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JAYARAMAN et al.(10) **Pub. No.: US 2016/0283856 A1**(43) **Pub. Date: Sep. 29, 2016**(54) **SYSTEM AND METHOD FOR DETERMINING
PSYCHOLOGICAL STRESS OF A PERSON****G06N 5/04** (2006.01)**A61B 5/16** (2006.01)(71) Applicant: **Tata Consultancy Services Limited,**
Mumbai (IN)(52) **U.S. Cl.**CPC **G06N 7/005** (2013.01); **G06N 5/045**
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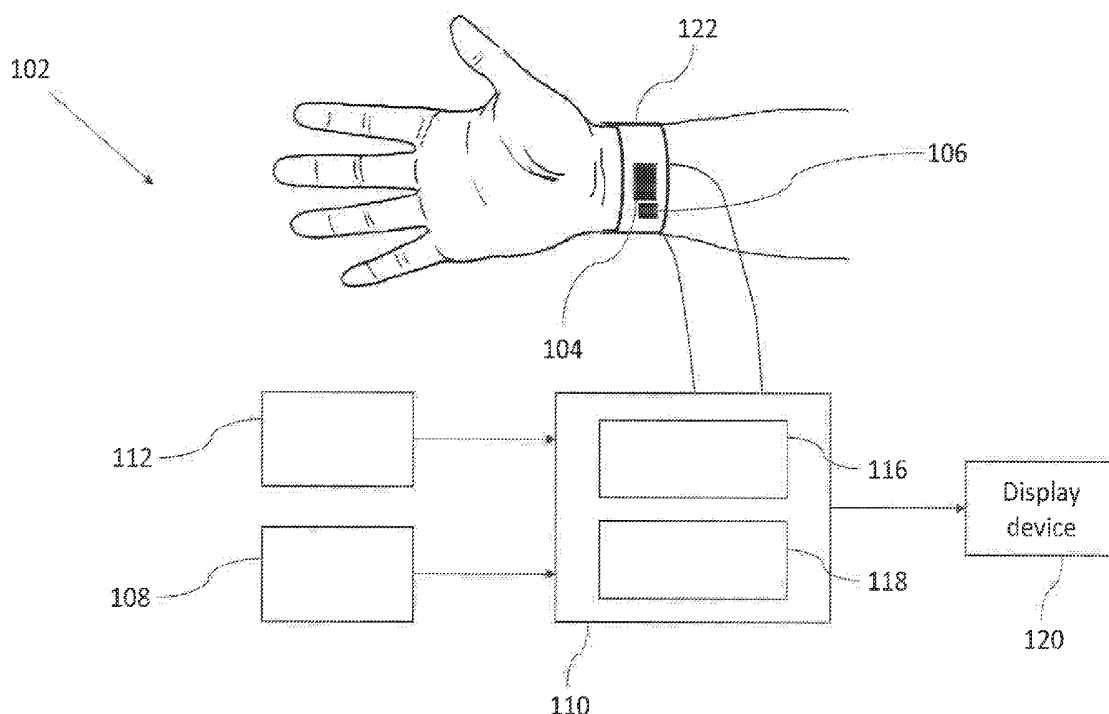
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ABSTRACT

A system for determining stress level of a person in real-time have been disclosed. In one aspect, the system captures physiological data associated to the person. In one embodiment, the physiological data may be captured by using a plurality of sensors attached at wrist or ankle or neck or waist or hip of the person, for a predetermined time interval. The plurality of sensors may include a wrist watch or a wristband or a textile material. The system further pre-processes the physiological data in order to extract one or more physiological parameters. In one aspect, the pre-processing may include performing an analysis on the physiological data. The system further determines the stress level of the person upon performing the statistical analysis on the one or more physiological parameters. According to another embodiment, a method for real time determination of stress level of the person has also been provided.

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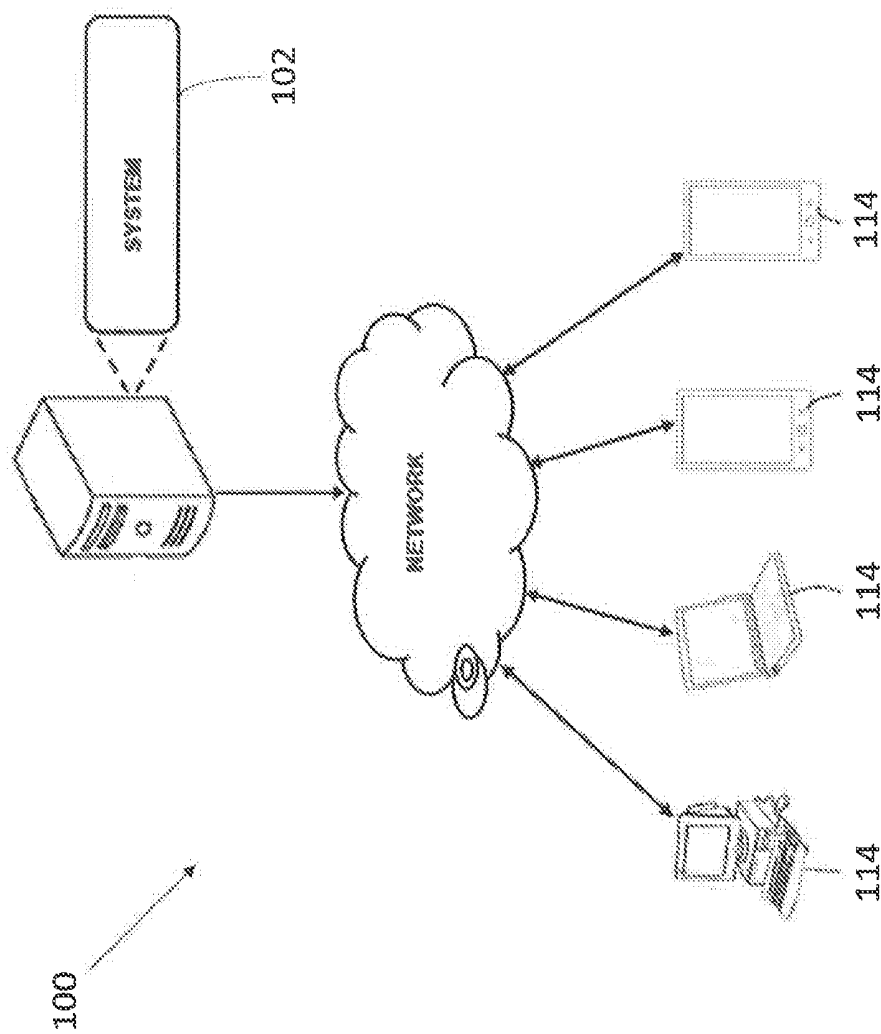


