient lying in a bed **41**, e.g. in a patient room **40**. An evaluator **31** is provided to receive and evaluate one or more reaction signals captured by a reaction unit **141**, in this embodiment a camera mounted above the bed for monitoring the patient. Said reaction signals reflect the person's reaction to a stimulus. A scoring unit **32** is provided to determine a delirium score from said evaluation of one or more reaction signals.

[0052] The elements **30** to **32** may be provided in the patient room **40** as well, but are preferably at a separate location, e.g. in a nursing station or central monitoring room of a station in a hospital. The generated data, in particular the

delirium score, is displayed on a bedside patient monitor **42** and/or a nurse monitor **51**, preferably included in an overall overview of all patients that can be assessed at the nursing station **50**.

[0053] The present invention can be applied to person monitoring in general, in particular for automatic detection of delirious patients in hospitals, in particular ICUs, PACUs, and geriatric wards, but also in nursing homes, and senior living facilities.

[0054] In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or an does not exclude a plurality. A single element or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

[0055] A computer program may be stored/distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with or as part of other hardware, but may also be distributed in other forms, such as via the Internet or other wired or wireless telecommunication systems.

[0056] Furthermore, the different embodiments can take the form of a computer program product accessible from a computer usable or computer readable medium providing program code for use by or in connection with a computer or any device or system that executes instructions. For the purposes of this disclosure, a computer usable or computer readable medium can generally be any tangible device or apparatus that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution device.

[0057] In so far as embodiments of the disclosure have been described as being implemented, at least in part, by software-controlled data processing devices, it will be appreciated that the non-transitory machine-readable medium carrying such software, such as an optical disk, a magnetic disk, semiconductor memory or the like, is also considered to represent an embodiment of the present disclosure.

[0058] Further, a computer usable or computer readable medium may contain or store a computer readable or usable program code such that when the computer readable or usable program code is executed on a computer, the execution of this computer readable or usable program code causes the computer to transmit another computer readable or usable program code over a communications link. This communications link may use a medium that is, for example, without limitation, physical or wireless.

[0059] A data processing system or device suitable for storing and/or executing computer readable or computer usable program code will include one or more processors coupled directly or indirectly to memory elements through a communications fabric, such as a system bus. The memory elements may include local memory employed during actual execution of the program code, bulk storage, and cache memories, which provide temporary storage of at least some computer readable or computer usable program code to reduce the number of times code may be retrieved from bulk storage during execution of the code.

[0060] Input/output, or I/O devices, can be coupled to the system either directly or through intervening I/O controllers. These devices may include, for example, without limitation, keyboards, touch screen displays, and pointing devices. Different communications adapters may also be coupled to the system to enable the data processing system to become coupled to other data processing systems, remote printers, or storage devices through intervening private or public networks. Non-limiting examples are modems and network adapters and are just a few of the currently available types of communications adapters.

[0061] The description of the different illustrative embodiments has been presented for purposes of illustration and description and is not intended to be exhaustive or limited to the embodiments in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. Further, different illustrative embodiments may provide different advantages as compared to other illustrative embodiments. The embodiment or embodiments selected are chosen and described in order to best explain the principles of the embodiments, the practical application, and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims.

1. A delirium detection system for detecting delirium of a person, the system comprising a processor and a computer-readable storage medium, wherein the computer-readable storage medium contains instructions for execution by the processor, wherein the instructions cause the processor to perform the steps of:

controlling a stimulus unit to output a stimulus for stimulating the person,

receiving and evaluating one or more reaction signals captured by a reaction unit and reflecting the person's reaction to a stimulus, and

determining a delirium score from said evaluation of one or more reaction signals.

2. The system as claimed in claim **1**, wherein the instructions further cause the processor to control a visual and/or audio stimulus unit to generate and output a visual and/or audio stimulus.

3. The system as claimed in claim **1**, wherein the instructions further cause the processor to receive and evaluate visual, audio and/or vital sign reaction signals captured by corresponding reaction units.

4. The system as claimed in claim **1**, wherein the instructions further cause the processor to output a notification if the delirium score indicates or suggests delirium of the person.

5. The system as claimed in claim **1**, wherein the instructions further cause the processor to control a visual stimulus unit to show pictures or to show objects at changing positions.

