METHOD AND SYSTEM FOR AUTOMATIC PSYCHIATRIC DISORDER DETECTION AND CLASSIFICATION

Field of the Invention

[0001] The present invention relates to a signal processing and data classification technique applicable to psychiatric disorder detection and classification using heart rate and activity time-series data. The methods of the present invention reduce large sets of raw data to a plurality of characteristic parameters used for rapid psychiatric state analysis, thus they are well-suited for implementation by computers and microprocessors of embedded and portable devices.

Background of the Invention

[0002] The diagnosis of psychiatric disorders conventionally involves manual evaluation of a subject's history, physical, behavioral and medical conditions. In the United States, the diagnostic manual DSM used by psychiatric and mental health professionals details symptoms and criteria useful for classification and diagnosis of the variety of disorders. The scope of said manual is encyclopedic and said classification is typically complex and time-consuming. Even the abridged version written for the primary care practitioners presents 9 methodologies for confirming a psychiatric diagnosis for a more focused set of psychiatric concerns, particularly anxiety and depression. Thus, there is a pressing need for quick, reliable and automatic analysis of an individual's psychiatric conditions, for use by not only general medical practitioners, who routinely encounter patients with cognitive, mood or behavioral problems, but also companies and governmental departments which require the mental state of their employees monitored.

[0003] Kelsoe Jr. et al. discloses in US040053257A1 a genomics method for identifying genes for psychiatric disorder diagnosis and treatment. In US6245021, Stampfer demonstrates the psychophysiological correlation between heart rate and psychiatric status. He concludes that certain clinical states are consistently associated with distinctly different heart rate patterns. Stampfer proposes a method of cross-checking a subject's recorded heart rate pattern with a database of reference heart rate patterns indicative of psychiatric disorders. Said reference patterns are preferably collected from a

sufficient number of patients with associated psychiatric disorders. While Kelsoe's approach is possibly capable of classifying more types of disorders, Stampfer's method requires simpler equipment setup for heart rate measurement, thereby it is more suitable for general use by primary care practitioners. However, Stampfer highlights in his patent that while plots of heart rate versus time of day can reveal the qualitative aspect of circadian activity at a glance, it is difficult to quantify the temporal aspect in a numerical form. 24-hour means of normal and difference plots of measured heart rates have been shown unsuitable for use as the discriminatory parameters for type classification.

Summary of the Invention

[0004] The present invention overcomes the above and other limitations by providing efficient signal processing and data classification methods for computing numerical signatures of heart rate patterns useful for automatic psychiatric disorder analysis without the need for subjective comparison of measured heart rate patterns against reference patterns. Each of said numerical signatures constitutes unique combination of not more than 6 scalar characteristic parameters. The present invention further provides 2 efficient methodologies for analyzing said numerical heart-rate signatures to indicate whether a subject exhibits psychiatric abnormality, which is further classified into 6 types of disorders. Thus, the present invention is particularly suited for efficient computation by microprocessors and computers.

[0005] In accordance with an aspect of the present invention, a method for detecting psychiatric abnormality includes extracting from subsets of heart rate data a plurality of characteristic parameters for use by an abnormality alert step to determine whether an individual or a subject has psychiatric abnormality.

[0006] In accordance with another aspect of the present invention, a method for further classifying psychiatric disorder includes the use of said characteristic parameters for use by a disorder classification step to determine the type of psychiatric disorder said subject has suffered from.

[0007] In accordance with yet another aspect of the present invention, a psychiatric disorder detection system comprises sensors, memory, data exchange interface, internal clock and processor for control and computation, and said system exchanges data with external devices and post-processors via its wired or wireless data exchange interface.

[0008] It is apparent to those skilled in the art that the present invention can readily be incorporated in portable or desktop products for disorder alert, screening, monitoring and analysis. Individuals, life-style product manufacturers, airlines, security service providers, police, defence departments and medical practitioners are among the intended users of said products.

Brief Description of the Drawings

[0009] Preferred embodiments according to the present invention will now be described with reference to the Figures, in which like reference numerals denote like elements.

[0010] **Figure 1** illustrates the operational flow of the present method and system for psychiatric detection and classification .

[0011] **Figure 2** shows the process flow of the pre-processor in said method and detection

[0012] **Figure 3** shows the process flow of the signature generator in said method and detection.

[0013] **Figure 4** shows the operational flow of the Abnormality Alert step used in said method and detection.