FIG. 1

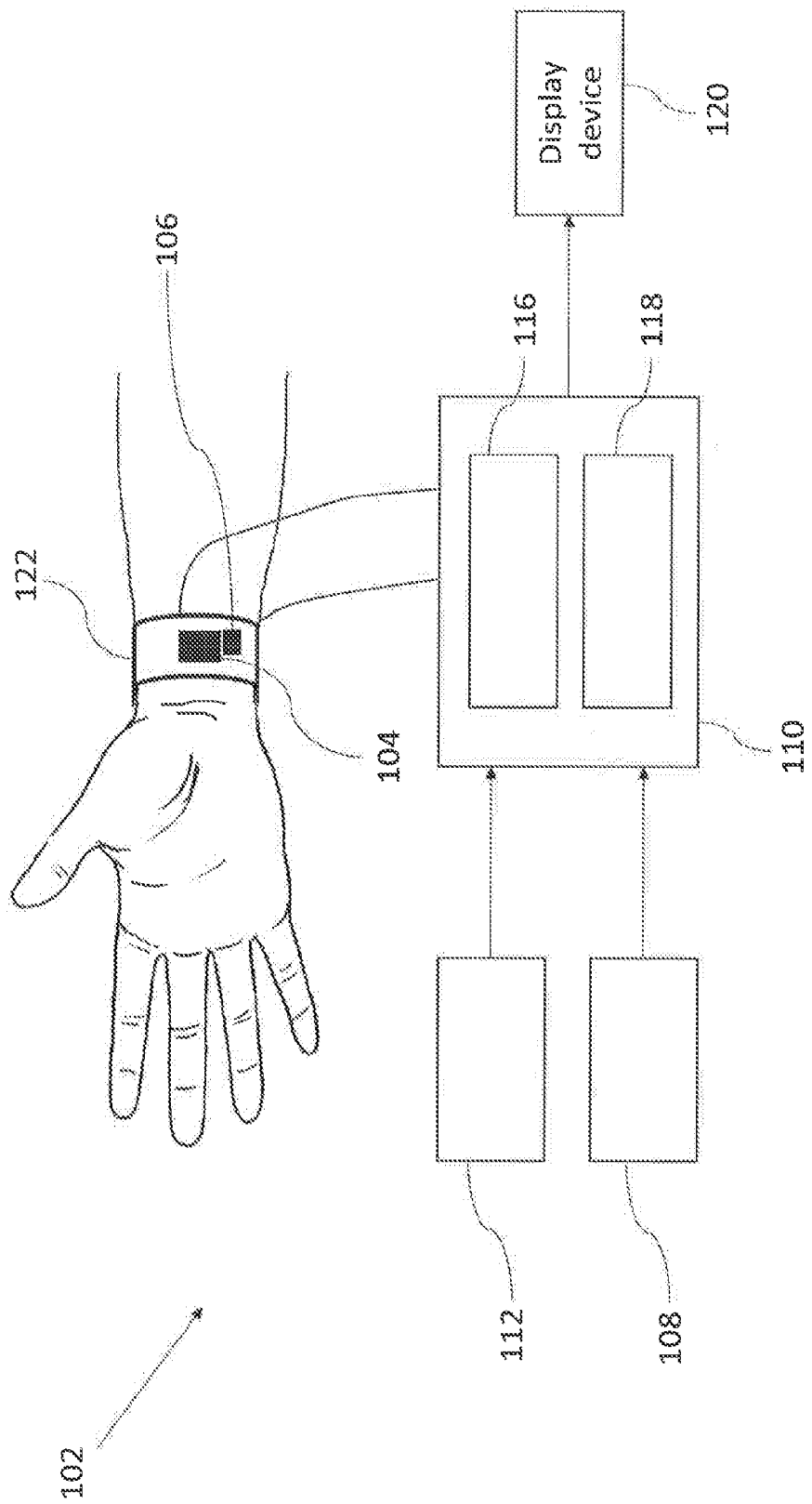


FIG. 2

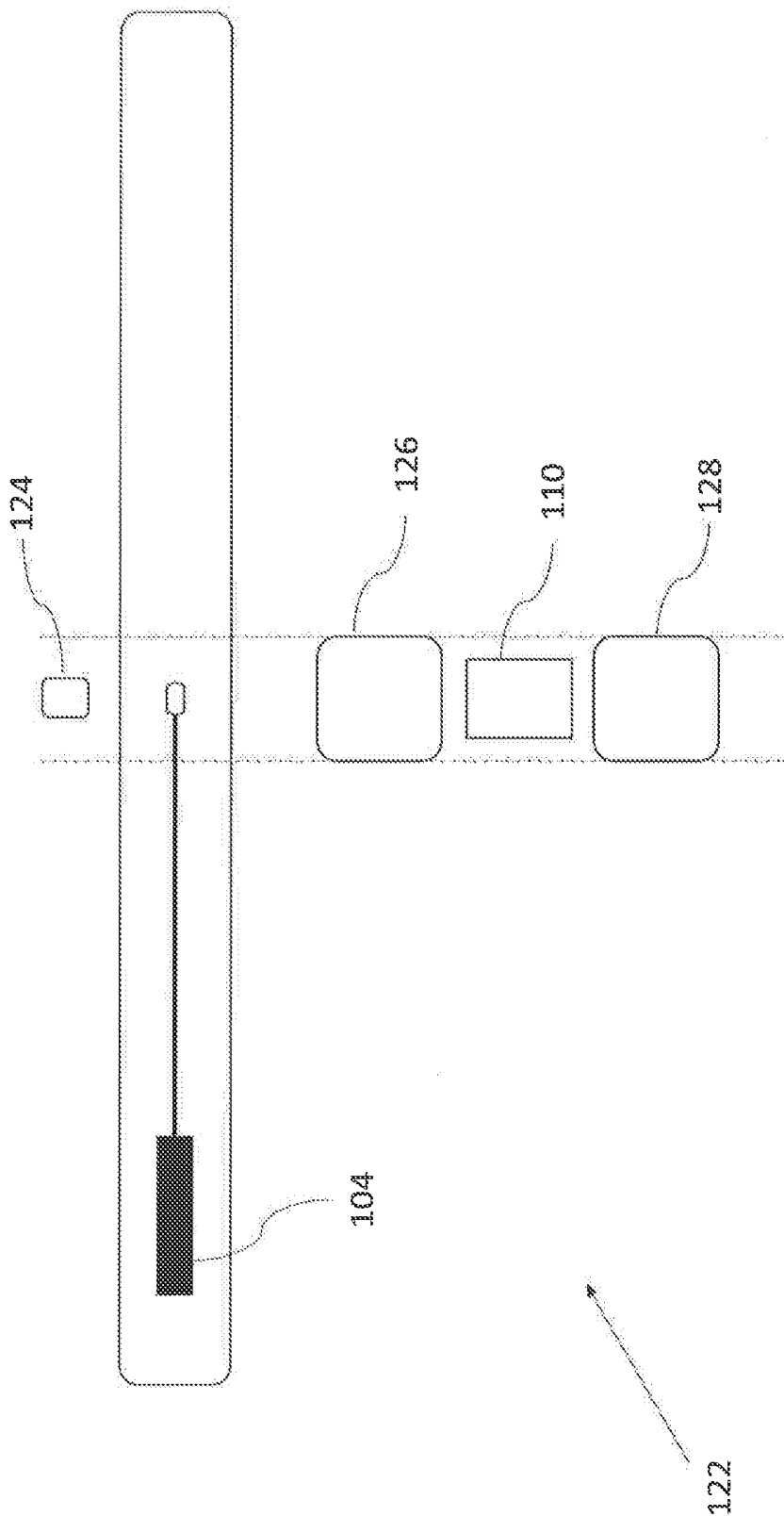


FIG. 3

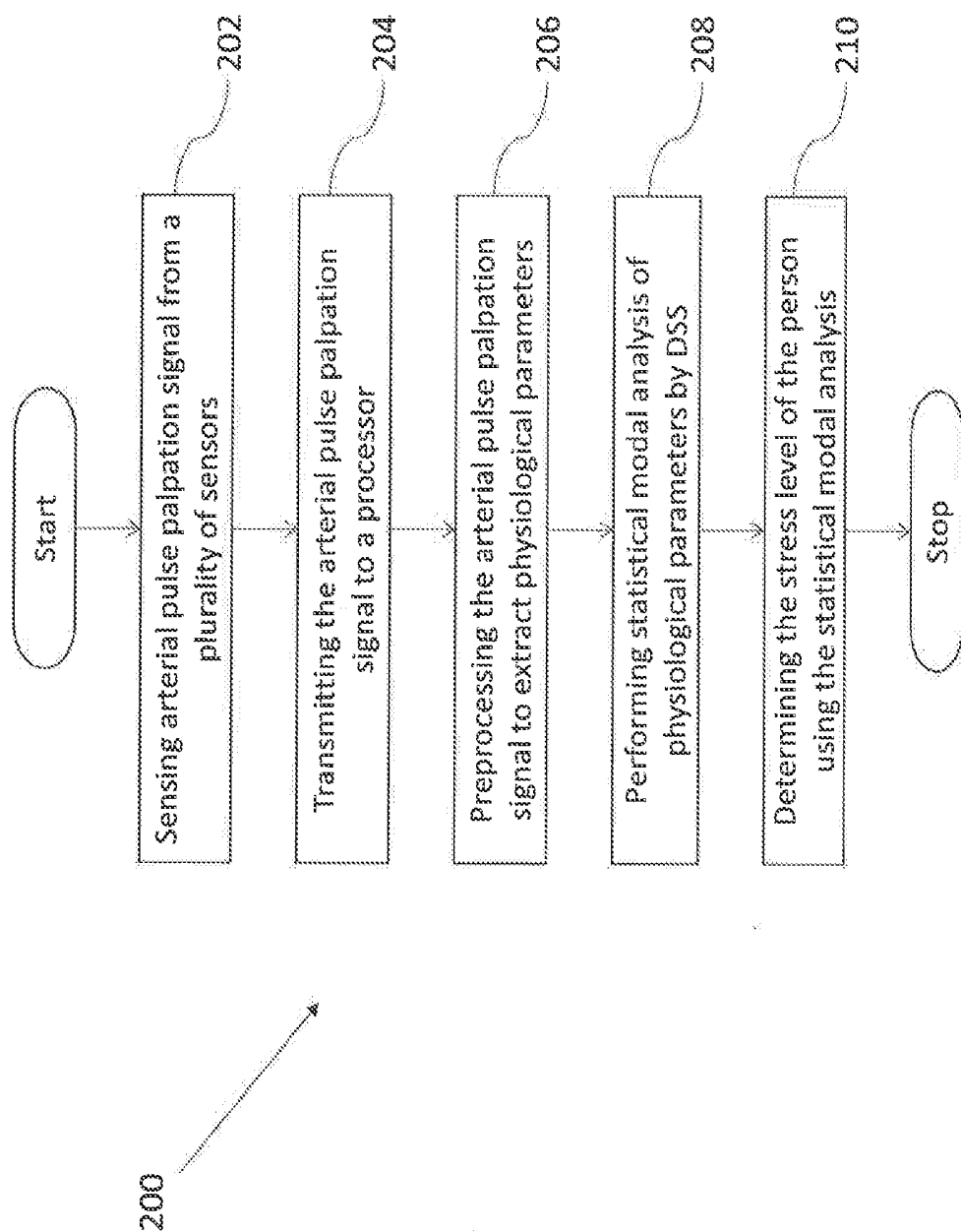


FIG. 4

SYSTEM AND METHOD FOR DETERMINING PSYCHOLOGICAL STRESS OF A PERSON

CROSS-REFERENCE TO RELATED APPLICATIONS AND PRIORITY

[0001] The present application claims priority from Indian provisional specification no. 1003/MUM/2015 filed on 25th Mar., 2015, the complete disclosure of which, in its entirety is herein incorporated by references.

TECHNICAL FIELD

[0002] The present subject matter described herein, in general, relates to a system and a method for determining a stress level of a person in real-time, and more particularly to the system and the method for determining the stress level based on physiological data associated to the person.

BACKGROUND

[0003] Stress level of a person is one of the biomarker or indicators of the health of the person. On the other hand, stress in the working environment can lead to poor health and even injury. Common complaints due to stress include loss of concentration; mood and sleep disturbances, upset stomach, cardiac disorder and headache. Measurement of stress may provide inference or act as an indicator about the physiological and psychological health of the person. Therefore, continuous monitoring of an individual stress level is essential for managing personal health and wellness. In order to determine the stress level, various methods have been used by the caregivers.

[0004] In order to characterize the stress level of the person, currently following techniques are being performed: a) questionnaires, Electroencephalogram (EEG), face expression, Photoplethysmogram (PPG) and Electrocardiogram (ECG). One of the methods involves monitoring