Title: METHOD AND SYSTEM FOR CARDIO FITNESS

Abstract: The method, system and computer program product calculates a duration of time spent by a biological object in a pre-defined cardio zone. The pre-defined cardio zone is defined by a minimum heart rate threshold and a maximum heart rate threshold. The method/system/computer program product further includes receiving the pre-defined cardio zone, heart rate information of the biological object and motion information of the biological object. Thereafter, method/system/computer program product selects one or more time intervals in which both i) the heart rate is in the pre-defined cardio zone and ii) the corresponding motion information are present and subsequently determines the duration based on the one or more time intervals.
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Method and System for Cardio Fitness

FIELD OF THE INVENTION

The invention relates to a method and system for cardio fitness of a biological object, in particular a human being. The invention further relates to a computer program product for the cardio fitness of the biological object.

BACKGROUND OF THE INVENTION

The importance of cardio-respiratory fitness (CRF) is well established. Heart rate within a certain zone has been proven to improve cardio-respiratory fitness and exercise capacity. This zone can be referred to as heart rate (HR) cardio zone. The American College of Sports Medicine and other associations, such as the American Heart Association or the European Society of Cardiology, have published standard guidelines in which it is indicated that a certain number of minutes of exercise, in the heart-rate (HR) cardio zone during a day, are beneficial to increase or maintain CRF. It is essential to note that these guidelines not only state that the HR should be in the cardio HR zone, but that the person should exercise with his or her HR in the cardio HR zone.

CRF can be improved by physically exercising at a defined intensity. This exercise intensity can be monitored by using heart rate information. Physical exercise can bring the heart rate of a person to their personalized HR cardio zone, which depends on age, gender and the fitness level. Physical exercise in this zone typically improves or maintains CRF. Such cardio zones can be defined for people who are healthy and want to remain fit as well as for people who are cardiac patients and want to monitor their CRF. However, currently, heart rate information captured by heart rate monitors at various instances provides false positives. For instance, the person is tensed or under stressful situation and due to which his heart rate is elevated. Though this time period of elevated heart rate is counted in the zone, it is not a true depiction of the time spent by the user/patient in the HR cardio zone. Similar situation where such a depiction of time spent is a false positive is the elevated heart rate during the recovery phase after an exercise. Yet another example, where it is very important to know persons true depiction of time spent in the particular HR cardio zone is of patients
suffering from chronotropic incompetence. Unfortunately, false positives do not give the right depiction to the concerned physician.

Garmin Forerunner 920XT Owner's Manual discloses a wrist worn device that calculates the time spent in multiple zones based on the motion detection.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved method, a system for cardio fitness and a computer program product for implementing the improved method.

The system for cardio fitness, according to the first aspect of the invention, comprising an interface for receiving a pre-defined cardio zone of a biological object, the pre-defined cardio zone being defined by a minimum heart rate threshold and a maximum heart rate threshold; a heart rate sensor for detecting heart rate of the biological object; a motion sensor for detecting a motion information of the biological object; and a processing unit for selecting the detected heart rate only if the detected heart rate is in the pre-defined cardio zone; checking if the motion information is present corresponding to the detected heart rate; and calculating a duration of the time spent in the pre-defined cardio-zone by selecting one or more time intervals in which both i. the selected heart rate; and ii. the corresponding motion information are detected. In an embodiment of the invention, the processing unit calculates the duration of the time by adding the one or more selected time intervals.

The system as described above provides the advantages over the existing systems. The user/patient now can precisely know/ be aware of the time spent/duration in the pre-defined cardio zone. Since, the system incorporates the motion sensor, the processing unit is programmed such that it selects the time interval(s) in which both heart rate in the zone and the motion information are detected. Such a system thus provides measurements that are accurate and right depiction of the time spent in the pre-defined cardio zone. Further, the system as described above performs the calculation in real time, thus, helps in instant understanding of the duration of time spent in the pre-defined cardio zone. Such a system also helps doctors and fitness instructors to monitor their patients and students respectively.

