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(54) **USER CONTROL SYSTEM AND METHOD FOR INFANT CARE APPARATUS**

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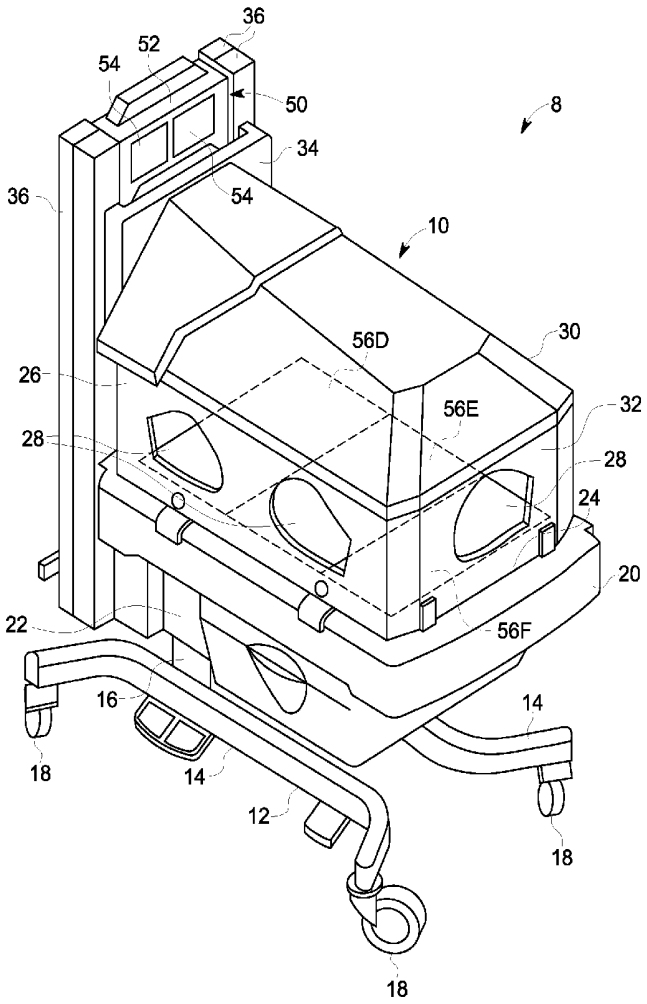
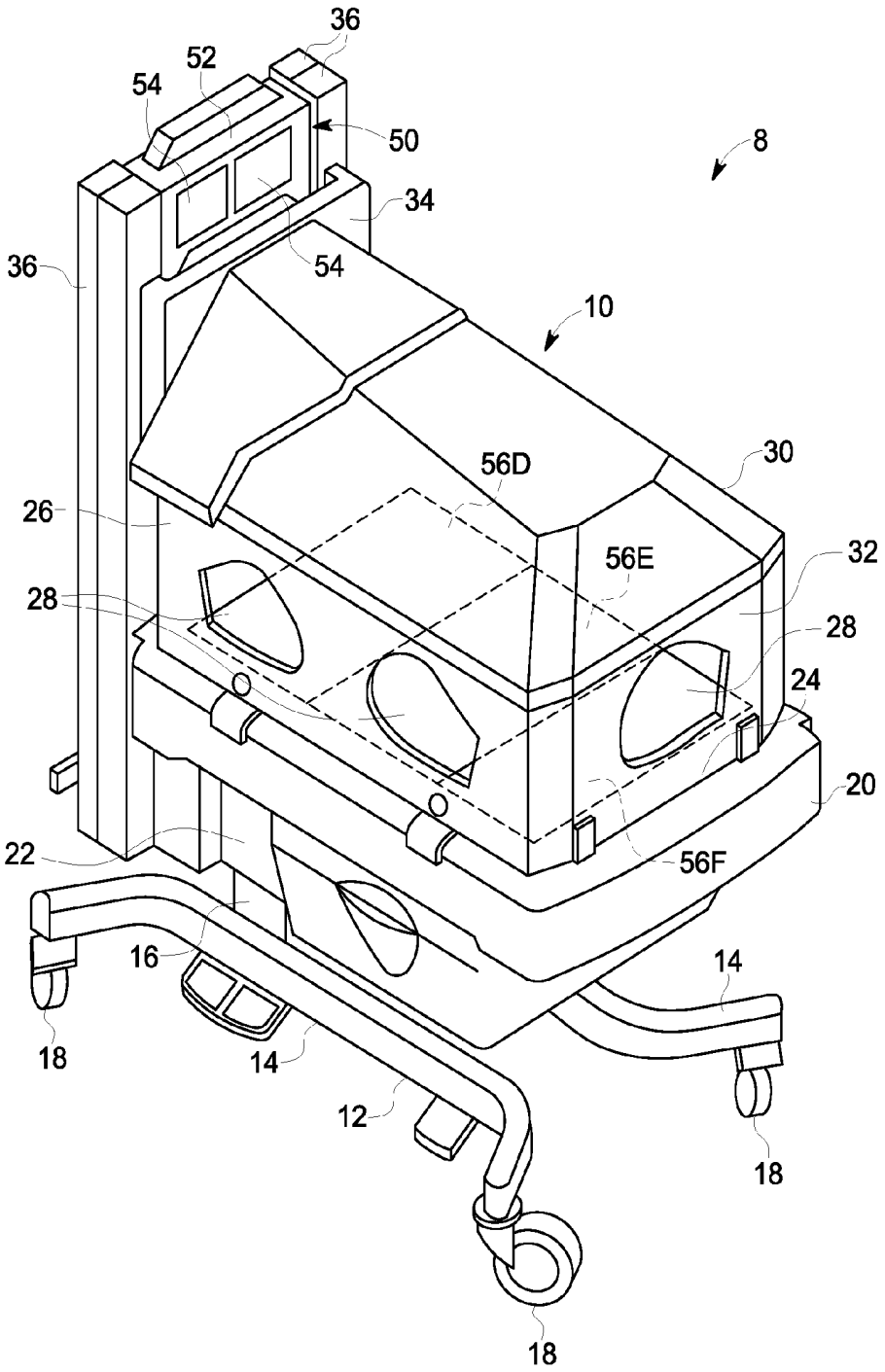
(57) **ABSTRACT**