physiological signals, such as electrocardiogram (ECG) signals, of the person to ascertain the stress level for managing personal stress assessment. Current methods of monitoring the physiological signals include measuring the physiological signals over duration of time, either by inducing stress among participants by making them undergo a stress test or perform a relaxation exercise. On the other hand; the traditional approaches for detecting the stress level have used more electrodes or location of electrode and long duration of event base recording. For example, the ECG or the EEG based approaches may require minimum of two electrodes at two different locations. As an addendum, such traditional approaches also use threshold technique for detecting the stress level of the person. In another technique, stress can be measured by determining the level of the hormone cortisol in the blood; which is an invasive technique of measurement. Cortisol is a corticosteroid hormone that is involved in the response to stress.

[0005] Yet another technique uses monitoring stress related pattern of muscle activity. However, these devices require skin-contacted electrodes in order to gather stress status data, so that the actual application of these devices is very annoying to the user. Moreover, the known devices are bound to influence the state of relaxation of the user in a negative way. A lot of traditional techniques have also been explored for the determination of stress level. One of the traditional techniques involves use of Hrallasika method. Hrallasika means palpation of heart from Sanskrit. In traditional medical approach, the pulse palpations were followed for disease

diagnosis tool. This technique has not been explored for the stress determination or similar diagnostic purpose.

[0006] However, none of the traditional approaches had addressed detection of the stress level in real-time and in addendum single sensing technique. In addition, there is no system exist that manages the psychological and cardiac system of the person.

SUMMARY

[0007] Embodiments of the present disclosure present technological improvements as solutions to one or more of the above-mentioned technical problems recognized by the inventors in conventional systems.

[0008] In one implementation, a system and a processor implemented method for determining a stress level of a person in real-time is disclosed. The present invention may be used to capture physiological data associated to the person. In one embodiment, the physiological data may be captured by using a single or an array of sensors attached to wrist or ankle or neck or waist of the person. In one aspect, the array of sensor could be 2 or more sensing element embodied as a sensor. In one aspect, in order to measure the arterial pulse palpation rate, a sensor may be attached to the wrist of the person by using the wristwatch or the wristband or the textile as a cuff. The system further includes a transmitter, a storage device and a processor. The transmitter transmits the stream of pulse palpation signal to the processor. The processor further includes a preprocessing module and a decision support system module. The preprocessing module preprocesses the stream of arterial pulse palpation signal to extract a plurality of physiological parameters. The decision support module performs a statistical modal analysis of the plurality of physiological parameters and determines the stress level of the person based on the statistical modal analysis.

