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(54) Title: DEVICE, SYSTEM, AND METHOD OF IMPROVED DIAGNOSIS, DECISION-SUPPORT, AND ANALYSIS OF ELECTROENCEPHALOGRAMS

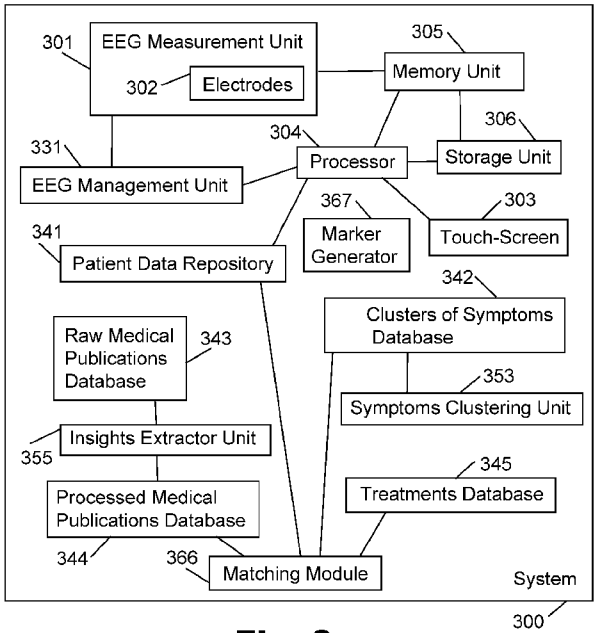


Fig. 3

(57) Abstract: Device, system, and method of improved diagnosis, decision-support, and analysis of electroencephalograms. A system includes: an electroencephalogram (EEG) device to sense EEG data from a user; and a database to store the EEG data, patient data, symptom data about clusters of symptoms, data about medical conditions and diseases, and information about treatment options. The system further includes a diagnosis unit (i) to analyze the EEG data with the patient data, and (ii) to compare the EEG data and the patient data to the symptom data, and (iii) to select, based on this comparison, at least one of: (I) a diagnosis of a corresponding medical condition or disease, (II) a selected treatment from the treatment options. The system also includes a display unit to display at least the EEG data and at least one of the diagnosis and the selected treatment.

DEVICE, SYSTEM, AND METHOD OF IMPROVED DIAGNOSIS, DECISION-SUPPORT, AND ANALYSIS OF ELECTROENCEPHALOGRAMS

FIELD OF THE INVENTION

[0001] The present invention relates to the field of medical devices and medical systems.

BACKGROUND

[0002] Electroencephalography (EEG) is an electro-physiological monitoring method for recording electrical activity of the brain. An EEG is typically non-invasive and utilizes multiple electrodes that are placed around the scalp. The electrodes measure voltage fluctuations resulting from brain activity, corresponding to spontaneous electrical activity of the brain over time.

[0003] EEG measurements may be used to diagnose various medical conditions or disorders, for example, epilepsy which may cause abnormalities in the electrical activity of the brain.

SUMMARY

[0004] The present invention may comprise devices, systems, and methods for performing, evaluating and/or utilizing electroencephalography (EEG); as well as for generating and analyzing EEG measurements or EEG readings.

[0005] The present invention may include an assistance and decision system (or a decision-support system, or a decision-assisting system), comprising: an electroencephalogram (EEG) device to sense EEG data from a user; a database to store said EEG data, patient data, symptom data about clusters of symptoms, data about medical conditions and diseases, and information about treatment options; a diagnosis unit (i) to analyze said EEG data with said patient data, and (ii) to compare said EEG data and said patient data to said symptom data, and (iii) to select, based on this comparison, at least one of: (I) a diagnosis of a corresponding medical condition or disease, (II) a selected treatment from said treatment options; a display unit to display at least said EEG data and at least one of said diagnosis and said selected treatment.

[0006] In accordance with the present invention, the diagnosis unit may evaluate combined data of said EEG data with patient data according to a plurality of test protocols, may determine

which of said test protocols said combined data matches, and may select a suitable treatment from a set of treatment options on the basis of this determination.

[0007] In some embodiments, the EEG device, the diagnosis unit and the display unit are integrated into a single device which further comprises a single housing and connectors for electrodes for said EEG device.

[0008] The present invention may provide other and/or additional benefits and/or advantageous.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Fig. 1 is a schematic block-diagram illustration of a system, in accordance with some demonstrative embodiments of the present invention.

[0010] Fig. 2, which is a flow-chart of a method in accordance with some demonstrative embodiments of the present invention.

[0011] Fig. 3 is a schematic block-diagram illustration of another system, in accordance with some demonstrative embodiments of the present invention.

[0012] Fig. 4 is a schematic illustration of a device, in accordance with some demonstrative embodiments of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0013] The present invention may comprise an assistance and decision system, and a method for evaluating electroencephalograms, as well as the use of same.

[0014] Electroencephalography (EEG) is a standard test method in neurology which is used for medical diagnostics as well as in research in neurology and neuroscience to measure the total electrical activity of the brain by recording fluctuations in voltage on the surface of the head and is represented graphically as an electroencephalogram.

[0015] The Applicants have realized that a disadvantage of electroencephalography is that the evaluation of the measurement results must be performed by trained neurologists on the basis of the visual interpretation of electroencephalograms. Therefore, the quality of the diagnosis depends on the neurologist's experience and/or knowledge, and the intra- and interpersonal precision of the interpretation is low. The Applicants have realized that evaluation of an EEG measurement may be subjective, or may depend on the particular skills of the human physician that reviews the EEG measurement. The Applicants have realized that a novice or inexperienced or less-experienced physician, may reach different conclusions when reviewing an EEG measurement, compared to an experienced physician or experienced neurologist.

[0016] In quantitative electroencephalography (QEEG), the measured EEG metrics, such as the frequency, amplitude and connectivity, may be quantified and represented graphically in the form of QEEG plots or "brain maps".

[0017] The Applicants have realized that it may be beneficial to construct an EEG / QEEG database, in order to ascertain whether the measured data for a patient deviates from standard values. Such a database may further be utilized to identify and generate indication(s) of the patient's disease or medical condition(s), and/or to generate treatment proposal(s); in addition to generating indications of whether the brain activity findings are normal or abnormal.

[0018] The present invention may comprise systems and methods to better evaluate the data obtained from EEG measurements, so that not only can disturbances be detected, but also for reliably diagnosing relevant medical condition(s) or problem(s).

[0019] Reference is made to Fig. 1, which is a schematic block-diagram illustration of a system 100, in accordance with some demonstrative embodiments of the present invention. System 100 may be an EEG measurement and/or assistance and/or decision system (or decision assisting system). System 100 may comprise, for example: an electroencephalography device (EEG device) 101 able to perform an EEG measurement (e.g., by using multiple electrodes placed on a person's scalp); an input unit 102; an output unit 103; a computer 104 or other computing platform or processing unit; a first database 111; and a second database 112. Patient data may be transmitted from a user to the EEG device 101 via the input unit 102. The EEG device 101 may exchange data with the computer 104, and the patient data and the data measured with the EEG device 101 may be relayed to the computer 104. The first database 111 may store data measured by the EEG device 101. The second database 112 may store patient data, data about clusters of symptoms, and information about treatment options.

[0020] The computer 104 may be connected to the first database 111 and to the second database 112, via one or more wired links and/or wireless communication links, for the exchange of data. The computer 104 may evaluate the patient data and the data measured by the EEG device 101, may compare the data with the information about clusters of symptoms, and may select a suitable treatment from the second database 112; and may transmit or convey the findings to output unit 103 (e.g., to a display unit). A "cluster of symptoms" may comprise a set or group or batch of symptoms (e.g., "fatigue" and "headache" and "nausea") that may be grouped together since a particular patient exhibits them in combination or in aggregate, and/or since they were researched as a group or cluster of symptoms or related conditions in a study or research. The clustering of symptoms may be performed based on receiving an indication from a patient, or from a group of patients or from multiple patients, that all exhibit or report

such symptoms in combination; and/or based on indications in medical literature or studies that certain sets of two or more symptoms may typically or may often be found together at the same patient, or may otherwise be related or associated with each other (for example, symptom A may typically follow one day after symptom B is exhibited; such as, a rash appearing one day after fever, or a fever appearing one day after a rash, in certain medical conditions or diseases).

[0021] By using the assistance and decision system 100, the diagnostic process may be improved, treatment proposals may be generated, and treatment results may be evaluated.

[0022] Input unit 102 may comprise any suitable man-machine interface, for example, a keyboard, a mouse, a touchpad, a touch-screen, or other suitable input device allowing a user of the EEG device 101 to input data.

[0023] Output unit 103 may be or may comprise, for example, a monitor, a display unit, a screen, a touch-screen, a printer, or the like. Optionally, input unit 102 and output unit 103 may be implemented as a single device, for example, a touchscreen.

[0024] Patient data may comprise all personal data about the patient to be treated, for example, gender, age, previous illnesses, and all symptoms the patient has complained about.

[0025] Computer 104 may be integrated into the EEG device 101, such that a single housing may house or may encapsulate both the EEG device 101 and the computer 104. However, other embodiments may be used, in which the computer 104 may not be part of the EEG device 101 but rather may be connected to the EEG device via a hardwired link or wireless data exchange connection or wireless communication link(s). In some implementations, computer 104 may be a remote computer or server, or a "cloud computing" server or device. Optionally, client / server architecture may be utilized by system 100; other suitable architecture(s) may be used.

[0026] The first database 111 and/or the second database 112 may be integrated into the EEG device 101, and may be implemented as local database(s) or as locally-stored repositories which may utilize a local or internal storage unit. In some implementations, databases 111 and/or 112 may be arranged or implemented separately from the EEG device 101, and may exchange data with one another over a hardwired link and/or over a wireless connection. Optionally, databases 111 and/or 112 may be implemented by using remote databases or "cloud computing" repositories. Optionally, databases 111 and/or 112 may comprise one or more storage media, for example, a hard disk drive (HDD), a CD ROM, a solid state drive (SSD), or the like.

