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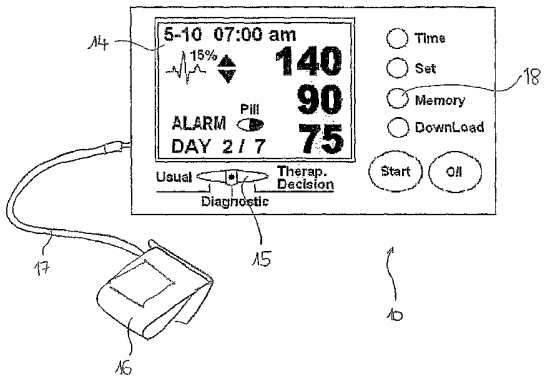
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(54) **Title:** A BLOOD PRESSURE MEASURING DEVICE AND A METHOD FOR OPERATING A BLOOD PRESSURE MEASURING DEVICE



(57) **Abstract:** A device (10) for self-monitoring the blood pressure of a patient comprises an alarm generator. The alarm generator (11) is designed in such a way as to remind the patient to carry out a blood pressure measurement or to switch the blood pressure measuring device (10) on. The alarm generator works according to a predetermined measurement schedule. The device (10) will carry out a specific phase of measuring blood pressure at home according to a clinically validated criterion, and will calculate an accurate blood pressure reading on the basis of a plurality measurement values. The device (10) can provide a doctor with accuracy data for diagnosing whether the user has hypertension or not. This diagnostic device is further operable in a therapeutic decision mode, which can monitor the blood pressure for assessing the effect of antihypertensive drug treatment. In the extended mode, the alarm generator works according to a predetermined daily measurement. The alarm generator is designed in such a way as to remind the patient to carry out a blood pressure measurement and the following drug intake. Also during the treatment phase, the antihypertensive drug may lead to patient's occurrence probability of irregular heartbeat having the tendency of rising or descending, which can be a reference index for assessing the types and doses of treated antihypertensive drug. The device (10) can also use a selectable switch to operate as a regular home blood pressure monitor.

WO 2006/133735 A1

A blood pressure measuring device and a method for operating a blood pressure measuring device

The invention relates to a blood pressure measuring device and to a method for operating a blood pressure measuring device.

Blood pressure measuring devices for self-monitoring of blood pressure at home are widely used today. In view of diagnostics of hypertension, it is much easier for a patient to verify the blood pressure at home instead of going to a hospital or to a doctor. Home measurements also allow to acquire a plurality of blood pressure measurement data.

With a recommended validated blood pressure measuring device, the self-monitoring of blood pressure at home can be more effective and convenient than conventional measurements. Home blood pressure measurements can prevent from common known "white-coat hypertension" or "effect" which may lead to overdose or inappropriate medication. The recent clinical reports also show that home BP measurements can have high predictive power and reliability for the hypertension and cardiovascular disease.

It is known that most people lack for the right knowledge of the procedures for self-monitoring of blood pressure.
Thus the measurement values of outpatients measurements are, however, sometimes not very reliable. In particular, it is known that the measurement made on the first day of a series of subsequent measurements may falsify the complete measurement sequence. In addition, the specific time when measurements are made is of certain relevance. Furthermore, if a patient forgets to make regular measurements, the results may not be reliable enough for making diagnostics.

It is therefore an object of the present invention to provide a blood pressure measuring device and a method for operating such a device which allows patients to self-monitor their blood pressure in view of a subsequent diagnostics to be made by a doctor. According to the present invention, these and other objects are solved according to the independent patent claims.

The blood pressure monitoring device according to the invention comprises an alarm generator. The alarm generator is designed such as to remind the patient to carry out a blood pressure measurement or to automatically witch the device on according to a predetermined measurement schedule. The measurement schedule is typically based on clinically tested protocols which have turned out to lead to reliable measurements. By including such an alarm generator, it is made sure that the patient does not forget to make regular measurements. In view of diagnostics of hypertension, this invention can guide users how to do the recommended validated procedures of self-monitoring of blood pressure at home, which will enhance the reading's accuracy and patient's compliance.

Preferably, the measurement schedule is stored in a memory within the device. It is possible to have a predefined measurement schedule stored in a read only memory. Alternatively, it is also possible to store a specific measurement schedule for an individual patient. Such an individual measurement schedule can be defined by a doctor.

The device further may comprise a memory for storing the results of a plurality of measurements made according to the measurement schedule.

In particular, it is possible to provide the device with a calculating means for forming averages of the results from at least two measurements. In particular, the calculating means can be used for forming daily averages based on at least two measurements on one day. They may also be used for forming averages of a plurality of such daily measurement results, in particular of such daily averages.

The device further may be provided with a means for displaying the averages. Such means allow the user to verify the current average from time to time, e. g. in the evening of each day.

In particular, it is known that the measurement made on the first day of a series of subsequent measurement may falsify the complete measurement sequence. By using the accuracy reading, a medical doctor can be more distinct to diagnose patient's true level of hypertension. According to a preferred embodiment of the invention, the calculation means for forming the averages are designed such as to disregard measurements which have been made on the first day of a series of subsequent measurement days.

The measurement schedule may generate an alarm daily, in particular in the morning and in the evening. Such alarm can be repeated for a predetermined number of days, e.g. for at least three days, in particular for seven subsequent days. In addition to generating an alarm, the device may be designed in such a way that measurements can only be made in a certain time window, e. g. 3 hours around the alarm time. The patient thus can decide to make later or earlier measurement, but still within a time window which leads to reliable results.

The device according to the present invention is particularly suitable for carrying out measurements according to verified blood pressure measurement recommendations. Such recommendations are e. g. known from article "Self-monitoring of blood pressure at home: how many measurements are needed?" (George S. Stergiou, in Journal of Hypertension 1998, Vol. 16, no. 6, page 725) from the "European Society of Hypertension recommendations for conventional, ambulatory and home blood pressure measurement" (Eoin O'Brien et al, published in Journal of Hypertension, 2003, Vol. 21, no. 5, page 821).