An infant care system comprises a platform configured to support an infant and to receive an applied force on the platform. The infant care system also comprises at least two load cells connected to the platform, each of the two load cells configured to receive at least a portion of the applied force on the platform and generate a signal indicative of the portion of applied force received. The infant care system also comprises a processor configured to receive and analyze the signals from the load cells and perform a function based on the analyzed signals.




36
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36
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56D
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32
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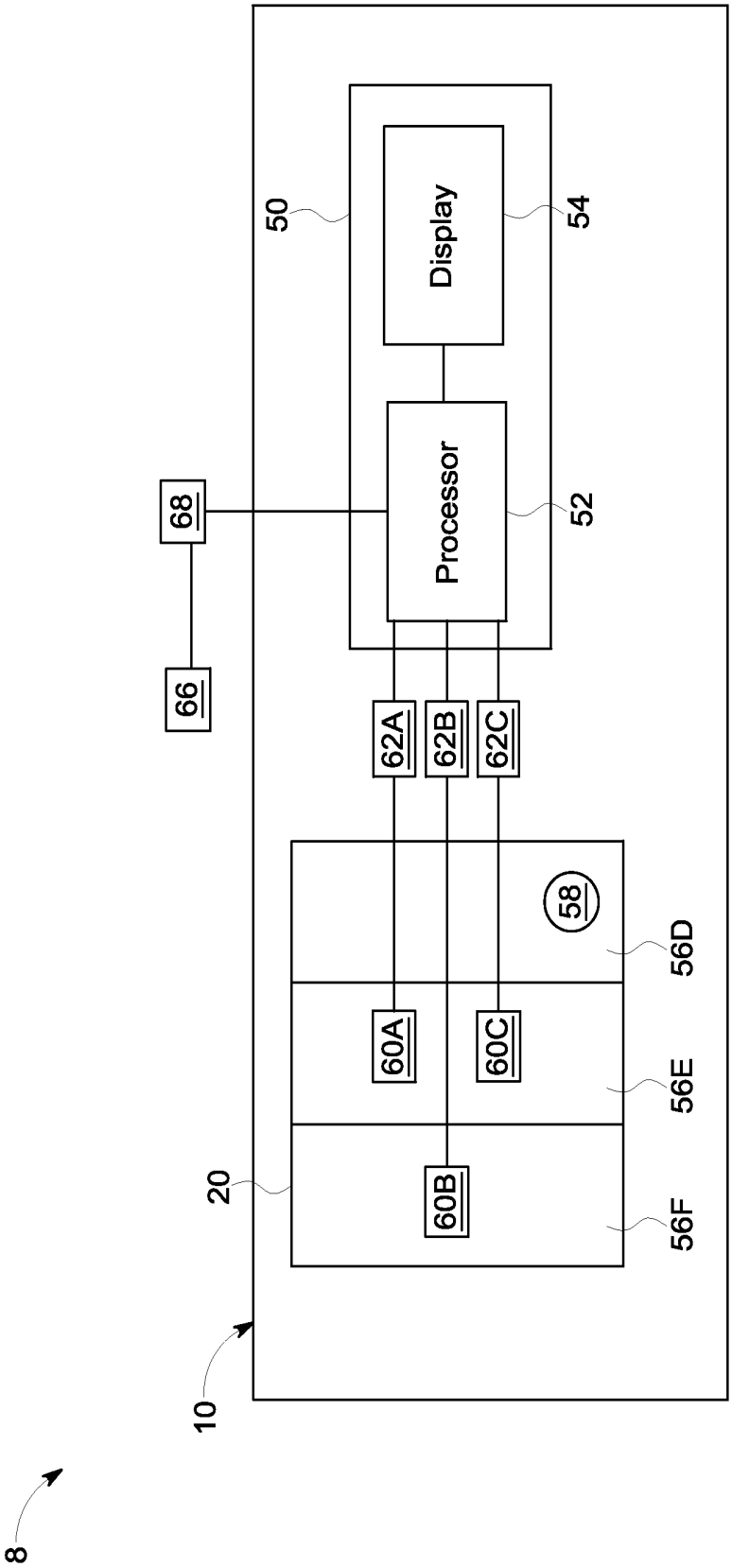
FIG. 1