[0027] In some embodiments, databases 111 and 112 may be implemented by using two separate databases; for example, in order to ensure that a one database stores only patient-

sensitive information or other private information or confidential information, whereas another, separate, database stores public information, medical research data, medical insights extracted from such research, and other information which may not be confidential and/or which may not include patient-sensitive data or personally-identifying information. In other embodiments, the first and second databases 111-112 may alternatively be implemented as a single or an integrated database, or by using two volumes or two objects within a same unit or device or storage medium or storage unit; optionally while taking measures in order to ensure that patient privacy and confidentiality is maintained and/or that personal data is not exposed (e.g., security measures, encryption, access control, pre-defined and selective read/write privileges).

[0028] In some embodiments of the present invention, the computer 104 may exchange data with a plurality of EEG devices 101, via one or more wired links and/or wireless communication links. This may allow the system 100 to collect and analyze data from multiple EEG devices and/or sensors; and further allows the measurement results (EEG and/or QEEG) of a plurality of EEG devices to be collected, evaluated, compared and/or analyzed, such that that the stored volume of data and thus also the diagnostic precision may be increased across system 100.

[0029] Reference is made to Fig. 2, which is a flow-chart of a method in accordance with some demonstrative embodiments of the present invention. According to the method, the activity (e.g., electric activity) of a patient's brain may be measured or sensed (block 210) by using an EEG device. The measured data, as well as patient data (e.g., of the corresponding patient) may be stored (block 220) in a first database. The first database may further store (block 230) data about clusters of symptoms. Data about the clusters of symptoms (e.g., obtained from a first computer) may be analyzed or evaluated (block 240) for its relevance with respect to the particular patient data; and a computer or other processing unit may compile or may generate (block 250) a diagnosis of the condition of the patient (or the patient's brain), based on the data about clusters of symptoms and its relevance to the current patient. The diagnosis information may be relayed or transmitted or displayed (block 260), for example, to or via a local or remote output unit, or to a local or remote recipient device. Other suitable operations may be performed, in accordance with the present invention.

[0030] The methods and systems of the present invention may provide one or more advantages. For example, diagnostics may be improved because the evaluation of the measurement of the brain activity (e.g., electric voltage and/or electric currents, and/or changes in electric voltage or current) may have an improved sensitivity and accuracy in comparison with conventional analysis tools (e.g., a questionnaire filled manually by a patient).

[0031] Additionally or alternatively, an improved prognosis for therapeutic results may be achieved. Analysis of the QEEG measurement may be more sensitive in predicting therapeutic results for pharmacological procedures on patients with psychiatric disorders, compared with than conventional questionnaires or interviews. In a demonstrative example, with regard to depression evaluation by a psychiatrist: conventional systems may reach 30% predicted value, whereas QEEG efficiency may reach up to 90% predicted value when using the system and method of the present invention. Other performance goals may be achieved or increased.

[0032] Additionally or alternatively, ease of use may be achieved or improved by using the present invention. Due to the automatic reporting function which may specify a specific marker for psychiatric disorders, a medical clinic or physician need not manually interpret the measurements or the results of the measurements, thereby saving significant time and effort, and/or obviating the need for teaching sessions, and/or shortening the time for interpretation.

[0033] Additionally or alternatively, cost reduction may be achieved. For example, an increase in the number of patients receiving an optimal treatment in a shorter period of time may result in a decline in the cost of treatment and/or in the cost of doing business (e.g., fewer days of work missed due to illness of patients). Similarly, less time spent by physicians on manually reviewing EEG or QEEG results, may allow such physicians to attend to other, profit-generating, tasks; or may allow such physicians to see or to handle an increased number of patients or medical cases.

[0034] Additionally or alternatively, the present invention may bring advantage(s) for the patient. The quantification of the brain parameters (e.g., electric activity, electric voltage and/or electric current, as measured near the brain), before, during and after a treatment, may significantly alter the procedure and/or the result for the patient. They receive an objective acknowledgement, treatment options are improved and the results of the treatment are evaluated. The quality of the treatment may be monitored constantly or continuously; and less successful treatment methods may be modified or replaced or improved (e.g., quality management), which may result in improved patient satisfaction and/or increased quality of patient care.

[0035] As discussed above, the measured and evaluated data of a plurality of EEG devices and patient data may be preferably stored in the first database 111. This may have the advantage that the quality of the diagnosis is improved through the quantity of data thereby ascertained, because this information serves as comparative examples which, when the symptoms are the same or essentially similar or generally similar, may allow the computer 104 to reach a conclusion that it is the same cause and/or disease.

[0036] Information about clusters of symptoms in the first database 111 may be or may comprise information about studies and/or cases described in the literature, stored as data, and/or optionally represented by using threshold values, look-up tables, or other format for representing conditions or for enabling comparison operations or search operations. Optionally, publications in the fields of neurology, psychiatry, psychology, neurosciences and/or other medical fields or other fields, may be processed so that they may be stored in or added to the database(s) 111-112.

[0037] The data about clusters of symptoms in the first database 111 may be evaluated or analyzed based on its significance for an individual patient or a group of patients; and a marker or indicator may be generated (e.g., by the computer 104, or by a processor or other analysis unit or marker generation module) from such data analysis, indicating the probability of the accuracy of the diagnosis. To do so, the information from publications in the fields of neurology, psychiatry, psychology, neurosciences and/or other suitable fields, may be evaluated by determining its significance with respect to a patient or a group of patients. Optionally, the marker may indicate a percentage probability, or other value which may indicate the likelihood that a match exists (e.g., an indicator in a pre-defined range of values, or other pre-defined scale).

[0038] In some implementations, data stored in database(s) 111-112 may correspond to the latest status of scientific information or knowledge. For example, data about clusters of symptoms stored in the first database 111 may be updated at pre-defined time intervals (e.g., every day, every week, every month, or the like), or upon a triggering event (e.g., once a new volume of a medical journal is published; or once an important study is published; or based on a command from a system operator to perform an immediate update, or to perform an update at a scheduled time or date), and may be periodically re-evaluated or re-analyzed by the computer 104. Optionally, computer 104 may implement or may utilize an updater unit or updater module, which may control the timing, the frequency and/or the type of such updates, and may perform such updates at pre-defined time intervals, on demand, and/or upon a triggering condition or triggering event.

[0039] The computer 104 may generate proposals for treatment options, for example, based on the diagnosis made, by performing comparison of data with information about therapeutic options stored in the second database 112, and then relaying or transferring or transmitting such proposals to the output unit 104. For example, known treatment options from the technical literature may be processed in such a way that the computer 104 may determine suitable

treatment option(s) on the basis of the diagnosis made, and then propose such treatment option(s) to the user via the output unit 103.

[0040] Some embodiments of the present invention may utilize the assistance and decision system 100 for evaluation of electroencephalograms (EEG and/or QEEG measurement results) for detection of psychological disorders and/or psychiatric disease conditions, such as depression, anxiety disorders, attention deficit hyperactivity disorders (ADHD), autism, Autism Spectrum Disorders (ASD), post-traumatic stress disorders (PTSD), migraines, epilepsy, and/or other medical condition.

[0041] In some demonstrative implementations, the present invention may comprise a decision assistance system based on analysis of scientific literature. For example, publications about clusters of symptoms, such as psychological disorders, in the scientific literature or other information sources (e.g., data collected from formal or reliable sources, such as from government agencies in or government health departments) may be collected and evaluated or analyzed. In the analysis, typical EEG patterns, in particular QEEG patterns, may be determined and assigned to individual diseases or medical conditions or medical symptoms. These patterns may then be transferred into, or may be converted into, one or more IF - THEN algorithms or logic sequences or pseudo-code or code, which may be used in conjunction with the measured patterns or the sensed data. The assistance and decision system may thus transform or convert the information obtained from the scientific publications into algorithms that conform to IF - THEN logic and/or to other logic, including (but not limited to) converting such information into data which may then be parsed, searched, or queried upon by utilizing one or more query languages or programming languages or automatic scripts.

[0042] The following example demonstrates an exemplary sequence of a process, in accordance with the present invention. A literature search may be performed, for example, pre-selection of relevant EEG and/or QEEG studies and selection of the studies with the complete description of the methodology. The relevant information of the studies may be used as data input for which a program incorporating the IF - THEN logic may be created. In such program, a logic may be generated for each statement in the study. Each logic may be evaluated by the influence factor of the journal (e.g., journal impact factor or "JIF") in which it was published, and the number of volunteers or participants in the study. Optionally, a weighted formula may be used, such that a journal that is associated with higher quality may have a greater influence; and a study that included a greater number of participants (e.g., beyond pre-defined threshold values) may have a greater influence (e.g., as detailed further below; taking into account, for example, the prestige or quality or reputation of a journal or an author; the

number of citations or recitations of a paper; the level of definiteness of conclusions or recommendations in a study). The result of this evaluation may be referred to as an "index". All logics for a particular disease (or medical condition, or medical symptom) may be linked together or grouped together, in a chain or group or subset within the program or by using a common or inter-connected data structure.

[0043] Each logic may be "active" or "inactive", with regard to a particular run or iteration of the analysis; for example, the logic may be "inactive" for a study having only male subjects, when the particular EEG or QEEG measurement is performed on a female patient. Similarly, the logic may be "active" for a study having only male subjects, when the particular EEG or QEEG measurement is performed on a male patient. In some embodiments, a parameter or field-value of "active" (or "relevant"), associated with a particular study or logic thereof, may have binary value (e.g., True or False).

[0044] In some implementations, the following formula may be used in order to determine the marker percentage, or an indicator of the certainty or the likelihood that a particular marker is indeed correct or relevant to a particular patient:

Marker % = (total logic "TRUE") / (total logic "TRUE + FALSE")

[0045] Optionally, an Index or a weighting factor may be present in the numerator or in the denominator of the above-mentioned formula; for example, to indicate that a particular algorithm or test-method or test-protocol or study or cluster-of-symptoms has an increased (or reduced) weight, due to one or more parameters (e.g., a very large number of participants in a study; a key study that was re-confirmed by numerous other studies; or the like). Other suitable formula may be used.

[0046] For example, for each disease (or symptom, or medical condition) multiple logics may be created, corresponding to multiple (respective) studies or study-portions. In a demonstrative example, multiple different studies may show that depression is normally accompanied by QEEG patterns in the forehead region of the brain. Other multiple studies may show that reverse patterns in the posterior portion of the brain may also be associated with depression. The system of the present invention may generate a first IF-THEN logic for the forehead region, and a second IF-THEN logic for the posterior portion of the brain.