[0014] **Figure 5** depicts the operational flow of the Disorder Classification step used in said method and detection.

[0015] **Figure 6a & b** show respectively the activity and heart rate time series data sets used in an evaluation.

[0016] **Figure 7** illustrates an exemplary device designed to implement the present system for psychiatric detection and classification.

Detailed Description of the Invention

[0017] The present invention may be understood more readily by reference to the following detailed description of certain embodiments of the invention.

[0018] **Figure 1** shows the operation flow of the present method and system. Pre-processor **102** separates the raw heart rate data into a plurality of data sets for use by analyzer **103** and signature generator **105**. Analyzer **103** comprises two steps, Abnormality

Alert and the Disorder Classification, which analyze a subject's recorded heart rate and activity time-series data **101** by weighing a plurality of characteristic parameters against some pre-determined values. Said characteristic parameters are generated in signature generator **105** wherein heart rate data from pre-processor **102** is conditioned and reduced to a group of 6 scalar characteristic parameters and they form the discriminatory signature of the subject's measured heart rate pattern **101**. Disorder Classification step classifies the psychiatric state of the subject under study as normal or six other common types of disorders. The output of Abnormality Alert provides a clear indication whether said subject has any psychiatric abnormality, which serves as a quick and useful alert for further medical examination and treatment. Abnormality Alert step is computationally very efficient, which makes it particularly suited for implementation in mobile, embedded and portable devices. Finally, post-processor **104** processes analysis results for display, database update and any other related applications.

[0019] **Figure 2** illustrates the process flow of pre-processor **102**. In step **210**, the sleep and non-sleep periods are determined and used as reference for the subsequent step **220** of separating raw heart rate time-series data **101** into a plurality of data subsets **231** corresponding to heart rate data during non-sleep and full sleep periods, left (or first) and right (or second) halves of sleep period. Said determination of sleep and non-sleep periods makes use of the activity data set representing the body movement of the subject under study. The time interval during which measurement is taken is categorized as non-sleep period unless the magnitude of a data point falls above a certain threshold value and the magnitudes of the subsequent data points remain higher than said threshold value for a pre-determined period of time, which indicates sleep period.

[0020] Signature generator **105** in **Figure 3** computes the average values of time series data and/or performs strong peak detecting and counting functions in step **302**. Input data for step **302** includes both the heart rate time-series data during sleep and non-sleep periods **231** generated by pre-processor **102 (Figure 2)**, or said heart-rate data during the right-half (sr) and left-half (sl) of said sleep period with strong peaks attenuated by process DSP_SA in step **301**. DSP_SA is activated by step **310** only if the parameters of interest are related to average heart rate during either the right or left half of sleep period.

[0021] DSP_SA in **301** is an important process which first detects the presence of strong peaks during sleep period. A peak is categorized as strong peak if its value is

significantly greater than the average values in the neighboring regions by a pre-determined relative value. Said relative value typically ranges between but not limited to 20% - 30%. Said detected strong peaks are then ignored in subsequent calculation. Instead, the corresponding average heart rate value calculated for the same sleep period would be used. The attenuation of said noise-like strong peaks greatly enhances the accuracy of subsequent and associated processes.

[0022] Output data **303** of said signature generator comprises the values of the following six characteristic parameters which form the signature of the subject's raw heart-rate pattern useful for psychiatric disorder classification:

AI(s): Average value of heart rate in beats per minute (bmp) during the sleep period. For improved accuracy, heart rate data is not used in the present computation if said sleep period is shorter than a pre-determined duration.

AI(ns): Average value of heart rate in bmp during the non-sleep period. For improved accuracy, heart rate data is not used in the present computation if said non-sleep period is shorter than a pre-determined duration.

AI(sl): Average value of heart rate in bmp during the left-half of the sleep period. Each sleep period is further divided into 2 equal time intervals. The left or first portion is denoted as period "sl". Strong peaks are attenuated by DSP_SA in step **301**, the average heart rate in bpm during the "sl" period is then computed. For enhanced accuracy, heart rate data is discarded in the present computation if said "sl" period is shorter than a pre-determined duration.

AI(sr): Average value of heart rate in bmp during the right-half of the sleep period. The sleep period is further divided into 2 equal time intervals. The right or second portion is denoted as period "sr". Strong peaks are attenuated by DSP_SA in step **301**, the average heart rate in bpm during the "sr" period is then computed. For enhanced accuracy, heart rate data is discarded in the present computation if said "sr" period is shorter than a pre-determined duration.