According to a further preferred embodiment of the invention, the device may be operated in different operating modes. The operation mode as described herein above is a so-called diagnostic mode. It is primarily used in advance of diagnostics by a doctor. The device also may be operated in a regular measurement mode and/or in a so-called therapeutic mode. In the regular mode, the device is operating in a manner comparable to a current state of the art blood pressure monitoring devices. In the therapeutic mode, the device may operate in a similar way as in the diagnostic mode. The number of consecutive measurement days however may be larger, typically extend to more than two weeks. The device is operable in the therapeutic decision mode, which can monitor the blood pressure for assessing the effect of antihypertensive drug treatment. In this mode, the alarm generator works according to a predetermined daily measurement. The alarm generator is designed in such a way as to remind the patient to carry out a blood pressure measurement and the following drug intake

In particular, the device may be provided with a manual switch for switching between these operating modes. The switch may be

mechanical. It may also be electronic by means of a touch screen or by means of set-up buttons in combination with information displayed on a display screen.

According to another aspect of the invention, the device may furthermore comprise means for storing the occurrence of an irregular heartbeat and means for calculating the occurrence percentage of irregular heartbeats measurements within a predetermined period of time of measurement. The device is furthermore provided with means for displaying such a occurrence percentage. It is already known to measure irregular heartbeats or arrhythmia automatically and in parallel during blood pressure measurements. Such a device and method is e. g. disclosed in EP 960 598. According to the present invention, irregular heartbeat detection may e. g. be made in accordance with this disclosure. Other known means for detection may also be used. This aspect of the invention allows the user to have more reliable information relating to irregular heartbeats than just information relating to a single occurrence of an irregular heartbeat. It's proven that there is a high correlation of results between self-monitoring and ambulatory blood pressure measurements. It is also known that doctors have a difficulty in treatment for many complicated cases of hypertension. In view of medication treatment of hypertension, by using similar procedures, this invention can also monitor the effect of treated medication at home in a convenient and economical way. The indication for rising or descending occurrence probability of irregular heartbeat is designed such as to provide the doctor with a reference index for assessing the types and doses of treated antihypertensive drug.

In particular, the device may furthermore be provided with means for determining whether there is an increase or a decrease of this occurrence percentage in the course of time measurement.

While such an irregular heartbeat monitoring device in a blood pressure monitor is particularly advantageous in context with the device according to a predetermined measurement schedule, the irregular heartbeat indication can also be useful in context with other blood pressure measuring devices.

According to a further aspect of the invention, there is provided a method for operating a blood pressure measuring device. In particular, the method is applicable to devices as described herein above. In a first step, there is provided a predetermined measurement schedule in the device. This may be a preset schedule, e. g. set by the manufacturer of the device. It may also be a schedule which is provided on a patient individual basis in a memory within the device. When certain criteria of the measurement schedule are fulfilled, an alarm signal is generated or the device is automatically turned on. The alarm signal reminds the patient to carry out a measurement.

The alarm typically is generated daily, in the morning and in the evening. In particular, it can be generated for a plurality of successive days, in particular seven days for diagnostic purposes. It is also possible to create alarms for a larger number of days, in particular for therapeutic purposes. Operation of the device during times outside a time window around the alarm time may be blocked in the diagnostic mode.

According to the invention it is also possible to form averages of a plurality of measured values. In particular, daily averages and averages of a plurality of subsequent daily measurements or daily averages may be formed.

For determination of averages, it is preferred to disregard the measurement values which have been made on the first day of the measurement schedule.

The invention will now be explained in more details in the following embodiments with reference to the accompanying drawings, which show:

Fig. 1 a schematic representation of a blood pressure measuring device according to the invention

Fig. 2 a schematic representation of several modules of a device according to the invention

Fig. 3 an enlarged view of a display and user interface of a device according to the present invention

Fig. 4 and 5 Flow charts of the operation of a device according to the invention in two different operating modes and

Fig 6 and 7 Flow charts of the operation of a device according to the invention with irregular heart beat detection.

Fig. 1 shows a blood pressure measuring device 10. The blood pressure measuring device 10 comprises a main unit in a housing. A cuff 16 is attached to the housing by means of a tube 17. The cuff is adapted to be placed around an upper arm of the user. The blood pressure measuring unit works in a manner known in the art, in particular by inflating the cuff and slowly decreasing the pressure in the cuff while measuring the pressure within cuff. Based on the pressure signals and the blood pressure is determined in the oscillometric method. The device is provided

with a display 14 for proving a plurality of measurement data and user instructions. Furthermore, the device is provided with operation buttons such as a memory button 18 for displaying stored results (see also Fig. 3).

According to Fig. 2, the blood pressure monitor 10 comprises a calculating unit 13 which controls operation of the device 10. A real-time clock 11 is in operative connection with the calculating means 13. The real-time clock together with the calculating unit 13 is designed to create an alarm according to a predetermined measurement schedule.

The device 10 further comprises an EEPROM memory 12 which is in operative connection with the calculating means 13. Measurement results and/or a measurement schedule may be stored in the memory 12. The device 10 furthermore may be optionally provided with a speaker 19 for indicating an audible alarm, with a printer 20 or with an interface for connection to a personal computer 21.

Fig. 3 shows in some more details the display and user interface part of the device 10 according to the invention. A memory button 18 may be used for displaying average values stored in a memory as will be described hereinafter. An on/off button 22 is used to turn the device 10 on or off. A start button 23 is used to start the measurement of the blood pressure values.

The display 14 comprises a plurality of different display sections. In a systolic blood pressure display section 30, systolic blood pressure values are displayed. In a diastolic blood pressure display section 31, diastolic blood pressure values are displayed. In a pulse display section 32, pulse values may be displayed.

Furthermore, the device may comprise a medication display section 33. In this section, the user may be reminded to take his or her medication according to a predetermined schedule. A medication display section 33 is especially used in context with a therapeutic measurement mode.

In a measurement day display section 34, the number of the day in a sequence of predetermined measurement days may be indicated. Typically, during diagnostic measurements, measurements are made on seven successive days.

In an alarm display section 35, an alarm symbol may be displayed.

In an irregular heartbeat display section 36, the occurrence percentage of irregular heartbeat measurements during a predefined measurement period, in particular during the measurements which have been made according to the measurement schedule may be displayed. In an irregular heartbeat trend display section 37, the change, in particular increase or decrease of the occurrence percentage of irregular heartbeats may be displayed.

In a time and date display section 38, the date and the current time may be indicated.

Fig. 4 shows a flow chart for operation of the device of the present invention in a first, so-called diagnostic mode. For this diagnostic mode, blood pressure measurements shall be made for a predetermined number of days, in particular seven days for one specific patient. At the start of this measurement sequence, parameter values in the device 10 are set to zero. In particular, temporary variables DIA and SYS for the systolic and dia-

stolic blood pressure, the number of measurement days and a parameter N relating to measurements within the day are set to zero.