6. The system as claimed in claim **1**, wherein the instructions further cause the processor to control an audio stimulus unit to issue sounds, read text and/or ask questions.

7. The system as claimed in claim **1**, wherein the instructions further cause the processor to receive and evaluate visual reaction signals captured by a camera showing the person's reaction to a stimulus.

8. The system as claimed in claim **7**, wherein the instructions further cause the processor to receive and evaluate

gestures, mimics, eye blinking, eye movement, head movement, lip movement and/or movement of one or more other body parts.

9. The system as claimed in claim **7**, wherein the instructions further cause the processor to control a stimulus unit to issue a moving object and/or a moving sound, to receive eye movement signals and/or head movement signal and to evaluate if the person loses track of the moving object and/or moving sound.

10. The system as claimed in claim **7**, wherein the instructions further cause the processor to control a visual stimulus unit to show an oddball object within a series of non-oddball objects and to receive and evaluate a reaction signal reflecting the person's response to the showing of the oddball object.

11. The system as claimed in claim **1**, wherein the instructions further cause the processor to receive and evaluate audible reaction signals captured by a microphone recording the person's audible reaction or answer to a stimulus.

12. The system as claimed in claim **1**, wherein the instructions further cause the processor to receive and evaluate vital sign reaction signals captured by one or more vital sign measurement units recording one or more vital signs of the person in reaction to a stimulus.

13. The system as claimed in claim **12**, wherein the instructions further cause the processor to receive and evaluate the person's EEG signal, ECG signal, heart rate signal, breathing rate signal, blood pressure signal, temperature signal, skin conductivity signal and/or body movement signal.

14. The system as claimed in claim **1**, wherein the instructions further cause the processor to output a stimulus at regular or irregular intervals.

15. The system as claimed in claim **1**, further comprising a visual stimulus unit for outputting a visual stimulus including a monitor, a TV set, a light apparatus and/or a beamer and/or an audio stimulus unit for outputting an audible stimulus including a loudspeaker.

16. The system as claimed in claim **1**, further comprising by a reaction unit including a camera, a microphone and/or one or more sensors.

17. The system as claimed in claim **1**, wherein said reaction unit includes one or more of an EEG sensor, an ECG sensor, a heart rate sensor, a breathing rate sensor, a blood pressure sensor, a temperature sensor, a skin conductivity sensor and/or a body movement sensor.

18. A delirium detection method for detecting delirium of a person, the method comprising the steps of:

controlling a stimulus unit to output a stimulus for stimulating the person,

receiving and evaluating one or more reaction signals captured by a reaction unit and reflecting the person's reaction to a stimulus, and

determining a delirium score from said evaluation of one or more reaction signals.

19. A non-transitory computer-readable recording medium that stores therein a computer program product, which, when executed by a processor, causes the method as claimed in claim **18** to be performed.

20. A delirium detection system for detecting delirium of a person, the system comprising:

a controller configured to control a stimulus unit to output a stimulus for stimulating the person,

an evaluator configured to receive and evaluate one or more reaction signals captured by a reaction unit and reflecting the person's reaction to a stimulus, and

a scoring unit configured to determine a delirium score from said evaluation of one or more reaction signals.

* * * * *

专利名称(译)	谵妄检测系统和方法		
公开(公告)号	US20160354023A1	公开(公告)日	2016-12-08
申请号	US14/730262	申请日	2015-06-04
[标]申请(专利权)人(译)	皇家飞利浦电子股份有限公司		
申请(专利权)人(译)	皇家飞利浦N.V.		
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[标]发明人	FALCK THOMAS VAN DER HEIDE ESTHER MARJAN HEINRICH ADRIENNE XIE YINGRONG		
发明人	FALCK, THOMAS VAN DER HEIDE, ESTHER MARJAN HEINRICH, ADRIENNE XIE, YINGRONG		
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摘要(译)

一种用于人的del妄的自动，不显眼和可靠检测的del妄检测系统，包括处理器和计算机可读存储介质，其中所述计算机可读存储介质包含由所述处理器执行的指令。所述指令使处理器执行以下步骤：控制刺激单元输出刺激以刺激人，接收和评估由反应单元捕获的一个或多个反应信号，并将该人的反应反映到刺激，以及确定del妄分数从一个或多个反应信号的所述评估。