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(54) **METHOD AND SYSTEM FOR MONITORING PAIN OF USERS IMMERSSED IN VIRTUAL REALITY ENVIRONMENT**

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(2013.01); **A61B 5/7246** (2013.01); **A61B 5/744** (2013.01); **G06T 19/006** (2013.01)

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2012/0136274 A1* 5/2012 Burdea A61B 5/04842
600/545

* cited by examiner

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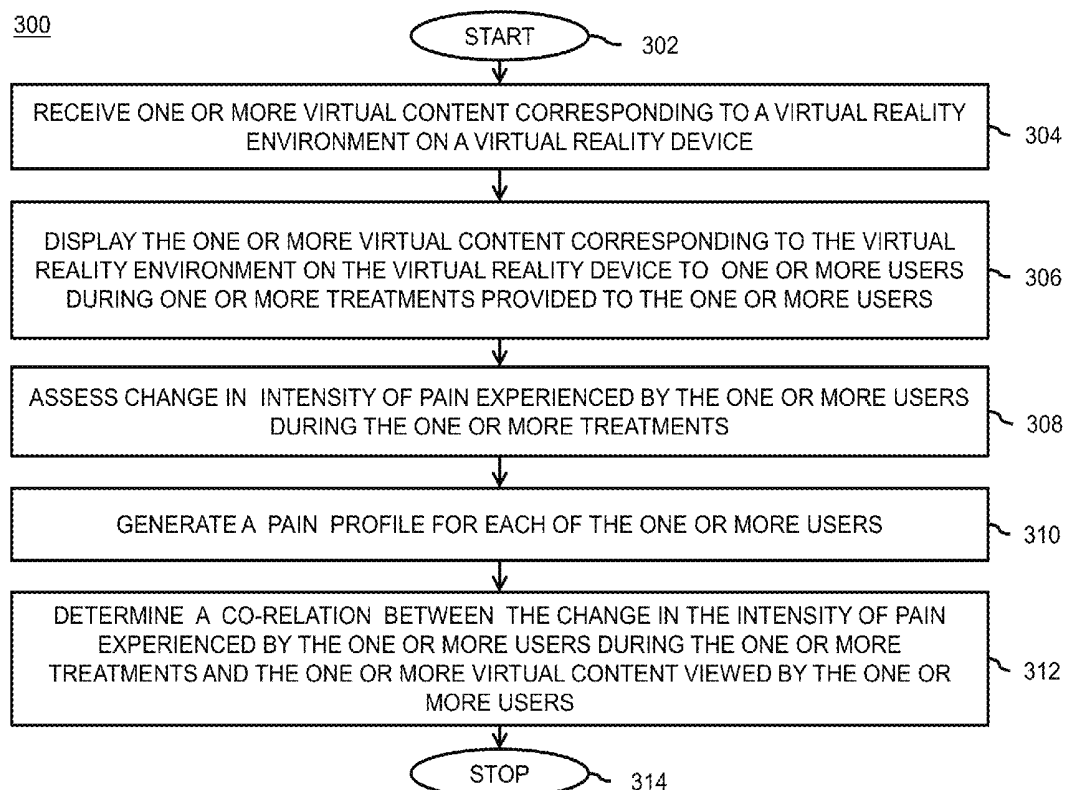
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(57) **ABSTRACT**

The present disclosure provides a method and system for monitoring a change in intensity of pain experienced by one or more users using a virtual reality environment. The method includes receiving one or more virtual content corresponding to the virtual reality environment on a virtual reality device, displaying the one or more virtual content corresponding to the virtual reality environment on the virtual reality device to the one or more users during one or more treatments provided to the one or more users, assessing the change in the intensity of pain experienced by the one or more users during the one or more treatments, generating a pain profile for each of the one or more users and determining a co-relation between the change in the intensity of pain experienced by the one or more users and the one or more virtual content viewed by the one or more users.