The device 10 is then put into a waiting mode. It is waited until the on/off key 22 shown in Fig. 3 is pressed or until the time is 7 am or 7 pm. If one of these conditions is fulfilled, in a next step, it is verified whether the current time is between 6 or 9 am or between 6 and 9 pm. If this is not the case, the device is put back in a waiting condition. By this step, it is made sure that the user cannot make measurements at inappropriate time intervals, e. g. at times lying outside the 6 to 9 am/pm range. When the user presses the start button 23 (Fig. 3), the measurement procedure will start.

If the time is within this range, it is determined whether the time is before or after noon. If the time is in the morning, a morning measurement procedure is started. If the time is in the evening, a different evening measurement procedure is started.

In the morning measurement procedure, in a first stage, the user is asked to rest for five minutes. Optionally, the device may play music during this time. Playing of music can be disabled/enabled by the user or by a doctor. After this rest period which allows stabilising the blood pressure, a first blood pressure measurement is made. The results S1, D1 for the systolic and diastolic blood pressure are saved in the memory 12.

There follows a rest period before taking another measurement. The rest period typically may be 60 seconds. After this rest period, a second blood pressure measurement is done. The results for the systolic blood pressure S2 and the diastolic blood pressure D2 are saved. After completion of this morning measurement

procedure, the parameter value N is set to 1 indicating that a morning measurement has been made.

The measurement procedure for the evening measurement is substantially identical to the morning measurement. Two blood pressure measurements are made whereby systolic blood pressure values S3, S4 and diastolic blood pressure values D3, D4 are determined and saved. After termination of this procedure, it is verified whether the parameter N is equal to 1. If no, it is judged that there was no morning measurement of the same day and the device is put back into the waiting status.

If there was a morning measurement, the parameter for the measurement day is increased by one. A systolic and diastolic average blood pressure value Sd, Dd for this day is calculated by summing the stored values D1, D2, D3, D4 and S1, S2, S3, S4 respectively and by dividing them by 4.

If these are measurements of the first measurement day, i. e. if the parameter DAY is equal to 1, the parameter values are disregarded and the device is set back into the waiting status.

If the measurements were not made on the first measurement day, operation is continued and the calculated daily averages Sd, Dd are added to variables SYS and DIA which are temporary variables for the systolic and diastolic blood pressure.

If the measurement day is not equal to 7, the device is set back into the waiting status. If the measurement day is equal to 7, blood pressure measurements in the morning and in the evening of seven days have been successfully made. Consequently, an average blood pressure value for the systolic pressure and for the diastolic pressure is obtained by dividing the content of the tem-

porary variables SYS and DIA by 6. Division by six is made because measurements of the first day are disregarded.

By this method, it is made sure that measurements of six days are considered. Measurements of the first day are disregarded. Only days where measurements in the morning and in the evening have been made are considered. All measurements have been made in the predetermined time window.

Fig. 5 shows a flow chart of the device operating in the therapeutic operation mode. Operation is substantially identical to the one as shown in Fig. 4 with the following differences:

After completion of the morning and evening measurement procedure, the user is reminded to take a drug. Indication can be made by sound and/or by a display.

Contrary to the flow chart shown in Fig. 4, daily measurements are continued for fourteen days, i. e. until the variable DAY is equal or above 14.

If this condition has been reached, average systolic pressure values and diastolic pressure values are calculated by dividing the variables SYS and DIA through a number corresponding to the number of days minus 1. One day is subtracted because measurement values of the first day are disregarded during formation of averages.

Fig. 6 shows a flow chart of an irregular heartbeat probability detection mode. In a first step, it is determined how many measurements on successive days have been made. If there are less than a predetermined number of days, in particular less than 5

to 10 subsequent measurement days, an irregular heartbeat probability is calculated and displayed.

If there have been more measurement days than a predetermined number xday of days, the past occurrence percentage of irregular heartbeats P1% is stored in a variable P2 %. A new percentage P1% is calculated. Depending on the relationship between these probabilities P1% and P2%, an increase or a decrease of occurrence percentage of irregular heartbeat measurements is displayed by means of a rising icon or a descending icon. In addition, the percentage of irregular heartbeats also will be displayed. Determination of the percentage or number or irregular heartbeats may be made in a known manner.

In Fig. 7, a flow chart for an alternative therapeutic decision mode is shown. In addition to the flow chart of Fig. 5, there is irregular heartbeat detection. For irregular heartbeat or arrhythmia, a variable "Arr" is used. At the beginning of the procedure the variable "Arr" and also a variable "total" relating to the number of measurements will be set to zero. In addition, average values for evening and morning measurements for the systolic and diastolic blood pressure are used and will also be set to zero.

In addition to the procedure explained with reference to Fig. 5, during each measurement, the variable total will be increased by 1. Furthermore, if a irregular heartbeat is detected during one measurement, a variable "Arr" will be increased by 1.

If the variable "day" indicating the number of measurement days is above a predetermined value xday (see also Fig. 6) the percentage of irregular heartbeats and a rising/descending tendency of irregular heartbeats will be displayed.

In addition to the procedure shown with reference to Fig. 5, in the procedure shown in Fig. 7 morning and evening averages are also calculated for the systolic and diastolic blood pressure.

Claims

1. A blood pressure measuring device (10) for self-monitoring the blood pressure of a patient,
wherein said device (10) comprises an alarm generator (11) designed in such a way as to remind the patient or switch the device on to carry out a blood pressure measurement according to a predetermined measurement schedule.

2. A blood pressure measuring device according to claim 1, wherein said device (10) is provided with a memory (12) having said measurement schedule stored therein.

3. A blood pressure measuring device according to one of the claims 1 or 2, wherein the device (10) comprises a memory (12) for storing results of measurements made according to said measurement schedule.

4. A blood pressure measuring device according to claim 3, wherein the device (10) comprises a calculating means (13) for forming averages of the results of at least two measurements, in particular for forming daily averages based on at least two measurements made on one day and/or for forming averages of a plurality of daily measurements.

5. A blood pressure measuring device according to claim 4, said device (10) further comprising means (14, 18) for displaying said averages.

6. A blood pressure measuring device according to one of the claims 4 or 5, wherein said calculating means (13) for forming averages are designed in such a way as to disregard

measurements made on the first day of a series of subsequent daily measurements.