[0047] In some implementations, some or all the defined logics may compete with one another, and may be combined (e.g., by utilizing a weighted formula) into a marker for a certain disease or medical condition. By using these logics, a marker for a disease (or medical condition) is not only right or wrong, or relevant / irrelevant, but may assume a value between 0% and 100% indicating its likelihood of relevancy. If all the logics for a certain marker are

correct, then the marker assumes a value of 100%; and if all the logics for a certain maker are wrong, then the marker assumes a value of 0%. In some implementations, due to competing results of scientific studies, it may be unlikely for a marker to assume a value of 100%, although a marker value that may be close to 100% (e.g., 99%) may possibly be achieved with regard to certain medical conditions for which there are clear and unanimous medical studies that point at the same direction. The marker may be generated or calculated by computer 104, or by a suitable processor or marker generator module or by a marker generator unit. The marker may indicate, for example, what percentage of the studies in a particular clinical field (e.g., studies about Depression) is relevant to a particular patient (e.g., female, age 45, smoker) having a particular cluster of symptoms (e.g., depression and fatigue and headache).

[0048] The marker (or other relevancy score or relevancy indicator) may indicate, for example, that 20 percent of studies in the field of Depression, are relevant (or "active") for this particular patient and/or for the patient's cluster-of-symptoms. The marker may optionally be computed by using a weighted formula, which may increase (or decrease) the marker's value based on the quality or relative weight of one or more particular studies. For example, even though only 20 percent of the studies are relevant to a particular patient, those 20 percent may be significantly relevant because they included a large number of participants, or are known to be high-quality studies that were later re-confirmed by numerous other studies, or are otherwise known to be authoritative in the field, and the marker may be increased or adjusted upwardly to reflect such added weight. Similarly, a marker may be reduced or adjusted downwardly to reflect that a particular study was retracted or partially-retracted or later corrected, or that a particular study has received numerous response papers that negate it or contradict it or criticize its methods or its conclusions.

[0049] The marker generator system of the present invention may thus be implemented as an automated, automatic, tool that may perform meta-analysis of research papers in a particular field, thereby saving significant time and efforts that a human physician may need to spend in order to review dozens of hundreds of such research papers or studies, in order to classify them or sort them based on relevancy to a particular patient and/or to the patients cluster-of-symptoms, and/or in order to allocate the suitable weight and/or relevancy-score for each such study.

[0050] In the demonstrative field of diagnosing and/or treating depression, the following are two examples of logic sequences which may be generated and/or utilized by the present invention:

IF person is female, AND

IF person's age is between 20 and 40 years, AND

IF the alpha waves on the left frontal cortex are greater than the alpha waves on the right frontal cortex while the eyes are closed,

THEN "depression" = TRUE

(based on publication number 123456 which had 270 participants)

Logic 1

IF person is female, AND

IF persons' age is between 30 and 50 years, AND

IF the alpha waves of the right lateral cortex are greater than the alpha waves of the left lateral cortex while the eyes are closed,

THEN "depression" = TRUE

(based on publication number 765432 which had 98 participants)

Logic 2

[0051] These demonstrative logics for depression may be utilized or activated only if the person is female and within the age range, which is different for the two sets of rules. If both logics are activated and true, then the marker may have a greater percentage or certainty and may have a greater reliability, relative to a scenario in which only one logic is activated or true. The reliability of markers may be defined on the basis of the quality of the studies that are used (for example, impact factor, influence level, number of volunteers or participants, year of publication, the number of times that each publication was cited or re-cited).

[0052] In a demonstrative implementation, logics may be programmed by using programs such as LabVIEW (RTM), a visual programming language from National Instruments Corporation, Austin, Texas, USA, or by using other suitable tools or programs. Optionally, additional information about the source of the logic (e.g., publication, author, year of publication) may be assigned to each logic.

[0053] In another demonstrative example in the field of depression, a literature search may be performed, searching for QEEG studies related to depression in one or more databases (e.g., in the PubMed database which is accessible through PubMed.org), including but not limited to database(s) of publications or studies or clinical trials in one or more medical fields. Relevant

information from the studies may be extracted or obtained from the publications, and a logic may be created for each statement from the study.

[0054] An "Index" may be calculated; such as, for an exemplary study having 100 participants, and having a journal inclusion factor of 2.4, the Index may be a product of these two values, creating an Index value of 240 points.

[0055] In some implementations, some or all the logics that are related to a particular disease (or a particular medical condition) may be combined in a chain in the application or program. Optionally, a marker percentage indicator may be implemented as an automated report that the system may output.

[0056] Some embodiments of the present invention may generate an EEG measurement followed by an automated analysis and a report based on input by the physician or other professional (e.g., nurse, medical assistant, EEG device operator), such as the age, gender and possible diseases (or medical conditions, or symptoms) of the patient.

[0057] The assistance and decision system may optionally be implemented as a single-station system, such that the EEG device 101, the computer 104 and the databases 111-112 may be integrated into a single unit and may be co-located at a single location. Alternatively, the system may be implemented by using multiple devices or units, which may be separate from each other, and which may be co-located in proximity to each other (e.g., in the same room, or in the same building), or which may be distributed across multiple locations (e.g., by utilizing a remote server or remote databases).

[0058] Optionally, a single-station implementation may be suitable for physicians or professionals in small practices. Such single station implementations of the assistance and decision system may receive updated data about clusters of symptoms and their evaluation, by having the system learn that the various patients examined by this system and their evaluations are used as the basis for additional analyses; and/or by further updating the local databases by receiving updates from an external or remote computer or server, which in turn may receive data from an up-to-date external database.

[0059] In other implementations of the assistance and decision system, the system (or some components thereof) may be connected to an external computer and/or external databases and/or remote computers and/or remote databases. The external databases may be managed and/or updated centrally, thereby ensuring that the latest scientific research results are entered into the database and evaluated accordingly, so that the results supplied by the assistance and decision system correspond to the latest knowledge as well as discoveries in the relevant technical field. Optionally, a plurality of separate EEG devices (which may not necessarily be

operated by the same entity, or within the same location) may be connected to one or more such external computers and external databases.

[0060] In accordance with the present invention, results of successful treatments and the respective patient data, optionally anonymized to preserve privacy and confidentiality, may be stored in (or uploaded to) the first database 111, and may thus be included in future analyses or in subsequent evaluations performed by the same EEG device 101 or by other, co-located or remotely-located, EEG device(s). Such a networked implementation may be suitable for hospitals or for a number of networked medical practices, which are may be maintained by or from a central location.

[0061] The present invention may comprise an assistance and decision system, comprising an EEG device, an input unit, an output unit, a computer, a first database and a second database; wherein patient data from a user is transmitted or transferred to the EEG device via the input unit; wherein the EEG device exchanges data with the computer; wherein the data measured with the EEG device as well as the patient data is relayed to the computer; wherein the first database stores data measured by the EEG device, as well as patient data; wherein data about clusters of symptoms, and/or data about treatment options, are stored in the second database; wherein the computer exchanges data with the first database and the second database; wherein the computer is to evaluate and/or analyze the data measured by the EEG device and the patient data, by comparing such data with data about clusters of symptoms and to by selecting a suitable treatment and/or diagnosis from the second database based on this evaluation; wherein a description of the selected treatment is transferred or transmitted to the output unit or to a display unit.

[0062] In some implementations, the computer is integrated into the EEG device. In some implementations, the first and/or second database(s) is / are integrated into the EEG device. In some implementations, the computer exchanges data with a plurality of EEG devices.

[0063] The present invention may comprise a method of evaluating electroencephalograms, according to which a patient's brain activity is measured with an EEG device, this data being stored in a first database together with patient data; wherein the first database also contains data about clusters of symptoms; the data about clusters of symptoms is evaluated for relevance to the patient data; a computer generates a diagnosis of the condition of the patient's brain based on the data about clusters of symptoms contained in the first database and the relevance of such data to the present patient, and relays or transfers this data to an output unit.

[0064] In some implementations, the measured and evaluated data of a plurality of EEG devices and patient data are saved in the first database. In some implementations, information about studies and cases described in the technical literature is stored as data about clusters of symptoms in the first database. In some implementations, the data about clusters of symptoms in the first database is evaluated on the basis of its significance for a single patient or a group of patients; and a marker is created from such data, reflecting the probability of the accuracy of the diagnosis. In some implementations, data about clusters of symptoms stored in the first database is updated at regular intervals and reevaluated by the computer. In some implementations, the computer generates proposals for treatment options on the basis of the diagnosis made, by performing data comparison with information about treatment options stored in a second database and relays this to the output unit.

[0065] The present invention may further comprise a use of the assistance and decision system as described above, and/or a method for evaluation of electroencephalograms for recognition of psychological disorders and/or psychiatric diseases.

[0066] Reference is made to Fig. 3, which is a schematic block-diagram illustration of a system 300, in accordance with some demonstrative embodiments of the present invention. System 300 may be an EEG measurement and/or assistance and/or decision system (or decision assisting system).

[0067] System 300 may comprise, for example: an EEG measurement unit 301, optionally comprising one or more electrodes 302; a touch-screen 303 to display output and to receive input from a human operator; a processor 304 able to execute code or programs or machine-readable instructions; a memory unit 305 (e.g., Read Access Memory (RAM), or Flash memory), and a storage unit 306 (e.g., hard disk drive (HDD), solid state drive (SDD), or the like).

[0068] An EEG measurement controller 331 may control the EEG measurement unit 301, for example, to acquire and/or monitor and/or sense brain electrical activity and/or brain electrical voltage data and/or brain electrical current data, optionally by utilizing electrodes 302 that may be placed on or around or along or near a person's scalp or head or face or forehead or other suitable body region(s) or organ(s). The sensed or measured EEG signals may be stored temporarily in memory unit 305, and/or may be stored in storage unit 306 for long term storage. Processor 304 may execute code that analyzes the EEG measurements, or that extracts insights or conclusions from such EEG measurements; or, an EEG analysis module or EEG analysis unit may perform these operations. Optionally, QEEG or "brain

maps" (e.g., color-coded brain maps) may be generated or constructed from EEG measurements, by the processor 304 or by other suitable QEEG generator module.