8
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20
50
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Display
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66
62A
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58
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60A
60C
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60B
56F

FIG. 2

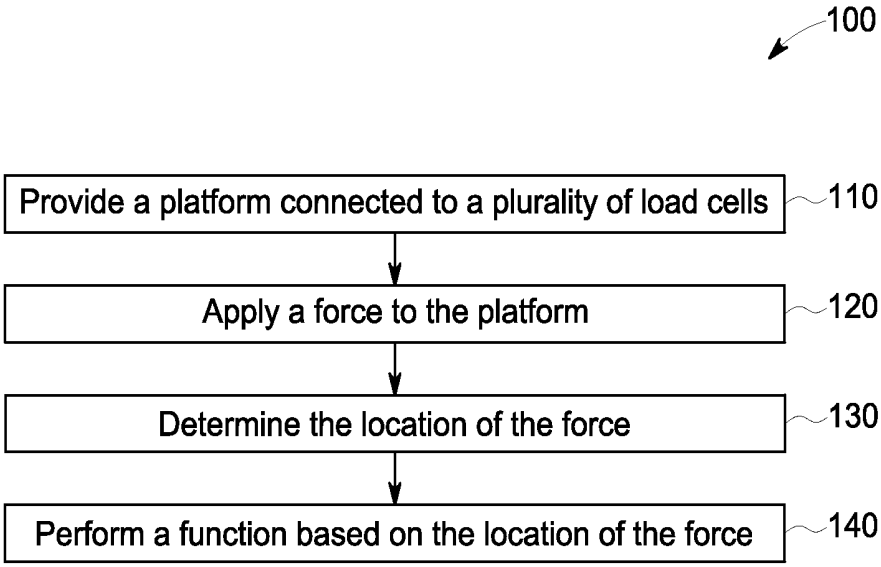
100
Provide a platform connected to a plurality of load cells
110
Apply a force to the platform
120
Determine the location of the force
130
Perform a function based on the location of the force
140

FIG. 3

USER CONTROL SYSTEM AND METHOD FOR INFANT CARE APPARATUS

BACKGROUND OF THE INVENTION

[0001] The subject matter disclosed herein relates to an infant care apparatus. In particular, the present invention relates to a system and method of controlling the infant care apparatus.

[0002] When working inside the incubator infant compartment, it is often challenging for the caregiver to react to the incubator controller prompts or alarms. To do so, the caregiver's hands must leave the infant compartment space to either interact with the controller directly or, in some cases, use a hands free alarm silence mechanism. Depending on the nature of the caregiver's interaction with the patient inside the compartment, this may interfere with sterility requirements, slow the caregiver from acting as quickly as desired, or interrupt a procedure.

[0003] Currently all alarms, independent of their nature, cause or origin, are silenced by the same caregiver action: engaging the same "alarm silence" button. The current systems do not provide a confirmation that the caregiver understands the alarm nature, cause or origin before the caregiver silences it.