[0009] In another embodiment, the present invention may capture the physiological data by using an integrated smart phone sensor. It may be understood that the present invention may require minimum of 1 minute of the arterial pulse palpation rate. In one scenario, the present invention may capture the physiological data and transmit the physiological data to a smart phone or an external device having a decision support system (DSS) module installed on the smart phone or the external device. Once the physiological data is transmitted, the smart phone may receive the physiological data and perform analysis on the physiological data to determine the stress level. In one aspect, the DSS application may upload the physiological data to a central server where further cardiac clinical analysis may be performed.

[0010] In one embodiment, the DSS application may be capable of receiving status information pertaining to the person such as standing, sitting, running and so on from the integrated smart phone sensor. In another scenario, the present invention may provide the stress level of the person based on the integrated smart phone sensor.

[0011] In another embodiment, a processor implemented method has also been provided for measuring the real time stress of the person. Initially, at least one stream of arterial pulse palpation signal is sensed for a predefined time period using a plurality of sensors. The sensed stream of arterial pulse palpation signal is transmitted to the processor. The stream of arterial pulse palpation signal is then preprocessed to extract a plurality of physiological parameters using the preprocessing module. Finally a statistical modal analysis of the plurality of physiological parameters is performed by a

decision support module present in the processor to determine the stress level of the person.

[0012] In another embodiment, a non-transitory computer-readable medium having embodied thereon a computer program for determining a stress level of a person in real time has also been provided. Initially, at least one stream of arterial pulse palpation signal is sensed for a predefined time period using a plurality of sensors. The sensed stream of arterial pulse palpation signal is transmitted to the processor. The stream of arterial pulse palpation signal is then preprocessed to extract a plurality of physiological parameters using the preprocessing module. Finally a statistical modal analysis of the plurality of physiological parameters is performed by a decision support module present in the processor to determine the stress level of the person.

[0013] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The foregoing detailed description of embodiments is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the disclosure, there is shown in the present document example constructions of the disclosure; however, the disclosure is not limited to the specific methods and apparatus disclosed in the document and the drawings.

[0015] The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The same numbers are used throughout the drawings to refer like features and components.

[0016] FIG. 1 illustrates a network implementation of a system for determining a stress level of a person in real-time, in accordance with an embodiment of the present disclosure;

[0017] FIG. 2 illustrates the system for determining the stress level of the person, in accordance with an embodiment of the present disclosure;

[0018] FIG. 3 illustrates a wearable sensor to monitor an arterial pulse palpation rate in the wrist, in accordance with an embodiment of the present disclosure; and

[0019] FIG. 4 illustrates the flow chart for determining the stress level, in accordance with an embodiment of the present disclosure.

[0020] The Figures depict various embodiments of the present invention for purposes of illustration only. One skilled in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles of the invention described herein.

DETAILED DESCRIPTION OF THE INVENTION

[0021] Some embodiments of this invention, illustrating all its features, will now be discussed in detail.

[0022] The words “comprising,” “having,” “containing,” and “including,” and other forms thereof, are intended to be equivalent in meaning and be open ended in that an item or items following any one of these words is not meant to be an exhaustive listing of such item or items, or meant to be limited to only the listed item or items.

[0023] It must also be noted that as used herein and in the appended claims, the singular forms “a,” “an,” and “the” include plural references unless the context clearly dictates otherwise. Although any systems and methods similar or equivalent to those described herein can be used in the practice or testing of embodiments of the present invention, the preferred, systems and methods are now described. In the following description for the purpose of explanation and understanding reference has been made to numerous embodiments for which the intent is not to limit the scope of the invention.

[0024] One or more components of the invention are described as module for the understanding of the specification. For example, a module may include self-contained component in a hardware circuit comprising of logical gate, semiconductor device, integrated circuits or any other discrete component. The module may also be a part of any software programme executed by any hardware entity for example processor. The implementation of module as a software programme may include a set of logical instructions to be executed by a processor or any other hardware entity.

[0025] The disclosed embodiments are merely exemplary of the invention, which may be embodied in various forms.

[0026] Method steps of the invention may be performed by one or more computer processors executing a program tangibly embodied on a computer-readable medium to perform functions of the invention by operating on input and generating output. Suitable processors include, by way of example, both general and special purpose microprocessors. Generally, the processor receives (reads) instructions and data from a memory (such as a read-only memory and/or a random access memory) and writes (stores) instructions and data to the memory. Storage devices suitable for tangibly embodying computer program instructions and data include, for example, all forms of non-volatile memory, such as semiconductor memory devices, including EPROM, EEPROM, and flash memory devices; magnetic disks such as internal hard disks and removable disks; magneto-optical disks; and CD-ROMs. Any of the foregoing may be supplemented by, or incorporated in, specially-designed ASICs (application-specific integrated circuits) or FPGAs (Field-Programmable Gate Arrays). A computer can generally also receive (read) programs and data from, and write (store) programs and data to, a non-transitory computer-readable storage medium such as an internal disk (not shown) or a removable disk.

[0027] In one implementation, a system and a method for determining a stress level of a person in real-time is disclosed. The present invention may be used to capture physiological data associated to the person. In one embodiment, the physiological data may be captured by using a plurality of sensors attached to wrist or ankle or neck or waist of the person. In one aspect, in order to measure the arterial pulse palpation rate, a sensor may be attached to the wrist of the person by using the wrist watch or the wristband or the textile as a cuff. The system further includes a transmitter, a storage device and a processor. The transmitter transmits the stream of pulse palpation signal to the processor. The processor further includes a preprocessing module and a decision support system module. The preprocessing module preprocesses the stream of arterial pulse palpation signal to extract a plurality of physiological parameters. The decision support module performs a statistical modal analysis of the plurality of physiological parameters and determines the stress level of the person based on the statistical modal analysis.