[0069] System 300 may further comprise one or more repositories or databases, which may be integrated into a common housing or device, or which may be remote and may be accessible over wired or wireless communication link(s). Such databases or repositories may comprise, for example: a patient data repository 341, a cluster of symptoms database 342, a raw medical publications database 343, a processed medical publications database 344.

[0070] Patient data repository 341 may store patient data, for example, patient name, date of birth, gender; current diseases, current medical symptoms; prior diseases, prior medical symptoms, dates of visit(s), date of medical procedures performed, and/or other suitable patient-related data pertaining to the patient and/or his medical history and/or his current medical condition.

[0071] Cluster of symptoms database 342 may store data representing clusters or groups or subsets or batches of symptoms, which may be grouped together by a Symptoms Clustering Unit 353 based on analysis of medical publications or studies or research. For example, a cluster of symptoms may be grouped together, corresponding to (or being associated with) a particular medical condition and/or medical symptom and/or treatment.

[0072] Raw medical publications database 343 may store data and/or partial copies and/or full copies of medical studies, publications and/or research papers, which may be obtained from one or more external sources (e.g., from the PubMed database). Optionally, each item or data-item or record in the raw medical publications database 343 may be associated with a Journal Influence Score (JIF) or other quality indicator; which may reflect, for example, the relative prestige of the journal or publication (and/or its authors), as well as the number of times that a particular study was cited in subsequent research papers, and optionally taking into account the influence or the quality of the citing papers in order to estimate or determine the JIF of a cited paper.

[0073] Processed medical publications database 344 may store processed data that was extracted from, or that summarizes, the content of items stored in the raw medical publications database 343. Optionally, an Insights Extractor Unit 355 may extract insights and/or conclusions from the raw medical publications, based on contextual analysis, by using meta-data or tags or chapter headings, by contextual analysis of the Abstract chapter and/or the Conclusions chapter of a study or a publication, by utilizing Natural Language Processing (NLP), by searching for pre-defined strings or sequences of characters or words, and/or by other suitable methods.

[0074] The Insights Extractor Unit 355 may construct insights in a format which may be suitable for IF – THEN queries and/or for searching via Boolean operators and/or for searching via Natural Language Processing (NLP).

[0075] Optionally, the Symptoms Clustering Unit 353 may operate in conjunction with the Insights Extractor Unit 355, in order to group-together a batch of symptoms as a cluster of symptoms that is determined to be associated with a particular medical condition, based on insights that were extracted by the Insights Extractor Unit 355 from the processed medical publications data.

[0076] Optionally, a marker generator 367 may generate an accuracy marker or a quality indicator, which may define or indicate a significance (or relevance) for a single patient or for a group of patients, of a cluster of the test protocols relating to a particular disease and/or of one or more studies and/or one or more conclusions of such study or studies. The generated marker may be implemented as a single indicator, or as a set or array of indicators, or as a weighted indicator which takes into account multiple parameters; for example, a relevance score of a study to a particular patient; a relevance score of a study to an EEG measurement of a patient; a relevance score of a study to one or more characteristics of a patient (e.g., age, gender, profession, dietary regime, smoking or non-smoking, alcohol consumption); a quality indicator of the journal, or book, or publication venue (e.g., conference), or other medium through which the medical study was published; a quality indicator of one or more authors and/or publishers of a study; a quality indicator related to, or associated with, the number of times that a medical study was cited or re-cited, and optionally also data or meta-data about such citing papers (e.g., their own quality indicators; their timing; whether they are fresh and recent, or old; quality indicators of their authors and/or publishers); and/or other parameters which may be taken into account for generating (or updating, or modifying) such marker.

[0077] Treatments database 345 may store data describing possible treatments, treatment routes and/or treatment proposals, including but not limited to relevant medications, supplements, dietary recommendations, life habit recommendations (e.g., increase exercise, quite smoking), relevant surgeries and/or treatments that may be administered or performed. Each treatment may be associated with the symptom or medical condition that it is intended to cure or to treat. Optionally, each treatment may be associated with a success score or relevance score, indicating an estimated success or estimated usefulness of a particular treatment for treating a particular disease or condition or symptoms.

[0078] A matching module 366 may search for, or may locate or determine, a match between or among: (a) one or more symptoms of a particular patient, and/or (b) a current or

recent EEG measurement of that particular patient, and/or (c) a cluster of symptoms as stored in the cluster of symptoms database 342, and/or (d) a disease or medical condition (e.g., which may be associated with the symptoms of the particular patient, or with the EEG measurement of the particular patient), and/or (e) a treatment proposal obtained from the treatment database 345. In some embodiments, the matching module 366 may match between (i) symptoms, and (ii) EEG measurement, and (iii) a disease or medical condition. In other embodiments, the matching module 366 may match between (i) symptoms of a particular patient, and (ii) EEG measurement, and (iii) a cluster of symptoms that is reflected in medical research, and (iv) a disease or medical condition that is associated with the patient' symptoms and/or with the cluster of symptoms, and optionally also with the EEG measurements of the particular patient. Other suitable matching operations or correlations or associations may be performed, based on pre-defined logic or criteria or conditions, and/or by taking into account other and/or additional data (e.g., patient age, gender, profession, dietary regime, whether the patient smokes, whether the patient drinks alcohol, or the like).

[0079] The matches may be ranked or sorted based on one or more criteria, and top matches (or all matches, or some matches) may be displayed to the user (e.g., to a physician or nurse or other medical professional) or may otherwise be transferred or transmitted to a recipient, or may be uploaded or sent to another destination or unit.

[0080] In some embodiments, the system may not necessarily perform or generate a diagnosis of a disease or a medical condition; but rather, may generate proposals for treatment options and/or for test protocols and/or for medical studies which are relevant (or, which may be relevant) to a particular symptom or cluster-of-symptoms. In other embodiments, the system may generate an EEG interpretation or a QEEG interpretation, or may present data which may facilitate or assist or support EEG / QEEG interpretation by a physician or other professional. In still other embodiments, the system may generate a diagnosis or a proposed diagnosis, or a set of diagnosis proposals, which may assist a physician in reaching his own diagnosis of the patient. Accordingly, portions of the discussion herein which may relate to a "diagnosis", or to a "diagnosis unit", may also comprise a system or a unit that generates treatment proposal(s), and/or diagnosis proposal(s), and/or data which may support a physician in reaching a diagnosis, and not necessarily a conclusive diagnosis (although this may be achieved by utilizing the system of the present invention).

[0081] The system(s) and/or device(s) of the present invention may utilize one or more databases, which may be local and/or remote, and which may store suitable information and records, for example: (1) patient number, (2) patient age in years, (3) patient gender, (4) patient

handedness, (5) date of measurement, (6) patient's measurements, (7) the system's report regarding that patient and/or that measurement. In some implementations, for example, some or all of these records may be stored locally in a local database, optionally as pseudonymised data and/or as anonymised data; additionally or alternatively, some or all of these records may be stored remotely in a remote database (e.g., a "cloud computing" database), optionally as pseudonymised data and/or as anonymised data. Other storage schemes may be used.

[0082] Reference is made to Fig. 4, which is a schematic illustration of a device 400, in accordance with some demonstrative embodiments of the present invention. Device 400 may comprise, for example, a housing 401 (e.g., box, shell, container, packaging) to contain therein some or all of the other components and/or units of device 400. Optionally, a handle 402 or other protrusion or bridge-structure may protrude from a side or an edge of housing 401, or may be otherwise integrated with or connected to housing 401, to allow a user to carry and/or move the device 400.

[0083] Optionally, one or more sides or edges or panels of device 400 may comprise one or more sockets 403, ports, inlets, outlets, connectors, mechanical connectors, electrical connectors, input sockets, output sockets, and/or other suitable connecting elements. Optionally, one or more electrodes, such as EEG electrode 405, may be connected to such socket(s) 403, via a suitable cable or electricity-conducting wire 404. Device 400 may comprise, internally thereto, an EEG measurement unit or processor, which may sense or measure EEG data, brain activity data, brain voltage data, brain voltage changes data, brain current data, brain current changes data, and/or other EEG information. The captured data may be stored in a memory unit or storage unit, which may be internal to device 400.

[0084] Device 400 may further comprise a wireless transceiver (e.g., Wi-Fi transceiver, cellular transceiver) to provide an Internet connection to device 400; and optionally a port or socket for connecting device 400 to a local area network (LAN) or to other devices or peripherals (e.g., a printer; an Ethernet outlet or connection). Optionally, device 400 may be placed in or onto, or in proximity to, a docking station or docking port, which may facilitate the connection of device 400 to such additional functionalities, and/or which may facilitate the connection of device 400 to the Internet, and/or which provide charging power to the internal power cell or rechargeable battery of device 400.

[0085] Device 400 may further comprise a screen, for example, a touch-screen 411 able to display one or more panels or information-items, which may be prepared for display by the internal processor of device 400; for example: an EEG panel 411 or window or tab to display EEG measurement of a patient; a Q-EEG panel 412 or window or tab to display Q-EEG

information or "brain map"; a Symptoms panel 413 or window or tab to display one or more symptoms that a patient exhibits or reports; a Patient Data panel 414 or tab or window to display identifying data of the patient (e.g., name) and/or non-identifying data about the patient (e.g., age, gender, smoking habit, alcohol consumption); a Diagnosis panel 415 or tab or window to display a determined diagnosis; a Treatments panel 416 or tab or window to display one or more proposed treatment options; and/or other or additional panels or tabs or windows to display other or additional information. Optionally, one or more audio speaker(s) 420 may be comprised in device 400, to output audible alerts or notifications.

[0086] Optionally, device 400 may comprise an internal battery or power-cell, which may be rechargeable and/or replaceable; and/or may receive power via an electric cable from an electric outlet. Optionally, device 400 may be lightweight and/or portable, and/or may have a small form factor (e.g., may be implemented similarly to a Tablet device).

[0087] The present invention may include an assistance and decision system (or a decision-support system, or a decision-assisting system), comprising an EEG device, an input unit, and output unit, a computer, a first database, and a second database. Patient data may be transmitted to (or entered into) the EEG device via the input unit. The EEG device may exchange data with the computer, and the data measured with the EEG device as well as the patient data may be relayed to the computer. The first database may store data measured by the EEG device, as well as patient data. The second database may store data about clusters of symptoms, as well as information about treatment options. The computer may exchange data with the first database and/or the second database. The computer may evaluate or analyze the data measured by the EEG device and the patient data, and may compare the sensed data with data about clusters of symptoms, in order to select a suitable diagnosis and/or treatment from the second database based on such evaluation. The diagnosis choice and/or treatment choice may be transferred or transmitted to a recipient or an output unit.