7. A device according to one of the claims 1 to 6, wherein said measurement schedule generates a daily morning and a daily evening alarm which is repeated for a predetermined number of days, preferably for at least three, in particular for seven subsequent days.

8. A device according to one of the claims 1 to 7, wherein the device (10) comprises means for blocking operation of said device outside a time window around an alarm time.

9. A device according to one of the claims 1 to 8, wherein said device (7) is operatable in a diagnostic mode based on said measurement schedule and in at least one of a regular mode and a therapeutic mode.

10. A device according to claim 9, wherein said device is provided which a switch (15) for manually switching between said operating modes.

11. A blood pressure measuring device (10), in particular according to one of the claims 1 to 10, comprising
- means for detecting irregular heartbeats
- means for storing occurrence of an irregular heartbeat
- means for calculating an occurrence percentage of irregular heartbeat measurements within a predetermined period of time and
- means (14, 36) for displaying said occurrence percentage.

12. A blood pressure measuring device according to claim 11, wherein the device (10) comprises calculating means for determining an increase or decrease of said occurrence percentage and means (37) displaying said increase or decrease.

13. A method for operating a blood pressure measuring device (10), in particular a device according to one of the claims 1 to 11, comprising the steps of
- providing a predetermined measurement schedule
- when a criteria of said schedule is fulfilled, generating an alarm signal reminding a patient to carry out a measurement or switching on said device (10).

14. A method according to claim 13, wherein an alarm is generated daily in the morning and in the evening for a plurality of successive days, in particular for seven successive days.

15. A method according to one of the claims 13 or 14 wherein averages of a plurality of measurement values are formed, in particular wherein daily averages and averages of a plurality of subsequent daily measurements are formed.

16. A method according to claim 14, wherein measurements of the first measurement day are disregarded for calculation of said averages.

17. A method according to one of the claims 12 to 16, wherein operation of the device (10) is blocked if the current time is not within a predetermined time window around an alarm time.

18. A method for operating a blood pressure measuring device, in particular according to one of the claims 13 to 17, comprising the steps of
    - detecting irregular heartbeats
    - calculating an occurrence percentage of irregular heartbeat measurements in a predetermined period of time
    - displaying said occurrence percentage.

19. A method according to claim 8, comprising the further step of detecting an increase or decrease of said occurrence percentage.

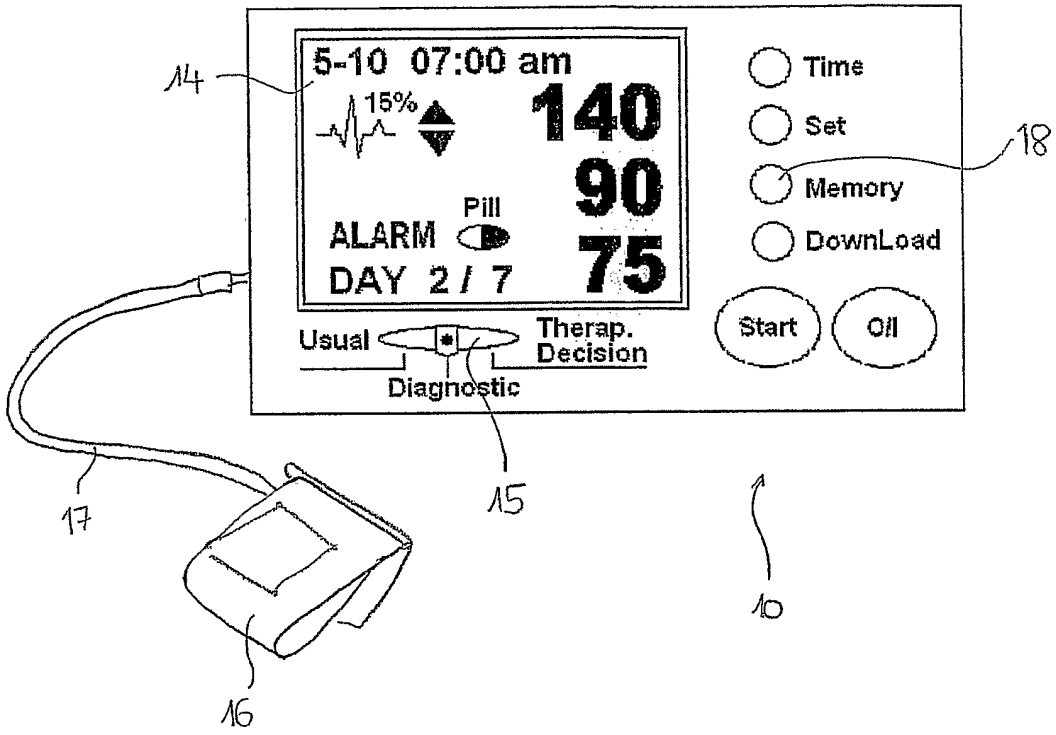

14
5-10 07:00 am
15%
140
90
Pill
ALARM
DAY 2 / 7
75
Time
Set
Memory
DownLoad
18
Start
Oil
Usual
Therap.
Decision
Diagnostic
15
17
16
10