17 Claims, 3 Drawing Sheets

300



100

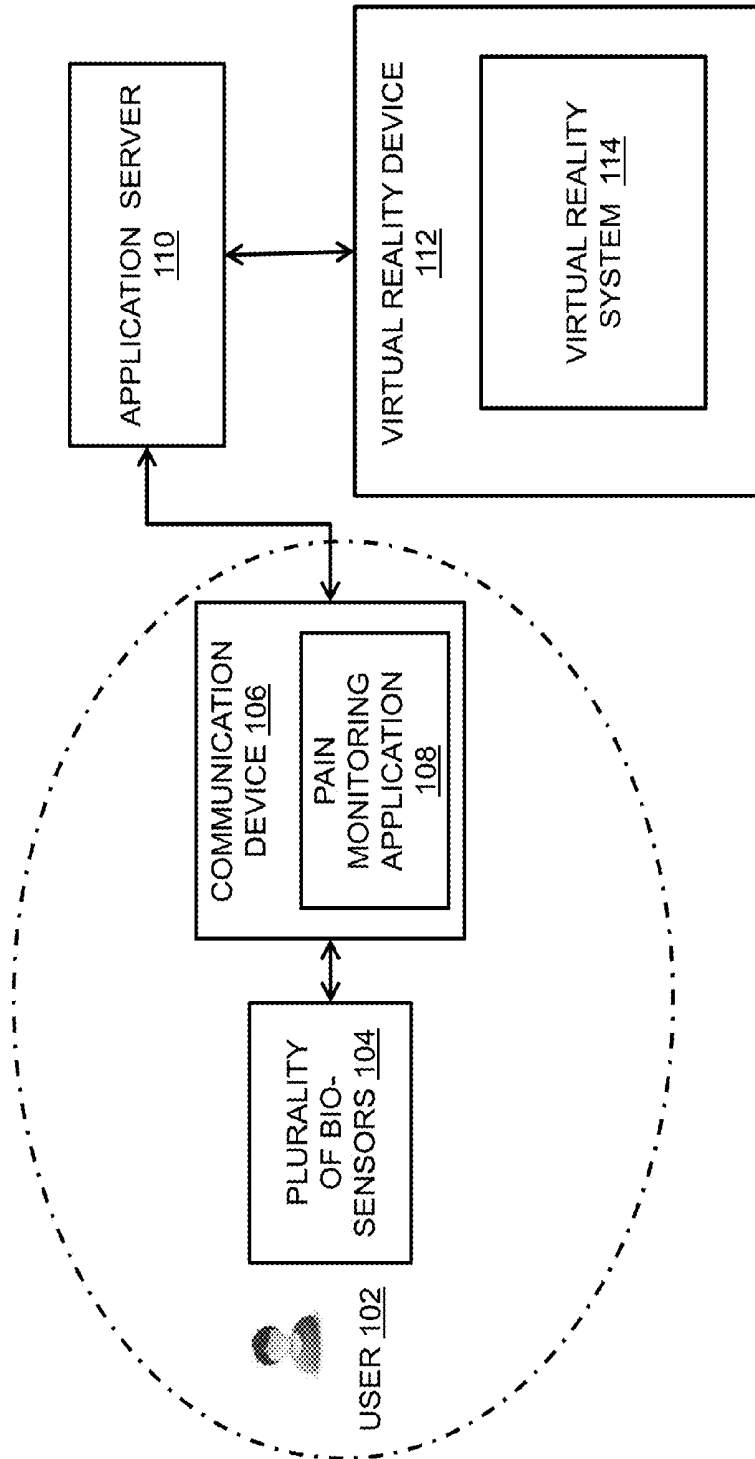


FIG. 1

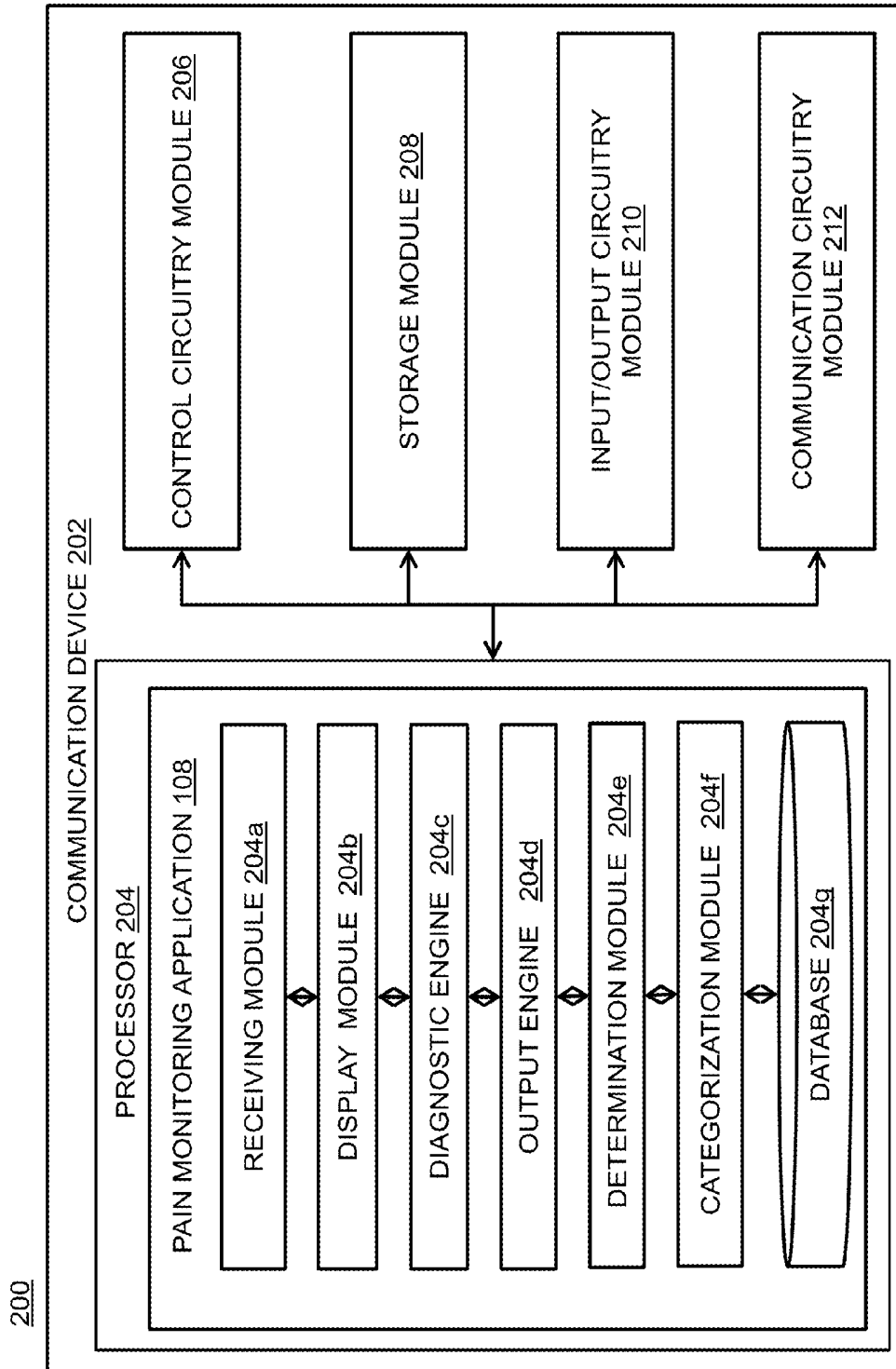


FIG. 2

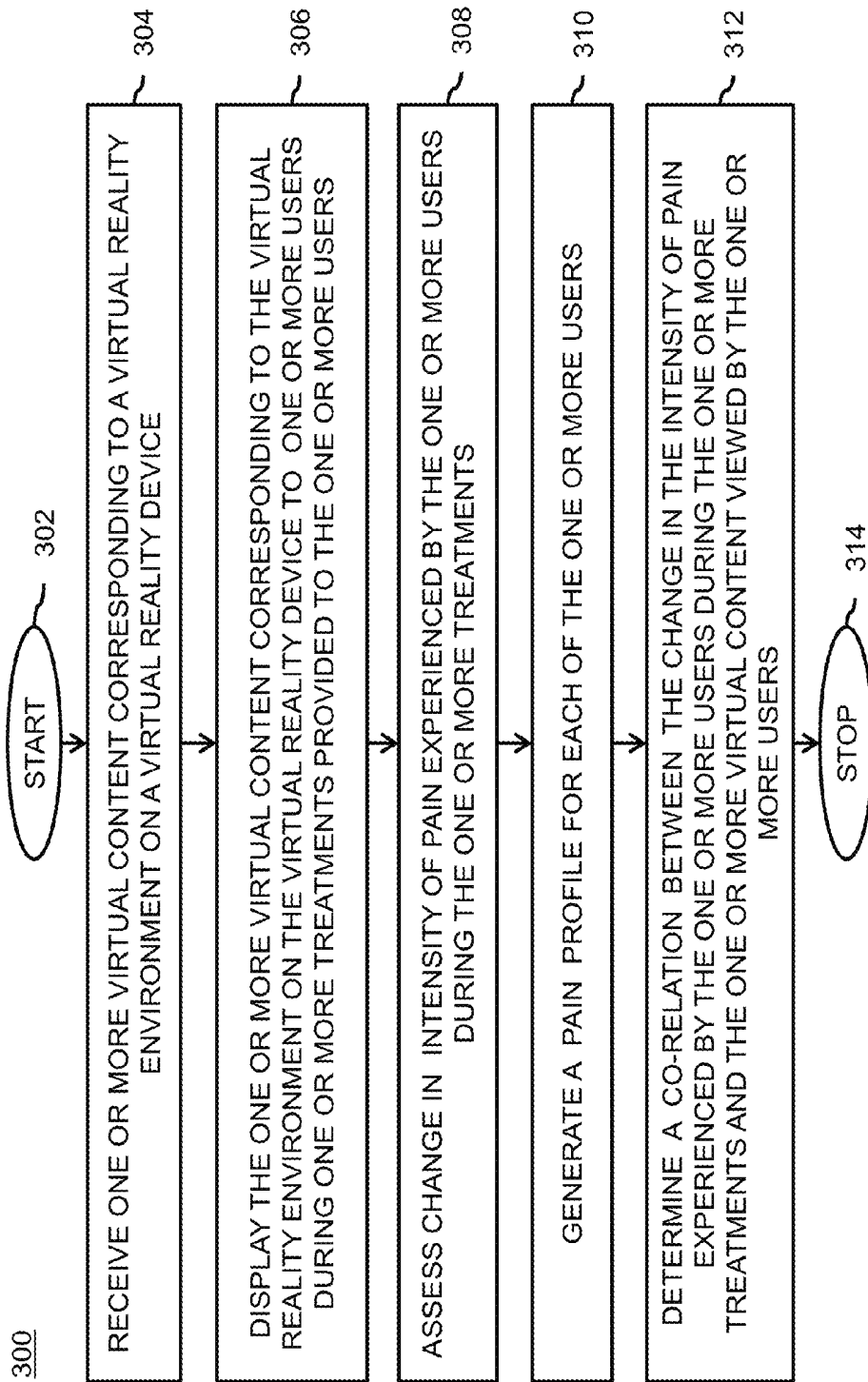


FIG. 3

METHOD AND SYSTEM FOR MONITORING PAIN OF USERS IMMERSSED IN VIRTUAL REALITY ENVIRONMENT

TECHNICAL FIELD

The present invention relates to the field of biomedical technology and, in particular, relates to monitoring pain of users immersed in a virtual reality environment.

BACKGROUND

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage. In fact, the pain is a stressor and environment challenge that requires an organism to respond. It is a specific emotion, caused by a stimulus that reflects homeostatic behavioral drive, similar to temperature, itching, hunger, thirst and the like. It may be categorized according to various factors, including type of damage, time for healing and the like. Experience of the pain varies from person to person due to inter-individual variability. Moreover, intensity of the pain varies from cause to cause in the individual. Thus, pain management is an extremely important issue.

In the present scenario, a method which has gained a great amount of attention in field of biomedical technology is virtual reality therapy. Many medical professionals have started to make use of a virtual reality environment for treating patients suffering from the pain. The virtual reality environment is an artificial environment created using computer systems and sensory simulation devices including visual displays, audio, motion devices and the like. The medical professionals immerse the patients in a virtual reality by using a virtual reality system. Moreover, the virtual reality system combines two or three dimensional images with audio stimuli for creating the virtual reality environment. The virtual reality environment is produced by utilizing a graphic generating computer, a head mounted display with a tracking device, sensory input devices and the like.