[0088] The present invention may comprise an assistance and decision system (or a decision-support system), comprising: an electroencephalogram (EEG) device to sense EEG data from a user; a database (or multiple databases) to store said EEG data, patient data, symptom data about clusters of symptoms, data about medical conditions and diseases, and information about treatment options; a diagnosis unit (i) to analyze said EEG data with said patient data, and (ii) to compare said EEG data and said patient data to said symptom data, and (iii) to select, based on this comparison, at least one of: (I) a diagnosis of a corresponding medical condition or disease, (II) a selected treatment from said treatment options; a display

unit to display at least said EEG data and at least one of said diagnosis and said selected treatment.

[0089] The present invention may comprise an assistance and decision system (or a decision-support system), comprising: an EEG device to generate EEG (electroencephalogram) data from a user; a diagnosis unit to evaluate said EEG data with said patient data, to compare it to symptom data about clusters of symptoms and to select a suitable treatment from a set of treatment options on the basis of this comparison; and a display unit to display at least said EEG data and said suitable treatment.

[0090] The present invention may comprise a disease diagnosis and treatment system comprising: an EEG device to generate EEG (electroencephalogram) data from a user; a diagnosis unit to evaluate combined data of said EEG data with patient data according to a plurality of test protocols, to determine which of said test protocols said combined data matches and to select a suitable treatment from a set of treatment options on the basis of this determination; and a display unit to display at least said EEG data and said suitable treatment.

[0091] In some embodiments, said EEG device, diagnosis unit and display unit are integrated into a single unit also having connectors for electrodes for said EEG device.

[0092] In some embodiments, said test protocols are formed from information about studies and cases described in technical literature.

[0093] In some embodiments, said diagnosis unit comprises a marker generator to generate an accuracy marker defining a significance for a single patient or a group of patients of a cluster of said test protocols relating to a single disease.

[0094] In some embodiments, the system may comprise an updater to update said clusters of test protocols.

[0095] In some embodiments, said determination is for the recognition of psychological disorders and psychiatric diseases.

[0096] In some embodiments, said diagnosis unit comprises a plurality of logic units, wherein each said logic unit defines one said test protocol.

[0097] In some embodiments, said diagnosis unit comprises a marker unit to combine the results of said plurality of logic units operative on said combined data.

[0098] In some embodiments, said marker incorporates an index combining at least an influence factor for a study implementing said test protocol and the number of participants in said study.

[0099] In some embodiments, said EEG data is in the form of one or more QEEG (quantitative EEG) maps.

[00100] Some embodiments of the present invention may comprise an assistance and decision system comprising: an electroencephalogram (EEG) device to sense EEG data from a user; a database to store said EEG data, patient data, symptom data about clusters of symptoms, data about medical conditions and diseases, and information about treatment options; a diagnosis unit (i) to analyze said EEG data with said patient data, and (ii) to compare said EEG data and said patient data to said symptom data, and (iii) to select, based on this comparison, at least one of: (I) a diagnosis of a corresponding medical condition or disease, (II) a selected treatment from said treatment options; a display unit to display at least said EEG data and at least one of said diagnosis and said selected treatment.

[00101] In some embodiments, the diagnosis unit is to evaluate combined data of said EEG data with patient data according to a plurality of test protocols, to determine which of said test protocols said combined data matches and to select a suitable treatment from a set of treatment options on the basis of this determination.

[00102] In some embodiments, said EEG device, diagnosis unit and display unit are integrated into a single device which further comprises a single housing and connectors for electrodes for said EEG device.

[00103] In some embodiments, said test protocols are formed from information about studies and cases described in technical literature.

[00104] In some embodiments, said diagnosis unit comprises a marker generator to generate an accuracy marker defining a significance for a single patient or a group of patients of a cluster of said test protocols relating to a particular disease.

[00105] In some embodiments, the system further comprises: comprising an updater unit to update said clusters of test protocols.

[00106] In some embodiments, said determination is for recognition of psychological disorders and psychiatric diseases.

[00107] In some embodiments, said diagnosis unit comprises a plurality of logic units, wherein each logic unit of said plurality of logic units defines one test protocol of said test protocols.

[00108] In some embodiments, said diagnosis unit comprises a marker generation unit to combine the results of said plurality of logic units operative on said combined data.

[00109] In some embodiments, said marker incorporates an index that reflects at least: (i) an influence factor for a study implementing said test protocol, and (ii) the number of participants in said study.

[00110] In some embodiments, said EEG data is in the form of one or more Quantitative EEG (QEEG) maps.

[00111] In some embodiments, said diagnosis unit is integrated into the EEG device.

[00112] In some embodiments, the database is integrated into the EEG device.

[00113] In some embodiments, the diagnosis unit exchanges data with a plurality of EEG devices.

[00114] In some embodiments, the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular disease.

[00115] In some embodiments, the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular disease, and (iv) a particular treatment option.

[00116] In some embodiments, the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a cluster of symptoms that is a subject of a particular medical research, and (iv) a medical condition that is the subject of said particular medical research.

[00117] In some embodiments, the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a cluster of symptoms that is a subject of a particular medical research, and (iv) a medical condition that is the subject of said particular medical research, and (v) a particular treatment option that was researched in said particular medical research.

[00118] In some embodiments, the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol, and (iv) a particular disease or medical condition.

[00119] In some embodiments, the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol, and (iv) a particular treatment option

[00120] In some embodiments, the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol, and (iv) a particular disease or medical condition, and (v) a particular treatment option.

[00121] In some embodiments, the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol.

[00122] In some embodiments, the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol, and (iv) a cluster of symptoms that is a subject of a particular medical research, and (v) a medical condition that is the subject of said particular medical research.

[00123] In some embodiments, the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol, and (iv) a cluster of symptoms that is a subject of a particular medical research, and (v) a medical condition that is the subject of said particular medical research, and (vi) a particular treatment option that was researched in said particular medical research.

[00124] In some embodiments, the diagnosis unit is to generate a diagnosis of medical a condition of the brain of the user based on at least: (i) data about clusters of symptoms, and (ii) relevance of the data about clusters of symptoms to said user.

[00125] In some embodiments, the diagnosis unit is to generate a diagnosis of medical a condition of the brain of the user based on at least: (i) data about clusters of symptoms, and (ii) relevance of the data about clusters of symptoms to an EEG measurement of said user.

[00126] In some embodiments, the diagnosis unit is to generate a diagnosis of medical a condition of the brain of the user based on at least: (i) data about clusters of symptoms, and (ii) relevance of the data about clusters of symptoms to both (I) an EEG measurement of said user and (II) one or more patient-specific characteristics of said user.

[00127] In some embodiments, the diagnosis unit is to generate a diagnosis of medical a condition of the brain of the user based on at least: (i) data about clusters of symptoms, and (ii) relevance of the data about clusters of symptoms to both (I) an EEG measurement of said user and (II) one or more patient-specific characteristics of said user; wherein said patient-specific characteristics comprise one or more of: age, gender, profession, dietary characteristic, smoking characteristic, alcohol consumption characteristic.

[00128] In some embodiments, the system comprises: an updater unit to save in said database both (i) measured EEG data and (ii) analyzed EEG data, obtained from a plurality of EEG devices.

[00129] In some embodiments, information about studies and cases described in technical literature is stored as data about clusters of symptoms in said database.

[00130] In some embodiments, data about clusters of symptoms in the database is analyzed based on of its significance for a single patient or a group of patients, and wherein a marker generator is to generate a marker reflecting the estimated probability of accuracy of the diagnosis.

[00131] In some embodiments, data about clusters of symptoms is stored in the database, and is updated at pre-defined time intervals, and is re-analyzed by the diagnosis unit at pre-defined time intervals.

[00132] In some embodiments, the diagnosis unit is to generate proposals for treatment options based on the diagnosis made, by performing data comparison with information about treatment options stored in said database.

[00133] In some embodiments, a method comprises: sensing an electroencephalogram (EEG) data from a user; storing in a database said EEG data, patient data, symptom data about clusters of symptoms, data about medical conditions and diseases, and information about treatment options; performing: (i) analyzing said EEG data with said patient data, and (ii) comparing said EEG data and said patient data to said symptom data, and (iii) selecting, based on this comparison, at least one of: (I) a diagnosis of a corresponding medical condition or disease, (II) a selected treatment from said treatment options; generating as output at least said EEG data and at least one of said diagnosis and said selected treatment.

[00134] In some embodiments, the method comprises: evaluating combined data of said EEG data with patient data according to a plurality of test protocols, and determining which of said test protocols said combined data matches, and selecting a suitable treatment from a set of treatment options on the basis of this determination.

[00135] In some embodiments, the method is performed by a system in which an EEG measurement unit, a diagnosis unit, and a display unit are integrated into a single device which further comprises a single housing and connectors for electrodes for said EEG device.

[00136] In some embodiments, said test protocols are formed from information about studies and cases described in technical literature.

[00137] In some embodiments, the method comprises: generating an accuracy marker defining a significance for a single patient or a group of patients of a cluster of said test protocols relating to a particular disease.

[00138] In some embodiments, the method comprises: updating said clusters of test protocols at pre-defined time intervals.

[00139] In some embodiments, said determination is for recognition of psychological disorders and psychiatric diseases.

[00140] In some embodiments, said EEG data is in the form of one or more Quantitative EEG (QEEG) maps.

[00141] The system(s) and/or device(s) of the present invention may optionally comprise, or may be implemented by utilizing suitable hardware components and/or software components; for example, processors, processor cores, Central Processing Units (CPUs), Digital Signal Processors (DSPs), circuits, Integrated Circuits (ICs), controllers, memory units, registers, accumulators, storage units, input units (e.g., touch-screen, keyboard, keypad, stylus, mouse, touchpad, joystick, trackball, microphones), output units (e.g., screen, touch-screen, monitor, display unit, audio speakers), acoustic microphone(s) and/or sensor(s), optical microphone(s) and/or sensor(s), laser or laser-based microphone(s) and/or sensor(s), wired or wireless modems or transceivers or transmitters or receivers, GPS receiver or GPS element or other location-based or location-determining unit or system, network elements (e.g., routers, switches, hubs, antennas), and/or other suitable components and/or modules.