[0004] Therefore, a system comprising a user interface within the infant compartment is desired. It would allow the caregiver to react to incubator controller prompts and to silence incubator or patient alarms without removing his or her hands from the infant compartment and thereby quickly controlling the incubator while preserving sterility. Additionally, such a system could provide a method for confirming the caregiver understands the nature of the alarm, thereby potentially increasing the quality of care given to the infant.

[0005] The above-mentioned shortcomings, disadvantages and problems are addressed herein which will be understood by reading and understanding the following specification.

BRIEF DESCRIPTION OF THE INVENTION

[0006] In an embodiment an infant care system comprises a platform configured to support an infant and to receive an applied force on the platform; at least two load cells connected to the platform, each of the two load cells configured to receive at least a portion of the applied force on the platform and generate a signal indicative of the portion of applied force received; and a processor configured to receive and analyze the signals from the load cells, and perform a function based on the analyzed signals.

[0007] In another embodiment, a user interface for an infant care apparatus comprises an infant support platform comprising a plurality of zones, the platform configured to receive an applied force; a plurality of load cells connected to the platform, the load cells configured to each receive a portion of the applied force and generate a signal indicative of the portion of applied force received; and a processor configured to receive the signals from the plurality of load cells, determine in which of the plurality of zones the force was applied, and perform a function based on the zone.

[0008] In another embodiment, a method of controlling an infant care system comprises providing a platform for supporting an infant, the platform connected to a plurality of load cells; applying a force to the platform, wherein each of the plurality of load cells receives a portion of the force and generates a signal indicative thereof; determining with a processor a location of the force with respect to the platform based on the signals from the plurality of load cells; and performing with a processor a function based on the location of the force.

[0009] Various other features, objects, and advantages of the invention will be made apparent to those skilled in the art from the accompanying drawings and detailed description thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a perspective view of an infant care apparatus in accordance with an embodiment of the disclosure;

[0011] FIG. **2** is schematic diagram of an infant care system in accordance with an embodiment of the disclosure; and

[0012] FIG. **3** is a flow diagram illustrating a method for controlling an infant care system in accordance with an embodiment of the disclosure.

DETAILED DESCRIPTION OF THE INVENTION

[0013] In the following detailed description, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific embodiments that may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the embodiments, and it is to be understood that other embodiments may be utilized and that logical, mechanical, electrical and other changes may be made without departing from the scope of the embodiments. The following detailed description is, therefore, not to be taken as limiting the scope of the invention.

[0014] FIG. **1** is a perspective view of an infant care apparatus **10** in accordance with an embodiment of the disclosure. The infant care apparatus **10** depicted in FIG. **1** is a hybrid incubator/warmer; however, it should be appreciated that other types of infant care apparatus **10** are envisioned. For example, the infant care apparatus **10** may be an infant warmer or an infant incubator.

[0015] The infant care apparatus **10** includes a base **12** comprising a pair of U-shaped members **14** that are joined together and which provide support for a stationary vertical base member **16**. Wheels **18** may provide for ready movement of the infant care apparatus **10**.

[0016] A platform **20** is provided which supports an infant in the infant care apparatus **10**. The platform **20** may be mounted in cantilever manner to a movable vertical base member **22** in a manner such that the user can adjust the height of the platform **20** by raising and lowering the movable vertical base member **22** with respect to the stationary vertical base member **16** to the preferred height by the user. The platform **20** includes a flat, planar surface **24** that actual underlies the infant when positioned with the infant care apparatus **10**. The platform **20** may comprise a plurality of zones **56** D, E, F. It should be appreciated that the quantity and configuration or zones may vary in different embodiments. For example, in the depicted embodiment, there are three zones **56** D, E, F. In another embodiment, there may be a single zone.

[0017] Extending upwardly around the periphery of the platform **20** are a plurality of walls **26**, normally of a transparent plastic material and which surround the flat planar surface **24** to enclose the infant on the flat, planar surface **24**. The walls **26** can have handholes **28** to enable the caregiver to reach the infant, however, if even more access is required to

the infant, at least one of the side walls **26** can be dropped downwardly to open fully for complete access to the infant to carry out procedures on the infant or for introducing and removing the infant from the infant care apparatus **10**.

[0018] A hood **30**, when in the position as shown in FIG. **1**, may abut the upper peripheral edges of the walls **26** to enclose therein an infant compartment **32** that provides a controlled environment where heat and humidity can be controlled to aid in the development and wellbeing of the infant. The hood **30** may be of a conventional design, however, in the embodiment as shown, the hood **30** can be raised and lowered vertically to cover and uncover the infant compartment **32**.

