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(54) METHOD AND DEVICE FOR WIRELESS TRANSMISSION AND PROCESSING OF PSYCHOPHYSIOLOGICAL DATA

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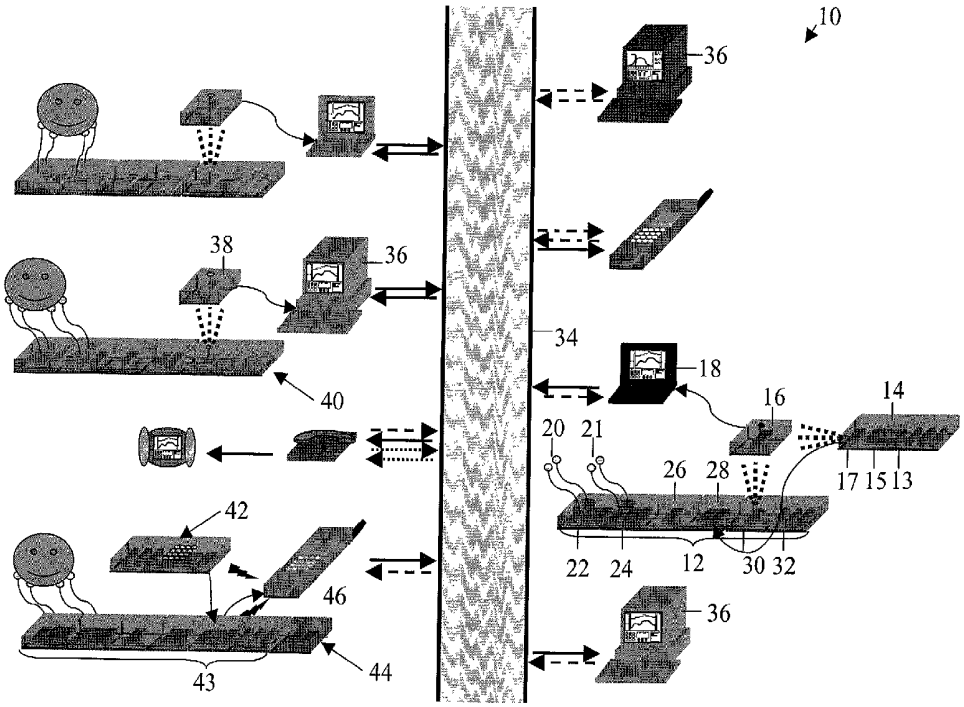
(57) ABSTRACT

The devices and methods of the present invention includes a communication network system that may be used to measure, analyze and distribute psychophysiological and other subject related data in real time from living subjects, such as human beings, or other data sources, who may be close to each other or scattered at different locations. The communication of psychophysiological information or devices may be bi- or multi-directional for psychophysiological intersubject interaction, so that two or more subjects may interchange their psychophysiological data after processing in one or more steps by the means of platforms of different kinds. The representation of processed physiological or other data for oneself or other subjects may be effectuated in different symbolic, functional or physical ways.



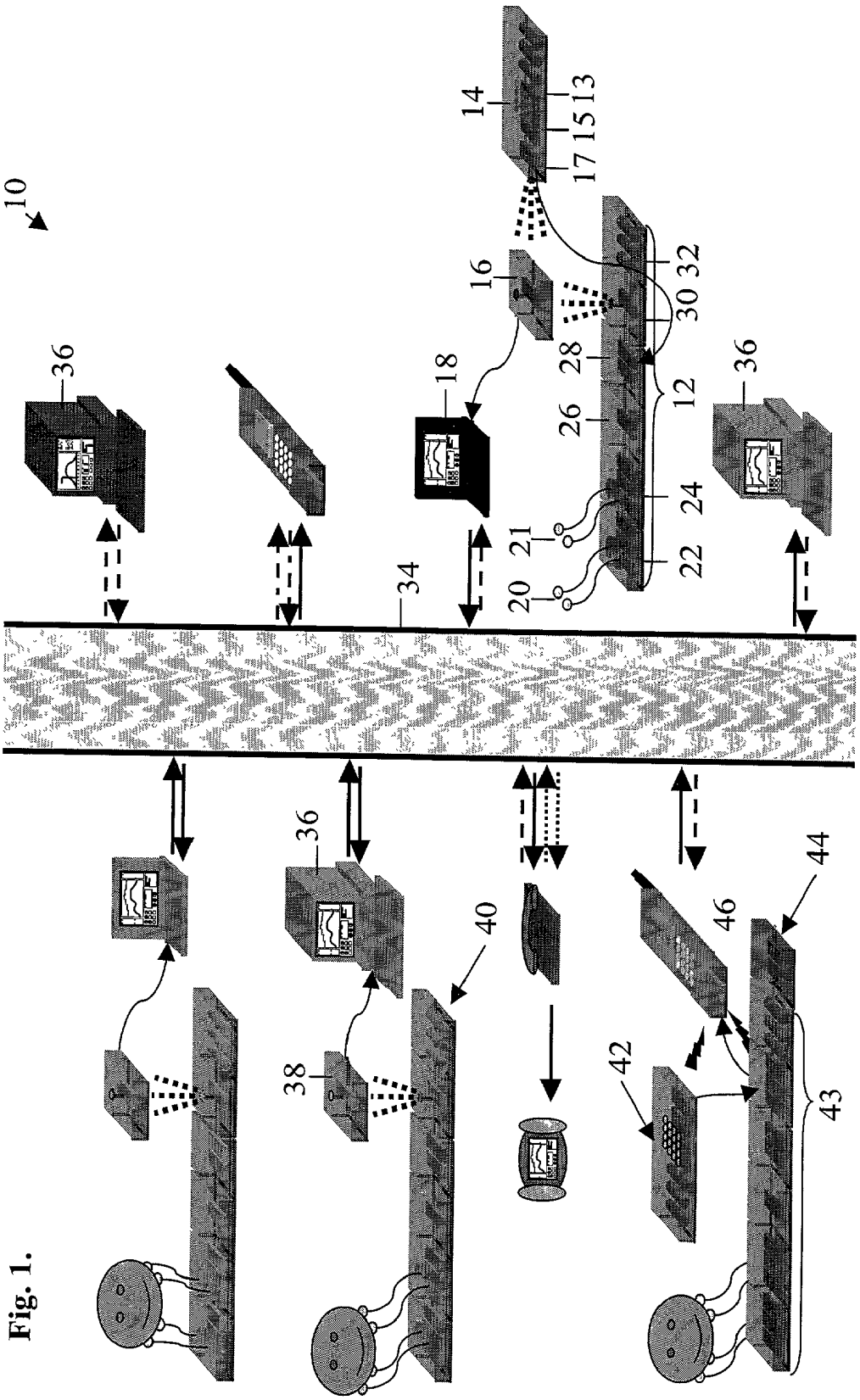

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Fig. 1.