N(strong_pk)S: Number of strong peaks during the sleep period. The AI(s) generated in process **302** is taken as reference for a peak determination methodology to locate all the strong peaks present during sleep period. In particularly, a peak is categorized as strong peak if its value exceeds AI(s) by a pre-

determined value which is typically but not restricted to 10bpm – 20bpm. Finally, the number of strong peaks present during the sleep period is determined.

N(strong_pk)NS: Number of strong peaks during the non-sleep period.

The AI(ns) generated in process **302** is taken as reference for a peak determination methodology to locate all the strong peaks present during non-sleep period. In particularly, a peak is categorized as strong peak if its value exceeds AI(ns) by a pre-determined value which is typically but not restricted to 10bpm – 20bpm. Finally, the number of strong peaks present during the non-sleep period is determined.

[0023] It should be highlighted that the number of characteristic parameters required to form a discriminatory signature useful for the present psychiatric disorder classification depends on the type of disorder the subject has suffered from. It shall be clear in later discussion that said number of characteristic parameters ranges from 3 for delusional disorder to 5 for depression and general anxiety disorders.

[0024] Both steps Abnormality Alert and Disorder Classification comprise a plurality of decision-making steps using the values of the characteristic parameters AI and N (**303**) generated in signature generator **105**, which may be a stand-alone process or a sub-step called upon by other processes and tasks of Abnormality Alert and Disorder Classification (**105 in Figures 4 & 5**). The values of said characteristic parameters are compared with a set of thresholds T_n whose values are pre-determined.

[0025] More specifically, the Abnormality Alert step depicted in **Figure 4** executes the following sequence of processes or steps:

First, it checks whether AI(s) is greater than threshold parameter T_5 and that AI(ns) is greater than threshold parameter T_6 in step **410**, A positive outcome, which represents high average heart rates during sleep and non-sleep periods, causes Abnormality Alert step to terminate with an output indicating "abnormal" **411**.

If the conditions in step **410** are not met, Abnormality Alert step continues to check whether AI(ns) is greater than AI(s) by T_1 and that AI(ns) is greater than T_9 in step **420**. A positive outcome, which represents a sharp change in average heart rates between sleep and non-sleep periods, causes Abnormality Alert to terminate with an output indicating "abnormal" **421**.

If the conditions in step **420** are not met, Abnormality Alert step advances to step **440** which computes the magnitude of the difference of AI(sl) and AI(sr) during sleep period and check whether said magnitude is less than T_4. A negative outcome, which represents strong difference in the average heart rates between the first-half and the second-half of sleep period, causes Abnormality Alert to terminate with an output indicating "abnormal" **442**.

If the condition in step **440** is met, Abnormality Alert step further checks whether N(strong_pk)S is greater than T_{41} in step **450**. A positive outcome, which represents excessive number of strong peaks detected during sleep period, causes Abnormality Alert to terminate with an output indicating "abnormal" **451**.

If the condition in step **450** is not met, Abnormality Alert step terminates with an output indicating "normal" psychiatric state **452** of the subject under study.

[0026] The Disorder Classification step depicted in **Figure 5** builds upon Abnormality Alert to further classify any detected abnormality into 6 types of psychiatric disorders as elaborated below:

If the conditions in aforesaid step **410** are met, Disorder Classification step further checks whether N(strong_pk)S and N(strong_pk)NS are greater than threshold parameter T_7 in step **510**. A positive outcome, which represents excessive number of strong peaks detected during sleep and non-sleep periods, causes Disorder Classification to terminate with an output indicating "acute psychosis disorder" **511**. A negative outcome, however, causes Disorder Classification to terminate with an output indicating "other advanced types of mental disorders" **512**.

If the conditions in step **420** are met, Disorder Classification step continues to check whether N(strong_pk)S is less than T_8 in step **520**. A negative outcome, which represents excessive number of strong peaks detected during sleep period, causes Disorder Classification to terminate with an output indicating "other advanced types of mental disorders" **522**. A positive outcome, however, causes Disorder Classification to terminate with an output indicating "delusional disorder" **521**.

If the condition in step **450** is met, which represents excessive number of strong peaks ($> T_{41}$) detected during sleep period, causes Disorder Classification step to terminate with an output indicating "panic disorder" **591**. A negative outcome,

however, causes Disorder Classification to terminate with an output indicating "normal" state **452**.