The virtual reality systems have been around for a long time. In addition, the virtual reality systems have found various applications in the field of health care and the pain management. The virtual reality systems are used for various medical applications such as computer aided surgery, wheel chair with the virtual reality system, repetitive strain injury and the like. The concept of virtual reality technology was first used for treatment of acrophobia in 1993. Moreover, in the present time, one such method and system that measures the patient's emotions by using one or more sensors is HumanSim system. Another method and system allows the medical professionals to utilize the virtual reality technology for arriving at a particular diagnosis. Yet another method and system allows the medical professionals to conduct a robotic surgery by using the virtual reality technology. Yet another method and system allows the medical professionals to treat soldiers suffering from Post Traumatic Stress Disorder by immersing the soldiers in stress due to war in the virtual reality environment. Several other present systems are known in the art that utilize the virtual reality technology for treatment of the patients. One such system is presented in U.S. Pat. No. 5,546,943 which proposes a use of the virtual reality system for allowing the patient to view their internal anatomy based on data of their medical scan. Another such method and system allows the doctors to reduce the pain of the patients by immersing the patient in a video game virtual reality environment.

The existing methods and systems for treatment of the pain of the patients using the virtual reality technology are not quite feasible. The existing methods and systems do not allow the medical professionals to measure an effect of viewing of virtual reality content on perception of the pain by the patients. Further, the existing methods and systems do not provide information relating to category or types of the patients experiencing a reduction in the pain while viewing the virtual reality content in the virtual reality environment. In addition, the existing methods and systems do not utilize one or more sensors properly for judging an effect of the virtual content on intensity of the pain of the patients. Moreover, the existing methods and systems do not provision the medical professionals to know whether the virtual reality system is truly effective for treatment of the patients or not.

In light of the above stated discussion, there is a need for a method and system that overcomes the above stated disadvantages.

SUMMARY

In an aspect of the present disclosure, a computer-implemented method for monitoring a change in intensity of pain experienced by one or more users using a virtual reality environment is provided. The one or more users wear a virtual reality device. The computer-implemented method includes receiving, with a processor, one or more virtual content corresponding to the virtual reality environment on a virtual reality device; displaying, with the processor, the received one or more virtual content corresponding to the virtual reality environment on the a virtual reality device to the one or more users during one or more treatments provided to the one or more users; assessing, with the processor, the change in the intensity of pain experienced by the one or more users during the one or more treatments; generating, with the processor, a pain profile for each of the one or more users and determining, with the processor, a co-relation between the change in the intensity of pain experienced by the one or more users during the one or more treatments and the one or more virtual content viewed by the one or more users. The virtual reality device is associated with a pain monitoring application. The assessing is performed on a set of pain monitoring scales using a plurality of bio-markers associated with the one or more users. The set of pain monitoring scales is utilized based on an age category for each of the one or more users. The plurality of bio-markers is measured by a plurality of bio-sensors. The generated pain profile shows the change in the intensity of pain experienced by the one or more users. The pain profile for each of the one or more users is viewed by other one or more users on a corresponding plurality of communication devices. The co-relation represents an effect of the one or more virtual content on the intensity of pain of the one or more users.

In an embodiment of the present disclosure, the computer-implemented method further includes categorizing, with the processor, the one or more users based on the change in the intensity of pain of the one or more users and characteristics of the one or more users. Examples of the characteristics of the one or more users utilized for the categorizing include age, gender, mentality, other one or more physical characteristics (for example, weight and height), Body Mass Index, family history or behavior of the one or more users during the one or more treatments.

In another embodiment of the present disclosure, the computer-implemented method further includes storing,

with the processor, the one or more virtual content viewed by the one or more users, the characteristics of the one or more users, the generated pain profile of the one or more users and the plurality of bio-markers associated with the one or more users.

In an embodiment of the present disclosure, the one or more virtual content includes one or more video content, one or more image content, one or more text content and one or more graphic content.

In an embodiment of the present disclosure, the plurality of bio-markers includes heart rate, heart rate variability (HRV), blood flow, blood pressure, movements due to shifts in central blood mass and myocardial electrophysiological responses, respiration information, emotions, skin conductance, Photoplethysmography (PPG), oxygen saturation, electrocardiography (ECG), electroencephalography (EEG), muscle activity (EMG), accelerometer, EOG, temperature, blood glucose, systolic contraction, systemic resistance and cardiac output. Each of the plurality of bio-markers is projected on one or more screens for viewing by the other one or more users

In an embodiment of the present disclosure, the plurality of bio-sensors includes a finger based pulse oximeter, an accelerometer, a respiration monitor, a non-invasive glucose sensor and a 1-lead disposable electrocardiography (ECG) patch.

In an embodiment of the present disclosure, a first type of pain monitoring scales from the set of pain monitoring scales is utilized for assessing the change in the intensity of pain for a first set of users of the one or more users belonging to the age category of adult patients. The first type of pain monitoring scales includes any accepted pain scale including a Visual Analog Scale (VAS), a Verbal Numeric Rating Scale (VNRS), a Brief Pain inventory (BPI), a behavioral pain scale (BPS), a descriptor differential scale (DDS), a dolorimeter pain index (DPI), a neck pain and disability scale and a Visual Descriptive System (VDS).

In an embodiment of the present disclosure, a second type of pain monitoring scales from the set of pain monitoring scales is utilized for assessing the change in the intensity of pain for a second set of users of the one or more users belonging to the age category of pediatric patients. The second type of pain monitoring scales includes any accepted pediatric pain monitoring scale including a physician defined scale, a neonatal pain agitation and sedation scale (N-PASS), a pain assessment tool (PAT), a bernese pain scale for one or more neonates (BPSN), a Wong-Baker scale and a face, legs, activity, crying, and consolability (FLACC) scale.

In another aspect of the present disclosure, a computer system is provided. The computer system includes a non-transitory computer readable medium storing a computer readable program; the computer readable program when executed on a computer causes the computer to perform steps. The steps include receiving one or more virtual content corresponding to a virtual reality environment on a virtual reality device, displaying the received one or more virtual content corresponding to the virtual reality environment on the virtual reality device to one or more users during one or more treatments provided to the one or more users, assessing a change in intensity of pain experienced by the one or more users during the one or more treatments, generating a pain profile for each of the one or more users and determining a co-relation between the change in the intensity of pain experienced by the one or more users during the one or more treatments and the one or more virtual content viewed by the one or more users. The virtual

reality device is associated with a pain monitoring application. The assessing is performed on a set of pain monitoring scales using a plurality of bio-markers associated with the one or more users. The set of pain monitoring scales is determined and utilized based on an age category for each of the one or more users. The plurality of bio-markers is measured by a plurality of bio-sensors. The generated pain profile shows the change in the intensity of pain experienced by the one or more users. The pain profile for each of the one or more users is viewed by other one or more users on a corresponding plurality of communication devices. The correlation represents an effect of the one or more virtual content on the intensity of pain of the one or more users.

In an embodiment of the present disclosure, the computer readable program when executed on the computer causes the computer to perform a further step of categorizing the one or more users based on the change in the intensity of pain of the one or more users and characteristics of the one or more users. The characteristics of the one or more users utilized for the categorizing include age, gender, mentality, other one or more physical characteristics (for example, weight and height), Body Mass Index, family history or behavior of the one or more users during the one or more treatments.

In another embodiment of the present disclosure, the computer readable program when executed on the computer causes the computer to perform a further step of storing the one or more virtual content viewed by the one or more users, the characteristics of the one or more users, the generated pain profile of the one or more users and the plurality of bio-markers associated with the one or more users.

In an embodiment of the present disclosure, the one or more virtual content includes one or more video content, one or more image content, one or more text content and one or more graphic content.

In an embodiment of the present disclosure, the plurality of bio-markers includes heart rate, heart rate variability (HRV), blood flow, blood pressure, movements due to shifts in central blood mass and myocardial electrophysiological responses, respiration information, emotions, skin conductance, Photoplethysmography (PPG), oxygen saturation, electrocardiography (ECG), electroencephalography (EEG), muscle activity (EMG), accelerometer, EOG, temperature, blood glucose, systolic contraction, systemic resistance and cardiac output. Each of the plurality of bio-markers is projected on one or more screens for viewing by the other one or more users

In yet another aspect of the present disclosure, a system for monitoring a change in intensity of pain experienced by one or more users using a virtual reality environment is provided. The system includes a virtual reality device provided to the one or more users for viewing one or more virtual content during one or more treatments and a communication device. The communication device further includes a pain monitoring application to monitor the change in the intensity of pain experienced by the one or more users. The pain monitoring application further includes a receiving module in a processor, the receiving module is configured to receive the one or more virtual content corresponding to the virtual reality environment on the virtual reality device; a display module in the processor, the display module is configured to display the received one or more virtual content corresponding to the virtual reality environment on the virtual reality device to the one or more users during the one or more treatments provided to the one or more users; a diagnostic engine in the processor, the diagnostic engine is configured to assess the change in the intensity of pain experienced by the one or more users during the one or more

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treatments; an output engine in the processor, the output engine is configured to generate a pain profile for each of the one or more users and a determination module in the processor, the determination module is configured to determine a co-relation between the change in the intensity of pain experienced by the one or more users during the one or more treatments and the one or more virtual content viewed by the one or more users. The one or more virtual content is received from a virtual reality system. The assessing is performed on a set of pain monitoring scales using a plurality of bio-markers associated with the one or more users. The set of pain monitoring scales is determined and utilized based on an age category for each of the one or more users. The plurality of bio-markers is measured by a plurality of bio-sensors. The generated pain profile shows the change in the intensity of pain experienced by the one or more users. The pain profile for each of the one or more users is viewed by other one or more users on a corresponding plurality of communication devices. The co-relation represents an effect of the one or more virtual content on the intensity of pain of the one or more users.