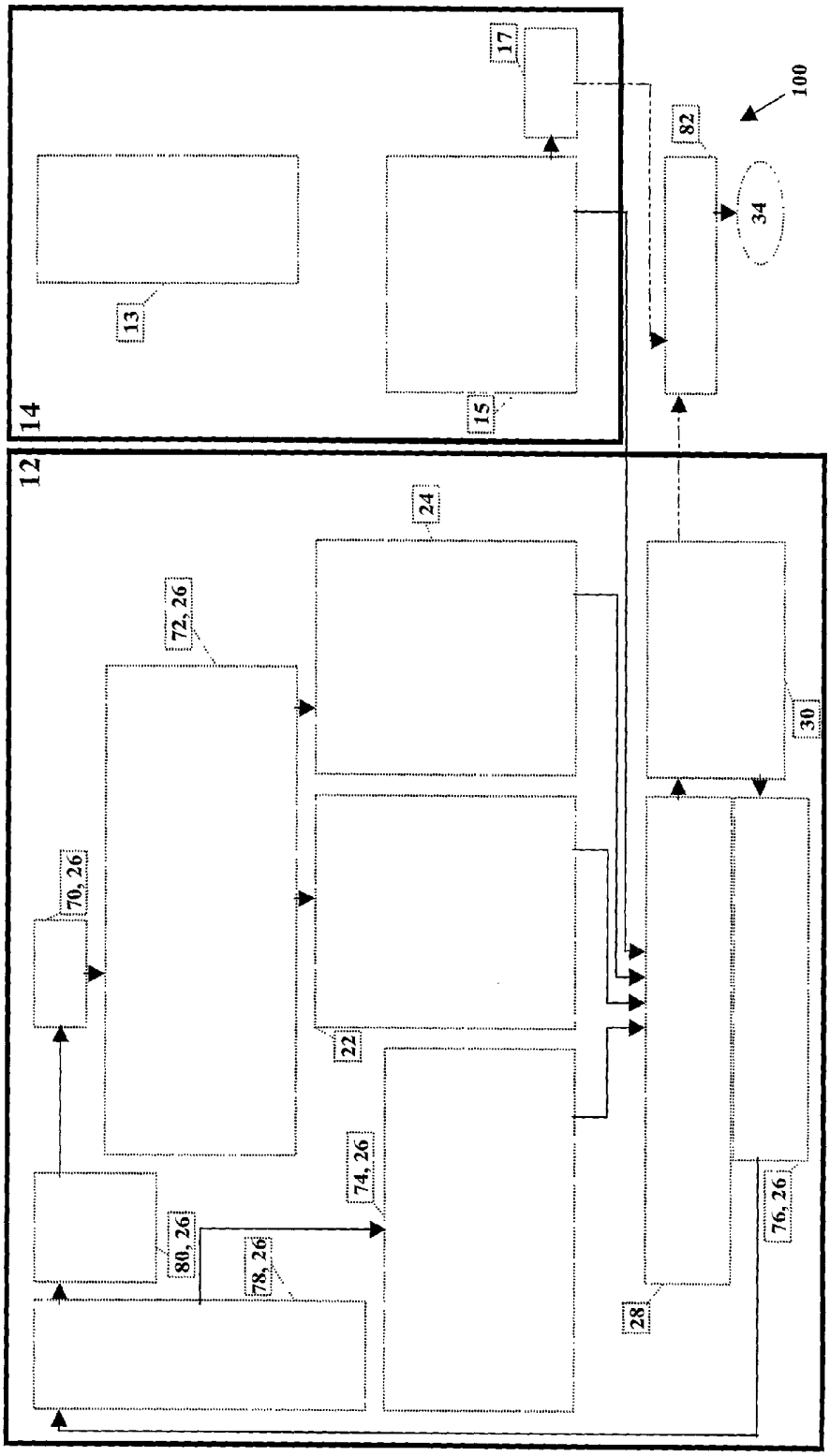

Figure 2.

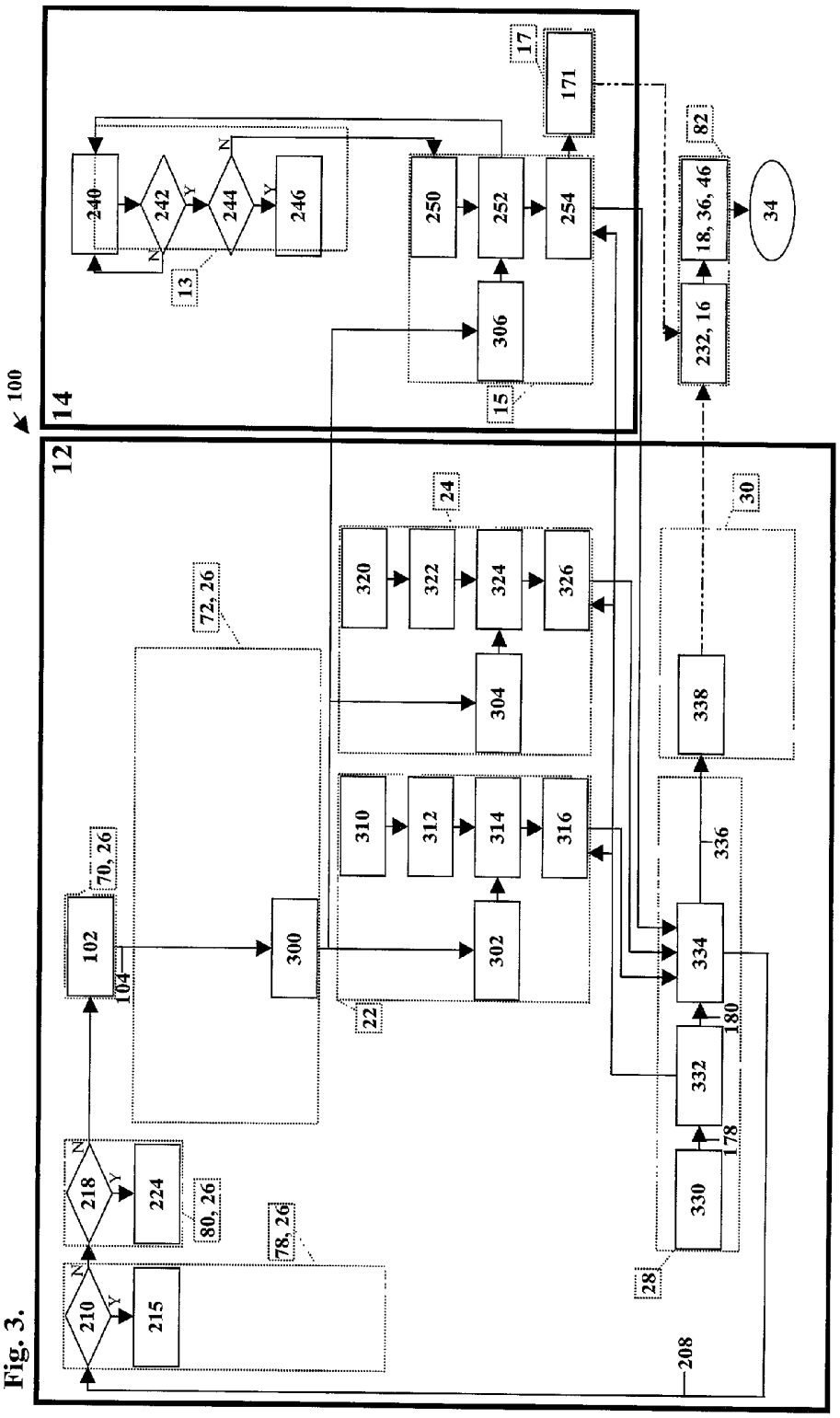
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Fig. 3.

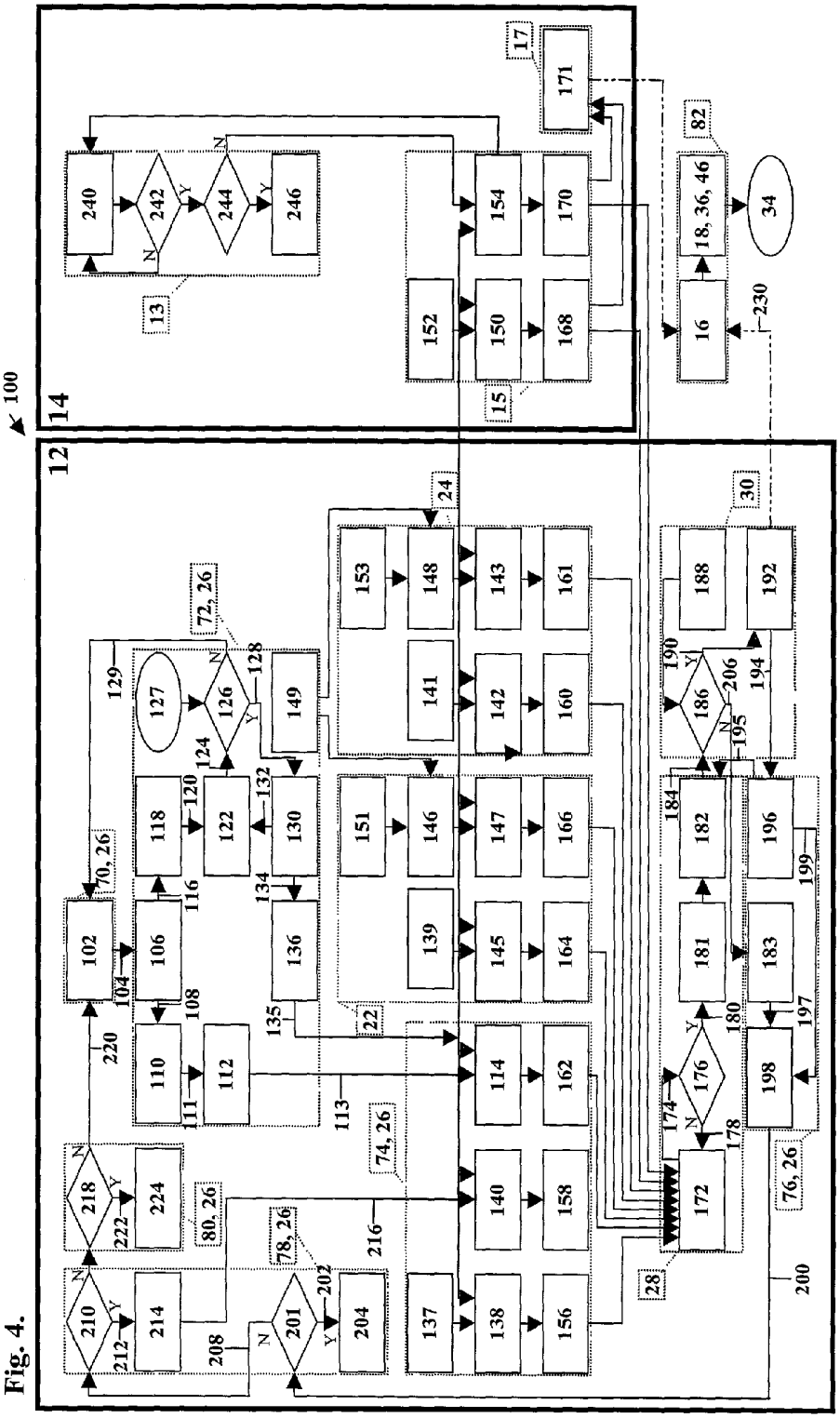
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Fig. 4.