If the condition in step **440** is not met, Disorder Classification step further executes the two sequences of steps listed below:

Step **445** compares AI(sr) and AI(sl) and if AI(sr) < AI(sl) then:

If AI(sl) – AI(sr) > T_2 and N(strong_pk)S ≤ T_{21} is true (steps **530** & **540**), which represents moderate number of detected strong peaks during sleep period and that AI(sl) is greater than AI(sr) by more than T_2, causes Disorder Classification step to terminate with an output indicating "general anxiety disorder" **542**. Otherwise, if either AI(sl) – AI(sr) ≤ T_2 or N(strong_pk)S > T_{21} is true, Disorder Classification terminates with an output indicating "other advanced types of mental disorders" **532**.

Otherwise if AI(sr) < AI(sl) is false then:

If AI(sr) – AI(sl) > T_3 and N(strong_pk)S ≤ T_{31} is true (steps **550** & **560**), Disorder Classification step then terminates with an output indicating "depression disorder" **562**. Otherwise, if either AI(sr) – AI(sl) ≤ T_3 or N(strong_pk)S > T_{31} is true, Disorder Classification terminates with an output indicating "other advanced types of mental disorders" **532**.

[0027] The values of T_n are typically but not restricted to the following:

T_1: 30 – 35 bpm

T_2: 8 – 12 bpm

T_3: 8 – 12 bpm

T_4: 2 – 5 bpm

T_5: 80 – 100 bpm

T_6: 110 – 130 bpm

T_7: 3 – 5

T_8: 2 – 4

T_9: 100 - 110 bpm

T_{21}, T_{31} & T_{41}: 1 – 3

[0028] The following example shows a process flow walk-through for the psychiatric detection and classification methodologies of the present invention. Given the acquired activity and raw heart-rate time series data (**Figures 6a & 6b** respectively) of an

individual, pre-processor **102** scans through said activity data set in step **210** to determine the sleep and non-sleep periods, followed by splitting said raw heart rate time series data into subsets (step **220**) which correspond to heart rate data during non-sleep, full sleep, left and right halves of sleep period (**231**). Signature generator **105** returns the values of related characteristic parameters with AI(s) = 63, AI(ns) = 89, AI(sl) = 56, AI(sr) = 69 and N(strong_pk) S = 0. The threshold values used for related T_n are $T_1 = 32$, $T_3 = 10$, $T_4 = 3$, $T_5 = 90$, $T_6 = 120$ and $T_{31} = 2$. Analyzer **103** initiates Abnormality Alert step and since AI(s) < T_5 and AI(ns) < T_6, Abnormality Alert advances from step **410** to step **420**; and since AI(ns) – AI(s) = 26 which is less than T_1, Abnormality Alert further advances to step **440** wherein abs[AI(sl) – AI(sr)] = 13 is found greater than T_4. Thereby, Abnormality Alert terminates with an output "abnormal" (**442**). Analyzer **103** further calls upon Disorder Classification step to further classify the disorder said individual has suffered from, with the process beginning with step **445** which compares AI(sr) against AI(sl). In this case, AI(sr) is greater than AI(sl), Disorder Classification therefore advances to step **550** which examines the number of strong peaks in the heart rate data during sleep period. As N(strong_pk)S = 0 which is less than T_{31}, Disorder Classification step terminates with the output "depression", which is in line with the result obtained using the visual inspection method proposed by Stampfer.

[0029] **Figure 7** illustrates an exemplary portable device **700** designed to implement the system outlined in **Figure 1**. Heart rate and activity data of the subject is typically captured by the heart rate **762** and movement (e.g. 3-axis accelerometer) **761** sensors integrated in typically one or a plurality of devices worn or carried by the subject under study. Said sensors can be of contact or contactless type. Contactless sensors allow said device to be located in proximity of the subject. Device **700** has the following characteristics:

(1) It may be standalone or integrated into other systems or devices which include but not limited to dedicated embedded systems, mobile telephones, personal digital assistants and computers.

(2) It comprises at least said sensors with drivers **751** & **752**, fixed and/or removable memory **720** for storing captured data **722** and software applications **721** (e.g. data compression module), wired or wireless data exchange interface **740** for exchanging data with external post-processors or computers **790**, an internal clock

780 for time stamping, and a micro-processor 710 for controlling said sub-systems and to compute analysis results in accordance with at least one of said classification methodologies in the present invention.