In an embodiment of the present disclosure, the system further includes a categorization module in the processor, the categorization module is configured to categorize the one or more users based on the change in the intensity of pain of the one or more users and characteristics of the one or more users. The characteristics of the one or more users utilized for the categorizing include age, gender, mentality, other one or more physical characteristics (for example, weight and height), Body Mass Index, family history or behavior of the one or more users during the one or more treatments.

In another embodiment of the present disclosure, the system further includes a database in the processor, the database is configured to store the one or more virtual content viewed by the one or more users, the characteristics of the one or more users, the generated pain profile of the one or more users and the plurality of bio-markers associated with the one or more users.

In an embodiment of the present disclosure, the one or more virtual content includes one or more video content, one or more image content, one or more text content and one or more graphic content.

In an embodiment of the present disclosure, the plurality of bio-markers includes heart rate, heart rate variability (HRV), blood flow, blood pressure, movements due to shifts in central blood mass and myocardial electrophysiological responses, respiration information, emotions, skin conductance, Photoplethysmography (PPG), oxygen saturation, electrocardiography (ECG), electroencephalography (EEG), muscle activity (EMG), accelerometer, EOG, temperature, blood glucose, systolic contraction, systemic resistance and cardiac output. Each of the plurality of bio-markers is projected on one or more screens for viewing by the other one or more users.

In an embodiment of the present disclosure, a first type of pain monitoring scales from the set of pain monitoring scales is utilized for assessing the change in the intensity of pain for a first set of users of the one or more users belonging to the age category of adult patients. The first type of pain monitoring scales includes any accepted pain scale including a Visual Analog Scale (VAS), a Verbal Numeric Rating Scale (VNRS), a Brief Pain inventory (BPI), a behavioral pain scale (BPS), a descriptor differential scale (DDS), a dolorimeter pain index (DPI), a neck pain and disability scale and a Visual Descriptive System (VDS).

In an embodiment of the present disclosure, a second type

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scales is utilized for assessing the change in the intensity of pain for a second set of users of the one or more users belonging to the age category of pediatric patients. The second type of pain monitoring scales includes any accepted pediatric pain monitoring scale including a physician defined scale, a neonatal pain agitation and sedation scale (N-PASS), a pain assessment tool (PAT), a bernese pain scale for one or more neonates (BPSN), a Wong-Baker scale and a face, legs, activity, crying, and consolability (FLACC) scale.

BRIEF DESCRIPTION OF THE FIGURES

Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 illustrates a system for monitoring a change in intensity of pain of one or more users, in accordance with various embodiments of the present disclosure;

FIG. 2 illustrates a block diagram of a communication device, in accordance with various embodiments of the present disclosure; and

FIG. 3 is a flowchart for monitoring the change in the intensity of the pain of the one or more users, in accordance with the various embodiments of the present disclosure.

DETAILED DESCRIPTION

It should be noted that the terms “first”, “second”, and the like, herein do not denote any order, quantity, or importance, but rather are used to distinguish one element from another. Further, the terms “a” and “an” herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.

FIG. 1 illustrates a system **100** for showing an interaction among various components for monitoring a change in intensity of pain experienced by one or more users using a virtual reality environment, in accordance with various embodiments of the present disclosure. The system **100** includes a plurality of bio-sensors **104**, a communication device **106** associated with a user **102**, an application server **110**, a virtual reality device **112** and a virtual reality system **114**. The user **102** may be a healthy individual or a patient suffering from the pain. Further, the user **102** is associated with the plurality of bio-sensors **104**. The plurality of bio-sensors **104** fetch a plurality of bio-markers associated with the user **102** in real time.

The plurality of bio-sensors **104** include but may not be limited to a finger based pulse oximeter, an accelerometer, a respiration monitor, a non-invasive glucose sensor and a 1-lead disposable electrocardiography (ECG) patch. The plurality of bio-markers includes markers such as heart rate (hereinafter ‘HR’), heart rate variability (hereinafter ‘HRV’), blood flow, blood pressure (hereinafter ‘BP’), movements due to shifts in central blood mass and myocardial electrophysiological responses, respiration information, emotions, skin conductance, Photoplethysmography (hereinafter ‘PPG’), oxygen saturation, electrocardiography (hereinafter ‘ECG’), electroencephalography (hereinafter ‘EEG’), muscle activity (hereinafter ‘EMG’), accelerometer, EOG, temperature, blood glucose, systolic contraction, systemic resistance, cardiac output, and the like.

In addition, the communication device **106** is associated with the user **102**. Examples of the communication device **106** include but may not be limited to mobile phone, tablet, laptop and desktop computer. The communication device **106** executes a pain monitoring application **108**. The pain

monitoring application **108** monitors the pain of the user **102** and allows tailoring of treatments accordingly. The pain monitoring application **108** communicates with the application server **110** via a communications network. The communications networks include but may not be limited to a local area network, a wide area network, a metropolitan area network, a virtual private network, a personal area network, a digital or analog cable television network or any other communication network presently known in the art.

Variability in the plurality of bio-markers associated with the user **102** corresponds to autonomic reactions. These symptoms (the autonomic reactions) are analyzed by the pain monitoring application **108** to analyze location and the intensity of the pain in body of the user **102**. In addition, the pain monitoring application **108** generates a preliminary pain profile for the user **102** based on the fetched plurality of bio-markers by the plurality of bio-sensors **104**. In an embodiment of the present disclosure, the preliminary pain profile depicts the intensity of the pain corresponding to the user **102**. The preliminary pain profile depicts the intensity of the pain of the user **102** currently not immersed in the virtual reality environment.

Further, the application server **110** is associated with the virtual reality device **112**. The virtual reality device **112** includes but may not be limited to Google glass, Oculus VR, Virtual Boy, Sega VR, Head mounted display, Data glove or any other wearable device capable of displaying a virtual reality scene to the user **102**. In an embodiment of the present disclosure, the virtual reality device **112** is provided to the user **102** of the one or more users during one or more treatments corresponding to a medical condition of the user **102**.

In addition, the virtual reality device **112** is associated with the virtual reality system **114**. The virtual reality device **112** provides one or more virtual content to the user **102**. The one or more virtual content corresponds to the virtual reality environment. The virtual reality system **114** includes but may not be limited to an Immersive virtual reality system, Window on the world, Real time Tele presence and augmented virtual reality. In an embodiment of the present disclosure, the virtual reality environment corresponds to an artificial environment shown to the user **102** during the one or more treatments. In an embodiment of the present disclosure, the virtual reality system **114** provides the one or more virtual content to the user **102** on the virtual reality device **112**. The one or more virtual content includes one or more video content, one or more image content, one or more graphics content and the like.

In an embodiment of the present disclosure, the application server **110** is associated with the virtual reality system **114** through the virtual reality device **112**. In another embodiment of the present disclosure, the pain monitoring application **108** is associated with the virtual reality system **114** through the application server **110**. The virtual reality system **114** provides the one or more virtual content to the pain monitoring application **108**.

It may be noted that in FIG. 1, the pain monitoring application **108** facilitates the monitoring of the change in the intensity of the pain of the user **102**; however, those skilled in the art would appreciate that the pain monitoring application **108** facilitates the monitoring of the change in the intensity of the pain of more users. It may also be noted that the user **102** is associated with the communication device **106**; however, those skilled in the art would appreciate that the user **102** may be associated with more than one communication devices having the pain monitoring application **108** installed. It may also be noted that the virtual

reality system **114** provides the one or more virtual content to the user **102**; however, those skilled in the art would appreciate that the virtual reality system **114** provides the one or more virtual content to more users.