METHOD AND DEVICE FOR WIRELESS TRANSMISSION AND PROCESSING OF PSYCHOPHYSIOLOGICAL DATA

TECHNICAL FIELD

[0001] This invention relates to a method and device for measuring, wireless transmission in real time over Internet or other net and processing of psychophysiological data, such as psychic events and states that may be traced in physiological systems.

BRIEF DESCRIPTION OF THE INVENTION

[0002] The devices and methods of the present invention includes a communication network system that may be used to measure, analyze and distribute psychophysiological and other subject related data in real time from living subjects, such as human beings, or other data sources, who may be close to each other or scattered at different locations. The communication of psychophysiological information or devices may be bi- or multi-directional for psychophysiological intersubject interaction, so that two or more subjects may interchange their psychophysiological data after processing in one or more steps by the means of platforms of different kinds. The representation of processed physiological or other data for oneself or other subjects may be effectuated in different symbolic, functional or physical ways.

[0003] Psychophysiological intersubject interaction may include, but is not restricted to, situations like

[0004] (a) Digital games, such as action games, strategic, role, sport, racing, and family games, childrens' games or any other type of digital game to which psychophysiological signals may be implemented as active parts or added to in stand-alone embodiments. For example: the heart rate and the sweat gland activity may be implemented in interactive digital games over net as conditions, i.e. some tasks cannot be performed unless a subject meets certain psychophysiological conditions, or some processes of the game or some characteristics of the role figures or objects, or some characteristics of the environment in the game, will be modified or exchanged depending on the players own or other players' psychophysiological conditions, or, own and others' psychophysiological signals will be displayed in suitable ways to oneself or to others.

[0005] (b) chatting, i.e. written or vocal or symbolical exchange of information over a net between two or more subjects for interpersonal communication. For example: When two or more subjects are communicating the concomitant psychophysiological reactions may be displayed in some suitable way so the subjects may draw some conclusions about the others. The ability to cheat is not a limiting factor for the use of the method since the uncertainty of the communication in chatting is one of the charms and a normal prerequisite of the phenomenon of chatting.

[0006] (c) group conversation, such as, for example, interactive role playing, theatre, drama or any other similar situation

[0007] (d) other cultural situation such as interactive happenings, arts exhibitions or similar

[0008] (e) entertainments of type interactive television programs including talk shows, musical entertainments, contests, interviews, political events

[0009] (f) emotional strategy games or exercises—new forms of entertainment that is made possible by the present invention.

[0010] (g) any other situation in which two or more subjects want to reveal their psychophysiological reactions or states for each others.

[0011] Other subject related data may include other media like

[0012] (a) sound in real time

[0013] (b) pictures, film, video, web camera pictures in real time

[0014] (c) smell

[0015] (d) any other medium by which a sensation can be transmitted over net

[0016] Other data sources may be

[0017] (a) log data, i.e. data encoded, for example by the usage of unit **14** in the system **10**, for descriptions of observed or felt reactions, states, behaviour or situations in which the subject is.

[0018] (b) time data

[0019] (c) positioning system devices

[0020] (d) light exposure, such as direct, reflected, white or other qualities of light

[0021] (e) ambient temperature

[0022] (f) winds, air humidity or other climatic circumstances

[0023] (g) sound exposure, such as sound levels

[0024] (h) mechanical forces of different kinds

[0025] (i) movement characteristics, i.e. acceleration and similar any other environmental data that are relevant for the situation

[0026] Platforms used may be such as

[0027] (a) computers, i.e. stationary, portable, handheld or other types

[0028] (b) game consoles, i.e. special hardware design mainly for digital games.

[0029] (c) mobile phones, or other communication devices using local or long distance or satellite telephone nets.

[0030] (d) mobile intelligent screens or electronic books or other similar communication devices for local or net communication

[0031] Networks may be

[0032] (a) Internet or other world wide web and related net functions as networks connecting to Internat from mobile telephones.

[0033] (b) Intranets of different types

[0034] (c) Local nets, such as within a home or neighboring houses or vehicles or similar

[0035] (d) micronets, such as connecting a computer or mobile phone with other devices, or, connecting one or more small devices like the measurement unit **12** and log unit **14** and other.

[0036] Symbolical representation of processed physiological or other data may be effectuated by changes on a computer screen or other visual medium in

[0037] (a) pictures

[0038] (b) verbal expressions in text or sounds

[0039] (c) diagrams

[0040] (d) colors

[0041] (e) acoustich codes/signals

[0042] (f) any other symbolic way

[0043] Functional representation of processed physiological or other data may be effectuated by changes in the function of

[0044] (a) computer program or routine, such as the processes of a computer game or other

[0045] (b) mobile phone or other communication device

[0046] (c) any other device or process that brings information to a subject.

[0047] Physical representation of processed psychophysiological or other data may be effectuated by changes in physical effects by devices applied to the subject's body by

[0048] (a) vibrating devices (as, for example, in some mobile telephones)

[0049] (b) tapping devices (simulating for example the heartbeat

[0050] (c) mechanical effector devices such as devices exerting mechanical pressure or movement to the subjects

[0051] (d) heating or cooling devices

[0052] (e) electrical devices

[0053] (f) any device giving some type of sensation to the subject.

[0054] Additional aspects (applications) of the invention. Of course, the applications of the devices and methods of the present invention are not restricted to psychophysiologically intersubject interactive situations. For example, in embodiments including a mobile phone or palm held computer or similar, with the possibility of connections networks, one or more subjects' psychophysiological or other data together or not with data from other sources, may be monitored at close or far distances in mobile or non-mobile isolated or non-isolated situations in the contexts of

[0055] (a) Psychological research/clinic, such as tele-psychotherapy, tele-dream analysis, Biofeedback, Autodesensibilization

[0056] (b) Sociopsychological research/clinic

[0057] (c) Psycho/behavioural therapy or other psychological psychiatric therapy. For example, when a patient is moving freely in the society or over wide landscapes or sea, and the measurement unit detects signs of anxiety the communication over a mobile telephone of the physiological signals in combination or not with verbal communication to a therapist or computerized device may enable suitable counteractions against the anxiety.

[0058] (d) Depression- or suicide research/clinic

[0059] (e) Menopause research/clinic

[0060] (f) Traffic research

[0061] In addition, the devices and methods of the present investigation may be used when the psychophysiological activity/reactivity of a multitude of subjects, gathered or scattered, should be monitored simultaneously, which has not been possible before. Such situations may be

[0062] (a) commercials research/evaluation. For example: Subjects scattered over many countries receiving commercials over a television satellite may send their psychophysiological reactions over a net to receiving aggregating computers which in turn may send the aggregated data to central computers for final analyses of culturally and in other ways varying subjects' reactions.

[0063] (b) music contests evaluation/monitoring. For example: many subjects' psychophysiological reactions may be measured and distributed over net for analyses evaluating the psychophysiological impact of different appearances. The subjects may be seated in a concert hall or by the television sets.

[0064] (c) film, video or television or similar evaluation/monitoring

[0065] (d) film, theatre, arts, happening contests/evaluations. For example: the actor' psychophysiological status may change the scenery and the audience's reactions may presented in different ways to the actors or change some qualities in the play.