The system further includes an information unit to provide information regarding the duration. For instance, time already spent in the cardio zone, time left to be spent in the cardio-zone. In an embodiment of the invention, the information unit can be one of a display unit or an audio unit or a haptic unit or a combination thereof.
In an alternative embodiment of the invention, the system includes a clock for synchronizing a time of the heart rate sensor a time of the motion sensor. Further, heart rate information representing the heart rate and the motion information representing motion are time stamped. In this advantageous embodiment, both the time stamped information related to motion and the heart rate can be stored in a memory. Further, these information points can be later used, i.e. not real time, to calculate the duration of time spent in the pre-defined cardio zone. Thus, the system selects only those heart rate data points for which it detects corresponding time stamped motion information. This can be advantageous, if the user desires to check the duration spent after he has completed the exercise. Further, such an embodiment is also beneficial for the overall power management of the system. The memory further stores pre-defined cardio zone information representing the pre-defined cardio zone.

The system, as described above can be embodied in a wearable device, such as wearable on wrist, chest, etc. Thus, all the measurements and calculation of the time spent will be performed in the wearable device.

In an alternative embodiment of the invention, the system (as described above) can be split into two or more modules. In first exemplary embodiment, the wearable device can only measure the heart rate and motion information and the processing of the information can be performed in a remote server. Thereafter, the wearable device can provide the information to the user through the inbuilt information unit. In the second exemplary embodiment of the invention, the functionalities of the server can be replaced by a wireless communication device, such as a mobile device. Thus, the wireless communication device can receive the measurements from the wearable device to perform the calculation of the duration. Thereafter, this information can be either displayed on the mobile device or wearable device or can be sent as an email to the user/fitness instructor/doctor. In the third exemplary embodiment of the invention, the system (as described above) can be embodied in a wireless communication device independently. There are various straps/bands available in the market that permit the users to strap on the wireless communication device, for instance on an arm/wrist using an armband/wristband respectively.

The invention further provides a method, according to the second aspect of the invention, for calculating a duration of time spent by a biological object in a pre-defined cardio zone. The pre-defined cardio zone is defined by a minimum heart rate threshold and a maximum heart rate threshold. The method includes receiving the pre-defined cardio zone, heart rate information of the biological object and motion information of the biological object. The method further includes selecting the received heart rate only if the received heart rate is
in the pre-defined cardio zone; checking if the motion information is present corresponding
to the received heart rate; and selecting one or more time intervals in which both i. the
selected heart rate and ii. the corresponding motion information are present. Thereafter, the
duration is determined based on the one or more time intervals. The method further includes
time stamping the received heart rate information and the received motion information. In an
embodiment of the invention, the method calculates the duration by adding the selected one
or more time intervals. The method also provides the information regarding the calculated
duration to the biological object. Furthermore, in an embodiment of the invention, the method
is a computer implemented method.

The invention, according to the third aspect of the invention, further provides a
computer program product having computer readable program code embodied therein for
calculating, when executed by a computer, a duration of time spent by a biological object in a
pre-defined cardio zone. The pre-defined cardio zone is defined by a minimum heart rate
threshold and a maximum heart rate threshold. The calculation includes receiving the pre-
defined cardio zone, heart rate information of the biological object and motion information of
the biological object. Thereafter, the program code selects the received heart rate only if the
received heart rate is in the pre-defined cardio zone; checks if the motion information is
present corresponding to the received heart rate; and selects one or more time intervals in
which both i. the selected heart rate and ii. the corresponding motion information are present
and determines the duration based on the one or more time intervals. The computer program
product further includes program codes for time stamping the received heart rate information
and the received motion information. In an embodiment of the invention, the program code
calculates the duration by adding the one or more selected time intervals. The computer
program product further includes program codes for providing the information regarding the
calculated duration to the biological object.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the method, system, computer implemented method
and computer program product according to the invention will be apparent from and
elucidated with reference to the implementations and embodiments described hereinafter, and
with reference to the accompanying drawings, which serve merely as non-limiting specific
illustrations exemplifying the more general concept.

Fig. 1 shows a method for calculating the duration of time spent by a
biological object in a pre-defined cardio zone according to the invention;
Fig. 2 shows a graph representing the motion information and heart rate information according to an embodiment of the invention;

Fig. 3 shows a schematic representation of a system for cardio fitness according to the invention;

Fig. 4 shows an implementation of the system as a wearable device according an embodiment of the invention; and

Fig. 5 shows another implementation of the system as a wearable device and a wireless communication device.