FIG.1

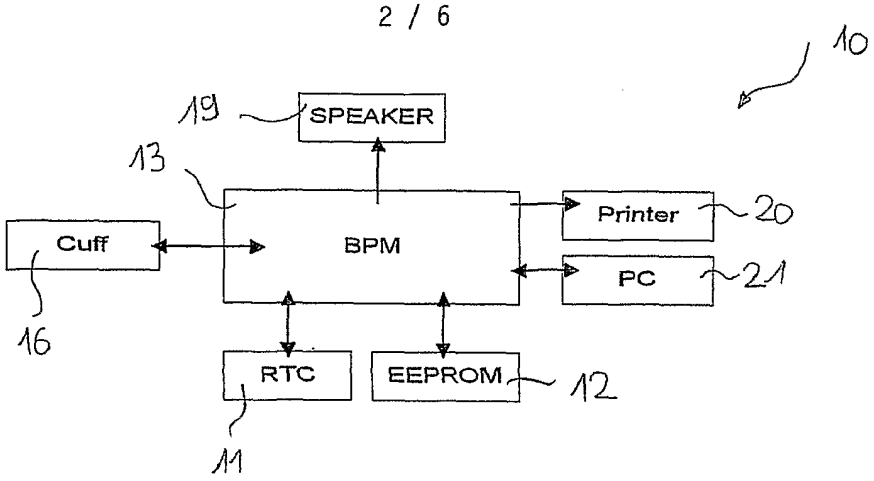

10
19
SPEAKER
13
Cuff
BPM
Printer
20
PC
21
16
RTC
EEPROM
12
11

FIG.2

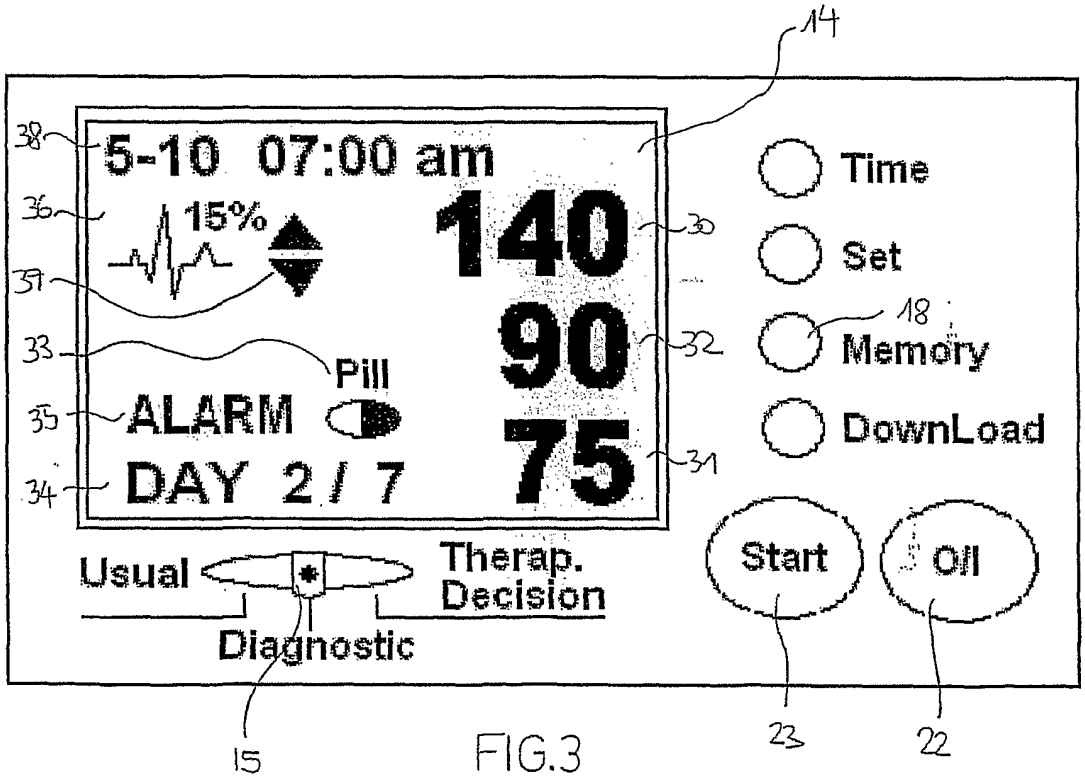

14
38
5-10 07:00 am
36
15%
140
30
37
90
32
Time
Set
18
Memory
33
Pill
35
ALARM
DownLoad
34
DAY 2 / 7
75
31
Start
Oll
Usual
Therap.
Decision
Diagnostic
15
23
22

