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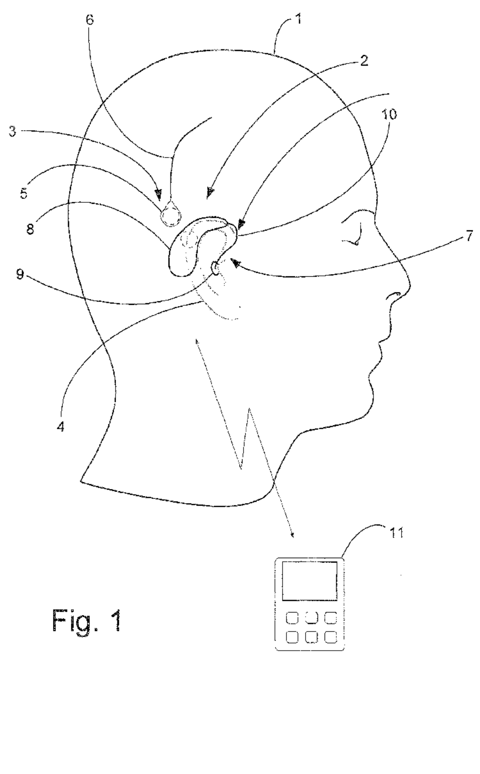

Fig. 1

(57) Abstract: An EEG monitoring system (2) adapted to be carried continuously by a person to be monitored. The EEG monitoring system (2) comprises electrodes for measuring at least one EEG signal from the person carrying the EEG monitoring system (2). The system also com- prises signal processing means adapted to receive, process and analyze at least a part of said at least one EEG signal. Furthermore the system comprises data logging means adapted to log data relating to said at least one EEG signal and a memory for storing said data relating to said EEG signal.

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EEG monitoring system and method of monitoring an EEG

The present invention relates to monitoring The invention specifically relates to an EEG monitoring system adapted to be carried continuously by a person to be monitored. The invention furthermore relates to a method of monitoring an EEG.

EEG is the commonly used abbreviation for Electro Encephalo-Gram, which is generally speaking a method of electrically monitoring brain activity of a person. Systems for monitoring EEGs have been known for many years. However with the general technological development, EEG monitoring systems, which may be carried or worn continuously by a person to be monitored, have been devised.

WO-A-2006/066577 discloses a system for continued wearing of a person suffering from diabetes, where blood sugar levels are monitored in order to warn against hypoglycaemic attacks. Low blood sugar levels have severe influences on the brain activity, and too low blood sugar levels may lead to unconsciousness and even death. The system disclosed WO-A-2006/066577 is a fully implanted subcutaneous system. The implanted electrodes are via electrical leads connected to a monitoring device capable of detecting the brainwaves characteristic for an imminent hypoglycaemic attack, and issuing a warning in the form of a vibration of the subcutaneous monitoring device. In WO-A-2006/066577 it is furthermore suggested that the implant may wirelessly communicate with an external unit, which may contain the more power demanding parts of the electronics, so as to obtain a long battery service life of the implanted subcutaneous parts. This will also allow an acoustic warning. In order to detect an imminent hypoglycaemic attack, the system of WO-A-2006/066577 looks at the frequencies and amplitudes of the brainwaves, which change prior to a hypoglycaemic attack as explained in WO-A-2006/066577, which is incorporated herein by reference, the brainwave going into a phase with waveform patterns with higher amplitudes and lower frequencies. It is suggested to use classifiers such as Bayesian classifiers, neural networks, or logistic regression, but WO-A-2006/066577 does not disclose any details on how. Finally, WO-A-

2006/066577 suggests the build-in of dynamic adaptation of the signal processing algorithms, so as to continuously adapt these to the individual carrying the system. Also in this respect the document is silent about any way of achieving such dynamic adaptation.

Based on this prior art it is the object of the present invention, to provide an improved system. In this it is *inter alia* a further object to present a system and a method for providing the dynamic adaptation referred to above.

According to a first aspect of the present invention these objects are achieved by an EEG monitoring system according to the opening paragraph, said system comprising electrodes for measuring at least one EEG signal from the person carrying the EEG monitoring system, signal processing means adapted to receive and process at least a part of said at least one EEG signal, analyzing means for analyzing the EEG signal, data logging means adapted to log data relating to said at least one EEG signal, and a memory for storing said data relating to said EEG signal.

According to a second aspect of the present invention these objects are achieved by a method for EEG monitoring using a portable EEG measuring system, said method comprising measuring at least one EEG signal from the person carrying the EEG monitoring system, receiving, processing and analyzing at least a part of said at least one EEG signal using a signal processing means, logging data relating to said at least one EEG signal using a data logging means, and storing said data relating to said EEG signal a memory.

By logging data it becomes possible to carry out extensive evaluation of the data, in turn allowing a better analysis, better detection of predetermined events and better understanding of the relation between an individual's brain waves and imminent events, such as hypoglycaemic or epileptic seizures, as well as the possibility of making individual adjustments.

According to a preferred embodiment of said first aspect of the invention, said signal processing means comprises a feature extractor for extracting a feature vector from said EEG signal. Using a feature extractor allows a substantial reduction in the original amount of information of an EEG signal to be considered in an evaluation process where content of the signal is to be classified.

According to a further preferred embodiment of said first aspect of the invention, said analysing means comprises an event classifier for detecting predetermined events based on said at least one signal. Using an event classifier is an efficient way of distinguishing between the important events and immaterial events.

According to yet a further embodiment of said first aspect of the invention, said logging means is adapted to log information about a number of events, such as their time of occurrence. Logging a number of events moreover is an efficient way of providing basis for a decision such as an alarm depending on the occurrence of the important events. Moreover it substantially reduces the information to be stored, as compared to e.g. the fully sampled EEG signal.

According to another preferred embodiment of said first aspect of the invention, the data logging means is adapted to log at least one feature vector, extracted from said EEG signal. Logging only the feature vector entails a substantial savings in storage space, which is important in a small device to be worn behind the ear.

According to yet another preferred embodiment of said first aspect of the invention, the data logging means is adapted to log the waveform of the at least one EEG signal. Keeping the full information of the waveform of the signal is preferable where storage considerations are of less importance.

According to an especially preferred embodiment of said first aspect of the invention, means are provided for detecting an abnormal brain condition based on the detected predetermined events, and initiating an alarm based on said detection of the abnormal brain condition.

According to a further preferred embodiment of said first aspect of the invention, the data logged by said data logging means is stored in said memory, upon detection of said abnormal brain condition. This allows the saving of information pertaining to the period leading up to the alarm to be stored for further analysis.

Embodiments of the method according to the second aspect of the invention generally provide the same advantages as the embodiments according to the first aspect.