DETAILED DESCRIPTION OF EMBODIMENTS

FIG. 1 shows a method 100 for calculating the duration of time spent by a biological object in a pre-defined cardio zone according to the invention. The method steps of FIG. 1 are explained in conjunction with FIG. 2.

The method 100 begins at S1 by receiving a pre-defined cardio zone. The pre-defined cardio zone can be defined as a zone in which the user (biological object) is supposed to exercise or perform a physical activity in order to maintain the cardio-respiratory fitness (CRF), also known as cardio-fitness. The pre-defined cardio zone can also be termed as zone of interest/ personalized HR cardio zone. The pre-defined cardio zone is defined by a minimum heart rate threshold and a maximum heart rate threshold. In an embodiment of the invention, the pre-defined cardio zone can be either provided as an input by the person who will be performing the exercise or can be received from an instructor/ doctor. As explained earlier, the pre-defined cardio zone is dependent on various factors related to the user, such as age, gender and the fitness level. For instance, for a person of age 30, the pre-defined cardio zone can be 80-110 bpm (beats per minute) and further he must spent a minimum of half an hour in this zone every day. In an embodiment of the invention, the duration, such as half an hour, may be pre-defined as per the standard guidelines. In an alternate embodiment, the duration may be received, preferably by a user/ doctor/ fitness instructor, along with the pre-defined cardio-zone at S1.

Post receiving the pre-defined cardio zone, the user begins the exercise.

Thereafter the method proceeds to step S2. At S2, the method receives motion information of the user. It may be apparent to a person skilled in the art that the motion information corresponds to the motion that the person performs while exercising. Given that exercise is a physical activity, the user is bound to produce some motion and information corresponding to the motion is captured at S2. Thereafter, at S3 heart rate information/ value is received. In
continuation to previous discussion, the physical activity will also pace/increase the heart rate of the user. This information is captured at S3. In an embodiment of the invention, the heart rate information is constantly received. Thus, though the step S2 an S3 are described as two subsequent steps, it may be apparent to a person skilled in the art that these two information/data points can be received in parallel as well.

Thereafter, given that the heart rate information is constantly received at S3, the method selects, at S4, only the heart rate information that is present in the pre-defined cardio zone. For instance, the heart rate values depicted as 'a' and 'b' in FIG. 2. In parallel, the heart rate information that is not in the pre-defined cardio zone is discarded at step S5.

For instance, the heart rate values depicted as 'd' and 'e' in FIG. 2.

Subsequently, at step S6 it is checked if the selected heart rate information has corresponding motion information. In an embodiment of the invention, the detection of the motion information corresponding to heart rate information is real time. In other words, the method constantly monitors the heart rate information and the motion information and selects only that heart rate information, which is present in the pre-defined cardio zone, and has corresponding motion information. For instance, the heart rate value 'a' depicted in FIG. 2. If there is no corresponding motion information then the selected heart rate information is discarded at S7. For instance, the heart rate value 'b' depicted in FIG. 2.

Thus, at S8, the moment in time, if it is detected that the heart rate information is in the pre-defined cardio zone and correspondingly the motion information is also present, then such a time interval is selected. The time interval may be a time window/duration for which the heart rate is in the pre-defined cardio zone and for which the corresponding motion is also present. The time interval can be as small as 1 second to a few minutes, hours, etc.

In another embodiment of the invention, the incoming motion information and heart rate information at S2 and S3 respectively are time stamped. This enables later analysis of the information. For instance, if at t1 it is observed that the heart rate information in the pre-defined cardio zone is present and simultaneously at t1 the motion information is also present then, then t1 is selected. Though the example is explained with a single time point, i.e. t1, it may be apparent that the time interval can be bigger time duration, such as t1-t2.