FIG.3

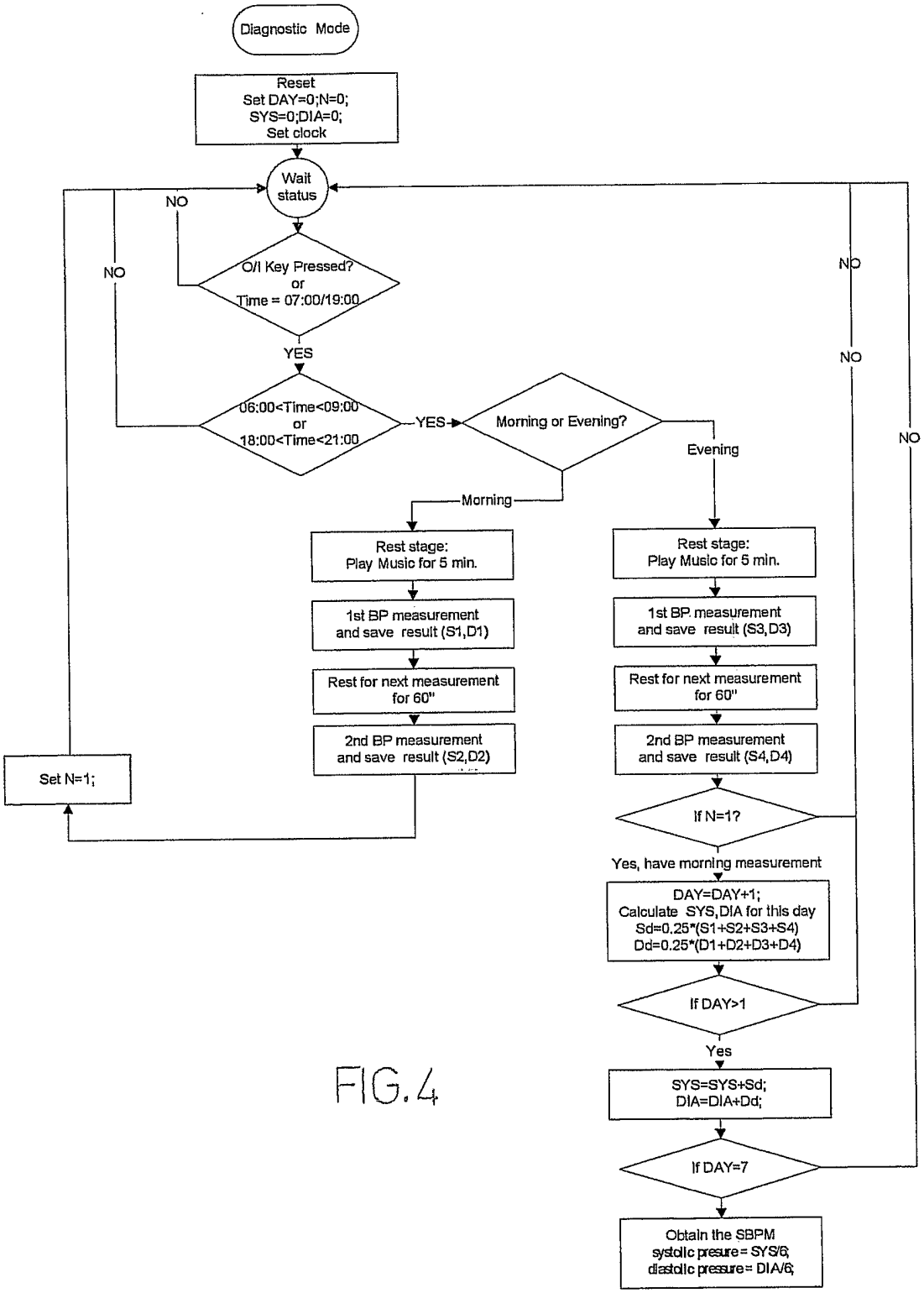

Diagnostic Mode
Reset
Set DAY=0;N=0;
SYS=0;DIA=0;
Set clock
Wait status
NO
O/I Key Pressed?
or
Time = 07:00/19:00
YES
06:00<Time<09:00
or
18:00<Time<21:00
YES
Morning or Evening?
Morning
Evening
Rest stage:
Play Music for 5 min.
1st BP measurement
and save result (S1,D1)
Rest for next measurement
for 60"
2nd BP measurement
and save result (S2,D2)
Set N=1;
Rest stage:
Play Music for 5 min.
1st BP measurement
and save result (S3,D3)
Rest for next measurement
for 60"
2nd BP measurement
and save result (S4,D4)
If N=1?
Yes, have morning measurement
DAY=DAY+1;
Calculate SYS,DIA for this day
Sd=0.25*(S1+S2+S3+S4)
Dd=0.25*(D1+D2+D3+D4)
If DAY>1
Yes
SYS=SYS+Sd;
DIA=DIA+Dd;
If DAY=7
Obtain the SBPM
systolic presure = SYS/6;
diastolic pressure = DIA/6;

FIG. 4

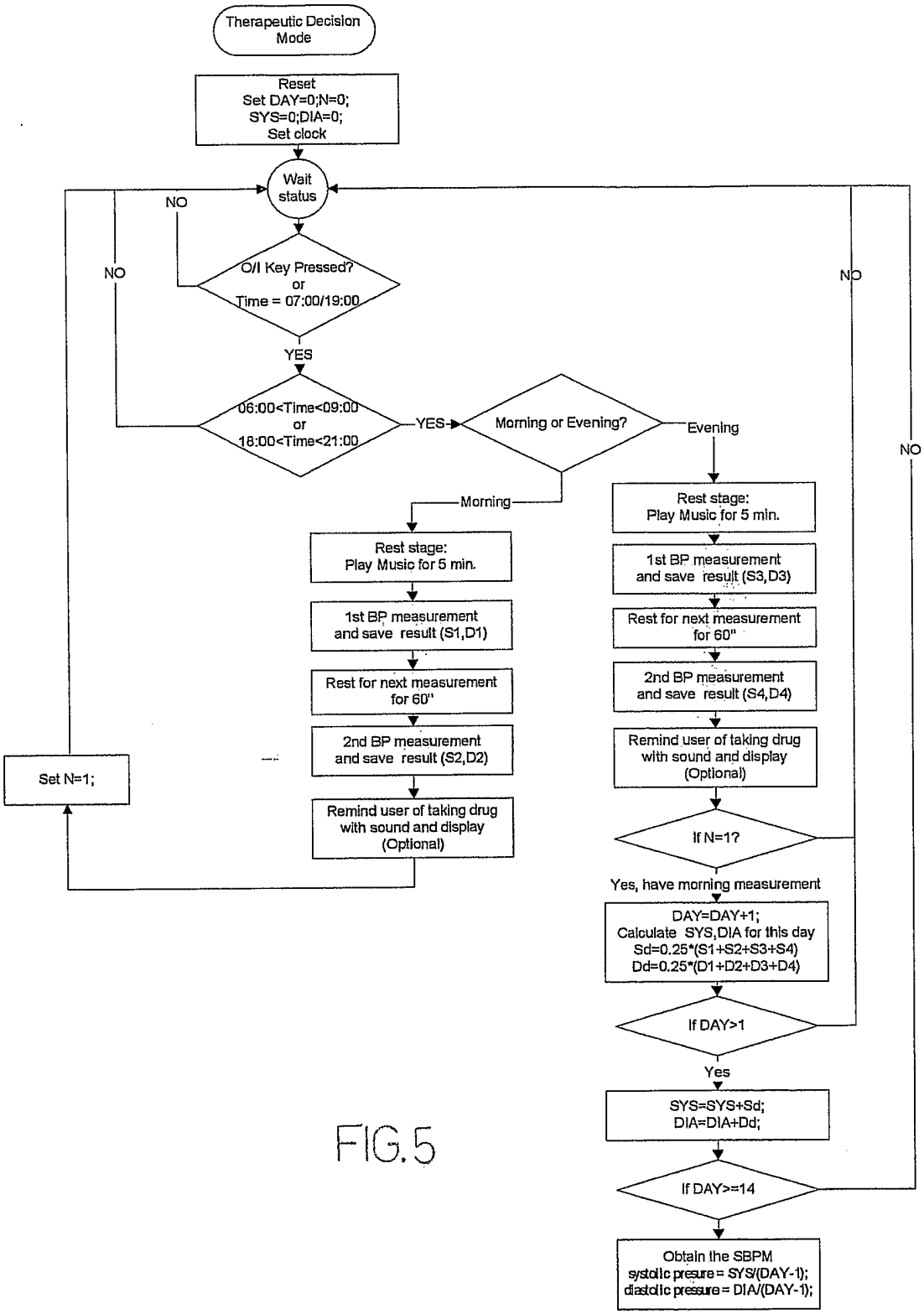

Therapeutic Decision Mode
Reset
Set DAY=0;N=0;
SYS=0;DIA=0;
Set clock
Wait status
NO
O/I Key Pressed?
or
Time = 07:00/19:00
YES
NO
06:00<Time<09:00
or
18:00<Time<21:00
YES
Morning or Evening?
Morning
Evening
Rest stage:
Play Music for 5 min.
1st BP measurement
and save result (S1,D1)
Rest for next measurement
for 60"
2nd BP measurement
and save result (S2,D2)
Remind user of taking drug
with sound and display
(Optional)
Set N=1;
Rest stage:
Play Music for 5 min.
1st BP measurement
and save result (S3,D3)
Rest for next measurement
for 60"
2nd BP measurement
and save result (S4,D4)
Remind user of taking drug
with sound and display
(Optional)
If N=1?
NO
Yes, have morning measurement
DAY=DAY+1;
Calculate SYS,DIA for this day
Sd=0.25*(S1+S2+S3+S4)
Dd=0.25*(D1+D2+D3+D4)
If DAY>1
NO
Yes
SYS=SYS+Sd;
DIA=DIA+Dd;
If DAY>=14
NO
Obtain the SBPM
systolic presure = SYS/(DAY-1);
diastolic pressure = DIA/(DAY-1);