[0019] The hood **30** is affixed to a movable vertical frame member **34** that moves with respect to, and interfits with stationary vertical frame members **36**. A lifting mechanism (not shown) is used to move the movable vertical frame members **34** and the hood **30** upwardly and downwardly with respect to the stationary vertical frame members **36**.

[0020] A radiant heater (not shown) can also be included for providing heat to the infant when the hood **30** is in its uppermost position and thus the infant care apparatus **10** can be operated in the manner of an infant warmer or as an incubator in the configured position as shown in the present FIG. **1**.

[0021] In the embodiment depicted in FIG. **1**, a control module **50** is conveniently positioned intermediate the stationary vertical frame members **36** and is operatively connected to a processor **52**. The control module **50** may include a display **54** to display various monitored parameters as well as include the various controls for operation of the functions of the infant care apparatus **10** and an infant care system **8**. For example, the display **54** may display patient physiological parameters such as Sp02, FiO2, or temperature; physiological and system alarms; microenvironmental parameters such as temperature or humidity; caregiver queries or prompts; or other information related to the infant care apparatus, the infant care system, the infant or the care setting. It should be appreciated that the infant care apparatus **10** may comprise more than one display **54**.

[0022] FIG. **2** is a schematic diagram of the infant care system **8** in accordance with an embodiment of the disclosure. Infant care system **8** comprises the infant care apparatus **10** as generally described with respect to FIG. **1**, having the platform **20** that is configured to receive and support an infant. In an embodiment, the platform **20** may be a scale. The platform **20** is also configured to receive an applied force at a location **58** on the platform **20** from a user, such as a caregiver. The applied force may be a single push, a double push, or a discrete force of some other identifiable pattern. A minimum magnitude of the applied force may also be pre-defined to be equal to or above an adjustable threshold, in order to avoid unintentional applied forces. Additionally, a duration range of the applied force may also be pre-defined to avoid unintentional applied forces.

[0023] The infant care system **8** also comprises a plurality of load cells **60** connected to the platform **20**. For the purpose herein, a load cell is defined as a transducer that converts a force into an electrical signal. The plurality of load cells **60** could be hydraulic load cells, pneumatic load cells, strain gauge load cells, or any other type of load cell or combination thereof. In the depicted embodiment, the infant care system **8** has three load cells **60** A, B, C and the load cells **60** A, B, C are arranged in a triangular pattern. However, it should be appreciated that other arrangements, configurations, or number of load cells may be envisioned. For example, load cells **60** A, B, C may be arranged linearly. In another example, the plurality of load cells **60** may comprise four load cells, which may be arranged in a quadrilateral formation or, alternatively, linearly. In another example, the plurality of load cells **60** may comprise two load cells, spaced apart and thereby arranged linearly.

[0024] The plurality of load cells **60** A, B, C is configured to each receive at least a portion of applied force and generate a respective signal **62** A, B, C. Signals **62** A, B, C are indicative of the portion of the applied force received by each of the load cells **60** A, B, C. The processor **52** is connected to the plurality of load cells **60** and is configured to receive the signals **62** A, B, C from the respective load cells **60** A, B, C.

[0025] The processor **52** is configured to identify the location **58** of the applied force. In the depicted embodiment, comprising three load cells **60** A, B, C, the processor **52** can identify the location **58** of the applied force by triangulation or simultaneously solving statically determinate force and moment static equilibrium equations. In another embodiment, for example comprising two load cells **60**, the processor **52** can identify the location **58** of the applied force by comparing the signals **62** from the load cells.

[0026] The location **58** may be a discrete location, or the location **58** may be associated with or mapped to one or more of the plurality of zones **56**. For example, in the embodiment depicted in FIG. **2**, the platform **20** comprises zones **56** D, E, F, and the location of the applied force **58** is associated with zone **56** D. It should be appreciated however, that other embodiments may be envisioned with different quantities and configurations of zones. For example, the platform **20** may be divided into quadrants, each quadrant being a zone. In another example, the zones may be located around the periphery of the platform **20**, so that each side of the platform **20** is a zone. In yet another example, the platform **20** may comprise a single zone that may extend over the whole flat, planar surface **24** or alternatively, over only a portion thereof.