[0028] Exemplary embodiments are described with reference to the accompanying drawings. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. Wherever convenient, the same reference numbers are used throughout the drawings to refer to the same or like parts. While examples and features of disclosed principles are described herein, modifications, adaptations, and other implementations are possible without departing from the spirit and scope of the disclosed embodiments. It is intended that the following detailed description be considered as exemplary only, with the true scope and spirit being indicated by the following claims.

[0029] According to an embodiment of the invention, a network implementation 100 of a system 102 for determining a stress level of a person in real-time, is shown in FIG. 1. In one aspect, the system 102 captures a plurality of physiological data associated to the person. In one embodiment, the plurality of physiological data may be captured by using a plurality of sensors 104. In one aspect the plurality of sensors 104 are the non-invasive plurality of sensors 104. The plurality of sensors 104 are attached to wrist or ankle or neck or waist or hip of the person. For example, a wristwatch or a wristband or a textile material such as cuff to measure the arterial pulse palpation rate or biological parameter. In one aspect, the arterial pulse palpation rate captured, from the plurality of sensors 104, for a predetermined ultra-short or short duration. The system 102 further pre-processes the physiological data in order to extract a plurality of physiological parameters. In one aspect, the pre-processing may include performing an analysis on the physiological data. The system 102 further determines the stress level of the person in the real-time based upon performing the statistical modal analysis of the plurality of physiological parameters.

[0030] Although the present subject matter is explained considering that the server (not shown) is implemented as a computing system, it may be understood that the server may also be implemented as a variety of computing systems, such as a laptop computer, a desktop computer, a notebook, a workstation, a mainframe computer, a server, a network server, a tablet, a mobile phone, and the like. In one implementation, the server may be implemented in a cloud-based environment. According to an embodiment, the system 102 may be implemented with the vehicle. Further, the server may track the activities of the system 102, and the system 102 is communicatively coupled to the server 102 through the network 100.

[0031] In one implementation, the network 100 may be a wireless network, a wired network or a combination thereof. The network 100 can be implemented as one of the different types of networks, such as intranet, local area network (LAN), wide area network (WAN), the internet, and the like. The network 100 may either be a dedicated network or a shared network. The shared network represents an association of the different types of networks that use a variety of protocols, for example, Hypertext Transfer Protocol (HTTP), Transmission Control Protocol/Internet Protocol (TCP/IP), Wireless Application Protocol (WAP), and the like, to communicate with one another. Further the network 100 may include a variety of network devices, including routers, bridges, servers, computing devices, storage devices, and the like.

[0032] According to an embodiment of the invention, the system 102 for determining the stress of the person is shown

in FIG. 2. In one embodiment, the system 102 includes a plurality of sensors 104, a transmitter 106, a storage device 108 or a memory 108 and at least one processor 110. The system 102 also includes an input/output (I/O) interface 112. The processor 110 may be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any devices that manipulate signals based on operational instructions. Among other capabilities, the processor 110 is configured to fetch and execute computer-readable instructions stored in the memory 108.

[0033] The I/O interface 112 may include a variety of software and hardware interfaces, for example, a web interface, a graphical user interface, and the like. The I/O interface 112 may allow the system 102 to interact with the user directly or through a plurality of client devices 114. Further, the I/O interface 112 may enable the system 102 to communicate with other computing devices, such as web servers and external data servers (not shown). The I/O interface 112 can facilitate multiple communications within a wide variety of networks and protocol types, including wired networks, for example, LAN, cable, etc., and wireless networks, such as WLAN, cellular, or satellite. The I/O interface 112 may include one or more ports for connecting a number of devices to one another or to another server.

[0034] The memory 108 may include any computer-readable medium and computer program product known in the art including, for example, volatile memory, such as static random access memory (SRAM) and dynamic random access memory (DRAM), and/or non-volatile memory, such as read only memory (ROM), erasable programmable ROM, flash memories, hard disks, optical disks, and magnetic tapes.

[0035] The processor 110 further includes a preprocessing module 116 and a decision support system (DSS) module 118. The modules generally include routines, programs, objects, components, data structures, etc., which perform particular tasks or implement particular abstract data types. The preprocessing module 116 and the decision support system (DSS) module 118 may include programs or coded instructions that supplement applications and functions of the system 102. The modules 116 and 118 described herein may be implemented as software modules that may be executed in the cloud-based computing environment of the system 102. In another embodiment the processor 110 may also include other modules performing various other functions of the system 102.

[0036] In one implementation, a system and a method for determining a stress level of a person in real-time is disclosed. The present invention may be used to capture physiological data associated to the person. In one embodiment, the physiological data may be captured by using the plurality of sensors 104. The plurality of sensors 104 can be attached to a primary location of the person such as wrist or ankle or neck or waist or hip to sense the arterial pulse palpation rate. For example, a wrist watch or a wristband or a textile material such as cuff to measure the arterial pulse palpation rate or biological parameter. In one example, in order to measure the arterial pulse palpation rate, an external sensor may be attached to the wrist of the person by using the wrist watch or the wristband or the textile as a cuff. Examples of the one or more external sensors may include, but not limited to, a piezo-electric sensor or a piezo-resistive sensor. It may be understood that the external sensor senses the arterial pulse

palpation rate of the person and thereby captures the physiological data associated to the person.