[0066] (e) monitoring a group of gathered or scattered athletes with or without the possibility to coaching, for example, the monitoring of a group of cyclists in a long cycle race with a global positioning system offers the possibility to compare the cyclists' psychophysiological status and positions on the road, and to give orders who is going to which relative place in the group. Another example is mass athletic events like the "Vasa race" or similar mass or mrathon races when the interest is to monitor a multitude of individuals' psychophysiological status. The psychophysiological data may be accompanied by environmental data or positional data.

[0067] Further, the devices and methods of the present invention may be used for pedagogical or self-knowledge purposes, for example for

[0068] (a) recommended psychological experiments using standard monitoring programmes

[0069] (b)planned psychological experiments with special programmes

[0070] (c) activity monitoring for choice of best time for learning or other activities

[0071] (d) the study of own reactions to certain events, stimuli or objects. Can be used for the study of what evokes psychophysiological reactions

[0072] (e) monitoring of own or others' psychophysiological signal during the day or 24 h periods.

[0073] (f) monitoring sleep

[0074] (g) own dream studies

[0075] (h) ergonomic studies. For example: the electromyogram from a certain group of muscles may be monitored, and when the computer detects an increased muscle tonus according to criteria, an alarm signal or a computer process may be initiated for a defined counteraction from the subject's side.

[0076] (i) monitoring any activity, for example jogging, mediation, car driving, sun bathing etc. etc. For example: a global positioning system together with environmental data (temperature, sound level or other) and psychophysiological information may be recorded simultaneously from one to several car drivers in interactive driving situations in the traffic during long time and over long distances and sent over mobile telephones and WAP and Internet or telephone net, enabling simultaneous analyses in central receiving computers.

[0077] (j) monitoring and controlling stress/anxiety or embarrassment situations in group or net situations.

[0078] (k) Call-up-alert functions such as when certain psychophysiological conditions are met, an alert signal may go to a computer or /mobile/ phone to call up a certain telephone number to a receiving computerized device or a person.

[0079] (l) Monitoring isolated persons' psychophysiological status.

BRIEF DESCRIPTION OF THE DRAWINGS

[0080] **FIG. 1** is a schematic system diagram of the units of the present invention; and

[0081] **FIG. 2** is a schematic flow diagram of the main processes and structures within the units of the present invention.

[0082] **FIG. 3** is a schematic flow diagram of the signals transmitted within the most preferred solution P of the present invention.

[0083] **FIG. 4** is a schematic flow diagram of the signals transmitted within the secondary solution S of the present invention.

DESCRIPTION OF EMBODIMENTS

[0084] With reference to FIGS. **1-4**, the device and method of the present invention includes a communication system **10** that may be used to measure and analyze psychophysiological signals or data from living subjects such as human beings or animals. The communication of psychophysiological information may be sent in one direction to analyzing device or devices or may be bi-directional for psychophysiological interaction, so that two or more subjects may interchange their psychophysiological data. Such a psychophysiologically interactive situation can be deducted from **FIG. 1** in which the example comprises an interaction over the units **18**, **36**, **46** from three subjects to three subjects.

[0085] The system **10** is a very small portable measurement- and distribution system for psychophysiological signals via wire or wireless transmission from one or many transmitting subjects to one or many subjects in both directions or one. The subjects may be geographically scattered or gathered and the transmission may occur via mobile telephones or similar devices, or via computers that may be connected to the Internet or other networks of transmitting and receiving devices or to one or many approved receiving subjects' devices including data processing in real time in one or many steps for a great number of global or local applications including, but not limited to, entertainment, scientific, commercial, public, sports, private, clinical, educational and many other applications.

[0086] The psychophysiological signals may include, but are not restricted to, electrical brain activity, sweating, heart rate, blood pressure, blood flow, respiration, eye movements, electrical and mechanical muscle activity, acceleration of movements and other such activities of a living subject. Certain behaviors, such as concentration, anger, emotional engagement, stress, physical exertion and relaxation trigger often different psychophysiological signals that may be analyzed.

[0087] In other words, the psychophysiological signals may be correlated with conditions of the subject who is measured. For example, eye movements and sweating may be analyzed together to find out how a viewer reacts to a television commercial. The eye movements may inform the advertiser what parts of the advertisement that catches a viewer's attention and the sweating may indicate the level of engagement and attention of the viewer. Another example is an on-line computer game between two or more subjects over a net in which the players' psychophysiological or other data through the system **10** are transmitted to the net and further to the other players, thus allowing the players' emotional reactions in the form of heart rate and sweating or other type of reactions influencing the qualities of the game and role characters and revealing the reactions for all or some subjects. A third example is a situation called "chatting" during which two or many subjects exchange verbal information, written and/or acoustically with or without web camera or other picture generated visual signals over a network, with the addition of their psychophysiological reactions in a similar way as in the example of on-line computer games over a net. Preferably, the system **10** includes a very small and lightweight measuring unit **12** and an optional log unit **14** that are in communication with a transit unit **16** that may be separate or part of a computer **18**, of a mobile telephone **46**, or of other communication device. As mentioned below, the units **12**, **14** may be communicating directly with another. An important feature of the present invention is that the communication system **10** may be in wireless communication with other communication and computer systems, also described in detail below. The system **10** is fully compatible with any currently available computer and communication devices.

[0088] The measuring unit **12** and the log unit **14** may be in communication with the transit unit **16** via infrared transmission, short wave radio technology (such as "Bluetooth communication" or other) or any other suitable communication medium. This means that psychophysiological data from several subjects, who may be at different locations, may simultaneously be analyzed and results be redistributed to anyone thus enabling situations of psychophysiological interaction. Of course, the communication may be via wires and other suitable links also.

[0089] The measurement unit **12** has a plurality of sensors **20** that may be attached to any part of the body of a subject to be measured or analyzed. Because the unit **12** is small, it may be placed relatively close to the source of the signals which may reduce any interferences. The type of sensors and amplifiers may be adjusted to what is being measured. For example, electrodermal activity (EDA) (sweat gland activity) may require electrodes of certain types and a DC voltage of about 0.5V compared to the measurement of brain activity that may require other types of electrodes and passive filtered amplification of bioelectrical AC signals. Breathing and other conditions may require other filtering amplification characteristics.

[0090] The measurement unit **12** has several modules including signal amplifiers **22** that modulate and amplify signals received from the sensors **20**. The unit **12** may also have a second set of amplifiers **24** that may be designed to measure other psychophysiological data such as for example blood flow. The amplifiers may be adapted to be cooperating with a set of sensors **21**. Of course, the measurement unit **12** may include additional sets of amplifiers for similar or different purposes, if necessary.

[0091] The measurement unit **12** may also have a process module **26** including, for example, a start/activation unit **70**, a timer unit **72** including analog to digital converter functions, a basic data unit **74**, a final logics unit **76** including, for example, buffer handling, a stop unit **78** and an optional reset unit **80**. The signal-formatting module **28** may be used to format the digital signals from the measurement modules **22**, **24** or other extra measurement modules, and from the process module **26**, or from other sources such. The formatted signals from the signal formatting unit **28** may be fed into a buffer at a certain rate, decided by the process module **26**, if needed, or continuously, to the transmitter module **30**, which may transmit the information out from the set of units **12** and **14**.

[0092] The transmission information may use infrared transmission, radio transmission (for example of type Bluetooth) or any other suitable transmission system, including wire, forward over a unit **16** or directly to a stationary or portable computer or other computerized device, which regardless of type of device is connected to the Internet or other type of net. For example, the transmission information may also be transmitted to a mobile telephone or a palm held computer or portable computerized screens or another portable device that is connected to the Internet or other type of net. The connection to mobile telephones and other portable devices is of particular interest because the subjects to be measured may be freely moving about anywhere in the world if the mobile phone or other device is connectable to the Internet or other net. The subject wearing the measurement unit **12** may connect the computer or other computerized device or the mobile telephone to a suitable web site or remote computer prior to starting a suitable application program to initiate the web-site and prepare the web-site or any other receiver to receive the psychophysiological information that is transmitted by the set of units **12** and **14**.

[0093] The measurement unit **12** has also a power supply module **32** for supplying the unit **12** and sensors **20**, **21** and others, if needed, with the necessary power. The unit **12** may, optionally, also be equipped with a module **44** containing for example a positioning system, such as global positioning system (GPS) that indicates the geographical position of the subject wearing the measurement unit **12**.