(3) It may be integrated into any objects in such a position and orientation that the subject's heart rate and movement can be detected and captured. In one such configuration, said device is incorporated in a watch worn around either wrist of said subject. In another configuration, said device is integrated in a bed such that the body of the subject comes in contact with said sensors during sleep sessions.

(4) It may perform data compression using proprietary or open-standard algorithms prior to storing captured data or executable codes in its memory 720, and prior to exchanging data via its wired or wireless data exchange interface 740;

(5) It may have an integrated screen 770 for displaying control options, parameter values and analysis results.

[0030] Data exchange interface 740 supports at least one of the communication standards which include but not limited to Bluetooth, Ethernet, infra-red, RFID, USB, Fire-Wire, RS232, IEEE802.11 and their variants. External post-processor or computer 790 receives, analyzes, displays, stores and archives captured data and results downloaded from device 700 for at least one subject. Said post-processor may execute one of the or both Abnormality Alert and Disorder Classification steps.

[0031] While the present invention has been described with reference to particular embodiments, it will be understood that the embodiments are illustrative and that the invention scope is not so limited. Alternative embodiments of the present invention will become apparent to those having ordinary skill in the art to which the present invention pertains. Such alternate embodiments are considered to be encompassed within the spirit and scope of the present invention. Accordingly, the scope of the present invention is described by the appended claims and is supported by the foregoing description.

CLAIMS

What is claimed is:

1. A method for detecting psychiatric abnormality in an individual, comprising the steps of:

acquiring the raw heart rate and corresponding activity time-series data of said individual;

splitting said raw heart rate data into a plurality of heart rate subsets in accordance with activity status derived from said activity time-series data of said individual;

generating from said heart rate subsets a numerical signature comprising a plurality of characteristic parameters capable of discriminately representing and differentiating said raw heart rate data from those taken from other subjects having a different state of psychiatric condition;

executing an abnormality alert step wherein said characteristic parameters are compared against a first set of threshold values to determine whether said individual has psychiatric abnormality; and

generating an output indicative of said psychiatric detection results.

2. The method of claim 1, wherein further psychiatric disorder classification step is executed and said classification step comprises the steps of:

comparing said characteristic parameters against a second set of threshold values to classify the type of psychiatric disorder said individual has suffered from; and

generating an output indicative of said psychiatric classification results.

3. The method of claim 1, wherein said raw data is measured continuously or sampled regularly over a period of time.

4. The method of claim 1, wherein said raw data is measured by appropriate sensors integrated in typically one or a plurality of devices worn or carried by or in proximity of said individual, and said sensors can be of contact or contactless type.

5. The method of claim 1, wherein body movement of said individual is used to form said activity data.

6. The method of claim 1, wherein said splitting of raw heart rate data comprises the steps of:

determining the sleep and non-sleep periods from said activity time series data by checking whether the magnitude of a activity data point falls below a certain pre-determined threshold value and said magnitudes of the subsequent data points remain lower than said threshold value for a pre-determined period of time, which indicates sleep period; and

splitting said heart rate raw data set into a plurality of data subsets corresponding to heart rate data recorded during non-sleep and full sleep periods, left (or first) half and right (or second) halves of sleep period.

7. The method of claim 1, wherein said characteristic parameters comprise but not limited to average values of heart rates during the full sleep period (AI(s)), the non-sleep period (AI(ns)), left-half and right-half of said sleep period (AI(sl) and AI(sr) respectively), and number of strong peaks during the full sleep and non-sleep periods (N(strong_pk)S and N(strong_pk)NS respectively); averaging operation for said average heart rates during left-half and right-half of sleep period is performed only after strong peaks are first identified and attenuated to average heart rate of the same sleep period.

8. The method of claim 7, wherein the heart rate values of said strong peaks exceed the average heart rate value of the same period by a pre-determined value.

9. The method of claim 7, wherein heart rate data is not used in the characteristic parameters computation if said corresponding sleep or non-sleep period is shorter than a pre-determined duration.

10. The method of claim 7, wherein the number of characteristic parameters required to form a discriminatory signature for psychiatric disorder classification depends on the type of disorder the subject has suffered from.