[00142] The system(s) and/or devices of the present invention may optionally be implemented by utilizing co-located components, remote components or modules, "cloud computing" servers or devices or storage, client/server architecture, peer-to-peer architecture, distributed architecture, and/or other suitable architectures or topologies.

[00143] In accordance with embodiments of the present invention, calculations, operations and/or determinations may be performed locally within a single device, or may be performed by or across multiple devices, or may be performed partially locally and partially remotely (e.g., at a remote server) by optionally utilizing a communication channel to exchange raw data and/or processed data and/or processing results.

[00144] Although portions of the discussion herein relate, for demonstrative purposes, to wired links and/or wired communications, some embodiments are not limited in this regard, but rather, may utilize wired communication and/or wireless communication; may include one or more wired and/or wireless links; may utilize one or more components of wired communication and/or wireless communication; and/or may utilize one or more methods or protocols or standards of wireless communication.

[00145] Some embodiments may be implemented by using a special-purpose machine or a specific-purpose device that is not a generic computer, or by using a non-generic computer or a non-general computer or machine. Such system or device may utilize or may comprise one or more components or units or modules that are not part of a "generic computer" and that are

not part of a "general purpose computer", for example, cellular transceivers, cellular transmitter, cellular receiver, GPS unit, location-determining unit, accelerometer(s), gyroscope(s), device-orientation detectors or sensors, device-positioning detectors or sensors, or the like.

[00146] Some embodiments may be implemented as, or by utilizing, an automated method or automated process, or a machine-implemented method or process, or as a semi-automated or partially-automated method or process, or as a set of steps or operations which may be executed or performed by a computer or machine or system or other device. Some embodiments may apply or may utilize, for example, Artificial Intelligence (AI) processes, machine learning, deep learning, and/or other suitable processes.

[00147] Some embodiments may be implemented by using code or program code or machine-readable instructions or machine-readable code, which may be stored on a non-transitory storage medium or non-transitory storage article (e.g., a CD-ROM, a DVD-ROM, a physical memory unit, a physical storage unit), such that the program or code or instructions, when executed by a processor or a machine or a computer, cause such processor or machine or computer to perform a method or process as described herein. Such code or instructions may be or may comprise, for example, one or more of: software, a software module, an application, a program, a subroutine, instructions, an instruction set, computing code, words, values, symbols, strings, variables, source code, compiled code, interpreted code, executable code, static code, dynamic code; including (but not limited to) code or instructions in high-level programming language, low-level programming language, object-oriented programming language, visual programming language, compiled programming language, interpreted programming language, C, C++, C#, Java, JavaScript, SQL, Ruby on Rails, Go, Cobol, Fortran, ActionScript, AJAX, XML, JSON, Lisp, Eiffel, Verilog, Hardware Description Language (HDL, BASIC, Visual BASIC, Matlab, Pascal, HTML, HTML5, CSS, Perl, Python, PHP, machine language, machine code, assembly language, or the like.

[00148] Discussions herein utilizing terms such as, for example, "processing", "computing", "calculating", "determining", "establishing", "analyzing", "checking", "detecting", "measuring", or the like, may refer to operations or processes of a processor, a computer, a computing platform or computing system, or other electronic device or computing device, that may automatically and/or autonomously manipulate and/or transform data represented as physical (e.g., electronic) quantities within registers and/or accumulators and/or memory units and/or storage units into other data.

[00149] Some embodiments of the present invention may perform steps or operations such as, for example, "determining", "identifying", "comparing", "checking", "querying", "searching", "matching", and/or "analyzing", by utilizing, for example: a pre-defined threshold value to which one or more parameter values may be compared; a comparison between (i) sensed or measured or calculated value(s), and (ii) pre-defined or dynamically-generated threshold value(s) and/or range values and/or upper limit value and/or lower limit value and/or maximum value and/or minimum value; a comparison or matching between sensed or measured or calculated data, and one or more values as stored in a look-up table or a legend table or a legend list or a database of possible values or ranges; a comparison or matching or searching process which searches for matches and/or identical results and/or similar results among multiple values or limits that are stored in a database or look-up table; utilization of one or more equations, formula, weighted formula, and/or other calculation in order to determine similarity or a match between or among parameters or values; utilization of comparator units, lookup tables, threshold values, conditions, conditioning logic, Boolean operator(s) and/or other suitable components and/or operations.

[00150] The terms "plurality" and "a plurality", as used herein, include, for example, "multiple" or "two or more". For example, "a plurality of items" includes two or more items.

[00151] References to "one embodiment", "an embodiment", "demonstrative embodiment", "various embodiments", "some embodiments", and/or similar terms, may indicate that the embodiment(s) so described may optionally include a particular feature, structure, or characteristic, but not every embodiment necessarily includes the particular feature, structure, or characteristic. Furthermore, repeated use of the phrase "in one embodiment" does not necessarily refer to the same embodiment, although it may. Similarly, repeated use of the phrase "in some embodiments" does not necessarily refer to the same set or group of embodiments, although it may.

[00152] As used herein, and unless otherwise specified, the utilization of ordinal adjectives such as "first", "second", "third", "fourth", and so forth, to describe an item or an object, merely indicates that different instances of such like items or objects are being referred to; and does not intend to imply as if the items or objects so described must be in a particular given sequence, either temporally, spatially, in ranking, or in any other ordering manner.

[00153] Some embodiments may be used in, or in conjunction with, various devices and systems, for example, a Personal Computer (PC), a desktop computer, a mobile computer, a laptop computer, a notebook computer, a tablet computer, a server computer, a handheld computer, a handheld device, a Personal Digital Assistant (PDA) device, a handheld PDA

device, a tablet, an on-board device, an off-board device, a hybrid device, a vehicular device, a non-vehicular device, a mobile or portable device, a consumer device, a non-mobile or non-portable device, an appliance, a wireless communication station, a wireless communication device, a wireless Access Point (AP), a wired or wireless router or gateway or switch or hub, a wired or wireless modem, a video device, an audio device, an audio-video (A/V) device, a wired or wireless network, a wireless area network, a Wireless Video Area Network (WVAN), a Local Area Network (LAN), a Wireless LAN (WLAN), a Personal Area Network (PAN), a Wireless PAN (WPAN), or the like.

[00154] Some embodiments may comprise, or may be implemented by using, an "app" or application which may be downloaded or copied or installed or obtained from an "app store" or "applications store" or "app market", for free or for a fee, or which may be installed or pre-installed on a computing device or electronic device, or which may be otherwise transported to and/or installed on such computing device or electronic device.

[00155] Functions, operations, components and/or features described herein with reference to one or more embodiments of the present invention, may be combined with, or may be utilized in combination with, one or more other functions, operations, components and/or features described herein with reference to one or more other embodiments of the present invention. The present invention may thus comprise any possible or suitable combinations, re-arrangements, assembly, re-assembly, or other utilization of some or all of the modules or functions or components that are described herein, even if they are discussed in different locations or different chapters of the above discussion, or even if they are shown across different drawings or multiple drawings.

[00156] While certain features of some demonstrative embodiments of the present invention have been illustrated and described herein, various modifications, substitutions, changes, and equivalents may occur to those skilled in the art. Accordingly, the claims are intended to cover all such modifications, substitutions, changes, and equivalents.

CLAIMS

1. An assistance and decision system comprising:

an electroencephalogram (EEG) device to sense EEG data from a user;

a database to store said EEG data, patient data, symptom data about clusters of symptoms, data about medical conditions and diseases, and information about treatment options;

a diagnosis unit (i) to analyze said EEG data with said patient data, and (ii) to compare said EEG data and said patient data to said symptom data, and (iii) to select, based on this comparison, at least one of: (I) a diagnosis of a corresponding medical condition or disease, (II) a selected treatment from said treatment options;

a display unit to display at least said EEG data and at least one of said diagnosis and said selected treatment.

2. The system of claim 1, wherein the diagnosis unit is to evaluate combined data of said EEG data with patient data according to a plurality of test protocols, to determine which of said test protocols said combined data matches and to select a suitable treatment from a set of treatment options on the basis of this determination.

3. The system of claim 1, wherein said EEG device, diagnosis unit and display unit are integrated into a single device which further comprises a single housing and connectors for electrodes for said EEG device.

4. The system of claim 2, wherein said test protocols are formed from information about studies and cases described in technical literature.

5. The system of claim 2, wherein said diagnosis unit comprises a marker generator to generate an accuracy marker defining a significance for a single patient or a group of patients of a cluster of said test protocols relating to a particular disease.

6. The system of claim 2, further comprising an updater unit to update said clusters of test protocols.

7. The system of claim 2, wherein said determination is for recognition of psychological disorders and psychiatric diseases.

8. The system of claim, 2 wherein said diagnosis unit comprises a plurality of logic units, wherein each logic unit of said plurality of logic units defines one test protocol of said test protocols.

9. The system of claim 8, wherein said diagnosis unit comprises a marker generation unit to combine the results of said plurality of logic units operative on said combined data.

10. The system of claim 9, wherein said marker incorporates an index that reflects at least: (i) an influence factor for a study implementing said test protocol, and (ii) the number of participants in said study.

11. The system of claim 1, wherein said EEG data is in the form of one or more Quantitative EEG (QEEG) maps.

12. The system of claim 1, wherein said diagnosis unit is integrated into the EEG device.

13. The system of claim 1, wherein the database is integrated into the EEG device.

14. The system of claim 1, wherein the diagnosis unit exchanges data with a plurality of EEG devices.

15. The system of claim 1, wherein the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular disease.

16. The system of claim 1, wherein the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular disease, and (iv) a particular treatment option.

17. The system of claim 1, wherein the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a cluster of symptoms that is a subject of a particular medical research, and (iv) a medical condition that is the subject of said particular medical research.

18. The system of claim 1, wherein the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a cluster of symptoms that is a subject of a particular medical research, and (iv) a medical condition that is the subject of said particular medical research, and (v) a particular treatment option that was researched in said particular medical research.

19. The system of claim 2, wherein the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol, and (iv) a particular disease or medical condition.