[0094] Two or more measurement units of type **12** with one or more amplifiers each applied to one or more subjects can connect to a 'micronet'. The micronet can include a local signal receiver like the transit unit **16** of a computer **18** or of a mobile telephone or of any communication device for further transmission to a net. Such a solution will, for example, enable the measurement and sending electromyographical (muscle activity) signals from left and right legs and arms separately to a mobile telephone or other device, without uncomfortable wire interconnections between the extremities. In addition, such a micronet enables situations of psychophysiological interaction locally without a transmission via the Internet.

[0095] The optional transit unit **16** may be adapted to demodulate the signals received from the transmitter module **30** so that the transmitted data is in a format that may easily be used in the computer **18**, mobile telephone **46** or other communication device. As mentioned above, preferably, the unit **16** is an integral component of a computer such as **18**, **36**, mobile telephone **46** or other communication or computer device. Alternatively, depending on the type of data format, the transit unit **16** is not needed and the transmission information is fed directly to an existing input port of the computer, mobile phone or other communication or computer device in connection with a net such as for example the Internet. An important feature of the unit **16** is that it may simultaneously receive information from several sources, for example, a module **30** and a log unit **14**.

[0096] In this way, the log unit **14** may be used to simultaneously transmit information to the transit unit **16** together with the transmitter module **30**. Alternatively, the information from the log unit **14** can be sent to the module **28** in the measurement unit **12**, a solution that is described in **FIG. 3** (communication from unit **254** to unit **234**, solution P) and in **FIG. 4** (communication from unit **14**, i.e. the ID register unit **168** and the data register **170** to the validity register unit **172**). One advantage of simultaneously using the log unit **14** is that an observer may observe the subject connected to the sensors **20**, **21** or other sensors and enter behavioral or environmental patterns such as anger, smile, provocation, external events or states etc. and transmit the information so that the information from the log unit **14** may appear in the same data body as the information transmitted from the measurement unit **12**. The use of a unit **14** or similar makes it easier to interpret the information transmitted by the unit **12**. Alternatively, the subject being measured may him/herself enter own or others behavioral or environmental patterns via the log unit **14** and further.

[0097] The log unit **14** may have a log key board module **13** consisting of a numerical key pad with coded messages so that a first button may be associated with a certain behavior such as anger, facial expression, provocation, calmness, physical aggression, crying, running away etc. A second button may be associated with a different behavior and so on. The current combination of coded keys may be held in a data module **15** which continuously is available to a transmit module **17** for wired or wireless continuous or timed transmission to a transit unit **16** or to a signal formatting module **28** of the measurement unit **12**. The coded message from the log unit **14** may be matched with

the information from the measurement unit **12** to confirm the if behavior of the subject to be measured by the unit **12**. The log unit **14** may also provide information about the status of the subject prior to the observed behavior as measured by the measurement unit **12**. Perhaps the subject was calm prior to the provocation.

[**0098**] When a computer **18** or other communication device receives the information, the device optionally may synchronize the information which may include identifiers so that it is possible to identify which of the measurement units **12**, if there are more than one unit **12**, that transmitted the information. Similarly, the computer **18** or other communication device optionally may identify which of the log units **14** that transmitted the information so that the transmitted information may be associated with the correct subject to be measured.

[**0099**] The format of the data may enable communication from unit **30** to unit **16** in connection with a computer **18**, mobile telephone **46** or other communication device, in a way that is independent of 'handshaking' based communication protocol. This construction avoids problems in reestablishing communication after unwanted communication interrupts.

[**0100**] The computer **18** may be connected to the Internet or other net **34** so that the information may be sent to one or more other computers **36** that is disposed remotely, thus enabling situations of psychophysiological/emotional interaction and/or aggregated analyzes in one to several steps including one to several levels of information processing and/or groups of connected subjects with units **12** and/or **14**. The computer **36** may be any suitable device including stationary, laptop or handheld or other computer, mobile phone or any other computerized communication device.

[**0101**] An extra module, the measurement module **44**, may be used for collecting extra data such as, for example, light exposure, sound level, mechanical pressure and/or GPS data including clock time and positioning information. The module **44** may be treated as one of other measurement modules of type **22**, **24**. A log unit **42**, that is similar to the log unit **14**, may transmit information via the measurement unit **43**, that is similar to the measurement unit **12**, directly to a mobile telephone **46** that in turn may be in communication with the Internet or other net **34**. The mobility of units **42**, **43**, **44**, may, for example, be used to analyze the training of athletes so that the psychological information is continuously transmitted to a coach for further analysis of the condition of the athlete and several athletes in real time. In other words, the flexibility of the system **10** permits the measurement of psychophysiological signals in real time from one or many independently moving subjects or subjects that may be very remote from another.

[**0102**] In an alternative embodiment, the measurement unit **12** may be a stand-alone biofeedback device that is not required to be connected to any computerized external device at all. The measurement unit **12** may, for example, have output possibilities for an acoustic signal that is proportional in frequency to the magnitude of a selected signal channel for the feedback. The measurement unit **12** may also have a digitally based visual messenger, for example, a small digital display, that conveys information related to the absolute or relative value of one or more selectable signal channels for the feedback. The display may, if equipped with suitable devices, such as GPS, show the exact time and the position in digital form and/or on a map. The measurement unit **12**, log unit **14**, transit unit **16** and computerized device or phone **18** may be used locally without being connected to the Internet and in such stand-alone configuration be useful in a wide range of applications.

[**0103**] In another alternative embodiment, the measurement unit **12** may send data via wire or via wireless communication, such as infrared or radio signals (for example, Bluetooth) or other communication means to external devices like, for example, sound equipment (such as, for example, head phones or sound amplifiers), visual equipment (such as, for example, digital displays, TV sets or projectors) or any equipment exerting sensory activation such as, for example, vibrating devices (as, for example, in some mobile telephones) or tapping devices (simulating the heartbeat or other physiological signals) or shifts in mechanical pressure or temperature applied to the subject's body or nerve stimulation devices through mechanical, electrical or magnetic stimulation of a subject's senses or nervous system.

[**0104**] **FIG. 2** shows the main processes and structures of a schematic flow diagram **100** of the signals that are transmitted when the measurement unit **12** and the optional log unit **14** are in operation. **FIG. 3** displays the most preferred solution (P) of that main processes and structures because of its simplicity, low cost and the possibility to shrink its size extremely much. **FIG. 4** contains a secondary solution (S) that offers very high fidelity of the digital signals to the receiving equipment to the original analog signals from the subject. The two solutions P and S are mutually exclusive within one single set of a measurement unit **12** and a log unit **14**, but can be mixed within a measurement system **10** consisting of two or more sets of units **12** and **14**.

[**0105**] First, the **FIG. 2** regarding the main structures and processes is explained, then the most preferred solution P, and last the secondary solution S.

[**0106**] In **FIG. 2**, showing the main structures and processes in the measurement system **100**, a start/activation unit **70** of the measurement unit **12** sends, from when the start button has been pressed, may set a continuous activation signal **104** high to a timer unit **72** of the process module **26**. The timer unit **72** sends at regular intervals time pulses that govern the timing of processes in the measurement modules **22** (measurement channel number 1, ch1) and **24** (optional measurement channels number 2, 3, 4 up to an unspecified number of measurement channels). The timer unit **72** also influences processes, directly or indirectly, in the log unit **14**, and the signal formatting module **28**. Further, processes in the transmitter module **30** may be timed by the timer unit **72**.

[**0107**] The measurement unit **22** (ch1) and optional measurement channels 2 etc. (ch2 etc.) in the measurement symbolically represented by the module **24**, includes amplification and signal conditioning functions specific to the type of signals measured through the sensors **20**, **21**. The units **22**, **24** etc. provides digitalized information from analog to digital converters of different kinds and varying capacity regarding resolution in magnitude and time.

[**0108**] The optional basic data module **74** contains, if present, basic information specifically related to the measurement unit **12**. The basic data, if module **74** is present,

are, together with the digital information from the measurement modules **22** and **24** etc. and that from the optional log unit **14**, if present, available to the signal-formatting module **28** continuously, or at times governed by the timer unit **72**. The signal-formatting module **28** provides continuous or timed availability of information in formatted, i.e. encoded, form to the transmitter module **30**. The transmitter unit **30** may, in turn, continuously or in a timed way, transmit the encoded information by infrared or radio signals or by wire to receiver units **82** that may be an optional transit unit **16** for further transmission, after suitable data conversion, to a computer **18**, **36** input port or a mobile telephone **46** input or other receiving device. The signals from units **18**, **36**, **46** may further be transmitted to the Internet or other net **34**. The optional buffer handling unit **76** in the process module **26** handles possible stop signals and buffer functions. The stop function **78** and the optional reset function **80** of the process module **26** may take care of possible maneuvers from the subject, having pressed a stop or reset button. The process continues-as long as the stop button has not been pushed-further via the start/activation function **72** of the process module **26**.