FIG. 2 illustrates a block diagram **200** of a communication device **202**, in accordance with various embodiments of the present disclosure. It may be noted that to explain the system elements of FIG. 2, references will be made to the system elements of FIG. 1. The communication device **202** includes a processor **204**, a control circuitry module **206**, a storage module **208**, an input/output circuitry module **210** and a communication circuitry module **212**. Further, the processor **204** includes a receiving module **204a**, a display module **204b**, a diagnostic engine **204c**, an output engine **204d**, a determination module **204e**, a categorization module **204f** and a database **204g**. The above stated components of the processor **204** enable working of the pain monitoring application **108** for monitoring the change in the intensity of the pain experienced by the user **102** using the virtual reality environment displayed on the virtual reality device **112** during the one or more treatments.

The receiving module **204a** in the processor **204** receives the one or more virtual content corresponding to the virtual reality environment on the virtual reality device **112**. The one or more virtual content is received during the one or more treatments on the virtual reality device **112**. In an embodiment of the present disclosure, the one or more virtual content is received from the virtual reality system **114**. The one or more virtual content corresponds to the virtual reality environment. In an embodiment of the present disclosure, the virtual reality environment is the artificial environment created by the virtual reality system **114** provided to the user **102** during the one or more treatments.

The display module **204b** in the processor **204** displays the received one or more virtual content corresponding to the virtual reality environment to the user **102** through the virtual reality device **112** during the one or more treatments. The user **102** views the one or more virtual content on the virtual reality device **112**. In an embodiment of the present disclosure, the displayed one or more virtual content is based on characteristics of the user **102**. The characteristics of the user **102** include but may not be limited to age of the user **102**, gender of the user **102**, popular visiting destinations corresponding to the user **102**, popular shows and games corresponding to the user **102** and the like. In an embodiment of the present disclosure, the user **102** is immersed in the virtual reality environment during the one or more treatments. In another embodiment of the present disclosure, the one or more virtual content is displayed for distracting the user **102** from the pain encountered during the one or more treatments.

For example, a user X is a male of age 48 suffering from first stage lung cancer and a user Y is a male of age 12 is suffering from brain tumor. The user X is provided with a chemotherapy treatment for treatment of the lung cancer by a medical practitioner K and the user Y is provided with a radiotherapy treatment for treatment of the brain tumor by a medical practitioner L. The user X and the user Y suffer excruciating pain during the chemotherapy treatment and the radiotherapy treatment. The pain monitoring application **108** generates a pain profile (the preliminary pain profile as stated above in the patent application) for the user X and the user Y. The pain profile depicts a current intensity of the pain experienced by the user X and the user Y. The medical practitioner K provides the user X with a virtual reality device (say Virtual Boy) and the medical practitioner L provides the user Y with a virtual reality device Samsung

Gear VR. The user X wears the virtual reality device Virtual Boy and the user Y wears the virtual reality device Samsung Gear VR. The user X views a virtual content in a form of a first scene of his mother in a waiting room and a second scene of a beach near his home on the virtual reality device Virtual Boy. The user Y views a virtual content in a form of a first scene of his favorite movie and a second scene of a religious place the user Y visits on the virtual reality device Samsung Gear VR.

Further, the diagnostic engine **204c** in the processor **204** assesses the change in the intensity of the pain experienced by the user **102** during the one or more treatments while viewing the one or more virtual content on the virtual reality device **112**. In an embodiment of the present disclosure, the diagnostic engine **204c** fetches the plurality of bio-markers associated with the user **102** by the plurality of bio-sensors **104**. In addition, the diagnostic engine **204c** performs the assessing on a set of pain monitoring scales using the fetched plurality of bio-markers associated with the user **102**. Further, the set of pain monitoring scales are utilized based on an age category of the user **102**. The plurality of bio-markers is measured by a plurality of bio-sensors. A change in statistical value of the plurality of bio-markers corresponding to the user **102** depicts the change in the intensity of the pain experienced by the user **102** during the one or more treatments.

In an embodiment of the present disclosure, a first type of pain monitoring scales from the set of pain monitoring scales are utilized for assessing the change in the intensity of pain for a first set of users of the one or more users belonging to the age category of adult patients. In addition, the first type of pain monitoring scales includes any accepted pain scale including a Visual Analog Scale (VAS), a Verbal Numeric Rating Scale (VNRS), a Brief Pain inventory (BPI), a behavioral pain scale (BPS), a descriptor differential scale (DDS), a dolorimeter pain index (DPI), a neck pain and disability scale, a Visual Descriptive System (VDS) and the like.

In an embodiment of the present disclosure, a second type of pain monitoring scales from the set of pain monitoring scales are utilized for assessing the change in the intensity of pain for a second set of users of the one or more users belonging to the age category of pediatric patients. Moreover, the second type of pain monitoring scales includes any accepted pediatric pain monitoring scale including a physician defined scale, a neonatal pain agitation and sedation scale (N-PASS), a pain assessment tool (PAT), a bernese pain scale for one or more neonates (BPSN), a Wong-Baker scale, a face, legs, activity, crying, and consolability (FLACC) scale and the like.

Continuing with the above stated example, the diagnostic engine **204c** assesses the change in the intensity of the pain of the user X while viewing the virtual content (the first scene and the second scene) on the virtual reality device Virtual Boy during the chemotherapy treatment and the change in the intensity of the pain of the user Y while viewing the virtual content (the first scene and the second scene) on the virtual reality device Samsung Gear VR during the radiotherapy treatment. The diagnostic engine **204c** fetches the plurality of bio-markers associated with the user X and the user Y.

Moreover, the output engine **204d** in the processor **204** generates a pain profile for the user **102** while viewing the one or more virtual content during the one or more treatments provided to the user **102**. The generated pain profile shows the change in the intensity of the pain experienced by the user **102**. Further, the generated pain profile includes the

information relating to the plurality of bio-markers fetched by the diagnostic engine **204c**. In addition, the pain profile for each of the one or more users is viewed by other one or more users on a corresponding plurality of communication devices. The plurality of communication devices includes a mobile phone, a laptop, a desktop computer and the like. In an embodiment of the present disclosure, the plurality of communication devices enables the other one or more users to assess the intensity of pain experienced by the user **102**.

Moreover, the output engine **204d** generates the pain profile for the user **102** by analyzing the intensity of the pain experienced by the user **102**. In an embodiment of the present disclosure, the intensity of the pain is analyzed for each increment between a former level of the pain and a next level of the pain. In another embodiment of the present disclosure, the pain profile is a newly generated pain profile for the user **102**. In another embodiment of the present disclosure, the change in the intensity of the pain is assessed against the intensity of the pain depicted by the preliminary pain profile generated for the user **102** (as described above in the detailed description of FIG. 1). In yet another embodiment of the present disclosure, the previously generated pain profile (the preliminary pain profile) depicts the intensity of the pain when the user **102** is not provided with the virtual reality device **112** for viewing the one or more virtual content.

Extending the above stated example, the output engine **204d** generates the pain profile for the user X while viewing the virtual content during the chemotherapy treatment and the pain profile for the user Y while viewing the virtual content during the radiotherapy treatment. The pain profile depicts a statistical change in the intensity of the pain shown by the values of the plurality of bio-markers as compared to the values of the plurality of the bio-markers depicted in the previously generated pain profile (the preliminary pain profile) of the user X and the user Y.

Going further, the determination module **204e** in the processor **204** determines a co-relation between the change in the intensity of the pain experienced by the user **102** during the one or more treatments and the one or more virtual content viewed by the user **102**. The determining of the co-relation between the change in the intensity of the pain and the one or more virtual content is based on the pain profile generated for the user **102** by the output engine **204d**. Further, the determination module **204e** determines the co-relation between the change in the intensity of the pain and the one or more virtual content for studying an effect of viewing the one or more virtual content by the user **102** on the intensity of the pain of the user **102**.

In an embodiment of the present disclosure, the co-relation between the change in the intensity of the pain and the one or more virtual content depicts an effect of distracting the user **102** by immersing the user **102** in the virtual reality environment on the intensity of the pain of the user **102**. The change in the intensity of the pain is depicted by the pain profile generated by the output engine **204d** for the user **102**.

In an embodiment of the present disclosure, the determination module **204e** determines the co-relation between the changed pain profile of the user **102** and the one or more virtual content viewed by the user **102**.

Continuing with the above stated example, the determination module **204e** determines the co-relation for the user X between the change in the intensity of the pain depicted in the generated pain profile of the user X and the virtual content viewed by the user X on the virtual reality device Virtual Boy. The determination module **204e** depicts a

significant decrease in the intensity of the pain of the user X while viewing the virtual content (the first scene of his mother in the waiting room and the second scene of the beach near his home). Similarly, the determination module **204e** determines the co-relation for the user Y between the change in the intensity of the pain depicted in the generated pain profile of the user Y and the virtual content viewed by the user Y on the virtual reality device Samsung Gear VR. The determination module **204e** depicts a slight decrease in the intensity of the pain of the user Y while viewing the virtual content (the first scene of his favorite movie and the second scene of the religious place the user Y visits).