The invention will now be describe in greater detail based on non-limiting exemplary embodiments, and with reference to the drawings on which

Fig. 1 depicts a head of a person with an EEG monitoring system according to the invention,

Fig. 2 depicts a block diagram of the EEG monitoring system of Fig. 1,

Fig. 3 depicts a block diagram an embodiment of the hypoglycaemia monitor and data logging blocks of Fig. 2,

Fig. 4 depicts integrated event level over time compared to plasma glucose level in the blood of a patient,

Fig. 5 depicts a histogram over event level versus time of day for a number of days,

Fig. 6 depicts a circular buffer for storing successive feature vectors, and

Fig. 7 is a scatter plot illustrating a simple classifier.

Fig. 1 schematically shows a head 1 of a person carrying an EEG monitoring system 2 according to the invention. The EEG monitoring system 2 comprises an implant unit 3 for measuring EEG's. The implant unit 3 is located subcutaneously behind the ear 4 of a patient. The implant unit 3 comprises an electronics part 5 and a probe means 6 with at least two electrodes 12 (not visible in Fig. 1) for picking up electrical EEG signals from the brain of the patient. The electronics part 5 of the implant unit 3 comprises the necessary electronics for means for sampling the EEG signals measured by the electrodes and transmitting them wirelessly to an external unit 7 forming part of the EEG monitoring system 2. Preferably, the energy supply to the implant unit 3 is received inductively from the external unit 7, so that the implant unit 3 has a long service life not constrained by battery power, is advantageous as the replacement of a battery would necessitate a surgical procedure for replacement of the whole implant unit 3.

As can be seen the external unit 7 may resemble a Behind-The-

Ear hearing aid (BTE hearing aid), comprising a housing part 8, which in normal use is placed behind an ear 4 of the person carrying the EEG monitoring system 2, and an earplug 9. Like a BTE hearing aid, the housing part 8 is connected to the earplug 9 in the ear canal of the person via an intermediate connection 10. This could be a traditional sound tube leading to an earplug or an electrical cord leading to a Receiver In The Ear type earplug (RITE earplug). This allows the external unit 7 to give off messages, such as alarms or warnings, into the ear 4 of the person carrying the EEG monitoring system 2.

As indicated, the EEG monitoring system 2 may optionally include a peripheral device 11, which as will be explained later may comprise additional and possibly more energy consuming electronic storage space for data.

Turning now to Fig. 2 the internal details of the EGG monitoring system 2 are schematically shown. Starting with the implant unit 3 it comprises two electrodes 12 for measuring the electrical brain waves. Evidently, there may be more than two electrodes 12, but for ease of description and illustration only two are shown. The electrodes are connected to an analog front-end 13, amplifying the electrical signals from the electrodes 12 before they are sampled to form a digital data signal. A typical sampling rate would be 256 Hz. 256 Hz being a good compromise between the wish of keeping the energy consumption of the implant unit 3 low, and the frequencies actually measurable with an implant located subcutaneously outside the scull. The sampled data is fed to a channel encoder 14, which in turn provides an input to a wireless data transmitter 15. As can be seen the wireless data transmitter 15 is preferably incorporated in the energy receiver, with which the energy supply is received from the external unit 7. Preferably the energy supply is received inductively using an implant unit coil 16, and the data transmission provided by varying the load on the implant unit coil 16. This load variation may readily be detected by the sensing the load on a corresponding combined energy transmitter and data receiver 17 feeding an external unit coil 18.

In the external unit 7 the data received from the energy transmitter and data receiver 17 is provided to a channel decoder 19, reconstructing the digital data signal from the front end 13 in the implant unit 3, and providing the reconstructed digital data signal to a hypoglycaemia monitor 20. The hypoglycaemia monitor 20 and the functionality thereof will be described in greater detail below. The hyperglycaemia monitor 20 delivers an output signal to the device operating controller 21, which in turn controls an audio generator 22 for generating an audio signal, such as a warning or an alarm to the speaker 23. As mentioned above the speaker 23 may be a part of a RITE earplug or it may be in communication with a passive earplug via a sound tube. The device operating controller also controls a data logging unit 24, which may be used to store information in a non-volatile memory 25 such as an EEPROM. As mentioned above information may also be transmitted to a peripheral device 11 having a data-logging reader 26 capable of receiving and reading the data and storing it in a suitable data storage 27, here termed flash datalogger, of larger capacity than available in the external unit 7, e.g. a flash memory. The peripheral device need not be a dedicated storage device, but may be a unit incorporating other functionalities too, e.g. a remote control unit.

Fig. 3 illustrate the hypoglycaemia monitor 20 broken down to four basic parts, namely a feature extractor 28, a classifier 29, an event integrator 30 and an alarm unit 31, as well as the data-logger 24 and the non-volatile memory 25. Furthermore, a real time clock 32 for keeping track of occurrence of events is shown. The input signal to the hypoglycaemia monitor 20 from the channel decoder 14 is essentially just a continuous bit-stream. In order to derive useful information, this bit-stream is first fed to a feature extractor 28 for extracting desired features. The feature extractor images the input signal in a feature vector FV in order to reduce the dimensions, the input signal having a higher dimension that the resulting feature vector FV.

As will be described understood from the below description such a dimension can be performed in many ways, that is to say the actual parameters forming the feature vector can be selected in many different ways. Parameters for a feature vector could be averaged FFT coefficients, power measurement for clinical bands, or the amplitude distribution in frequency bands, e.g. percentiles, median, skewness. Also trends, could be used, i.e. whether a given band feature is increasing or declining.

One way of doing this, is to subdivide the bit-stream into blocks, e.g. corresponding to the 256 Hz sampling rate. These blocks may be fed to an FFT with a suitable number of points e.g. 256 or 128. This will yield an output vector reflecting the energy distribution of the EEG signals over a corresponding number of frequency bands between 0 Hz and 256 Hz, i.e. over 128 bands each with a width of 2 Hz or 256 bands each with a width of 1 Hz, depending on the number of points of the FFT. For each block processed by the FFT, the FFT generates one output vector of the corresponding number of dimensions, i.e. 128 or 256 dimensional vector. Of course the output of the FFT could be averaged over a number of successive blocks.

This itself merely constitutes a change of basis. The feature vector FV is really only achieved by further reducing the dimensions. One way of achieving this is by looking at the energy distribution between specific broader frequency bands, in particular the frequency bands known as clinical bands. The clinical bands are normally defined as 0-4 Hz (Delta), 4-7 Hz (Theta), 8-12 Hz (Alpha), 12-30 Hz (Beta) and 30-100+ Hz (Gamma). However, for convenience slight deviations could be used in the feature vector, e.g. 0-4 Hz, 4-8 Hz, 8-16 Hz, 16-32 Hz and 32-256 Hz, the interval limits corresponding to multiples of 2. This would then yield a five dimensional feature vector FV, each dimension representing a momentary energy distribution in the different clinical bands of the EEG signal.