[**0109**] The most preferred solution P is generally characterized by one-bit analog to digital conversion of analog measurement signals and continuous binarily summation of an amplitude-modulated electrical wave, the amplitude of the wave being dependent on the order number of the channel number generating the signal at any moment, and the modulation activated by logical high signals from different information sources such as, for example, amplifiers (one bit high) and buttons (button pressed). Further, the amplitude-modulated signals are continuously added to each other into one single signal comprising the sum of all binarily amplitude-modulated single channels with currently logical signals set high. In addition, the continuously summated signal is also continuously sent further to a transmitter unit preferably designed for, but not restricted to, audio signal transmission.

[**0110**] **FIG. 3**, shows a schematic flow diagram of the most preferred solution P in detail, illustrating the signals that are transmitted when the units **12** and **14** are in operation. A start/activation unit **102** of the measurement unit **12** may send, from when the start button has been pressed, a continuous activation signal **104** to an analog timer unit **300** of the process module **26**. The analog timer unit **300** may send at regular intervals time pulses to the calibration unit **302** in the measurement module **22**, calibration unit **304** of units **24** (symbolizing additional measurement channels) and calibration unit **306** for an optional, wired log unit **24**. The calibration units send activation signals to the logical signal unit **314** of the measurement module **22**, the logical signal units **324** in optional additional measurement units **24**, and the logical signal unit **252** of the optional log unit **14** in order to set then logically high, thus simultaneously producing maximal level output signals from the logical signal units **314**, **324**, **252**.

[**0111**] Still describing the most preferred solution P, **FIG. 3**, the analog signals from amplifiers **310**, **320** or similar devices within the measurement units **22**, **24** etc., are continuously digitalized by analog to digital one bit converters **312**, **322**, built on analog technique. Increasing analog signal levels are converted to a logical one (high) signal, equal or decreasing signal levels are converted to a logical zero (low) signal, the logical signals being stored in the logical signal units **314**, **324**. The logical one-bit signals in the units **314**, **324**, are continuously modulating a sinus, or other form of, wave by the wave modulator units **316**, **326** of the measurement units **22**, **24**, into amplitudes of the wave different for different measurement modules. The wave is generated in the wave generator **330** and distributed by the wave distribution unit **332** to each of the measurement units' wave modulator units **316**, **326**. The modulation of the signal in measurement unit **22**, i.e. channel #1 (ch1), results in an amplitude of value 1 (arbitrary scale). The modulation of the signal in the first optional additional measurement unit **24**, i.e. channel #2 (ch2), results in an amplitude of value 2. The modulation of the signal in the next optional additional measurement unit **24**, i.e. channel #3 (ch3), results in an amplitude of value 4. Thus, the amplitude of the modulation is computed by the formula 2^ (Ch#-1) units, where "units" is the amplitude of channel #1 and "Ch#" is the order number from 1 up to the order number of an unidentified maximum number of channels in the measurement unit **12**. In a similar way, each of the keys in the keyboard module **13** of the log unit **14** can be seen as separate channels ch2, ch3 etc, or ch3, ch4 etc if there are two measurement modules **22**, **24**, or, ch4, ch5 etc if there three measurement modules **22**, **24** and similar. Thus, each current key code in effect in the key code register **250** results through the logical signal unit **252** and the wave modulator unit **254** an amplitude modulated wave representing the order number of the currently activated key. The units **252** and **254** symbolize similar units up to an undefined maximum of number corresponding to the number of keys available. The wave to be modulated is generated in the wave generator **330** and distributed by the wave distribution unit **332** to each of the log unit's wave modulator units. The amplitude-modulated signal is continuously available in the wave modulator unit **254**.

[**0112**] Alternatively, a similar wave generator, distributor and summator as **330**, **332**, **334**, may also be part of the log unit **14** in the case the log unit is not connected by wire to the measurement unit **12** but transmitting by the log transmitter unit **171** in the transmit module **17**. The summated signal from the log unit **14** is then transmitted to a receiving system **80** as described below for the measurement unit **12**.

[**0113**] Those in the wave modulator units **316**, **326**, **254** continuously available wave signals are summated by the summating unit **334** in the signal formatting module **28**, into one single summated output signal **336** comprising the sum of all binaurally amplitude modulated singles channels with currently logical signals set high. In addition, the continuously summated signal **336** is also continuously sent further to a transmitter unit **338** preferably designed for, but not restricted to, audio signal transmission. The by the transmitter unit **338** sent summated signal **336** may reach a receiving system **82** comprising an optional transit unit **16** and a computer **18**, **36** or a mobile phone **46** or other suitable receiving device for analyzes or presentation and may further be transmitted to a net **34**.

[**0114**] The summation in the signal-formatting module is followed by a stop button check **210** in the stop function unit **78** in the process module **26**. If the stop button has been pressed the process is terminated by the process termination unit **215** which lets the activation signal **104** go low. In the optional reset function unit **80** the reset button check **218**

chooses to reset the measurement unit **12** to its original status by the reset process unit **224**. If not, the process goes on as long as the activation signal **104** is high.

[**0115**] The measurement unit **14** comprises a log unit keyboard module **13**, a log data module **15** and an optional log data transmit module **17**. The log unit start/activation unit **240** activates the log key check unit **242** to check whether a log key has been pressed. If not, the log key check unit **242** allows the unit **240** to continue the loop. If the log key check unit **242** determines that a key has been pressed then the log stop key check **244** determines whether the log stop key was the one pressed. If yes, the log stop key check **244** forwards the process to a log process termination unit **246** that terminates the process in the log unit **14**. If, on the other hand, the log stop key check **244** finds that the key was not the log stop key, the code of the key is sent to the log key codes register **250** together with current other key codes. The key codes are transformed into logical signals in the way that the first key code is treated as channel #2 in a logical signal units **324**, the second as channel #3 etc. Thus, each of the keys in the keyboard module **13** of the log unit **14** is seen as a separate channel. Thus, each current key code in effect in the key code register **250** results through the logical signal unit **252** and the wave modulator unit **254** an amplitude modulated wave representing the order number of the currently activated key. The units **252** and **254** symbolize similar units up to an undefined maximum of number corresponding to the number of keys available. **14** are mutually exclusive. The **254** loaded into the log unit key register **154**

[**0116**] The secondary solution S is generally characterized by analog to digital conversion of a resolution by at least 8 bits, preferably higher, of the analog measurement signals. The conversion is typically timed to a high rate. The digitalized signals are kept in registers that, together with basic data such as unit ID:s, time ticks since start of conversion and maybe other information kept in registers, constitute the hardware base for the special data format that is used for each single sample that may or not be temporarily stored in an output data buffer for a timed transmission to a receiver system.

[**0117**] **FIG. 4** shows a schematic flow diagram of the secondary, alternative solution S in detail, illustrating the signals that are transmitted when the units **12** and **14** are in operation. More particularly, an activation unit **102** of the measurement unit **12** sends an activation signal **104** to a clock device **106**. The device **106** sends an increment signal **108** to an increment device **110**. The device **110** sends an increment signal **111** to a time counter **112** and the unit **112** sends a trace signal **113** to a time tracer **114** in the basic data unit **74** of the process module **26** that traces the time from the start of the unit **102**. The clock device **106** also sends an interval signal **116** to an interval increment device **118** that transmits an interval increment signal **120** to an interval counter **122** that counts the number of intervals. The counter **122** sends an interval comparison signal **124** to an interval comparison unit **126** that compares the number of intervals to a preset interval value received from a preset interval unit **127**. If the number of intervals is equal to the preset interval value then the comparison unit **126** sends an interval equal "yes"-signal **128** to a reset interval counter unit **130** that in turn sends a reset interval counter signal **132** to the interval counter **122**. Additionally, the reset interval counter unit **130** sends a "load activate" signal **134** to a central "download all registers" unit **136**. If the interval comparison unit **126** determines that the number of intervals is insufficient, then the unit **126** sends a continuation interval equal "no"-signal **129** to the activation unit **102** to instruct the device to continue sending information to the unit **118**.