Furthermore, there can be many such time intervals (in which both the heart rate is in the pre-defined cardio zone and the corresponding motion information is present) during the exercise/day which are constantly monitored (or detected). Thereafter, all such selected time intervals are further selected to determine/calculate an overall duration of the time spent in the pre-defined cardio zone at S9. In an embodiment of the invention, the
various selected time intervals are added together to calculate the overall duration of the time spent by the user in the pre-defined cardio zone. In an alternate embodiment, based on the duration calculated at S9, the remaining time left to perform the physical activity can also be provided to the user. For instance, at S9, it is already calculated that so far the person has exercised for 25 minutes, then remaining 5 minutes can be provided to the user as indication of the time left to complete the physical activity.

In yet another embodiment of the invention, the motion information data can also be set to a pre-defined threshold. Thus, if the heart rate information (in the pre-defined cardio zone) corresponds to motion information, however, the motion information is below the pre-defined threshold, then such heart rate information and thus the corresponding time interval will not be selected. For instance, the heart rate value ‘c’ depicted in FIG. 2.

Furthermore, once the duration is calculated at S9, it is provided to the user at S10. Various ways in which duration is provided to the user is explained in detail in conjunction with FIG. 3.

The method as described above, in an alternate embodiment, is embodied as a computer implemented method in which a computer or programmable processor is used which executes a computer readable program. Further the computer readable program is embodied in a computer program product, such as random access memory (RAM), read-only memory (ROM), hard disk drives, solid-state drives, USB flash drives, memory cards accessed via a memory card reader, floppy disks accessed via an associated floppy disk drive, optical discs accessed via an optical disc drive, magnetic tapes accessed via an appropriate tape drive, and/or other memory components, or a combination of any two or more of these memory components. In addition, the RAM may include, for example, static random access memory (SRAM), dynamic random access memory (DRAM), or magnetic random access memory (MRAM) and other such devices. The ROM may include, for example, a programmable read-only memory (PROM), an erasable programmable read-only memory (EPROM), an electrically erasable programmable read-only memory (EEPROM), another like memory device. The computer program product can also be an application (app) that can be installed on a computer/a wireless communication device/a portable electronic device.

FIG. 3 shows a schematic representation a system 300 for cardio fitness according to the invention.

The system 300 includes an interface 302, a motion sensor 304, a heart rate sensor 306, a processing unit 308, a memory 310 and an information unit 312. In various
embodiments of the invention, the system 300 is in close proximity, preferably in contact with the skin, of the user.

The interface 302 receives a pre-defined cardio zone. The pre-defined cardio zone has been explained in detail in conjunction with FIG. 1. The interface 302 in an embodiment is a user interface (UI) to receive the pre-defined cardio zone directly from the user. Few examples of UI include but are not limited to a touch screen, push buttons, and a Graphical User Interface. In another embodiment of the invention, the interface 302 receives the pre-defined cardio zone directly from another device, such as a server, an application (app) installed on a wireless communication device, a browser running on a client device such a computer of the user/health practitioner.

The motion sensor 304 detects/receives motion information data of the user when he is involved in a physical activity. In an embodiment of the invention, the motion sensor 304 is an accelerometer. Various kinds of accelerometers include but are not limited to optical accelerometer, triaxial (3D) accelerometers, and piezoelectric accelerometers.

The heart rate sensor 306 detects/receives heart rate values/information of the user. In an embodiment of the invention, the heart rate sensor 306 is a photoplethysmograph (PPG) sensor.

The processing unit 308 processes the received heart rate values and motion information and calculates the time interval spent by the user in the pre-defined cardio zone.

The processing unit 308 executes steps S4-S9 as explained above to determine/calculate the overall duration.

The term processing unit, as used herein, may be any type of controller or processor, and may be embodied as one or more controllers or processors adapted to perform the functionality discussed herein. Additionally, as the term processor is used herein, a processor may include use of a single integrated circuit (IC), or may include use of a plurality of integrated circuits or other components connected, arranged or grouped together, such as controllers, microprocessors, digital signal processors, parallel processors, multiple core processors, custom ICs, application specific integrated circuits, field programmable gate arrays, adaptive computing ICs, associated memory, such as and without limitation, RAM, DRAM and ROM, and other ICs and components.