In another embodiment of the present disclosure, the co-relation between the change in the intensity of the pain and the one or more virtual content helps one or more medical practitioners to determine whether the virtual reality system **114** is useful in reducing the intensity of the pain experienced by the user **102**. In yet another embodiment of the present disclosure, the co-relation between the change in the intensity of the pain and the one or more virtual content helps in studying the effect of the one or more virtual content on the intensity of the pain of the user **102**. In yet another embodiment of the present disclosure, the co-relation is performed for determining a change in perception of the pain of the user **102** and the other one or more users.

For example, a dentist A performs a root canal procedure on a patient B and provides the patient B with a virtual reality device Data Glove. The dentist A places one or more bio-sensors on body of the patient B for measuring one or more bio-markers associated with the patient B. The patient B uses the data glove while going through the root canal treatment. The dentist A recognizes a change in statistical value of the one or more bio-markers associated with the patient B and recognizes a decrease in the pain of the patient B.

In addition, the categorization module **204f** in the processor **204** categorizes the user **102** and other one or more users based on the change in the intensity of the pain experienced by the user **102** and the other one or more users and the characteristics of the user **102**. In an embodiment of the present disclosure, the categorization module **204f** categorizes the user **102** and the other one or more users into one or more groups of users based on the change in the intensity of the pain. In another embodiment of the present disclosure, the categorization of the user **102** and the other one or more users is performed for noticing one or more types of users from the one or users experiencing a decrease in the intensity of the pain. The one or more types of users are categorized based on the characteristics of the user **102** and the other one or more users. The characteristics of the one or more users utilized for the categorizing include age, gender, mentality, other one or more physical characteristics (for example, weight and height), Body Mass Index, family history, behavior of the one or more users during the one or more treatments and the like.

Moreover, the database **204g** in the processor stores the generated pain profile of the user **102**, the fetched plurality of bio-markers of the user **102**, the characteristics of the user **102** and the one or more virtual content viewed by the user **102**.

In an embodiment of the present disclosure, the one or more pain monitoring scales are utilized to measure the intensity of the pain experienced by the user **102**. The one or more pain monitoring scales include but may not be limited to a visual analog scale (VAS), a Verbal Numeric Rating Scale (VNRS), a Brief Pain inventory (BPI) and a Visual Descriptive System (VDS), a behavior pain scale (BPS), a

descriptor differential scale (DDS), a dolorimeter pain index (DPI), a neck pain and disability scale, a physician defined scale, a neonatal pain agitation and sedation scale (N-PASS), a pain assessment tool (PAT), a bernese pain scale for one or more neonates (BPSN), a Wong-Baker scale and a face, legs, activity, crying, and consolability (FLACC) scale. The scales used may vary as deemed appropriate by the physician and may depend upon the age and maturity of the user.

In another embodiment of the present disclosure, the intensity of the pain experienced by the user **102** is increased and measured several times on the user **102** to check consistency of, and improve upon the learned information with new observations. For example, the new observations are generated when the intensity of the pain experienced by the user **102** is increased or decreased again one or more times.

In yet another embodiment of the present disclosure, the method is repeated several times to obtain improved machine learning.

In an embodiment of the present disclosure, each of the plurality of bio-markers is projected on one or more screens for viewing by the other one or more users. In another embodiment of the present disclosure, the projecting is done for allowing the other one or more users to assess the intensity of pain. In an embodiment of the present disclosure, the other one or more users are in vicinity of the user **102**. In another embodiment of the present disclosure, the other one or more users are remotely located from the user **102**. The other one or more users include one or more doctors, parents or any other person.

In yet another embodiment of the present disclosure, the generated pain profile for the user **102** utilizes a pre-defined color coding based on the intensity and the location of the pain in the body of the user **102**. Intensity of the colors increases proportionally with respect to the pain experienced by the user **102**. Moreover, the intensity of the colors may differentiate areas in the body of the user **102** that are most susceptible to the pain. Further, the intensity of the colors may segregate affected or bruised areas in the body of the user **102** with healthy areas.

In yet another embodiment of the present disclosure, the pain monitoring application **108** may be used in various fields including dental treatment, medical treatment, sports/athletics, occupational health and the like. For example, a dental hygienist may utilize the pain monitoring application **108** to assist cleaning of patient's teeth.

In yet another embodiment of the present disclosure, the communication device **202** is associated with the plurality of bio-sensors **104** via the network (for e.g., LAN, WAN, MAN, Bluetooth, Wi-Fi and the like). Thus, the communication device **202** collects the inputs relating to the autonomic reactions including the heart rate variability, the galvanic skin response, the amount of pressure applied and the like from the user **102**.

In yet another embodiment of the present disclosure, the pain profile for the user **102** is generated by using any combination of sensors from the plurality of bio-sensors **104**.

In yet another embodiment of the present disclosure, the intensity of the pain is characterized by tremendous inter-individual variability and is different for different persons. It can be controlled by biological factors (gender, genetics and the like), psychological factors (mood, attention and the like) and social factors (marital status), experimental factors and the like. For example, a patient (user **102**) who is experiencing a chronic pain may not report same pain level as those who are new to the pain experience.

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In yet another embodiment of the present disclosure, treatment of the user **102** is based on his phenotypical characteristics, genotypical characteristics and mental attributes.

In yet another embodiment of the present disclosure, the virtual reality environment corresponds to a three dimensional, interactive and computer generated reality.

In yet another embodiment of the present disclosure, the virtual reality system **114** controls sensory experience of the user **102**.

In yet another embodiment of the present disclosure, the virtual reality system **114** is made up of one or more hardware components and one or more software components. The one or more hardware components include primary interfaces, tracking interfaces, visual interfaces, auditory interfaces, haptic interfaces, olfactory interfaces and the like. The one or more software components include but may not be limited to an input process, simulation process, rendering process and a world database.

Going further, the communication device **202** includes any suitable type of portable electronic device. Examples of the communication device **202** include but may not be limited to a personal e-mail device (e.g., a BlackBerry™ made available by Research in Motion of Waterloo, Ontario), a personal data assistant ("PDA"), a cellular telephone, a Smartphone, a handheld gaming device, a digital camera, the laptop computer, and a tablet computer. In another embodiment of the present disclosure, the communication device **202** can be a desktop computer.

From the perspective of this disclosure, the control circuitry module **206** includes any processing circuitry or processor operative to control the operations and performance of the communication device **202**. For example, the control circuitry module **206** may be used to run operating system applications, firmware applications, media playback applications, media editing applications, or any other application. In an embodiment, the control circuitry module **206** drives a display and process inputs received from a user interface.

From the perspective of this disclosure, the storage module **208** includes one or more storage mediums including a hard-drive, solid state drive, flash memory, permanent memory such as ROM, any other suitable type of storage component, or any combination thereof. The storage module **208** may store, for example, media data (e.g., music and video files), application data (e.g., for implementing functions on the communication device **202**).

From the perspective of this disclosure, the input/output circuitry module **210** may be operative to convert (and encode/decode, if necessary) analog signals and other signals into digital data. In an embodiment, the input/output circuitry module **210** may also convert the digital data into any other type of signal and vice-versa. For example, the input/output circuitry module **210** may receive and convert physical contact inputs (e.g., from a multi-touch screen), physical movements (e.g., from a mouse or sensor), analog audio signals (e.g., from a microphone), or any other input. The digital data may be provided to and received from the control circuitry module **206**, the storage module **208** or any other component of the communication device **202**.

It may be noted that the input/output circuitry module **210** is illustrated in FIG. 2 as a single component of the communication device **202**; however, those skilled in the art would appreciate that several instances of the input/output circuitry module **210** may be included in the communication device **202**.

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The communication device **202** may include any suitable interface or component for allowing the user **102** to provide inputs to the input/output circuitry module **210**. The communication device **202** may include any suitable input mechanism. Examples of the input mechanism include but may not be limited to a button, keypad, dial, a click wheel, and a touch screen. In an embodiment, the communication device **202** may include a capacitive sensing mechanism, or a multi-touch capacitive sensing mechanism.

In an embodiment, the communication device **202** may include specialized output circuitry associated with output devices such as, for example, one or more audio outputs. The audio output may include one or more speakers built into the communication device **202**, or an audio component that may be remotely coupled to the communication device **202**.