Successive feature vectors are stored at predetermined intervals, e.g. every 10 seconds, in a circular memory or buffer 33 of suitable length in the data logger 24, as illustrated in Fig. 6. The circular buffer 33 illustrated comprises N feature vector samples FV, where n indicates the time index for the sample. FV(n) is thus the feature vector FV sample at the current time, FV(n-1) is the previous feature vector sample, etc. For every update of the time index, e.g. every 10 seconds, as mentioned above, the oldest feature vector sample FV(n-N+1) is overwritten with the data of an new feature vector sample FV(n).

The classifier 29 monitors the feature vectors FV for predetermined patterns identifiable as signs of hypoglycaemia, e.g. by looking at the energy distribution between the clinical bands. The classifier may look at the RMS value of the energy in these clinical bands for patterns known to signal hypoglycaemia or imminent hypoglycaemia.

An example of such a classifier is illustrated by the scatter plot of Fig. 7, corresponding to a two dimensional classifier. Dimension 1, plotted along the abscissa could be the energy in the Theta band and dimension 2 plotted along the ordinate could be the energy in the Alpha band. The classifier outputs Class 1 if the energy in both the Alpha and the Theta band are low corresponding to the dark coloured squares 34, and Class 2 if the energy in both the Alpha band and the Theta band are high, corresponding to the light coloured circles 35. The optimum classifier is defined by the fully drawn line 36.

The classifier is thus adapted to distinguish between two classes indicated by dark coloured squares 34 and light coloured circles 35. Observations above this line 36 are classified as belonging to Class 2, whereas observations below the line 36 are classified as belonging to Class 1, e.g. hypoglycaemia.

As can be seen from the illustrated example, no two dimensional classifier which fulle separates the two classes exist. As indicated in the lower right-hand corner of Fig. 7, there are 5000 observations truly belonging to Class 1 and 1000 truly belonging to class 2. 4812 of the 5000 observations belonging to Class 1 are correctly classified and the remaining 188 incorrectly classified. Conversely, 34 observations belonging to Class 2 are incorrectly identified as Class 1 observations.

Logging the feature vector FV, and storing it when an alarm is triggered based on the events classified, will allow subsequent analysis of the data, which in turn would allow the angle and level of the line 36 to be modified, i.e. the classifier to be trained, in order to reduce the future number of false positives or negatives. A reduction in false positives and false negatives will, in turn, lead to a higher number of correct alarms and less false alarms. Though being simple a two dimensional classifier will not be sufficient for practical purposes in the context of the present invention, and is only to serve as an example.

Whereas a sampling frequency of 256 Hz may be suitable for sampling the EEG signals themselves, this frequency is far higher than the rate with which events need to be monitored, in order to detect developments in the signal pattern. The classifier thus would typically only perform its classification at longer intervals, e.g. once per second or 5 to 10 times per minute.

If such a pattern is detected, the classifier identifies an event and an event signal is output to the event integrator 30. The event integrator 30 integrates the event signals over time, in order to produce an event level signal. The integration preferably has a decaying function, so that the event integrator only gives rise to a high event level in periods with a high frequency of events. In this respect it should be noted that integration in this context is to be understood broadly, including first and second order recursive integration, e.g. an AR-filter, and including leaky integrations and other integrations with a decaying function.

The event level signal is detected by the alarm unit 31, which via the device operating controller 21 triggers the audio generator 22 or gives off a warning or an alarm in the speaker 23 upon predetermined criteria. A simple but preferred criterion is an event level threshold, which when exceeded triggers the alarm or warning.

Fig. 4 shows an example of an event level signal over time for a test person and compared to actual measured values for the plasma glucose level in the blood of the test person over the same time period. An event level threshold of 0.6 is indicated. As mentioned above, a simple two dimensional classifier will hardly suffice for the purposes of this invention, and the example is based on a more complex classifier using 29 dimensions.

Apart from logging the feature vector in a circular buffer 33, it is also possible to log the actually sampled EEG signal, preferably also in a circular buffer. Also the time of occurrence of events could be logged using the real time clock 32.

Seizures, such as hypoglycaemic seizures and epileptic seizures, do not develop in identical ways with identical patterns in different persons. Logging information and detecting events greatly improves the possibilities for gaining experience and learning more about when and in what situations the person carrying the EEG monitoring system is at risk of a seizure, such as a hypoglycaemic seizure or an epileptic seizure, as well as for detecting the individual patterns. This, in turn, allows for individual adaptation of algorithms, e.g. the training of the classifier, or adjustment of the alarm threshold, both leading to fewer false alarms.

The present invention therefore allows information to be stored at suitable points in time. One such suitable point in time would be when an alarm or a warning is triggered. In such an event the raw sampled data from the EEG signal for e.g. the last 30 minutes leading up to the warning could be stored in the non-volatile memory 25. However, as storage space may be sparse it might be feasible to subject the sampled data from the EEG signal to a loss-less data compression before storage. An alternative, saving even more storage space, could be to store only the entire circular feature vector buffer 33 comprising the feature vector samples FV(n-N+1) to FV(n), as illustrated in Fig. 6. In both cases information giving a picture of the events leading up to the incident is saved for later scrutiny.

As indicated in Fig. 2 information from the data logger and/or the non-volatile memory may be read out to a peripheral device 11. This peripheral device 11 could be a device for processing the information to learn more or it could be a larger but less energy efficient storage means, e.g. a flash memory or the like. This peripheral device 11 is not intended to be carried at all times. Rather, it is envisaged that it could be placed near the bed of the person carrying the EEG monitoring system according to the invention, and that data could be transferred thereto overnight when the person is asleep in his bed.

As an alternative to the alarm based storage of data, data could also be stored at regular intervals, e.g. every 15 minutes based on the real time clock 32, again depending on the amount of storage space available in the non-volatile memory 25.

In particular, it is in this respect preferred to save information about the event level. If the current event level is stored at regular intervals, e.g. every 15 minutes, it becomes possible to monitor the development of the person carrying the EEG monitoring device over a 24 hour period. Thus it may be possible to detect whether there are times during such a 24 hour period which are especially critical, and where the person carrying the EEG monitoring device could himself do something for his health, e.g. increase the intake of sugar or take his insulin.

This is in particular of interest if such data are accumulated over longer time periods such as months or even years.