The memory 310 stores pre-defined cardio zone information representing the pre-defined cardio zone, the heart rate information, the motion information, the calculated duration. Further, the memory 310 may store instructions (S1-S10) that are executable by the processing unit 308 for calculation of the duration of the time spent by the user in a pre-
defined cardio zone. In an alternate embodiment of system 300, the memory 310 (whole or in part) can also be outside the system 300 such as in cloud server architecture (depicted with dotted lines) and can be accessed over a network 316.

The memory 310 may include both volatile and/or nonvolatile memory and data storage components. Volatile components are those that do not retain data values upon loss of power. Nonvolatile components are those that retain data upon a loss of power. Thus, the memory may include, for example, random access memory (RAM), read-only memory (ROM), hard disk drives, solid-state drives, and/or other memory components, or a combination of any two or more of these memory components. In addition, the RAM may include, for example, static random access memory (SRAM), dynamic random access memory (DRAM), or magnetic random access memory (MRAM) and other such devices. The ROM may include, for example, a programmable read-only memory (PROM), an erasable programmable read-only memory (EPROM), and an electrically erasable programmable read-only memory (EEPROM), another like memory device. The memory is a computer readable medium.

The calculated duration/time spent by the user is provided to the user by the information unit 312. In an embodiment of the invention, the information unit 312 is one of a display unit, an audio unit, a haptic unit or a combination thereof. The information unit 312, for instance by means of the display, can also display the remaining time that the user needs to exercise to reach the target. It may be evident that the remaining time will also be calculated by the processing unit 308. Additionally, the current time spent in the cardio zone can also be simultaneously displayed.

In an alternative embodiment of the invention, the system 300 further includes a clock 314. The clock 314 synchronizes the time of the heart rate sensor 306 and the motion sensor 304. The clock 314 timestamps the received motion information and the heart rate information. In this advantageous embodiment, both the time stamped information related to motion and the heart rate can be stored in the memory 310. Given that the received information is time stamped, the analysis can be thus performed later. The processing unit 308 selects only that time stamped heart rate data points for which it detects corresponding time stamped motion information and thereby selects the time intervals in which both time stamped information is detected. Performing the calculation at a later point in time may also help in an improved power management of the system 300. Further, though the clock 314 and processing unit 308 are disclosed as two separate modules in the system 300, the clock 314 can also be an inbuilt module of the processing unit 308.
System 300 as described above can be embodied in as a wearable device, such as on a wrist, on the chest, etc. FIG. 4 shows an example of a wearable device 400 in the form of wrist based device. Such a wearable device 400 may interact with the user directly to receive the pre-defined cardio zone and to provide the duration of time spent in the physical activity. However, the wearable device 400 may also interact simultaneously via an app installed on a wireless communication device 500 over a network 600 as depicted in FIG. 5. Thus, the app receives the pre-defined cardio zone and thereafter transmits the zone (information) to the wearable device 400. Subsequently, the wearable device 400 transmits the calculated duration to the app for further indication, such as in form of an email, display in an app, audio display, haptic feedback, and the like to the user. In yet another embodiment of the invention, the wearable device 400 may include only the heart rate sensor 306 and the motion sensor 304 and corresponding information can be transmitted over the network 600 to the app on the wireless communication device 500 for further calculation. It may be apparent to a person skilled in the art that various combinations as described above are possible without deviating from the scope of the invention.

Various examples of the wireless communication device 500 include but are not limited to a mobile device, a cellular telephone, a smart phone, a music player, a web pad, a tablet computer system, or other devices with like capability.

Various examples of the network 600/316 include but are not limited to the Internet, intranets, extranets, wired networks, wireless networks, wide area networks (WANs), local area networks (LANs), or other suitable networks, etc., or any combination of two or more such networks.

It will be clear to a person skilled in the art that the scope of the present invention is not limited to the examples discussed in the foregoing, but that several amendments and modifications thereof are possible without deviating from the scope of the present invention as defined in the attached claims. While the present invention has been illustrated and described in detail in the figures and the description, such illustration and description are to be considered illustrative or exemplary only, and not restrictive. The present invention is not limited to the disclosed embodiments.