20. The system of claim 2, wherein the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol, and (iv) a particular treatment option

21. The system of claim 2, wherein the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol, and (iv) a particular disease or medical condition, and (v) a particular treatment option.

22. The system of claim 2, wherein the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol.

23. The system of claim 2, wherein the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol, and (iv) a cluster of symptoms that is a subject of a particular medical research, and (v) a medical condition that is the subject of said particular medical research.

24. The system of claim 2, wherein the diagnosis unit comprises a matching module to find a match among: (i) an EEG measurement of a particular user, and (ii) one or more symptoms of said particular user, and (iii) a particular test protocol, and (iv) a cluster of symptoms that is a subject of a particular medical research, and (v) a medical condition that is the subject of said particular medical research, and (vi) a particular treatment option that was researched in said particular medical research.

25. The system of claim 1, wherein the diagnosis unit is to generate a diagnosis of medical a condition of the brain of the user based on at least: (i) data about clusters of symptoms, and (ii) relevance of the data about clusters of symptoms to said user.

26. The system of claim 1, wherein the diagnosis unit is to generate a diagnosis of medical a condition of the brain of the user based on at least: (i) data about clusters of symptoms, and (ii) relevance of the data about clusters of symptoms to an EEG measurement of said user.

27. The system of claim 1, wherein the diagnosis unit is to generate a diagnosis of medical a condition of the brain of the user based on at least: (i) data about clusters of symptoms, and (ii) relevance of the data about clusters of symptoms to both (I) an EEG measurement of said user and (II) one or more patient-specific characteristics of said user.

28. The system of claim 1, wherein the diagnosis unit is to generate a diagnosis of medical a condition of the brain of the user based on at least: (i) data about clusters of symptoms, and (ii) relevance of the data about clusters of symptoms to both (I) an EEG measurement of said user and (II) one or more patient-specific characteristics of said user,

wherein said patient-specific characteristics comprise one or more of: age, gender, profession, dietary characteristic, smoking characteristic, alcohol consumption characteristic.

29. The system of claim 1, further comprising an updater unit to save in said database both (i) measured EEG data and (ii) analyzed EEG data, obtained from a plurality of EEG devices.

30. The system of claim 1, wherein information about studies and cases described in technical literature is stored as data about clusters of symptoms in said database.

31. The system of claim 1, wherein data about clusters of symptoms in the database is analyzed based on of its significance for a single patient or a group of patients, and wherein a marker generator is to generate a marker reflecting the estimated probability of accuracy of the diagnosis.

32. The system of claim 1, wherein data about clusters of symptoms is stored in the database, and is updated at pre-defined time intervals, and is re-analyzed by the diagnosis unit at pre-defined time intervals.

33. The system of claim 1, wherein the diagnosis unit is to generate proposals for treatment options based on the diagnosis made, by performing data comparison with information about treatment options stored in said database.

34. A method comprising:

sensing an electroencephalogram (EEG) data from a user;

storing in a database said EEG data, patient data, symptom data about clusters of symptoms, data about medical conditions and diseases, and information about treatment options;

performing: (i) analyzing said EEG data with said patient data, and (ii) comparing said EEG data and said patient data to said symptom data, and (iii) selecting, based on this comparison, at least one of: (I) a diagnosis of a corresponding medical condition or disease, (II) a selected treatment from said treatment options;

generating as output at least said EEG data and at least one of said diagnosis and said selected treatment.

35. The method of claim 34, comprising:

evaluating combined data of said EEG data with patient data according to a plurality of test protocols, and determining which of said test protocols said combined data matches, and selecting a suitable treatment from a set of treatment options on the basis of this determination.

36. The method of claim 34, wherein the method is performed by a system in which an EEG measurement unit, a diagnosis unit, and a display unit are integrated into a single device which further comprises a single housing and connectors for electrodes for said EEG device.

37. The method of claim 35, wherein said test protocols are formed from information about studies and cases described in technical literature.

38. The method of claim 35, further comprising:

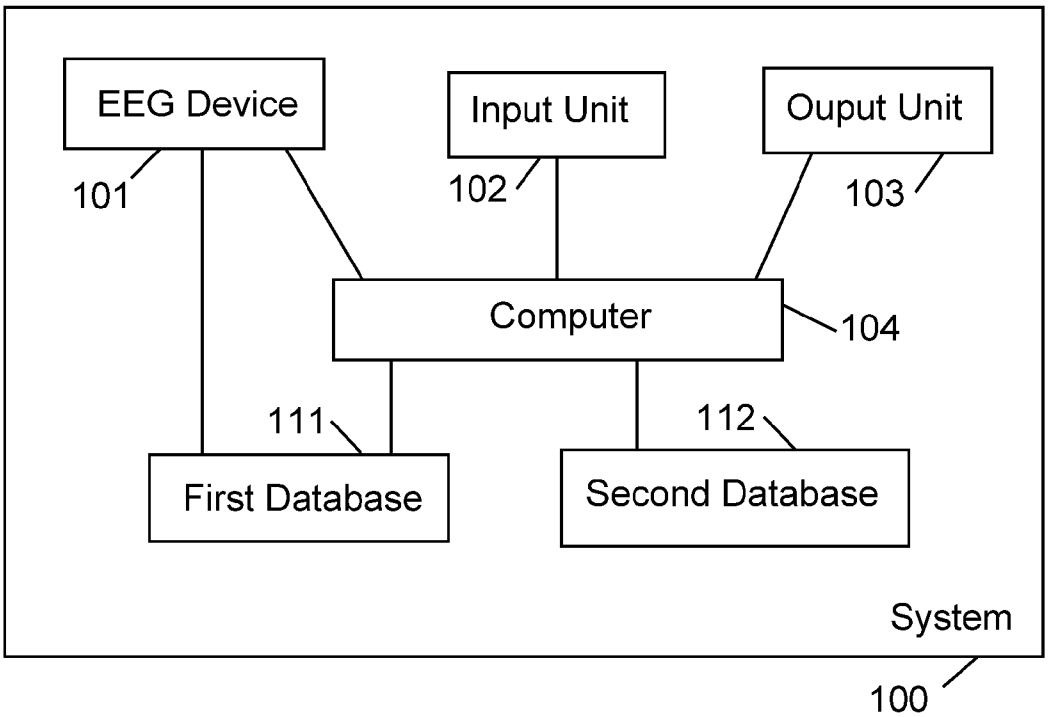
generating an accuracy marker defining a significance for a single patient or a group of patients of a cluster of said test protocols relating to a particular disease.

39. The method of claim 35, further comprising:

updating said clusters of test protocols at pre-defined time intervals.

40. The method of claim 35, wherein said determination is for recognition of psychological disorders and psychiatric diseases.

41. The method of claim 1, wherein said EEG data is in the form of one or more Quantitative EEG (QEEG) maps.


EEG Device
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Input Unit
102
Ouput Unit
103
Computer
104
111
First Database
112
Second Database
System
100

Fig. 1

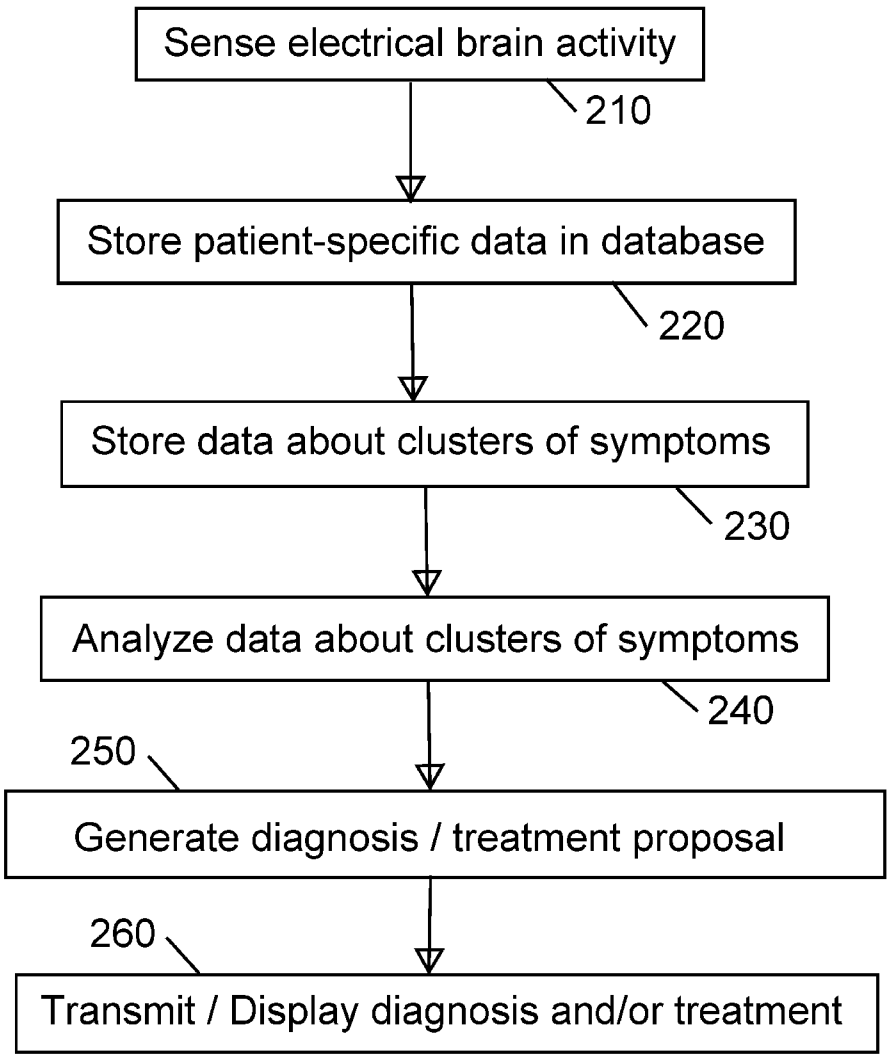
Sense electrical brain activity
210
Store patient-specific data in database
220
Store data about clusters of symptoms
230
Analyze data about clusters of symptoms
240
250
Generate diagnosis / treatment proposal
260
Transmit / Display diagnosis and/or treatment