Fig. 6 depicts a two dimensional histogram over event level versus time of day for a large number of days, and the greyscale indicates the height of the columns of the histogram. For each day in a longer period, each respective event level of the 96 time intervals has been added to the corresponding column of the histogram. A high intensity thus indicates that at this specific time a specific event level frequently occurs. It can readily be appreciated that about 16:00 the person carrying the EEG monitoring device very frequently has a very high event level. Likewise, the person usually has a low to moderate event level during the night. The histogram based on the logged data thus gives a clear indication that the person carrying the EEG monitoring device should be extra aware of hypoglycaemia in the late afternoon, and perhaps ought to take precautions by changing his daily rhythm of intake of sugar and insulin.

The full data of such a histogram could be stored in the non-volatile memory of the external unit 7. However, it would be preferred to store the data in the peripheral device, having more storage space, and possibly connected to a computer for computation and display of the histogram.

With the data logging described above, and storage of the logged data, in particular the event based storage, the person carrying the portable EEG monitoring system will not only be able to obtain an individually adapted alarm threshold and event classification, but also be able to obtain guiding information in terms of nutrition, use of insulin, and eating habits, and trough this learn the reaction patterns of his body.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

PATENT CLAIMS

1. A portable EEG monitoring system, said system comprising

electrodes for measuring at least one EEG signal from the person carrying the EEG monitoring system,

signal processing means adapted to receive, process and analyze at least a part of said at least one EEG signal,

data logging means adapted to log data relating to said at least one EEG signal, and

a memory for storing said data relating to said EEG signal.

2. An EEG monitoring system according to claim 1, wherein said signal processing means comprises a feature extractor for extracting a feature vector from said EEG signal.

3. An EEG monitoring system according to any one of claims 1 or 2, wherein said analyzing means comprises an event classifier for detecting important events based on said at least one signal.

4. An EEG monitoring system according to any one of the preceding claims, wherein the data logging means is adapted to log information about a number of events.

5. An EEG monitoring system according to claim 2, wherein the data logging means is adapted to log at least one feature vector extracted from said EEG signal.

6. An EEG monitoring system according to any one of preceding claims, wherein the data logging means is adapted to log the waveform of the at least one EEG signal.

7. An EEG monitoring system according to any one of claims 3-6, wherein means are provided for detecting an abnormal brain condition based on the detected important events, and initiating an alarm based on said detection of the abnormal brain condition.

8. An EEG monitoring system according to any one of claims 3-7, wherein the data logged by said data logging means is stored in said memory, upon detection of said abnormal brain condition.

9. A method for EEG monitoring using a portable EEG measuring system, said method comprising

measuring at least one EEG signal from the person carrying the

EEG monitoring system,

receiving, processing and analyzing at least a part of said at least one EEG signal using a signal processing means,

logging data relating to said at least one EEG signal using a data logging means, and

storing said data relating to said EEG signal a memory.

10. A method according to claim 9, wherein said signal processing comprises the extraction of a feature vector from said EEG signal using a feature extractor.

11. A method according to any one of claims 9 or 10, wherein important events are detected based on said at least one signal, using an event classifier.

12. A method according to any one of claims 9 to 11, wherein information about a number of events is logged using a data logging means.

13. A method according to claim 10, wherein at least one feature vector extracted from said EEG signal is logged in a data logging means.

14. A method according to any one of claims 9 to 13, wherein the waveform of the at least one EEG signal is logged in a data logging means.

15. A method according to any one of claims 11-14, wherein an abnormal brain condition is detected based on the important events, and an alarm initiated based on said detection of the abnormal brain condition.

16. A method according to any one of claims 11-15, wherein the data logged by said data logging means is stored in said memory, upon detection of said abnormal brain condition.