[**0118**] The registers may include a unit **12** ID code **137** that includes an identification of measurement unit **12**, loading its content into a unit **12** ID register **138**, a unit **12** base register **140** that includes information about which sample interval that is used and data about how the system is configured such as indicating whether the log unit **14** is included or not. The base register **140** also includes information about channel identifiers, number of channels of the data. The system **100** has at least one channel #1 measurement module **22** that may be a unit that is especially designed for electrodermal activity (EDA) that may be received from sweat glands of the subject measured and the channel #1 ID code **139** may be used to identify the hardware unit that is tracing the EDA. The channel #1 ID register **145** holds the channel 1# ID code **159** of the measurement unit **22**. The measurement unit **22** is used as an example to illustrate a typical channel, however, other types of measurement devices may also be used. The channel #1 analog device **151** mediates the analog data from the measurement unit **22** amplifier and the channel #1 digital device **146** contains the, by some analog to digital conversion circuit as the analog-to-digital converter **149**, digitalized EDA data that is loaded into the channel #1 digital data register **147**.

[**0119**] The system **100** may also have extra measurement units up to an undefined maximum number for measurements into channels #2 and up. Such extra measurement units are symbolized by depicting only one single measurement unit **24** in the system **100**. The ID of that unit is held in the optional channels ID code **141** which is loaded into the optional channels ID register **142**. The optional channels analog device **153** mediates the analog data from the measurement unit **24** amplifiers/amplifiers and the optional channels digital device **148** contains the, by some analog to digital conversion circuit as the analog-to-digital converter **149**, digitalized optional data that is loaded into the optional channels digital data register **143**. Such data may be, for example, other psychophysiological data, light exposure, integrated sound level or GPS data including clock time and positioning information and other variables. The measurement unit **24** may represent one to several extra optional units measuring several psychophysiological or other variables.

[**0120**] The measurement unit **14** is similar to that used in the most preferred solution P. However, in the present secondary solution S, the hardware log unit ID code **152** is loaded into the log unit ID register **150**. The log unit key register **154** includes the digital code that the log unit **14** currently is holding. That code comprises the current key combinations set by key operations at the log unit keyboard module **13**.

[**0121**] Preferably, and in the embodiment that the optional log unit **14** transmits its data to the signal formatting unit **28** of the measurement unit **12**, the received signals in the registers **138**, **140**, **114**, **145**, **147**, **142**, **143**, **150**, **154** are downloaded at the "download all registers" signal **135** from

the "download all registers" unit **136** to special download registers **156**, **158**, **162**, **164**, **166**, **160**, **161**, **168**, **170**, respectively. The registers may range from at least 8 bits, preferably 32 or higher number of bits, if necessary. All the special download registers each sends a signal to a download validity register **172**. The unit **172** is in invalid state until all the registers have sent an acceptable signal. The unit **172** therefore sends a validity signal **174** to a validity comparison unit **176** that determines if all the registers have sent a suitable signal. If the unit **176** determines that not all the registers have sent an acceptable signal, then the unit **176** sends back a validity "no"-signal **178** so that the unit **172** must wait a certain time period until the unit **172** again sends the validity signal **174** to the unit **176**. If the unit **176** determines that all the registers have a sent a signal for valid register data, the unit **176** transmits a validity "yes"-signal **180** to a load buffer unit **181** that at the place pointed to by the sample counter/pointer **182** loads the current sample of data held by the special download registers **156**, **158**, **162**, **164**, **166**, **160**, **161**, **168**, **170**, and possibly other registers belonging to other modules, such as, for example, unit **24** for ECG, respectively, into the data buffer. The sample counter comparison unit **186** compares the sample counter/pointer **182** to the transmit sample preset **188**, then it sends an sample increment signal **206** to the increment sample/pointer unit **183** to increment the sample counter/pointer **182** to the buffer with one unit. Concomitantly, a signal from the increment sample/pointer unit **183** forwards a toggle signal **197** to the toggle data unit **198** for toggling extra data in the extra data register unit **161**. If, on the other hand, the comparison unit **186** determines that the sample counter/pointer **182** is equal to the transmit sample preset unit **188**, the unit **186** sends a send "yes"-signal **190** to a forwarding send buffer data unit **192** that may forward through the transmitter medium **230** the infonnation in the data buffer (the buffer length may be one sample) to a signal receiver system **82**. The medium **230** may be a wire, short distance radio wave or an infra-red signal or other suitable medium, and the receiver system **82** may contain an optional transit unit **16** consisting of a radio signal receiver or infra-red light receiver, or a computer **18**, **36**, a mobile phone **46**, or other suitable receiving device etc. The send buffer data unit **192** also sends a sample counter reset signal **194** to a sample counter reset unit **196** that forwards a reset signal **195** to the sample counter/pointer **182**. The sample counter reset unit **196** forwards a toggle signal **199** to the toggle data unit **198** for optionally toggling extra data in the optional channels digital data download register **161** which contains data, from for example a GPS unit, of such a total size that it has to be toggled on part of the total data at a time into the sample data. The toggle unit **198** sends forward a control signal **200** to a stop bit check unit **201** to check if the user has pressed a stop button on the measurement unit **12** that in turn activates a stop bit. If the stop-bit check unit **201** determines that the stop bit has been activated, the unit **201** sends a stop signal **202** to a stop unit **204** to stop the operation of the start/activation unit **102**, i.e., the operation of the measurement unit **12**.

[**0122**] If the stop-bit check unit **201** determines that the user has not activated the stop button, then the unit **201** sends a stop "no"-signal **208** to the stop button check **210** that determines if the user has pressed the stop button on the measurement unit **12**. If the stop button has been activated then the stop button check **210** sends a stop button "yes"-signal **212** to a set stop bit unit **214** that through the stop flag signal **216** sets the stop bit in the unit **12** base register **140**. If the stop button check **210** determines that the stop button has not been pressed then the unit **210** sends a stop "no"-signal to a reset button check **218** that determines if the reset button has been pressed. If the reset button check **218** determines that the reset button has not been pressed then the unit **218** sends a stop/reset "no"-signal **220** to the start/activation unit **102** to permit the system to continue taking samples. If the reset button check **218** determines that the reset button has been set, the unit **218** sends a reset "yes"-signal **222** to a reset process unit **224** that resets the system.

[**0123**] Reference figures

10 measurement system
12 measurement unit
13 log unit key board module
14 optional log unit
15 log data module
16 optional transit unit
17 optional log data transmit module
18 computer
20 sensors
21 sensors
22 channel #1 measurement module
24 measurement module
26 process module
28 signal formatting module
30 transmitter module
34 Internet
36 computer
44 measurement module
46 mobile telephone
70 start/activation unit
72 timer unit
74 optional basic data module
76 optional buffer handling unit
78 stop function unit
80 optional reset function unit
82 receiving system
100 measurement system
102 start/activation unit
104 continous activation signal
106 clock device
108 increment signal
110 increment device
111 increment signal
112 time counter
135 "download all registers" signal
113 trace signal
114 time tracer
116 interval signal
118 interval increment device
120 interval increment signal
122 interval counter
124 interval comparison signal
126 an interval comparison unit
127 preset interval unit
128 interval equal "yes"-signal
129 continuation interval equal "no" signal
130 reset interval counter unit
132 reset interval counter signal
134 load activate signal
135 "download all registers" signal
136 "download all registers" unit
137 unit 12 ID code
138 unit 12 ID register
139 channel #1 ID code
140 unit 12 base register
141 optional channels ID code
142 optional channels ID register
143 optional channels digital data register
145 channel #1 ID register

-continued

146 channel #1 digital device
147 channel #1 digital data register
148 optional channels digital device
149 analog-to-digital converter
151 channel #1 analog device
150 log unit ID register
152 log unit ID code
153 optional channels analog device
154 log unit key register
156 unit 12 ID download register
158 unit 12 base download register
160 optional channels ID download register
161 optional channels digital data download register
162 time tracer download register
164 channel #1 ID download register
166 channel #1 digital data download register
168 log unit ID download register
170 log unit key download register
172 download validity register
174 validity signal
176 validity comparison unit
178 validity "no"-signal
180 validity "yes"-signal
181 load buffer unit
182 sample counter/pointer
183 increment sample/pointer unit
186 sample counter comparison unit
188 transmit sample preset
190 send "yes"-signal
192 send buffer data unit
194 sample counter reset signal
195 reset signal
196 sample counter reset unit
197 toggle signal
198 toggle data unit
199 toggle signal
200 control signal
201 stop bit check unit
202 stop signal
204 stop unit
206 sample increment signal
208 stop "no"-signal
210 stop button check
212 stop button "yes"-signal
214 set stop bit unit
215 process termination unit
216 stop flag signal
218 reset button check
220 stop/reset "no"-signal
222 reset "yes"-signal
224 reset process unit
230 transmitter medium
240 log unit start/activation unit
242 log key check unit
244 log stop key check
250 log key codes register
252 logical signal unit
254 wave modulator unit
300 analog timer unit
302 calibration unit
304 calibration unit
306 calibration unit
310 amplifyer
312 digital one bit converters
314 logical signal unit/s/
316 wave modulator unit
320 amplifyer
322 digital one bit converters
324 logical signal unit/s/
326 wave modulator unit
330 wave generator
332 wave distribution unit
334 summating unit 334
336 single summated output signal
338 transmitter unit§