11. The method of claim 1, wherein said abnormality alert step comprises decision-making steps involving first set of pre-determined threshold values as denoted by T_5, T_6, T_1, T_9, T_4 and T_{41}, and characteristic parameters AI(s), AI(ns), AI(sl), AI(sr) & N(strong_pk)S, and the output of said detection step is:

a) Normal psychiatric state *if* {AI(s) > T_5 and AI(ns) > T_6 is false} *and* {AI(ns) – AI(s)>T_1 and AI(ns)>T_9 is false} *and* {Abs[AI(sl)-AI(sr)}]<T_4 is true} and {N(strong_pk)S > T_{41} is false};

b) Abnormal if otherwise.

12. The method of claim 2, wherein said disorder classification step comprises decision-making steps involving second set of pre-determined threshold values as denoted by T_2, T_3, T_7, T_8, T_{21} and T_{31}, and characteristic parameters AI(s), AI(ns), AI(sl), AI(sr), N(strong_pk)S & N(strong_pk)NS, and the output of said classification step is:

a) Acute Psychosis Disorder *if* {AI(s)>T_5 and AI(ns)>T_6 is true} *and* {N(strong_pk)S > T_7 and N(strong_pk)NS> T_7 is true};

b) Delusional Disorder *if* {AI(s)>T_5 and AI(ns)>T_6 is false} *and* {AI(ns) – AI(s)> T_1 and AI(ns) >T_9 is true} *and* {N(strong_pk)S < T_8 is true};

c) Panic Disorder *if* {AI(s)>T_5 and AI(ns)>T_6 is false} *and* {AI(ns) – AI(s)>T_1 and AI(ns)>T_9 is false} *and* {Abs[AI(sl)-AI(sr)}]<T_4 is true} *and* {N(strong_pk)S > T_{41} is true};

d) General Anxiety Disorder *if* {AI(s)>T_5 and AI(ns)>T_6 is false} *and* {AI(ns) – AI(s) >T_1 and AI(ns)>T_9 is false} *and* {Abs[AI(sl) – AI(sr)}]<T_4 is false} *and* {AI(sr)<AI(sl) is true} *and* {AI(sl) – AI(sr)>T_2 is true} *and* {N(strong_pk)S >T_{21} is false};

e) Depression Disorder *if* {AI(s)>T_5 and AI(ns)>T_6 is false} *and* {AI(ns) – AI(s)>T_1 & AI(ns)>T_9 is false} *and* {Abs[AI(sl) – AI(sr)}]<T_4 is false} *and* {AI(sr)<AI(sl) is false} *and* {AI(sr) – AI(sl)>T_3 is true} *and* {N(strong_pk)S > T_{31} is false};

f) Other Advanced Type of Disorders *if* the output of said abnormality alert step is abnormal *and* all conditions a) through e) above are not met.

13. The method of claim 1, wherein part or whole of raw and split data, and part or whole of said abnormality alert result is saved in at least one recording medium or memory device.

14. The method of claim 2, wherein part or whole of raw and split data, and part or whole of said disorder classification result is saved in at least one recording medium or memory device.

15. A psychiatric disorder detection system comprising:

at least one processor for control and execution of steps for psychiatric abnormality detection and alert, and disorder classification.

at least one heart rate sensor and at least one body movement sensor;

memory for storing captured data and software applications;

interface for exchanging data with external devices;

an internal clock for time-stamping captured data;

16. The detection system of claim 15, wherein said movement sensor is a 3-axis accelerometer.

17. The detection system of claim 15, wherein said heart rate and movement sensors are of contact or contactless type.

18. The detection system of claim 15, wherein said system is a stand-alone device or integrated into other embedded, portable and desktop systems or devices,

19. The detection system of claim 18, wherein said device is designed such that it functions normally when worn or carried by or in proximity of the user.

20. The detection system of claim 15, wherein said memory is of fixed type or removable or a combination of fixed and removable.

21. The detection system of claim 15, wherein said interface supports at least one wired or wireless communication standards.

22. The detection system of claim 15, wherein said processor is programmed to execute steps or software applications related to psychiatric abnormality alert and classification.

23. The detection system of claim 15, wherein data compression is implemented and applicable to both data and software codes.

24. The detection system of claim 15, wherein a display screen is integrated for displaying control options and analysis results.

25. The detection system of claim 15, wherein said external devices further analyze, display, store and archive captured data and analysis results.

26. The detection system of claim 25, wherein said external devices are programmed to execute steps or software applications related to psychiatric abnormality alert and classification.