[0027] The infant care system **8** may also comprise a sensor **66** configured to sense a patient physiological parameter and generate a physiological parameter signal **68**. The sensor **66** may be an oxygen sensor to measure fraction of inspired oxygen (FiO2), a temperature sensor to measure body temperature, or a pulse oximetry sensor to measure oxygen saturation (SpO2). It should be appreciated, however, that other physiological sensors, such as ECG, or combinations thereof, may be envisioned. The processor **52** is also configured to generate alarms relating to alarm conditions of the infant care system **8** or the infant care apparatus **10**. For example, an alarm may be generated when the warmer heater power is too high for a pre-determined period of time. In another example, an alarm may be generated if the infant compartment **32** is below the preset temperature.

[0028] The processor **52** is configured to receive the physiological parameter signal **68** from the sensor **66**. The processor **52** may be configured to process the physiological parameter signal **68** and display the data associated with the signal **68** on the display **54**. The processor **52** is also configured to generate an alarm upon detection of an alarm condition. The alarm condition may be when the physiological parameter signal **68** is outside a predefined range. For example, the physiological parameter signal **68** may indicate that the temperature is too high or too low and the processor would generate an alarm related to temperature. The alarm condition may also be triggered by the occurrence an event or undesir-

able condition. For example, the alarm condition may also be that the sensor **66** has become disconnected or detached from the infant.

[0029] Based on the determined location **58** of the applied force, the processor **52** is also configured perform a function. The function may be alarm silence, query response or microenvironmental parameter adjustment. It should be appreciated that these embodiments of the function are non-limiting and that other embodiments of the function may also be envisioned.

[0030] In one embodiment, the function may be an alarm silence. For the purpose herein, alarm silence may be defined as the temporary or permanent inactivation of the alarm. The alarm silence may be related to an alarm generated in response to an alarm condition related to the infant physiological parameters, the infant care system **8** or the infant care apparatus **10**. The alarm silence may also be function-dependent, wherein the location **58** of the applied force is associated with a particular alarm. For example, when the processor **52** generates an alarm related to SpO2, a force applied generally proximate the infant's foot or in the zone closest to the infant's foot can silence the SpO2-related alarm, as the SpO2 sensor is attached to the infant's foot. In another example, when the processor **52** generates an alarm related to physiological temperature, a force applied generally proximate the infant's torso or in the zone closest to the infant's torso can silence the temperate-related alarm, as the physiological temperature sensor is attached to the infant's torso. In yet another example, when the processor **52** generates an alarm related to FiO2, a force applied generally proximate the infant's head or in the zone closest to the infant's head can silence the FiO2-related alarm as the FiO2 sensor is near the infant's mouth.

[0031] In another embodiment, the function may be a query response. For example, a query may be displayed on the display **54** and the caregiver may apply a force to the platform **20** to input a response. For example, the query response may be a yes or no, wherein the yes is mapped to one of the plurality of zones, for example **56**D, and the no is mapped to another of the plurality of zones, for example **56**F. In another example, the query response may be "increase" or "decrease", wherein the increase is mapped to one of the plurality of zones and the decrease is mapped to another of the plurality of zones. In yet another example, the query response may be a confirmation, and the applied force at any location or in any zone on the platform **20** may be the user input.

[0032] In yet another embodiment, the function may also be a microenvironmental parameter adjustment. For the purpose herein, microenvironmental parameter adjustment may be defined as the modification of a parameter or setting relating to the infant compartment **32**, the infant care apparatus **10** or the infant care system **8**. For example, an applied force may be used to input an increase or decrease in microenvironmental temperature or humidity. In one embodiment, one of the plurality, such as **56**D of zones may be mapped to increase microenvironmental temperature while another of the plurality of zones, such as **56**F may be mapped to decrease microenvironmental temperature. In another embodiment, one of the plurality of zones may be mapped to increase in microenvironmental humidity while another of the plurality of zones may be mapped to decrease microenvironmental humidity.

[0033] It should be appreciated that the infant care system **8** may also comprise additional devices (not pictured), such as a vital signs monitor. The processor **52** may be configured to receive signals from these devices and generate alarms upon determination of alarm conditions related thereto.