1. Method for interchanging, between a first subject and at least one second subject via a communication network system in real time, psychophysiological data and associated subject related data, where said first and second subjects are living beings, preferably human beings and said subjects located close to each other or scattered at different locations for achieving according to the method psychophysiological intersubject interaction, the method comprising:

collecting psychophysiological data from a first subject,

collecting first subject associated data, if any,

processing said collected first subject data in a first communication platform.

communicating said processed first subject data via said communicating network system to said second subject,

presenting said first subject psychophysiological data to said second subject as any of:

a symbolical, a functional or physical representation

collecting psychophysiological data from said second subject when reacting on said representation,

collecting said second subject associated data, if any,

processing said collected second subject data in a second communication platform,

communicating said processed second subject data via said communicating network system back to said first subject and

presenting said second subject psychophysiological data to said first subject as any of:

a symbolical, a functional or a physical representation.

2. Method according to claim 1, wherein the method includes the step:

arranging for communication of said data over a communication network system being any from the group:

Internet or other world wide web and related net functions as networks connecting to

Internet from cellular telephones,

Intranets of different types,

local nets, such as within a home or neighboring houses or vehicles or similar

micronets, such as connecting a computer or mobile phone with other devices, or, interconnecting one or more small electronic devices.

3. Method according to claim 2, comprising:

said psychophysiological data including measured values based on at least any of the manifestations from the group of: electrical brain activity, sweating, heart rate, blood pressure, blood flow, respiration, eye movements, electrical and mechanical muscle activity, acceleration of body part movements.

4. Method according to claim 3, wherein subject associated data includes any of the parameters from the group of:

log data related to the subject: such as parameters describing the subject's reactions, states or behaviour,

time,

information about the subject's geographical position,

light exposure,

ambient temperature,

climatic circumstances, such as: wind, air humidity,

surrounding sound levels,

subject affecting forces;

subject movement characteristics,

other environmental data relevant for the situation in which the subject is.

5. Method according to claim 4, wherein psychophysiological intersubject interaction includes any of the activities from the group of:

subject interacting in any of the activities from the group of: digital games, such as action games, strategic, role, sport, racing and family games, childrens' games, any other type of digital game to which psychophysiological signals may be implemented as active parts or added to in stand-alone embodiments,

chatting, i.e written or vocal or symbolical exchange of information over said network between said subjects for interpersonal communication,

group conversations, such as interactive role playing, theatre, drama or any other similar situation,

interactive happenings, such as art exhibitions,

entertainments, such as interactive television programs, musical entertainments, contests, interviews, political events,

emotional strategy games or exercises and

any other situation in which said two or more subjects reveal their psychophysiological reactions or states for each other.

6. Method according to claim 1, wherein said first or second communication platform is any from the group of:

a computer,

a game console including a special hardware design for use in digital games,

a cellular telephone,

a mobile intelligent screen or electronic book or its equivalence for local or net communication.

7. Method according to claim 1, wherein said symbolical representation is effectuated as a sign presented to the respective subject as any from the group of: a vision, a taste, a smell, a sound, a feeling.

8. Method according to claim 1, wherein said symbolical representation is effectuated as any from the group of:

a picture,

a verbal expression in text or sound,

a diagram,

a color,

an acoustic code/signal,

any other symbolic way.

9. Method according to claim 1, wherein said functional representation is effectuated as a change in the function of any from the group of:

a computer program or routine,

a cellular phone,

a communication device,

any other device or process that brings information to said first or second subject.

10. Method according to claim 1, wherein said physical representation is effectuated as a change in physical effect applied by a device attached to the respective subject's body.

11. Method according to claim 10, wherein said device is any from the group of: a vibrating device, a tapping device, a mechanical effector device, such as a device exerting mechanical pressure or movement on the subject, a heating device, a cooling device, an electrical stimulation device, any device causing some type of sensation to the subject.

12. Device for performing the method according to claim 1, characterised in that the device comprises:

a first measuring unit (**12**) provided with sensors (**20**, **21**) for measuring first psychophysiological data from a first subject, a first transit unit (**16**, **38**) receiving said first data from the first measuring unit (**12**) and for sending the received first data to a first communication platform (**18**, **36**, **46**) for processing the data before the data is sent over a communicating network system (**34**), a second communication platform (**18**, **36**, **40**, **46**) for receiving said first data, a first presentation unit (**18**, **36**) for presenting to a second subject said first data as any of a symbolical, a functional or a physical representation and

a second measuring unit (**12**) provided with sensors (**20**, **21**) for measuring second psychophysiological data from said second subject, a second transit unit (**16**, **38**) receiving said second data from the second measuring unit (**12**) and for sending the received second data to a third communication platform (**18**, **36**, **46**) for processing the data before the data is sent over the communicating network system (**34**), a fourth communication platform (**18**, **36**, **40**, **46**) for receiving said second data, a second presentation unit (**18**, **36**) for presenting said second data to said first subject as any of a symbolical, a functional or a physical representation.

13. A device according to claim 12, characterised in that the communication platform (**18**, **36**, **46**) is a computer, a cellular telephone or any other computerized communication device.

14. A device according to claim 12, characterised in that the communicating network is the world wide web, an intranet, a local net or a micronet.

15. A device according to claim 12, characterised in that any or all of the measuring unit (**12**), the transit unit (**16**, **38**) and the communication platform (**18**, **36**, **46**) are housed in the same unit or cabinet at any or all of said subjects.

16. A device according to claim 12, characterised in that the first and forth communication platforms are the same.

17. A device according to claim 12, characterised in that the second and the third communication platforms are the same.

18. A device according to claim 12, characterised in that a log unit (**14**) is provided together with the measurement

unit (**12**) for logging data associated to the subject being connected to the measurement unit (**12**).

19. A device according to claim 13, characterised in that the log unit (**14**) is receiving data from the measurement unit (**12**) and sending data to the transit unit (**16**, **38**) by means of wired or wireless connection.

20. A device according to claim 12, characterised in that the measurement unit (**12**) has a plurality of sensors (**20**, **21**) to be attached to any part of the human body of a subject for measuring or analysing psychophysiological parameters.

21. A device according to claim 20, characterised in that the measurement unit (**12**) has several modules, including at least any from the group of: signal amplifiers (**22**), amplifiers (**24**) designed to measure paraphysiological data, process modules (**26**) such as start/activation units, timer unit (**72**), analog to digital converter function units, basic data unit (**74**), final logics unit (**76**), stop unit (**78**), reset unit (**80**), signal formatting module (**28**), buffer unit, data transmitter module (**30**), power supply module (**32**).

22. A method for interchanging, between a first subject and at least one second subject via a communication network system in real time, psychophysiological data and associated subject related data, where said first and second subjects are living beings, preferably human beings and said subjects located close to each other or scattered at different locations for achieving psychophysiological intersubject interaction, characterized in that the psychophysiological data measured on the subject as analog signals are converted to digital signals by one-bit analog to digital conversion by a continuous binary summation of an amplitude-modulated electrical wave.

23. A method according to claim 22, wherein the amplitude of the wave is dependent on the order number of the channel number generating the signal for the moment.

24. A method according to claim 23, wherein the modulation of the wave is activated by logical high signals from different information sources.

25. A method according to claim 24, wherein the amplitude-modulated signals are continuously added to each other into one single signal comprising the sum of all binary amplitude-modulated single channels.

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申请号	US09/891604	申请日	2001-06-27
[标]申请(专利权)人(译)	THORELL LARS HAKAN		
申请(专利权)人(译)	THORELL LARS-HAKAN		
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摘要(译)

本发明的装置和方法包括通信网络系统，该通信网络系统可用于实时测量，分析和分发来自诸如人类或其他数据源的生物对象的心理生理学和其他受试者相关数据。相互之间或分散在不同地点。心理生理信息或装置的通信对于心理生理学主体间交互可以是双向的或多向的，使得两个或更多个主体可以在通过不同类型的平台的一个或多个步骤处理之后交换它们的心理生理学数据。可以以不同的符号，功能或物理方式实现对自身或其他对象的处理的生理或其他数据的表示。