FIG.5

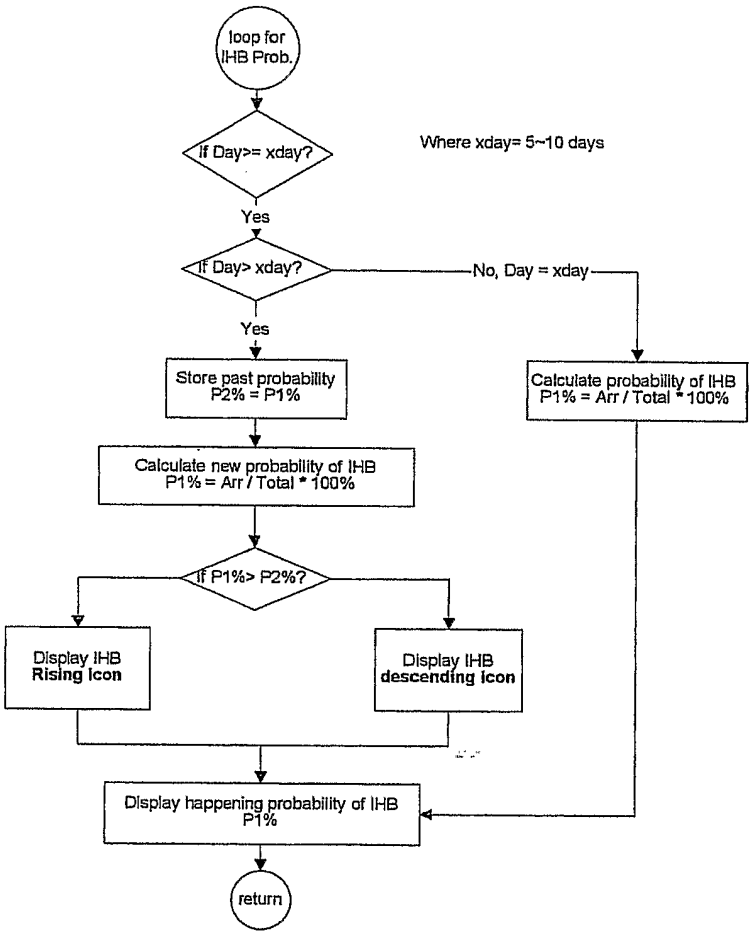

loop for IHB Prob.
If Day>= xday?
Where xday= 5~10 days
Yes
If Day> xday?
No, Day = xday
Yes
Store past probability P2% = P1%
Calculate probability of IHB P1% = Arr / Total * 100%
Calculate new probability of IHB P1% = Arr / Total * 100%
If P1%> P2%?
Display IHB Rising Icon
Display IHB descending icon
Display happening probability of IHB P1%
return