[0034] Having described the components of the infant care system **8** and the infant care apparatus **10**, an exemplary method **100** for controlling the infant care apparatus **10** will now be described in connection with FIG. **3**. The method **100** may include a step **110** providing a platform **20** for supporting an infant, the platform **20** connected to a plurality of load cells **60**. As described above with reference to FIG. **2**, in the depicted embodiment, there are three load cells **60** A, B, C connected to the platform **20**, and the load cells **60** A, B, C are arranged in a triangular pattern. It should be appreciated, however, that other arrangements, configurations and number of load cells **60** may be envisioned. For example, the three load cells may be arranged linearly. In another example, two load cells, spaced apart and thereby arranged linearly may be connected to the platform **20**. In yet another example, four load cells may be connected to the platform **20**, and the load cells may be arranged linearly or in a quadrilateral pattern.

[0035] The method **100** may include a step **120** comprising applying a force to a location **58** of the platform **20**, wherein each of the plurality of load cells **60** receives a portion of the force and generates a signal **62** A, B, C indicative thereof. The applied force may be a single push, a double push, or a discrete force of some other identifiable pattern of push. A minimum magnitude of the applied force may also be pre-defined to be equal to or above an adjustable threshold, in order to avoid unintentional applied forces. A duration range of the applied force may also be pre-defined to avoid unintentional applied forces.

[0036] The method **100** may include a step **130** comprising determining with the processor **52** the location **58** of the force with respect to the platform **20** based on the signals **62** from the plurality of load cells **60**. The step **130** may be made in a variety of ways. In one embodiment, the processor **52** may compare of the signals **62** from the plurality of load cells **60** and based on the signal with the highest amplitude, determine the general location **58** of the applied force. In another embodiment, the processor **52** may compare the signals **62** and identify in which of the plurality of zones **56** the force was applied. In yet another embodiment, the processor may determine a more specific location **58** of the applied force through triangulation.

[0037] The method **100** may include a step **140** comprising performing with the processor **52** a function based on the location **58** of the force. The function may be alarm silence, query response or microenvironmental parameter adjustment. In one embodiment, each of a plurality of zones **56** is mapped to a particular type of alarm. For example, when the processor **52** generates an alarm related to SpO2, a force applied in the zone proximate the infant's foot, such as **56**F, can silence the SpO2-related alarm. In another example, when the processor generates an alarm related to physiological temperature, a force applied in the zone proximate the infant's torso, such as **56**E, can silence the temperate-related alarm. In yet another example, when the processor generates an alarm related to FiO2, a force applied in the zone proximate the infant's head, such as **56**D, can silence the FiO2-related alarm.

[0038] In another embodiment, the function may be a query response. For example, a query may be displayed on the display **54** and the caregiver may apply a force to the platform **20** to input a response. In one embodiment, the query response may be a yes or no, wherein the yes is mapped to one

of the plurality of zones and the no is mapped to another of the plurality of zones. In another embodiment, the query response may be "increase" or "decrease", wherein the increase is mapped to one of the plurality of zones and the decrease is mapped to another of the plurality of zones. In yet another embodiment, the query response may be a confirmation, and the applied force at any location or in any of the plurality of zones **56** on the platform **20** may be the user input.

[0039] In yet another embodiment, the function may also be a microenvironmental parameter adjustment. For example, an applied force may be used to input an increase or decrease in microenvironmental temperature or humidity. In one embodiment, one of the plurality of zones may be mapped to increase microenvironmental temperature while another of the plurality of zones may be mapped to decrease microenvironmental temperature. In another embodiment, one of the plurality of zones may be mapped to increase in microenvironmental humidity while another of the plurality of zones may be mapped to decrease microenvironmental humidity.

[0040] The method **100** may also include setting the orientation of the infant with respect to the platform **20**. This step may be accomplished by applying a force to the platform **20** at a pre-determined location. For example, a caregiver may apply a force at the end of the platform **20** nearest an infant's feet to set the location of the infant's feet with respect to the platform **20**. Alternatively, a caregiver may apply a force at the end of the platform **20** nearest the infant's head to set the location of the infant's head with respect to the platform **20**. It should also be appreciated that this step may be performed before or after an infant is positioned on the platform **20**.

[0041] The invention described herein has many advantages. It would allow a caregiver to react to incubator controller prompts and to silence incubator or patient alarms without having to remove his or her hands from the infant compartment. This would not only help preserve sterility, but would also allow the caregiver to act quickly as it would require less movement and thereby minimize patient procedure interruption. Additionally, the implementation of the invention would not add clutter to an already crowded the infant compartment as the load cells could be contained within existing structure.

[0042] Aligning or mapping a user specific user input to an alarm conditions could ensure that caregiver does in fact understand the cause or origin of the alarm before silencing it and would decrease the chances of accidental or unintentional alarm silence. Furthermore, simultaneous alarms for multiple conditions are very common. This invention would allow different alarm silence actions for different alarms, thereby selectively silencing alarms.