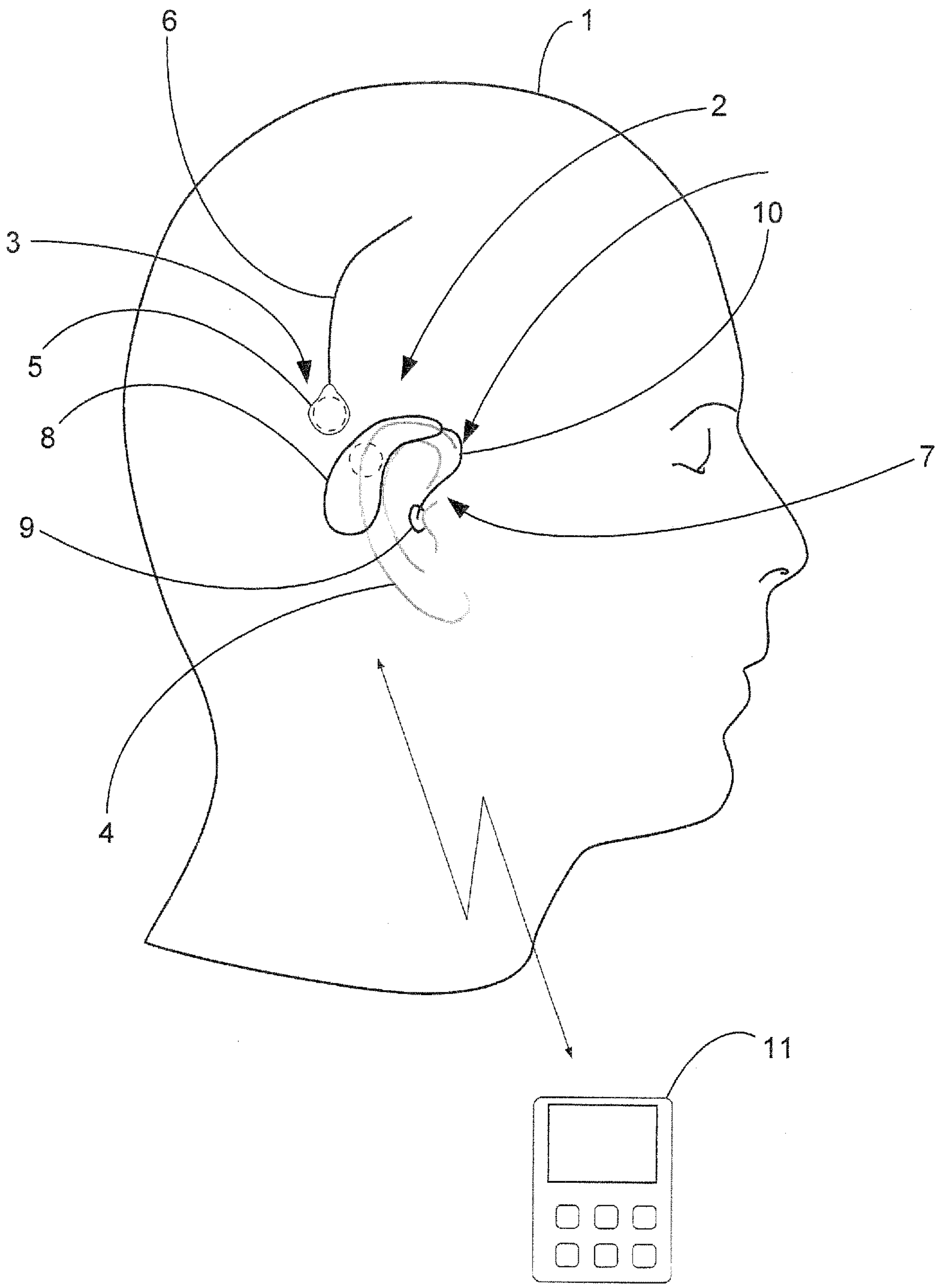
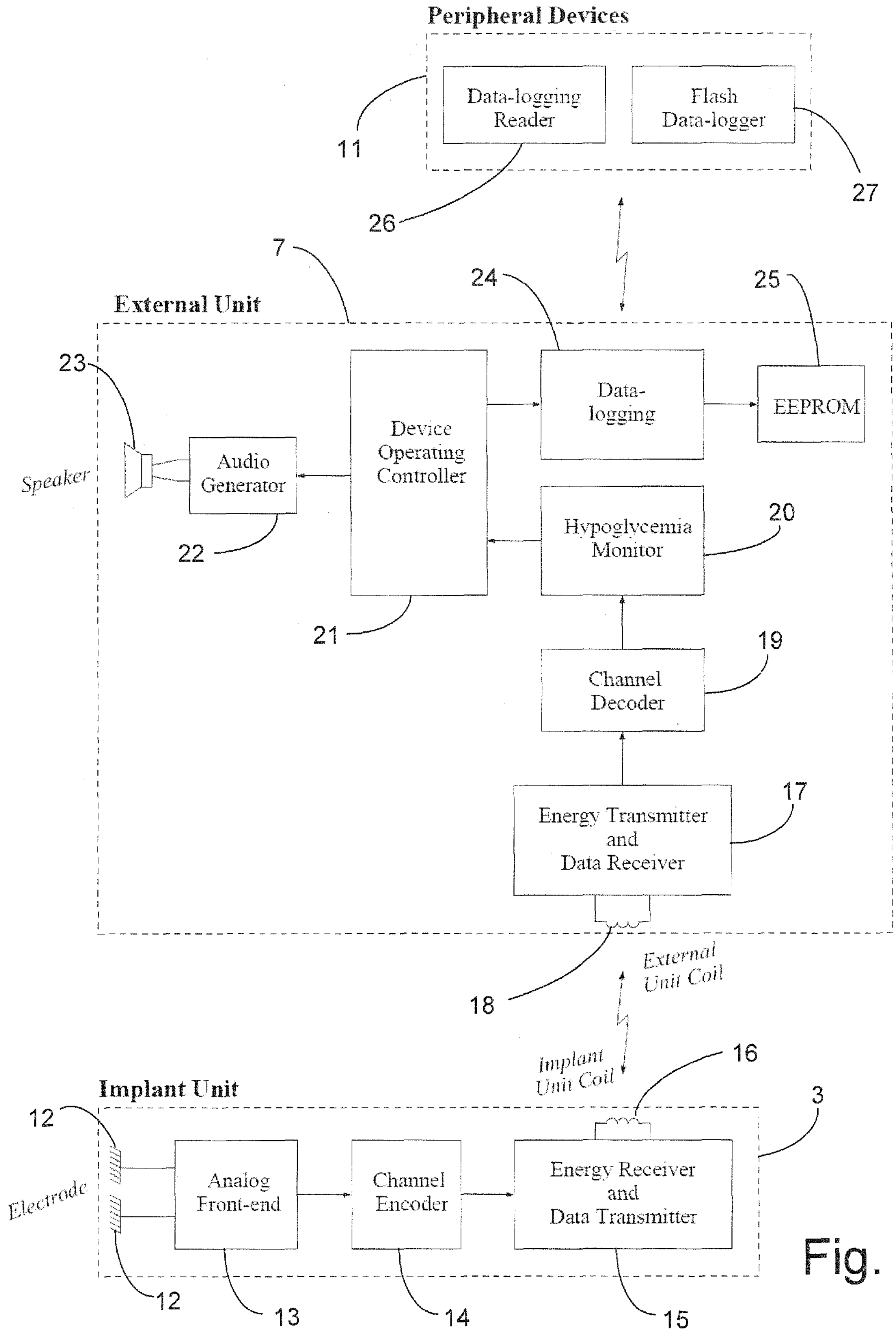
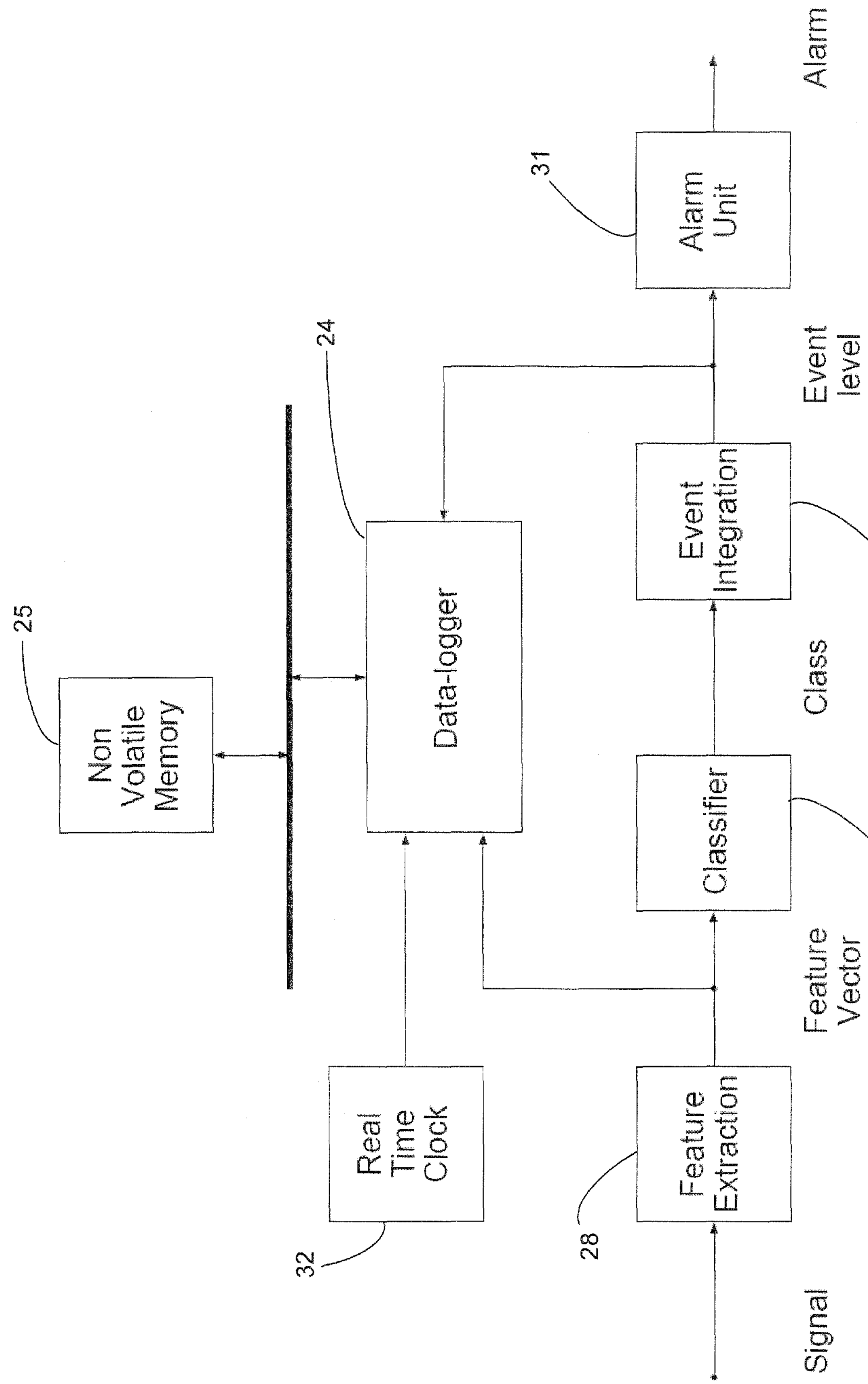