Fig. 2

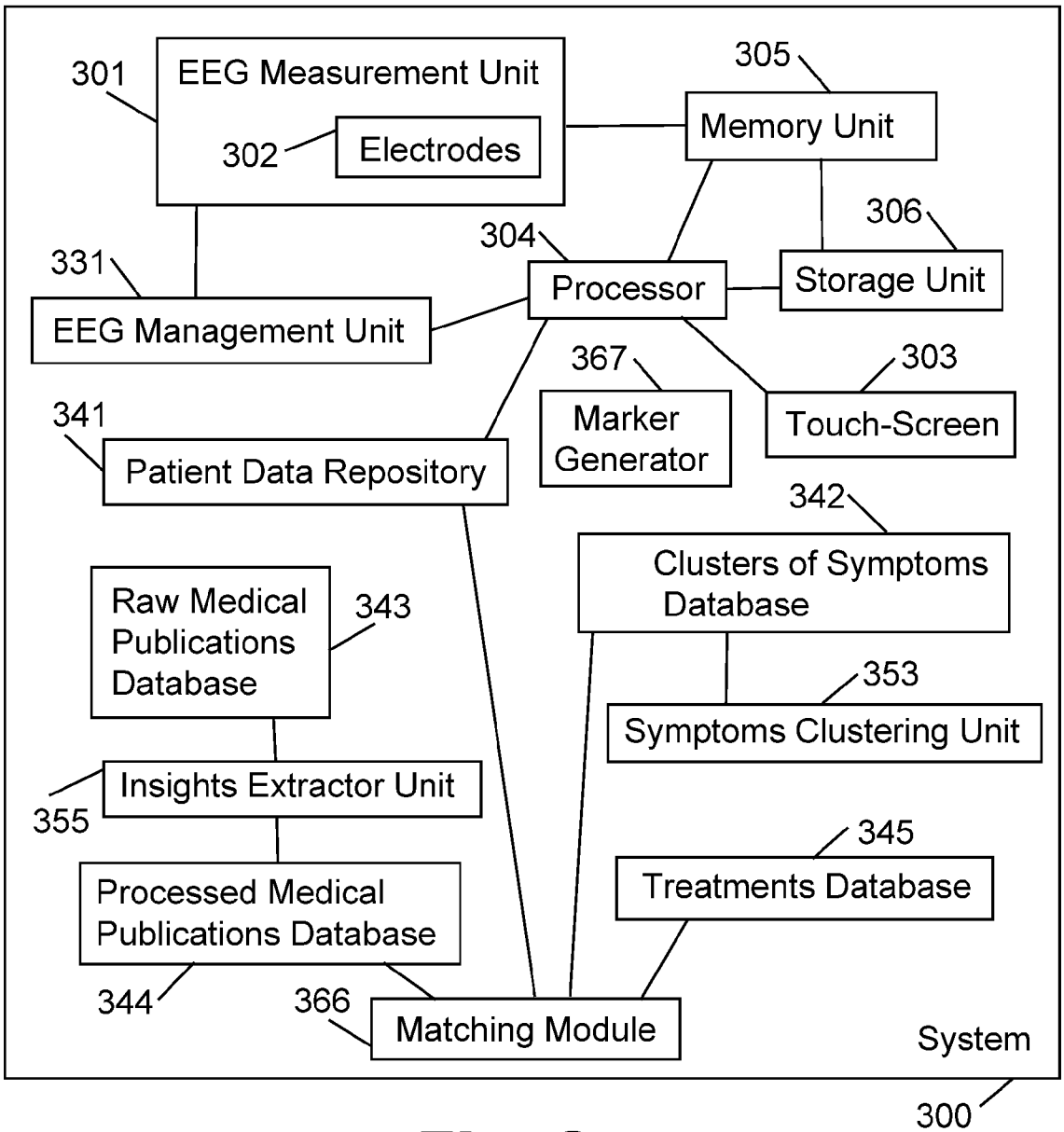
301
EEG Measurement Unit
302
Electrodes
305
Memory Unit
306
Storage Unit
304
Processor
331
EEG Management Unit
367
Marker Generator
303
Touch-Screen
341
Patient Data Repository
342
Clusters of Symptoms Database
Raw Medical Publications Database
343
353
Symptoms Clustering Unit
Insights Extractor Unit
355
345
Treatments Database
Processed Medical Publications Database
344
366
Matching Module
System
300

Fig. 3

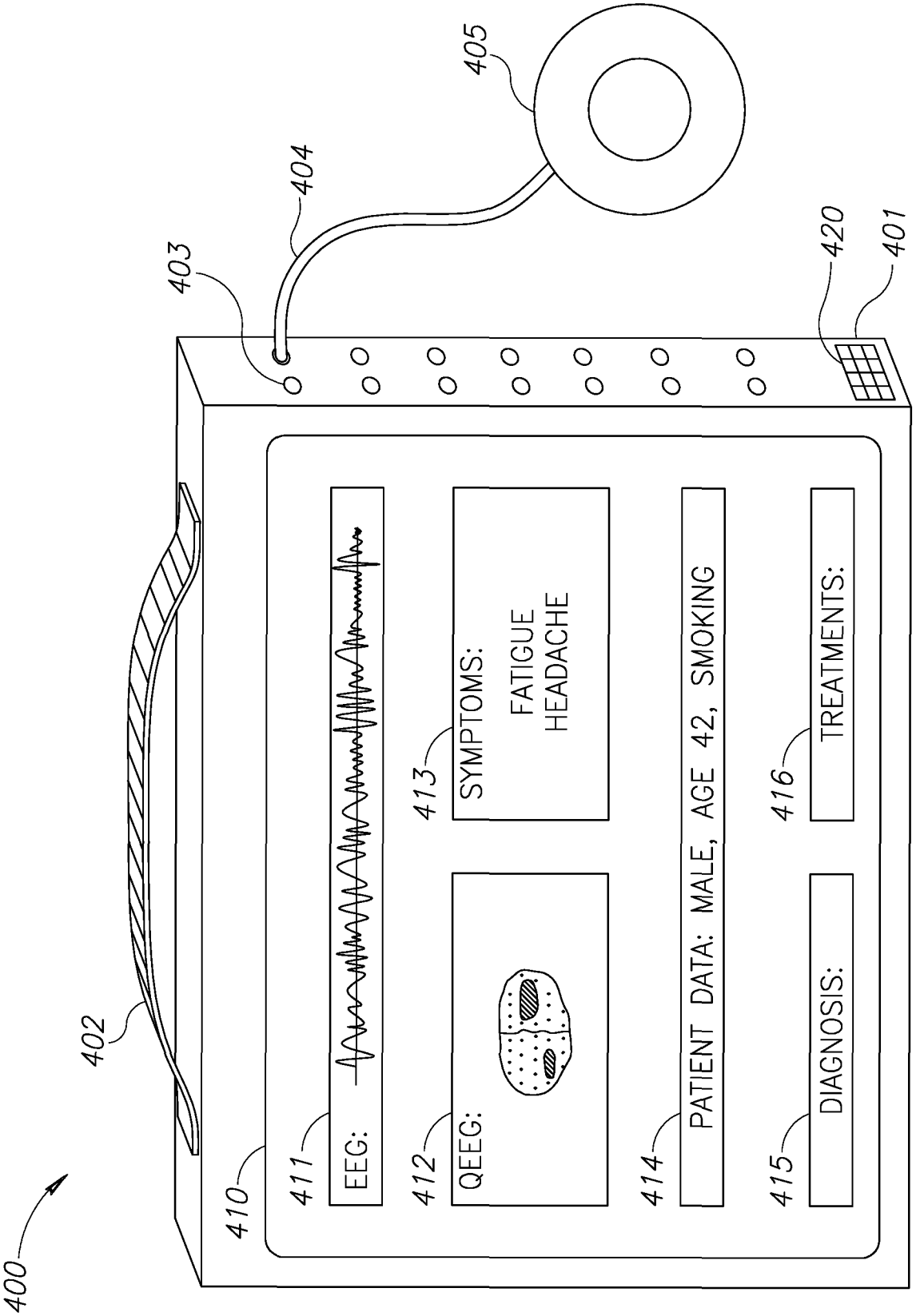
400
402
403
404
405
401
420
410
411
EEG:
412
QEEG:
413
SYMPTOMS:
FATIGUE
HEADACHE
414
PATIENT DATA: MALE, AGE 42, SMOKING
415
DIAGNOSIS:
416
TREATMENTS:

FIG.4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2016/053642

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/00 A61B5/16 A61B5/0476 G06F19/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/005899 A2 (CNS RESPONSE INC [US]) 23 January 2003 (2003-01-23) page 6, line 25 page 11, line 24 page 22, lines 21-23 page 25, lines 23-30 page 28, line 16 page 29, lines 11, 26-29 page 50, lines 6, 7, 13, 17 page 61, lines 11, 12, 20 page 70, line 1 page 108, line 16 page 109, lines 6-10 page 110, line 20 figures 14, 15 ----- -/--	1-33

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 October 2016	28/10/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Meyer, Wolfgang

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2016/053642

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/015942 A1 (OAKLEY DAVID [US] ET AL) 20 January 2011 (2011-01-20) paragraphs [0038], [0040], [0043], [0045], [0047], [0054], [0100] figures 1, 2, 3, 10	1-5, 7-10, 12-28, 30-33
X	WO 2009/103156 A1 (UNIV MCMASTER [CA]; HASEY GARY [CA]; KHODAYARI-ROSTAMABAD AHMAD [CA];) 27 August 2009 (2009-08-27) page 14, lines 27, 30 page 19, line 10 page 20, line 10 - page 22, line 9 page 28, line 11 page 64, line 13 figures 1-6	1,2, 5-11, 15-28, 31,33
A	WO 01/58351 A1 (CNS RESPONSE INC [US]) 16 August 2001 (2001-08-16) the whole document	1-33
A	US 8 930 218 B1 (OAKLEY DAVID [US] ET AL) 6 January 2015 (2015-01-06) the whole document	1-33

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2016/053642

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 34-41
because they relate to subject matter not required to be searched by this Authority, namely:

The present application does not meat the requirements of Rule 39.1(iv) PCT because claims 34-41 are comprising a diagnostic method. Particularly, the "diagnosis of a corresponding medical condition or disease" (claim 34) is an "investigation for medical purposes" (Guidelines-PCT III-9.10).

2. [ ] Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2016/053642

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US 8930218 B1	06-01-2015	NONE	