[0037] According to an embodiment, the arterial palpation signal is captured from at least one of a temporal artery, a facial artery, a carotid artery, a brachial artery, a radial artery, a femoral artery, a popliteal artery, a popliteal tibial artery and a dorsalis pedis artery of the person.

[0038] In another embodiment, the present invention may capture the physiological data by using an integrated smart phone sensor. It may be understood that the present invention may require minimum of 1 minute of the arterial pulse palpation rate. In one scenario, the present invention may capture the physiological data (including the arterial pulse palpation rate) and transmit the physiological data to a smart phone having the decision support system (DSS) module **118** or the decision support module **118** on the smart phone or an external device. Once the physiological data is transmitted, the smart phone may receive the physiological data and perform statistical modal analysis on the physiological data in order to determine the stress level. In one aspect, upon determining the stress level, the system **100** may display or generates an audio alarm to provide the outcome of the analysis to indicate the stress level of the person. The system **102** further includes a display device **120** to display the stress level. Further, the DSS module may upload the physiological data to a central server where further cardiac clinical analysis may be performed.

[0039] In one aspect, the DSS module **118** may be capable of receiving status information pertaining to the person from the integrated smart phone sensor. The status information may include, but not limited to, standing, sitting, and running. In one aspect, the arterial pulse palpation rate may be fused with the status information of the person to improve the accuracy of the status information. In one aspect, an additional sensor located near to the primary location may facilitate to determine the Pulse Wave Velocity (PWV). In one aspect, the system **102** may detect the PWV in the same segment of artery or location with ultra-short duration signal (i.e. 1 minute of arterial pulse palpation rate). In one aspect, the determination of the PWV in addition to the existing system, may help in determining the status information of the person and thereby help in improving the accuracy of the stress level of the person.

[0040] Yet another aspect, the DSS module **118** may be capable of receiving environment temperature information from the integrated smart phone sensor or smart watch sensor. In one aspect, the arterial pulse palpation rate may be fused with the temperature information to improve the accuracy of the stress information.

[0041] Further the DSS module **118** is configured to analyze the extracted physiological parameters to determine the stress level. In an example, a pulse signal captured from the person. The pulse signal is analyzed as follows: At step 1, the raw pulse data of mV signal is acquired through surface piezo electrode (not shown) and amplified to Voltage signal $X(n)$ at three different location of wrist. The Raw signals were pre-processed and peak-to-peak (PP) intervals PP (X) were extracted. At step 2: For example PP Interval PP(X) was interpolated and feature parameters $F(x)$ are extracted. The features parameters $F(x)$ extracted for all the enrolled users stored in a database. Once the probe data is determined, step 1 and step 2 may be performed. Further, the probe data may be matched with the database comprising the feature parameters $F(x)$ by using a statistical model or classification or matching

techniques. During the classification or the matching technique, one or more features listed in table may be used to determine the stress level.

[0042] FIG. 3 illustrates a wearable sensor **122** to monitor the arterial pulse palpation rate in the wrist according to an embodiment of the invention. An exploded view of the wearable sensor **122** for determining the stress of the person shown in FIG. 3. The figure shows the wearable sensor **122** including a screw **124**, an upper cover **126**, a lower cover **128** and the processor **110** which can be fitted between the upper cover **126** and the lower cover **128**.

[0043] As shown in the FIG. 3, a standalone sensor may be attached to the wrist of the person in order to determine the stress level. In addition to monitor the arterial pulse palpation rate, the wearable sensing unit may be used to determine the Pulse Wave Velocity (PWV).

[0044] FIG. 4 illustrates the flow chart **200** for determining the stress level of a person according to an embodiment of the invention. Initially at step **202**, at least one stream of arterial pulse palpation signal is sensed using the plurality of sensors **104**. The sensing is done only for a predefined time period, in an example, the signal is sensed for about one minute. At the next step **204**, the sensed pulse palpation signal is transmitted to the processor **110** using the transmitter **106**. The processor **110** further includes a plurality of modules such as the pre-processing module **116** and the decision support system (DSS) module **118**. At step **206**, the stream of arterial pulse palpation signal is preprocessed using the preprocessing module **116** to extract the plurality of physiological parameters. At the next step **208**, the statistical modal analysis of the extracted plurality of physiological parameters is performed using the DSS module **118**. The DSS module **118** can be present on the smart phone or can be present on an external device. And finally at step **210**, the stress level of the person is determined using the statistical modal analysis of the plurality of physiological parameters.

[0045] According to another embodiment of the invention, the system **102** can further provide an alert to a caregiver/doctor in case the stress level moves out of a predefined conditions. It should be appreciated that the system **102** can further provides a plurality of features to reduce the stress of the person.

[0046] According to another embodiment of the invention, the system **102** is synchronized with an entertainment system in a vehicle and the pulse palpation system **102** is configured to measure the stress level of a driver driving the vehicle. In case, the stress level moves out of the predefined conditions then the system **102** can interrupt or initiate the entertainment system of the vehicle. The entertainment system can be personalized in such a way that as soon as the stress level moves out of the predefined condition then a personalized music playlist can be played based on the choice of the driver, in order to reduce the stress level of the driver. In another example, a mobile phone of the user can also be personalized. In yet another example, the mobile gaming alert can also be personalized.

[0047] Exemplary embodiments discussed above may provide certain advantages. Though not required to practice aspects of the disclosure, these advantages may include those provided by the following features.

[0048] Some embodiments enable a system and a method to continuous monitor a stress level of a person in real-time by

integrating non-invasive one or more external sensors at one location like sensor attached at their wrist or ankle or neck or waist of the person.