The one or more speakers can be mono speakers, stereo speakers, or a combination of both. The audio component can be a headset, headphones or ear buds that may be coupled to the communication device **202** with a wire or wirelessly.

In an embodiment, the input/output circuitry module **210** may include display circuitry for providing a display visible to the user **102**. For example, the display circuitry may include a screen (e.g., an LCD screen) that is incorporated in the communication device **202**.

The display circuitry may include a movable display or a projecting system for providing a display of content on a surface remote from the communication device **202** (e.g., a video projector). In an embodiment, the display circuitry may include a coder/decoder to convert digital media data into the analog signals. For example, the display circuitry may include video Codecs, audio Codecs, or any other suitable type of Codec.

The display circuitry may include display driver circuitry, circuitry for driving display drivers or both. The display circuitry may be operative to display content. The display content can include media playback information, application screens for applications implemented on the electronic device, information regarding ongoing communications operations, information regarding incoming communications requests, or device operation screens under the direction of the control circuitry module **206**. Alternatively, the display circuitry may be operative to provide instructions to a remote display.

In addition, the communication device **202** includes the communication circuitry module **212**. The communication circuitry module **212** may include any suitable communication circuitry operative to connect to a communication network and to transmit communications (e.g., voice or data) from the communication device **202** to other devices within the communications network. The communication circuitry module **212** may be operative to interface with the communication network using any suitable communication protocol. Examples of the communication protocol include but may not be limited to Wi-Fi, Bluetooth RTM, radio frequency systems, infrared, LTE, GSM, GSM plus EDGE, CDMA, and quadband.

In an embodiment, the communication circuitry module **212** may be operative to create a communications network using any suitable communications protocol. For example, the communication circuitry module **212** may create a short-range communication network using a short-range communications protocol to connect to other devices. For example, the communication circuitry module **212** may be operative to create a local communication network using the Bluetooth, RTM protocol to couple the communication device **202** with a Bluetooth, RTM headset.

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It may be noted that the computing device is shown to have only one communication operation; however, those skilled in the art would appreciate that the communication device **202** may include one more instances of the communication circuitry module **212** for simultaneously performing several communication operations using different communication networks. For example, the communication device **202** may include a first instance of the communication circuitry module **212** for communicating over a cellular network, and a second instance of the communication circuitry module **212** for communicating over Wi-Fi or using Bluetooth RTM.

In an embodiment, the same instance of the communication circuitry module **212** may be operative to provide for communications over several communication networks. In an embodiment, the communication device **202** may be coupled a host device for data transfers, synching the communication device **202**, software or firmware updates, providing performance information to a remote source (e.g., providing riding characteristics to a remote server) or performing any other suitable operation that may require the communication device **202** to be coupled to a host device. Several computing devices may be coupled to a single host device using the host device as a server. Alternatively or additionally, the communication device **202** may be coupled to the several host devices (e.g., for each of the plurality of the host devices to serve as a backup for data stored in the communication device **202**).

It may be noted that in FIG. 2, various modules of the pain monitoring application **108** are shown that illustrates the working of the pain monitoring application **108**; however, those skilled in the art would appreciate that the pain monitoring application **108** may have more number of modules that could illustrate overall functioning of the pain monitoring application **108**. It may also be noted that the output engine **204d** generates the pain profile of the user **102**; however, those skilled in the art would appreciate that the output engine **204d** generates more than one pain profile for more than one user. It may also be noted that the database **204g** stores the pain profile of the user **102**; however, those skilled in the art would appreciate that the database **204g** stores more than one profile for more than one user.

FIG. 3 illustrates a flowchart **300** for monitoring the change in the intensity of the pain experienced by the one or more users using the virtual reality environment, in accordance with the various embodiments of the present disclosure. The flowchart **300** initiates at step **302**. At step **304**, the receiving module **204a** receives the one or more virtual content corresponding to the virtual reality environment on the virtual reality device **112**. The virtual reality device **112** is associated with the pain monitoring application **108**. At step **306**, the display module **204b** displays the one or more virtual content corresponding to the virtual reality environment on the virtual reality device to the user **102** during the one or more treatments provided to the user **102**. At step **308**, the diagnostic engine **204c** assesses the change in the intensity of the pain experienced by the user **102** during the one or more treatments. At step **310**, the output engine **204d** generates the pain profile for the user **102**. The generated pain profile shows the change in the intensity of the pain experienced by the user **102**. At step **312**, the determination module **204e** determines the co-relation between the change in the intensity of the pain experienced by the user **102** during the one or more treatments and the one or more virtual content viewed by the user **102**. The co-relation

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represents the effect of the one or more virtual content on the intensity of the pain of the user **102**. The flowchart **300** terminates at step **314**.

It may be noted that the flowchart **300** is explained to have above stated process steps; however, those skilled in the art would appreciate that the flowchart **300** may have more/less number of process steps which may enable all the above stated embodiments of the present disclosure.

While the disclosure has been presented with respect to certain specific embodiments, it will be appreciated that many modifications and changes may be made by those skilled in the art without departing from the spirit and scope of the disclosure. It is intended, therefore, by the appended claims to cover all such modifications and changes as fall within the true spirit and scope of the disclosure.

What is claimed is:

1. A computer-implemented method for monitoring a change in intensity of pain experienced by one or more users using a virtual reality environment, the one or more users wearing a virtual reality device, the computer-implemented method comprising:

receiving, with a processor, one or more virtual content corresponding to the virtual reality environment on the virtual reality device, wherein the virtual reality device is associated with a pain monitoring application;

displaying, with the processor, the received one or more virtual content corresponding to the virtual reality environment on the virtual reality device to the one or more users during one or more treatments provided to the one or more users;

assessing, with the processor, a change in an intensity of pain experienced by the one or more users during the one or more treatments, the assessing being performed on a set of pain monitoring scales using a plurality of bio-markers associated with the one or more users, the set of pain monitoring scales being determined and utilized based on an age category for each of the one or more users and the plurality of bio-markers are measured by a plurality of bio-sensors;

generating, with the processor, a pain profile for each of the one or more users, the generated pain profile showing the change in the intensity of pain experienced by the one or more users and the pain profile for each of the one or more users is viewed by the one or more users on a corresponding plurality of communication devices; and

determining, with the processor, a co-relation between the change in the intensity of pain experienced by the one or more users during the one or more treatments and the one or more virtual content viewed by the one or more users, the co-relation representative of an effect of the one or more virtual content on the intensity of pain of the one or more users; and

storing, with the processor, the one or more virtual content viewed by the one or more users, characteristics of the one or more users, the generated pain profile of the one or more users and the plurality of bio-markers associated with the one or more users.

2. The computer-implemented method as recited in claim 1, further comprising categorizing, with the processor, the one or more users based on the change in the intensity of pain of the one or more users and characteristics of the one or more users, wherein the characteristics of the one or more users utilized for the categorizing comprises age, gender, mentality, Body Mass Index, family history or behavior of the one or more users during the one or more treatments.

3. The computer-implemented method as recited in claim 1, wherein the one or more virtual content comprises one or more video content, one or more image content, one or more text content and one or more graphic content.

4. The computer-implemented method as recited in claim 1, wherein the plurality of bio-markers comprises heart rate, heart rate variability (HRV), blood flow, blood pressure, movements due to shifts in central blood mass and myocardial electrophysiological responses, respiration information, emotions, skin conductance, Photoplethysmography (PPG), oxygen saturation, electrocardiography (ECG), electroencephalography (EEG), muscle activity (EMG), accelerometer, EOG, temperature, blood glucose, systolic contraction, systemic resistance and cardiac output and wherein each of the plurality of bio-markers is projected on one or more screens for viewing by the other one or more users.

5. The computer-implemented method as recited in claim 1, wherein the plurality of bio-sensors comprises a finger based pulse oximeter, an accelerometer, a respiration monitor, a non-invasive glucose sensor and a 1-lead disposable electrocardiography (ECG) patch.

6. The computer-implemented method as recited in claim 1, wherein a first type of pain monitoring scales from the set of pain monitoring scales is utilized for assessing the change in the intensity of pain for a first set of users of the one or more users belonging to an age category of adult patients, wherein the first type of pain monitoring scales comprises any accepted pain scale comprising a Visual Analog Scale (VAS), a Verbal Numeric Rating Scale (VNRS), a Brief Pain inventory (BPI), a behavioral pain scale (BPS), a descriptor differential scale (DDS), a dolorimeter pain index (DPI), a neck pain and disability scale and a Visual Descriptive System (VDS).