Fig. 1



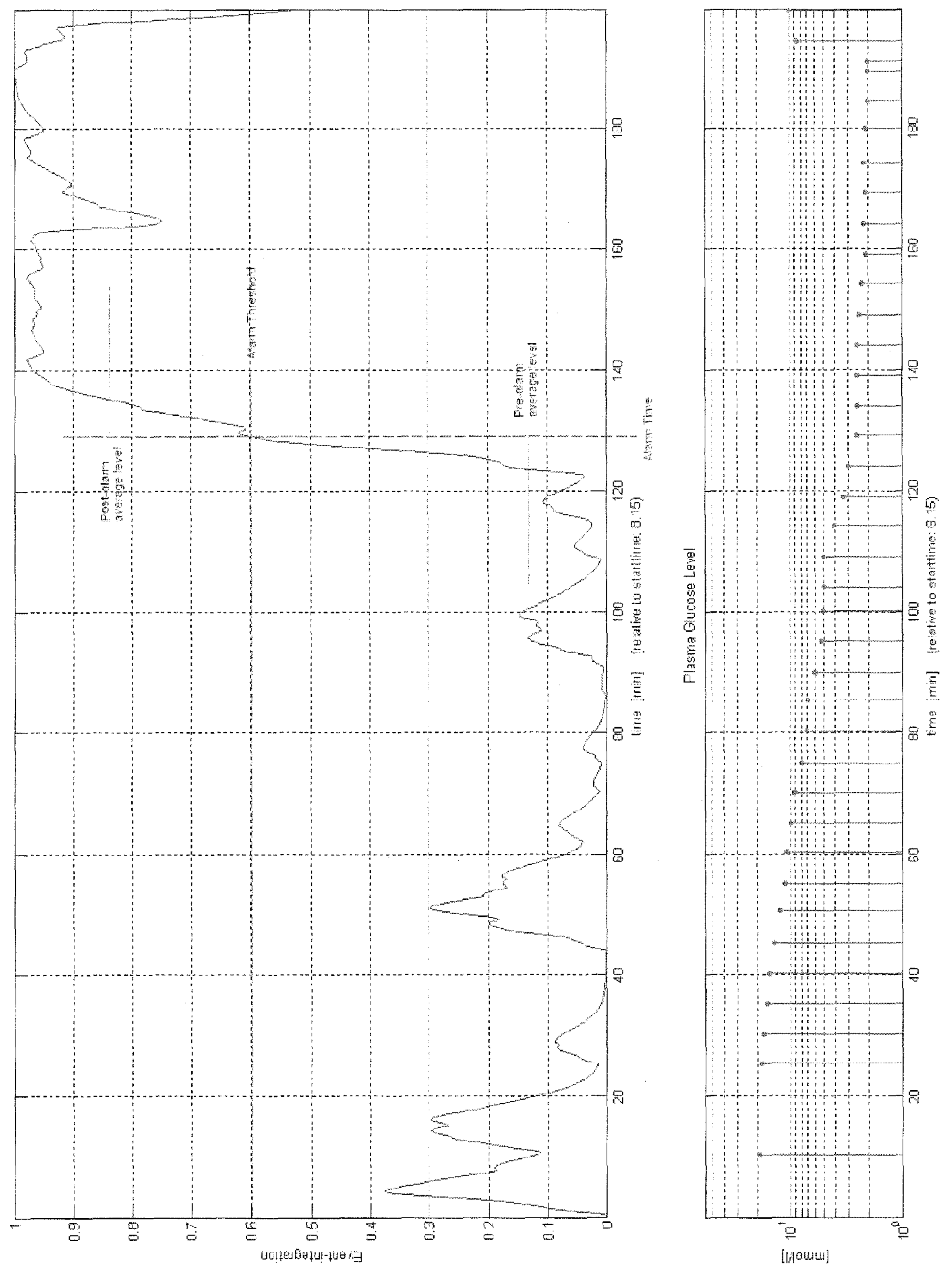
Peripheral Devices
Data-logging Reader
Flash Data-logger
11
27
26
7
24
25
External Unit
23
Device Operating Controller
Data-logging
EEPROM
Speaker
Audio Generator
Hypoglycemia Monitor
20
22
21
19
Channel Decoder
17
Energy Transmitter and Data Receiver
External Unit Coil
18
Implant Unit Coil
16
Implant Unit
3
12
Electrode
Analog Front-end
Channel Encoder
Energy Receiver and Data Transmitter
12
13
14
15

Fig. 2



Non Volatile Memory
25
Data-logger
24
Real Time Clock
32
Signal
Feature Extraction
28
Feature Vector
Classifier
29
Class
Event Integration
30
Event level
Alarm Unit
31
Alarm