[0049] Some embodiments enable a system and a method to facilitate the person to measure or alert the stress level without cumbersome electrode placement all over the body or group of region associated to the person.

[0050] Some embodiments enable a system and a method to assist the person to determine the stress level in short duration by capturing arterial pulse palpation rate for 1 minute duration.

[0051] Some embodiments enable a system and a method to determine the stress level in offline or real-time rather than inducing stress among the participants by making them undergo a stress test or perform a relaxation exercise.

[0052] Some embodiments enable a system and a method to determine Pulse Wave Velocity (PWV) of the system using more than one electrode system with same part or location of the person body.

[0053] Some embodiments enable a system and method to improve the determined stress level by adding an external or inbuilt atmosphere or environmental temperature.

[0054] It should be appreciated the device and method can also be used for the estimation of other parameters of the person such as heart rate, etc. It should also be appreciated that the device can also be implemented using Hrllasika based wearable nadi sensor.

[0055] In view of the foregoing, it will be appreciated that the present invention provides a method and device for the continuous estimation of the blood pressure using palpation signal captured from the artery. Still, it should be understood that the foregoing relates only to the exemplary embodiments of the present invention, and that numerous changes may be made thereto without departing from the spirit and scope of the invention as defined by the following claims.

What is claimed is:

1. A real time method for determining a stress level of a person, the method comprising a processor implemented steps of:

sensing at least one stream of arterial pulse palpation signal using at least one sensor for a predefined time period;
transmitting the stream of arterial pulse palpation signal by a transmitter to the processor;

preprocessing the stream of arterial pulse palpation signal to extract a plurality of physiological parameters by the processor;

performing a statistical modal analysis of the plurality of physiological parameters by a decision support module; and

determining the stress level of the person using the statistical modal analysis of the plurality of physiological parameters.

2. The method of claim 1 further includes uploading the physiological parameters by the processor to a central server for performing a cardiac clinical analysis.

3. The method of claim 1, further comprising providing additional information for the statistical analysis using an input interface.

4. The method of claim 1 further comprising providing an alert to a caregiver is stress level moves out of a predefined condition.

5. The method of claim 1, wherein the person is driving a vehicle.

6. The method of claim 5 further comprising personalization of the vehicle music system to provide a soothing music to the person to reduce the stress level of the person.

7. The method of claim 1 further comprising providing ambient temperature of the environment.

8. The method of claim 1, wherein the predefined time period is about one minute.

9. A system for determining a stress level of a person in real time, the system comprising:

at least one sensor attached to the person, the plurality of sensors configured to sense at least one stream of arterial pulse palpation signal for a predefined time period;

a transmitter for transmitting the stream of arterial pulse palpation signal;

a storage device; and

a processor coupled to the memory, the processor comprising,

a preprocessing module for preprocessing the stream of arterial pulse palpation signal to extract a plurality of physiological parameters, and

a decision support module for performing a statistical modal analysis of the plurality of physiological parameters and determining the stress level of the person based on the statistical modal analysis.

10. The system of claim 9 further includes a display device for displaying the outcome of the statistical modal analysis.

11. The system of claim 9, wherein the plurality of sensors are at least one of a piezoelectric sensor or a piezoresistive sensor or an array of piezoelectric sensor.

12. The system of claim 9, wherein the decision support module is inbuilt in a smart phone of the user.

13. The system of claim 9, wherein the plurality of sensors are attached to at least one of a wrist, neck, a hip, waist or an ankle of the person.

14. The system of claim 9, wherein the arterial palpation signal is captured from at least one of a temporal artery, a facial artery, a carotid artery, a brachial artery, a radial artery, a femoral artery, a popliteal artery, a popliteal tibial artery and a dorsalis pedis artery of the person.

15. The system of claim 9, wherein the plurality of sensors further include a single lead electrode for sensing the arterial palpation signal.

16. The system of claim 9, wherein the predefined time period is about one minute.

17. The system of claim 9 further includes a user interface to provide additional information for the statistical modal analysis.

18. The system of claim 17, wherein the additional information includes information related to at least one of running, walking, sitting or standing.

19. A non-transitory computer-readable medium having embodied thereon a computer program for determining a stress level of a person in real time, the method comprising:

sensing at least one stream of arterial pulse palpation signal using at least one sensor for a predefined time period;

transmitting the stream of arterial pulse palpation signal by a transmitter to the processor;

preprocessing the stream of arterial pulse palpation signal to extract a plurality of physiological parameters by the processor;

performing a statistical modal analysis of the plurality of physiological parameters by a decision support module; and

determining the stress level of the person using the statistical modal analysis of the plurality of physiological parameters.

* * * * *

专利名称(译)	用于确定人的心理压力的系统和方法		
公开(公告)号	US20160283856A1	公开(公告)日	2016-09-29
申请号	US15/069632	申请日	2016-03-14
申请(专利权)人(译)	塔塔咨询服务服务有限公司		
当前申请(专利权)人(译)	塔塔咨询服务服务有限公司		
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摘要(译)

已经公开了一种用于实时确定人的压力水平的系统。在一个方面，该系统捕获与该人相关的生理数据。在一个实施例中，可以通过使用附着在人的手腕或踝部或颈部或腰部或臀部的多个传感器捕获生理数据达预定的时间间隔。多个传感器可包括手表或腕带或纺织材料。该系统进一步预处理生理数据以便提取一个或多个生理参数。在一个方面，预处理可以包括对生理数据执行分析。系统在对一个或多个生理参数进行统计分析时进一步确定人的压力水平。根据另一实施例，还提供了一种用于实时确定人的压力水平的方法。