7. The computer-implemented method as recited in claim 1, wherein a second set of pain monitoring scales from the set of pain monitoring scales is utilized for assessing the change in the intensity of pain for a second set of users of the one or more users belonging to an age category of pediatric patients, wherein the second type of pain monitoring scales comprises any accepted pediatric pain monitoring scale comprising a physician defined scale, a neonatal pain agitation and sedation scale (N-PASS), a pain assessment tool (PAT), a bernese pain scale for one or more neonates (BPSN), a Wong-Baker scale and a face, legs, activity, crying, and consolability (FLACC) scale.

8. A computer program product comprising a non-transitory computer readable medium storing a computer readable program, wherein the computer readable program when executed on a computer causes the computer to perform steps comprising:

- receiving one or more virtual content corresponding to a virtual reality environment on a virtual reality device, the virtual reality device associated with a pain monitoring application;
- displaying the received one or more virtual content corresponding to the virtual reality environment on the virtual reality device to one or more users during one or more treatments provided to the one or more users;
- assessing a change in intensity of pain experienced by the one or more users during the one or more treatments, the assessing performed on a set of pain monitoring scales using a plurality of bio-markers associated with the one or more users, the set of pain monitoring scales being determined and utilized based on an age category for each of the one or more users and the plurality of bio-markers are measured by a plurality of bio-sensors;

generating a pain profile for each of the one or more users, wherein the generated pain profile shows the change in the intensity of pain experienced by the one or more users, the pain profile for each of the one or more users being viewed by the one or more users on a corresponding plurality of communication devices; and determining a co-relation between the change in the intensity of pain experienced by the one or more users during the one or more treatments and the one or more virtual content viewed by the one or more users, wherein the co-relation is representative of an effect of the one or more virtual content on the intensity of pain of the one or more users;

wherein the computer readable program when executed on the computer causes the computer to perform a further step of storing the one or more virtual content viewed by the one or more users, the characteristics of the one or more users, the generated pain profile of the one or more users and the plurality of bio-markers associated with the one or more users.

9. The computer program product as recited in claim 8, wherein the computer readable program when executed on the computer causes the computer to perform a further step of categorizing the one or more users based on the change in the intensity of pain of the one or more users and characteristics of the one or more users, the characteristics of the one or more users utilized for the categorizing comprising age, gender, mentality, Body Mass Index, family history or behavior of the one or more users during the one or more treatments.

10. The computer program product as recited in claim 8, wherein the one or more virtual content comprises one or more video content, one or more image content, one or more text content and one or more graphic content.

11. The computer program product as recited in claim 8, wherein the plurality of bio-markers comprises heart rate, heart rate variability (HRV), blood flow, blood pressure, movements due to shifts in central blood mass and myocardial electrophysiological responses, respiration information, emotions, skin conductance, Photoplethysmography (PPG), oxygen saturation, electrocardiography (ECG), electroencephalography (EEG), muscle activity (EMG), accelerometer, EOG, temperature, blood glucose, systolic contraction, systemic resistance and cardiac output, each of the plurality of bio-markers being projected on one or more screens for viewing by the other one or more users.

12. A system for monitoring a change in intensity of pain experienced by one or more users using a virtual reality environment the system comprising:

- a virtual reality device provided to the one or more users for viewing one or more virtual content during one or more treatments;
- a communication device, wherein the communication device further comprises a pain monitoring application to monitor a change in the intensity of pain experienced by the one or more users, wherein the pain monitoring application further comprises;
- a receiving module in a processor, the receiving module being configured to receive the one or more virtual content corresponding to the virtual reality environment on the virtual reality device; the one or more virtual content received from a virtual reality system on the virtual reality device;
- a display module in the processor, the display module being configured to display the received one or more virtual content corresponding to the virtual reality

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environment on the virtual reality device to the one or more users during the one or more treatments provided to the one or more users;

a diagnostic engine in the processor, the diagnostic engine being configured to assess the change in the intensity of pain experienced by the one or more users during the one or more treatments, the assessing performed on a set of pain monitoring scales using a plurality of bio-markers associated with the one or more users, the set of pain monitoring scales being determined and utilized based on an age category for each of the one or more users and the plurality of bio-markers measured by a plurality of bio-sensors;

an output engine in the processor, the output engine being configured to generate a pain profile for each of the one or more users, wherein the generated pain profile shows the change in the intensity of pain experienced by the one or more users and wherein the pain profile for each of the one or more users is viewed by the one or more users on a corresponding plurality of communication devices; and

a determination module in the processor, the determination module being configured to determine a co-relation between the change in the intensity of pain experienced by the one or more users during the one or more treatments and the one or more virtual content viewed by the one or more users, wherein the co-relation is representative of an effect of the one or more virtual content on the intensity of pain of the one or more users; and

a database in the processor, the database being configured to store the one or more virtual content viewed by the one or more users, the characteristics of the one or more users, the generated pain profile of the one or more users and the plurality of bio-markers associated with the one or more users.

13. The system as recited in claim 12, further comprising a categorization module in the processor, the categorization module being configured to categorize the one or more users based on the change in the intensity of pain of the one or more users and characteristics of the one or more users, the characteristics of the one or more users utilized for the categorizing comprising age, gender, mentality, Body Mass

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Index, family history or behavior of the one or more users during the one or more treatments.

14. The system as recited in claim 12, wherein the one or more virtual content comprises one or more video content, one or more image content, one or more text content and one or more graphic content.

15. The system as recited in claim 12, wherein the plurality of bio-markers comprises heart rate, heart rate variability (HRV), blood flow, blood pressure, movements due to shifts in central blood mass and myocardial electrophysiological responses, respiration information, emotions, skin conductance, Photoplethysmography (PPG), oxygen saturation, electrocardiography (ECG), electroencephalography (EEG), muscle activity (EMG), accelerometer, EOG, temperature, blood glucose, systolic contraction, systemic resistance and cardiac output, each of the plurality of bio-markers projected on one or more screens for viewing by the other one or more users.

16. The system as recited in claim 12, wherein a first type of pain monitoring scales from the set of pain monitoring scales is utilized for assessing the change in the intensity of pain for a first set of users of the one or more users belonging to an age category of adult patients, wherein the first type of pain monitoring scales comprises any accepted pain scale comprising a Visual Analog Scale (VAS), a Verbal Numeric Rating Scale (VNRS), a Brief Pain inventory (BPI), a behavioral pain scale (BPS), a descriptor differential scale (DDS), a dolorimeter pain index (DPI), a neck pain and disability scale and a Visual Descriptive System (VDS).

17. The system as recited in claim 12, wherein a second set type of pain monitoring scales from the set of pain monitoring scales is utilized for assessing the change in the intensity of pain for a second set of users of the one or more users belonging to an age category of pediatric patients, wherein the second type of pain monitoring scales comprises any accepted pediatric pain monitoring scale comprising a physician defined scale, a neonatal pain agitation and sedation scale (N-PASS), a pain assessment tool (PAT), a bernese pain scale for one or more neonates (BPSN), a Wong-Baker scale and a face, legs, activity, crying, and consolability (FLACC) scale.

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专利名称(译)	用于监视沉浸在虚拟现实环境中的用户的痛苦的方法和系统		
公开(公告)号	US9814423	公开(公告)日	2017-11-14
申请号	US14/835720	申请日	2015-08-26
[标]申请(专利权)人(译)	JAIN LAKSHYA BISARYA PRIYA		
申请(专利权)人(译)	JAIN , LAKSHYA BISARYA , PRIYA		
当前申请(专利权)人(译)	JAIN , LAKSHYA BISARYA , PRIYA		
[标]发明人	JAIN LAKSHYA BISARYA PRIYA		
发明人	JAIN, LAKSHYA BISARYA, PRIYA		
IPC分类号	A61B5/00 G06T19/00 A61B5/0205		
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外部链接	Espacenet USPTO		

摘要(译)

本公开提供了一种用于使用虚拟现实环境监视一个或多个用户所经历的疼痛强度的变化的方法和系统。该方法包括在虚拟现实设备上接收与虚拟现实环境对应的一个或多个虚拟内容，在一个或多个处理期间向一个或多个用户显示与虚拟现实设备上的虚拟现实环境对应的一个或多个虚拟内容。提供给一个或多个用户，评估一个或多个用户在一次或多次治疗期间所经历的疼痛强度的变化，为一个或多个用户中的每一个生成疼痛概况并确定之间的相关性。改变一个或多个用户所经历的疼痛强度以及一个或多个用户所观看的一个或多个虚拟内容。