Fig. 3


Event-integration
Post-alarm average level
Alarm Threshold
Pre-alarm average level
Alarm Time
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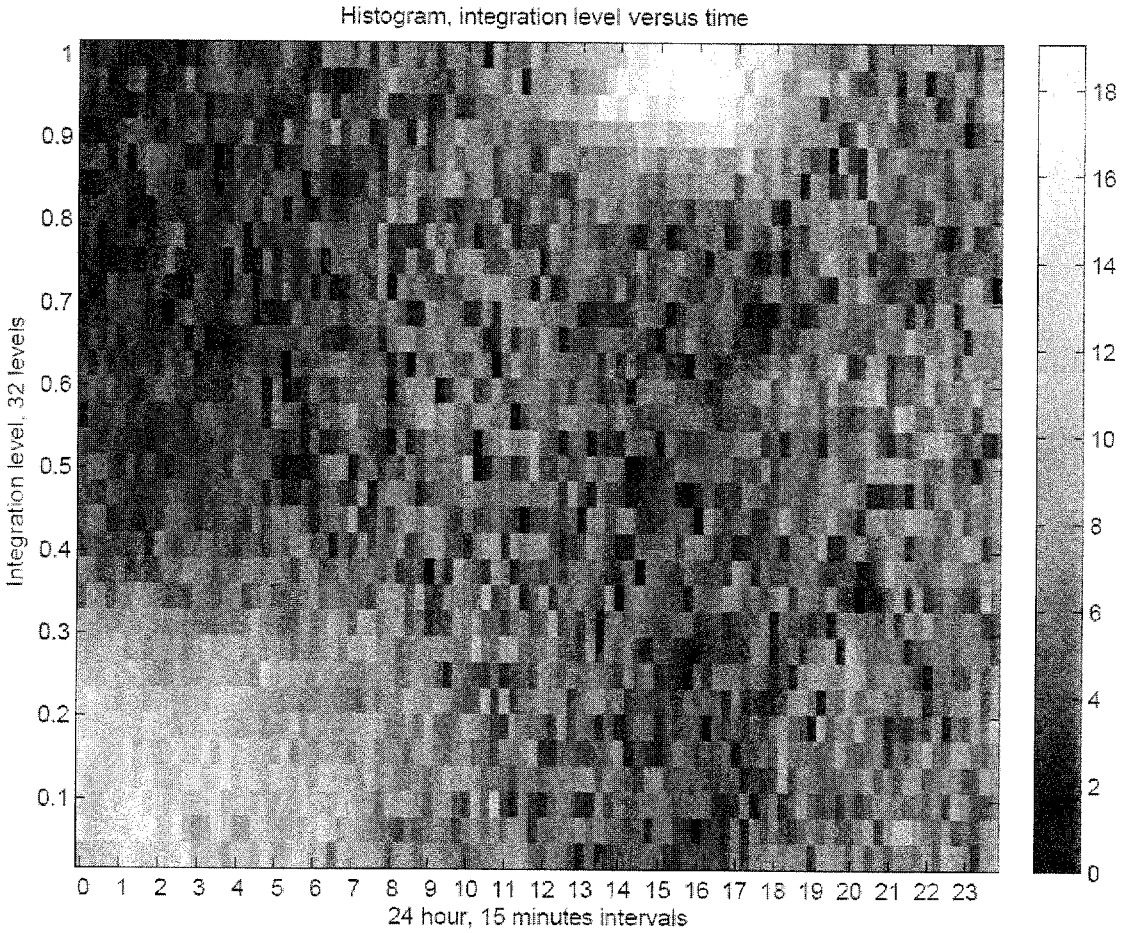
Plasma Glucose Level
[mmol/l]
time [min] (relative to starttime: 8.15)

Fig. 4


Histogram, integration level versus time
Integration level, 32 levels
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0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
24 hour, 15 minutes intervals
18
16
14
12
10
8
6
4
2
0

Fig. 5

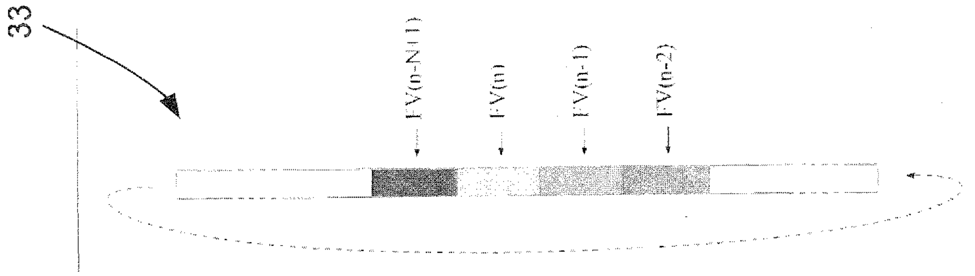
33
FV(n-N+1)
FV(n)
FV(n-1)
FV(n-2)