Variations to the disclosed embodiments can be understood and effected by a person skilled in the art in practicing the claimed invention, from a study of the figures, the description and the attached claims. In the claims, the word "comprising" does not exclude other steps or elements, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not
indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope of the present invention.
CLAIMS:

1. A system (300) for cardio fitness comprising:
   a. an interface (302) for receiving a pre-defined cardio zone of a biological object, the pre-defined cardio zone being defined by a minimum heart rate threshold and a maximum heart rate threshold;
   b. a heart rate sensor (306) for detecting heart rate of the biological object;
   c. a motion sensor (304) for detecting a motion information of the biological object; and
   d. a processing unit (308) for:
      i. selecting the detected heart rate only if the detected heart rate is in the pre-defined cardio zone;
      ii. checking if the motion information is present corresponding to the detected heart rate; and
      iii. calculating a duration of the time spent in the pre-defined cardio-zone by selecting one or more time intervals in which both
         i. the selected heart rate; and
         ii. the corresponding motion information are detected.

2. The system according to claim 1 further comprising a clock (314) for synchronizing a time of the heart rate sensor (306) and a time of the motion sensor (304).

3. The system according to claim 1, wherein heart rate information representing the heart rate and the motion information representing motion are time stamped.

4. The system according to claim 1, wherein the processing unit (308) calculates the duration of the time by adding the one or more selected time intervals.

5. The system according to any of the preceding claims further comprising a memory (310) to store pre-defined cardio zone information representing the predefined cardio zone, time stamped motion information, time stamped heart rate information.
6. The system according to claim 1 further comprising an information unit (312) to provide information regarding the duration.

7. The system according to claim 6, where the information unit (312) is at least one of a display unit, an audio unit and a haptic unit.

8. The system according to claim 1 is at least one of a wearable device (400) and a wireless communication device (500).

9. A method (100) for calculating a duration of time spent by a biological object in a pre-defined cardio zone, the pre-defined cardio zone being defined by a minimum heart rate threshold and a maximum heart rate threshold, the method comprising:
   a. receiving the pre-defined cardio zone (S1),
   b. receiving heart rate information (S3) of the biological object;
   c. receiving motion information (S2) of the biological object;
   d. selecting (S4-S8) the received heart rate only if the received heart rate is in the pre-defined cardio zone;
   e. checking if the motion information is present corresponding to the received heart rate; and
   f. selecting one or more time intervals in which both i. the selected heart rate and ii. the corresponding motion information are present; and
   g. determining the duration (S9) based on selected the one or more time intervals.

10. The method according to claim 9 further comprising time stamping the received heart rate information and the received motion information.

11. The method according to claim 9 further comprising providing information (S10) regarding the duration.

12. The method according to 9-11 is a computer implemented method.

13. A computer program product having computer readable program code embodied therein for calculating, when executed by a computer, a duration of time spent by a biological object in a pre-defined cardio zone, the pre-defined cardio zone being defined by a
minimum heart rate threshold and a maximum heart rate threshold, in which the calculation comprising:
a. receiving the pre-defined cardio zone,
b. receiving heart rate information of the biological object;
c. receiving motion information of the biological object;
d. selecting the received heart rate only if the received heart rate is in the pre-defined cardio zone;
e. checking if the motion information is present corresponding to the received heart rate; and
f. selecting one or more time intervals in which both i. the selected heart rate and ii. the corresponding motion information are present; and
g. determining the duration based on the one or more time intervals.

14. The computer program product according to claim 13 further comprising program codes for time stamping the received heart rate information and the received motion information.

15. The computer program product according to claim 13 further comprising program codes for providing information regarding the duration.
Pre-defined cardio zone
- 80-100 bpm

Time spent in the cardio zone: 18 mins

Time remaining in the cardio zone: 12 mins
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

INV. A61B5/0205 A61B5/024 A61B5/11

ADD.

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

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

A61B G04B A63B

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

Electronic database consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents :

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

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

L" document which may throw doubts on priority claim(s) or which establishes 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

* "Z" document member of the same patent family

Date of the actual completion of the international search:

18 February 2016

Date of mailing of the international search report:

25/02/2016

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Authorized officer:

Gooding Arango, J

Form PCT/ISA/210 (second sheet) (April 2005)
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