FIG.6

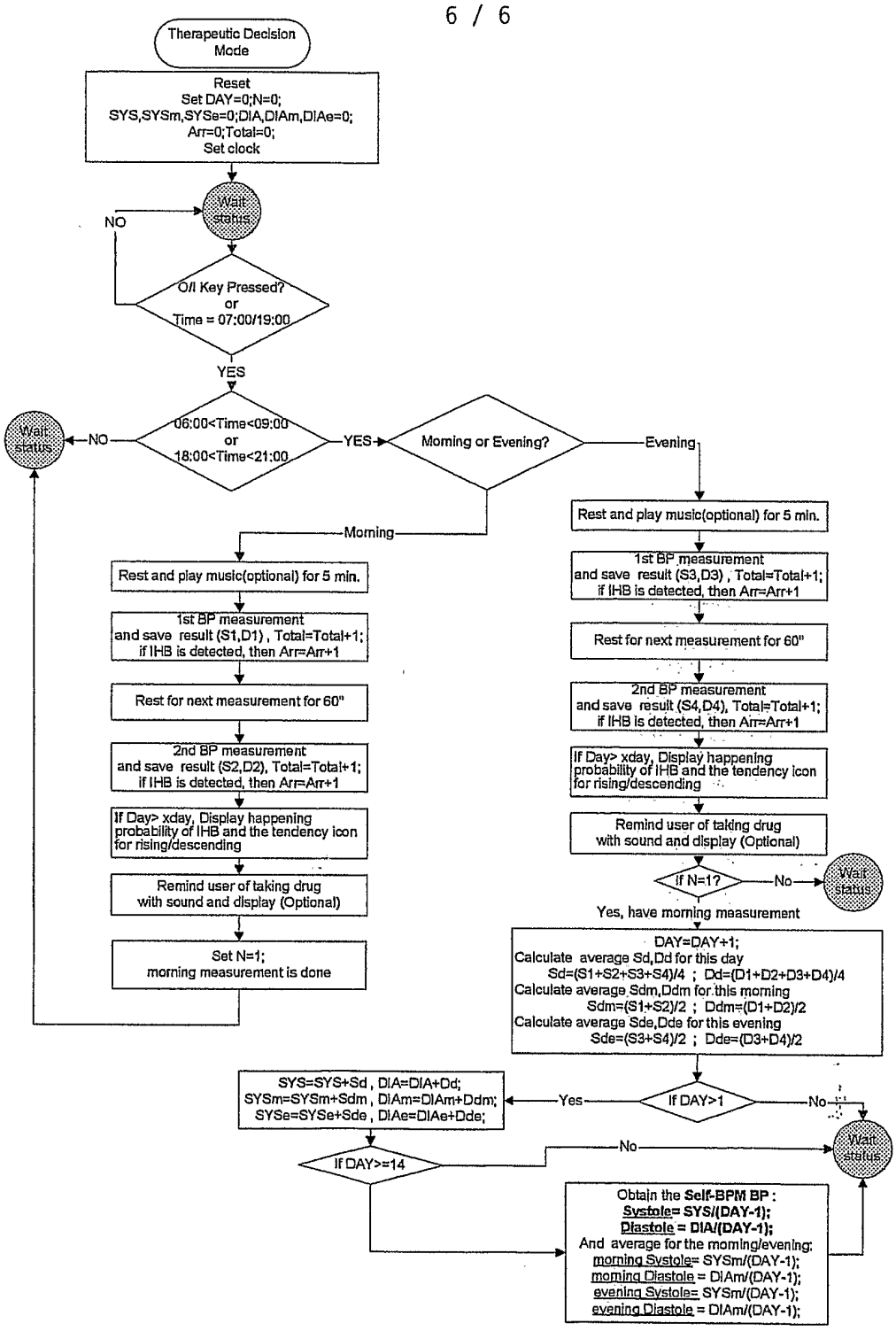

Therapeutic Decision Mode
Reset
Set DAY=0;N=0;
SYS,SYSm,SYSe=0;DIA,DIAm,DIAe=0;
Arr=0;Total=0;
Set clock
Wait status
NO
O/I Key Pressed?
or
Time = 07:00/19:00
YES
06:00<Time<09:00
or
18:00<Time<21:00
NO
Wait status
YES
Morning or Evening?
Morning
Evening
Rest and play music(optional) for 5 min.
1st BP measurement
and save result (S1,D1) , Total=Total+1;
if IHB is detected, then Arr=Arr+1
Rest for next measurement for 60"
2nd BP measurement
and save result (S2,D2), Total=Total+1;
if IHB is detected, then Arr=Arr+1
If Day> xday, Display happening probability of IHB and the tendency icon for rising/descending
Remind user of taking drug
with sound and display (Optional)
Set N=1;
morning measurement is done
Rest and play music(optional) for 5 min.
1st BP measurement
and save result (S3,D3) , Total=Total+1;
if IHB is detected, then Arr=Arr+1
Rest for next measurement for 60"
2nd BP measurement
and save result (S4,D4), Total=Total+1;
if IHB is detected, then Arr=Arr+1
If Day> xday, Display happening probability of IHB and the tendency icon for rising/descending
Remind user of taking drug
with sound and display (Optional)
If N=1?
No
Wait status
Yes, have morning measurement
DAY=DAY+1;
Calculate average Sd,Dd for this day
Sd=(S1+S2+S3+S4)/4 ; Dd=(D1+D2+D3+D4)/4
Calculate average Sdm,Ddm for this morning
Sdm=(S1+S2)/2 ; Ddm=(D1+D2)/2
Calculate average Sde,Dde for this evening
Sde=(S3+S4)/2 ; Dde=(D3+D4)/2
If DAY>1
Yes
No
SYS=SYS+Sd , DIA=DIA+Dd;
SYSm=SYSm+Sdm , DIAm=DIAm+Ddm;
SYSe=SYSe+Sde , DIAe=DIAe+Dde;
If DAY>=14
No
Wait status
Obtain the Self-BPM BP :
Systole= SYS/(DAY-1);
Diastole = DIA/(DAY-1);
And average for the morning/evening:
morning Systole= SYSm/(DAY-1);
morning Diastole = DIAm/(DAY-1);
evening Systole= SYSm/(DAY-1);
evening Diastole = DIAm/(DAY-1);

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2005/052739

A. CLASSIFICATION OF SUBJECT MATTER
A61B5/021 G06F19/00

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

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, BIOSIS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	EP 1 224 903 A (MICROLIFE INTELLECTUAL PROPERTY GMBH) 24 July 2002 (2002-07-24) column 7, line 43 - column 12, line 27; figures 1-3	1-5,7,9, 13-15 6,11,12, 16,18,19 8,17
Y	DATABASE BIOSIS 'Online! BIOSCIENCES INFORMATION SERVICE, PHILADELPHIA, PA, US; June 1998 (1998-06), STERGIOU GEORGE S ET AL: "Self-monitoring of blood pressure at home: How many measurements are needed?" XP002369023 Database accession no. PREV199800342943 cited in the application abstract	6,16

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[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

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"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

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"&" 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 February 2006	10/03/2006

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, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Fischer, O

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	& STERGIOU GEORGE S ET AL: "Self-monitoring of blood pressure at home: How many measurements are needed?" JOURNAL OF HYPERTENSION, vol. 16, no. 6, June 1998 (1998-06), pages 725-731, ISSN: 0263-6352	
Y	EP 0 960 598 A (MICROLIFE CORPORATION) 1 December 1999 (1999-12-01) cited in the application abstract column 3, line 29 - column 5, line 35; figures 1-7	11,12, 18,19
X	WO 02/053024 A (MICROLIFE INTELLECTUAL PROPERTY GMBH; LIN, KIN, YUAN; CHANG, RUEY-TING) 11 July 2002 (2002-07-11)	1-5,7,9, 13-15
A	page 1, paragraph 1 page 2, paragraph 3 - page 5, last paragraph page 7 page 9, last paragraph - page 13, last paragraph figures 1-6	6,8, 10-12, 16-19
X	US 6 699 195 B2 (NAKAZAWA FUMIO ET AL) 2 March 2004 (2004-03-02)	1-5,7, 13,14
A	column 2, line 35 - column 5, line 45 column 10, line 12 - column 14, line 46 column 17, line 59 - column 19, line 51 figures 1-3,7-9,13	6,8-12, 15-19
X	US 5 967 975 A (RIDGEWAY ET AL) 19 October 1999 (1999-10-19)	1-3,7, 13,14
A	column 3, line 9 - column 4, line 54 column 7, line 55 - column 8, line 40 column 10, lines 46-67 figures 1-4	4-6, 8-12, 15-19

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2005/052739

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 6 450 955 B1 (BROWN MICHAEL WAYNE ET AL) 17 September 2002 (2002-09-17) column 4, line 13 - column 5, line 65 column 8, lines 16-49 column 10, line 58 - column 11, line 14 column 12, lines 34-60 figures 1-5,9	1-3,7, 13,14 4-6, 8-12, 15-19
X A	US 4 944 305 A (TAKATSU ET AL) 31 July 1990 (1990-07-31) column 1, line 5 - column 4, line 50 column 7, line 44 - column 8, line 60 figures 1,6	1-3,13 4-12, 14-19

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2005/052739

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 4944305 A	31-07-1990	NONE	