Fig. 6

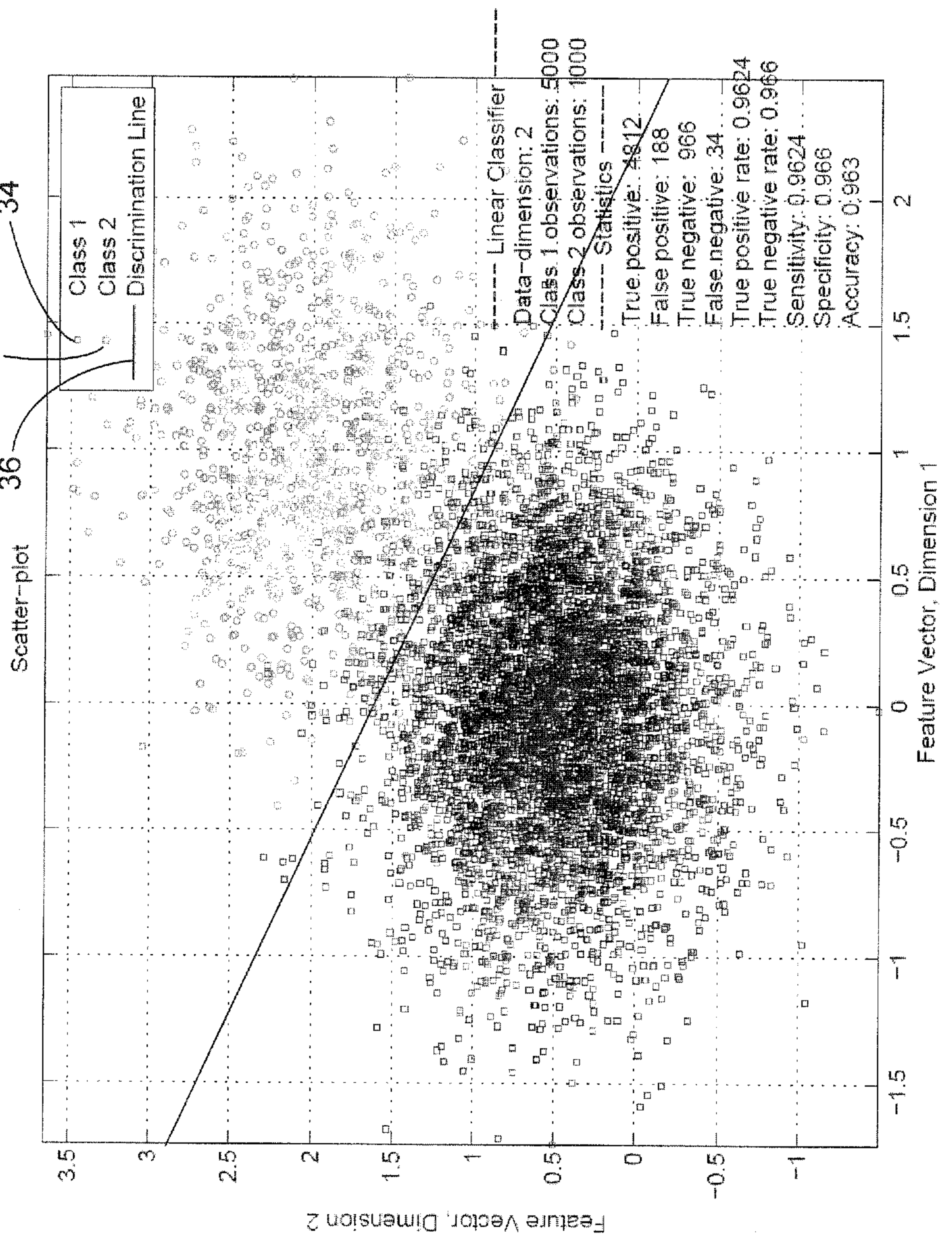
Scatter-plot
Class 1
Class 2
Discrimination Line
34
35
36
------ Linear Classifier ------
Data-dimension: 2
Class 1 observations: 5000
Class 2 observations: 1000
------ Statistics ------
True positive: 4812
False positive: 188
True negative: 966
False negative: 34
True positive rate: 0.9624
True negative rate: 0.966
Sensitivity: 0.9624
Specificity: 0.966
Accuracy: 0.963
Feature Vector, Dimension 1
Feature Vector, Dimension 2

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2009/050148

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

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 A61N

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/149952 A1 (BLAND MIKE [US] ET AL) 28 June 2007 (2007-06-28) paragraphs [0016] - [0021], [0024], [0028], [0043] - [0045], [0052] - [0068], [0073] - [0079], [0102], [0111]; figures 2-4	1-14
X	WO 2007/144307 A (HYPO SAFE AS [DK]; BECK-NIELSEN HENNING [DK]; MADSEN RASMUS ELSBORG [D) 21 December 2007 (2007-12-21) page 11, line 15 - page 13, line 20; figures 1,2 page 16, line 14 - page 23, line 11; claim 1	1-14

-/--

[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 document 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
17 September 2009	23/09/2009

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	Daoukou, Eleni

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 6 354 299 B1 (FISCHELL DAVID R [US] ET AL) 12 March 2002 (2002-03-12) column 13, lines 16-48; figures 1,3,4,7,8 column 14, lines 3-40 column 15, line 8 - column 16, line 20 column 16, line 61 - column 18, line 23 column 19, lines 8-36 column 20, lines 3-36 column 21, line 23 - column 22, line 45 column 23, line 46 - column 24, line 6 column 24, lines 50-59 column 29, lines 24-41 -----	1-14
X	WO 2006/066577 A (HYPOSAFE AS [DK]; BECK-NIELSEN HENNING [DK]) 29 June 2006 (2006-06-29) cited in the application page 5, lines 15-21; figures 1-5 page 6, line 19 - page 7, line 30 page 9, line 10 - page 10, line 2 page 10, lines 16-20 -----	1
A	TUPOLA ET AL: "Abnormal electroencephalogram at diagnosis of insulin-dependent diabetes mellitus may predict severe symptoms of hypoglycemia in children" JOURNAL OF PEDIATRICS, MOSBY-YEAR BOOK, ST. LOUIS, MO, US, vol. 133, no. 6, 1 December 1998 (1998-12-01), pages 792-794, XP005692576 ISSN: 0022-3476 page 794, middle column, lines 21-42 -----	1,9
A	BENDTSON I ET AL: "Nocturnal electroencephalogram registrations in type 1 insulin-dependent diabetic patients with hypoglycaemia" DIABETOLOGIA, SPRINGER, BERLIN, DE, vol. 34, no. 10, 1 January 1991 (1991-01-01), pages 750-756, XP002997592 ISSN: 0012-186X page 750, left-hand column, lines 20-27 pages 752-754; figure 4 -----	1-14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK2009/050148

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.: 15,16
because they relate to subject matter not required to be searched by this Authority, namely:
Rule 39.1(iv) PCT - Diagnostic method practised on the human or animal body

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 allsearchable 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 reportcovers 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/DK2009/050148

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 2007149952	A1	28-06-2007	EP	1977389	A2	08-10-2008
			WO	2007079191	A2	12-07-2007
WO 2007144307	A	21-12-2007	EP	2040608	A2	01-04-2009
US 6354299	B1	12-03-2002	US	6427086	B1	30-07-2002
WO 2006066577	A	29-06-2006	EP	1827209	A1	05-09-2007
			US	2009062678	A1	05-03-2009

patsnap

专利名称(译)	脑电图监测系统和监测脑电图的方法		
公开(公告)号	EP2445400A1	公开(公告)日	2012-05-02
申请号	EP2009776225	申请日	2009-06-26
[标]申请(专利权)人(译)	唯听助听器公司		
申请(专利权)人(译)	WIDEX A / S		
当前申请(专利权)人(译)	WIDEX A / S		
[标]发明人	KIDMOSE PREBEN WESTERMANN SREN ERIK		
发明人	KIDMOSE, PREBEN WESTERMANN, SØREN ERIK		
IPC分类号	A61B5/0476 A61B5/00		
CPC分类号	A61B5/0031 A61B5/0476 A61B5/4094 A61B5/6815 A61B5/6838 A61B5/7264		
外部链接	Espacenet		

摘要(译)

EEG监测系统（2）适于由待监测的人连续携带。 EEG监测系统（2）包括用于测量来自携带EEG监测系统（2）的人的至少一个EEG信号的电极。该系统还包括适于接收，处理和分析所述至少一个EEG信号的至少一部分的信号处理装置。此外，该系统包括：数据记录装置，适于记录与所述至少一个EEG信号有关的数据;以及存储器，用于存储与所述EEG信号有关的所述数据。