[0043] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

I claim:

1. An infant care system, comprising:

a platform configured to support an infant and to receive an applied force on the platform;

at least two load cells connected to the platform, each of the two load cells configured to receive at least a portion of the applied force on the platform and generate a signal indicative of the portion of applied force received; and

a processor configured to receive and analyze the signals from each of the two load cells, and perform a function based on the analyzed signals.

2. The infant care system of claim **1**, wherein the processor compares the signals from each of the two load cells and performs a function based on the comparison.

3. The infant care system of claim **1**, wherein the system comprises three load cells, arranged in a triangular pattern.

4. The infant care system of claim **3**, wherein the processor analyzes the signals from each of the three load cells to identify a location of the applied force.

5. The infant care system of claim **1**, wherein the applied force is a single push.

6. The infant care system of claim **1**, wherein the applied force is a double push.

7. The infant care system of claim **1**, wherein the processor is further configured to detect an alarm condition and generate an alarm, and wherein the function is alarm silence.

8. The infant care system of claim **7**, wherein the alarm condition relates to the infant care system or infant care apparatus.

9. The infant care system of claim **1**, further comprising a sensor configured to sense a patient parameter and generate a parameter signal.

10. The infant care system of claim **9**, wherein the patient parameter is one of temperature, FiO2 or SpO2.

11. The infant care system of claim **9**, wherein the processor is further configured to receive the patient parameter signal and generate an alarm upon detection of an alarm condition.

12. The infant care system of claim **11**, wherein the patient parameter is SpO2,the location of the applied force is generally proximate to a foot of the infant, and the function is alarm silence.

13. The infant care system of claim **11**, wherein the patient parameter is temperature, the location of the applied force is generally proximate to an infant's torso, and the function is alarm silence.

14. The infant care system of claim **11**, wherein the patient parameter is FiO2, the location of the applied force is generally proximate to an infant's head, and the function is alarm silence.

15. The infant care system of claim **11**, wherein the function is silencing the alarm.

16. The infant care system of claim **1**, wherein the function is adjusting a microenvironmental parameter.

17. The infant care system of claim **1**, further comprising a display configured to display a query to the user and wherein the function is a response to the query.

18. A user interface for an infant care apparatus, comprising:

an infant support platform comprising a plurality of zones, the platform configured to receive an applied force;

a plurality of load cells connected to the platform, the load cells configured to each receive a portion of the applied force and generate a signal indicative of the portion of applied force received; and

a processor configured to receive the signals from the plurality of load cells, determine in which of the plurality of zones the force was applied, and perform a function based on the zone.

19. The user interface of claim **18**, wherein the function is one of alarm silence, query response or microenvironmental parameter adjustment.

20. A method of controlling an infant care apparatus comprising:

providing a platform for supporting an infant, the platform connected to a plurality of load cells;

applying a force to the platform, wherein each of the plurality of load cells receives a portion of the force and generates a signal indicative thereof;

determining with a processor a location of the force with respect to the platform based on the signals from the plurality of load cells; and

performing with a processor a function based on the location of the force.

21. The method of claim **20**, further comprising setting the orientation of the infant on the platform.

22. The method of claim **20**, wherein the function is silencing an alarm.

23. The method of claim **22**, further comprising sensing with a sensor SpO2 and the location of the applied force is generally proximate to a foot of the infant.

24. The method of claim **22**, further comprising sensing with a sensor temperature and the location of the applied force is generally proximate to an infant's torso.

25. The method of claim **22**, further comprising sensing with a sensor FiO2 and the location of the applied force is generally proximate to the infant's head.

* * * * *

专利名称(译)	用于婴儿护理设备的用户控制系统和方法		
公开(公告)号	US20150272802A1	公开(公告)日	2015-10-01
申请号	US14/230811	申请日	2014-03-31
[标]申请(专利权)人(译)	通用电气公司		
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当前申请(专利权)人(译)	通用电气公司		
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摘要(译)

婴儿护理系统包括平台，该平台被配置为支撑婴儿并在平台上接收施加的力。婴儿护理系统还包括连接到平台的至少两个测力传感器，两个测力传感器中的每一个被配置为接收平台上施加的力的至少一部分并产生指示所接收的施加力的部分的信号。婴儿护理系统还包括处理器，该处理器被配置为接收和分析来自测力传感器的信号并基于分析的信号执行功能。