(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 591 718 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
05.11.2014 Bulletin 2014/45

(21) Application number: **11838303.3**

(22) Date of filing: **09.09.2011**

(51) Int Cl.:
G01J 5/08 *(2006.01)* ***A61B 5/01*** *(2006.01)*
G01J 5/02 *(2006.01)* ***G01J 5/00*** *(2006.01)*
G06T 11/20 *(2006.01)* ***A61B 5/00*** *(2006.01)*

(86) International application number:
PCT/RU2011/000695

(87) International publication number:
WO 2012/060732 (10.05.2012 Gazette 2012/19)

(54) **METHOD FOR DISPLAYING THE TEMPERATURE FIELD OF A BIOLOGICAL SUBJECT**

VERFAHREN ZUR ANZEIGE DES TEMPERATURBEREICHS EINES LEBEWESENS

PROCÉDÉ DE REPRÉSENTATION DU CHAMP DE TEMPÉRATURE D'UN OBJET BIOLOGIQUE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **02.11.2010 RU 2010144628**

(43) Date of publication of application:
15.05.2013 Bulletin 2013/20

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Description

[0001] The present invention relates to medicine and veterinary medicine, namely, to the measurements for diagnostic purposes by measuring the temperature of the body parts; the invention can be used in medical and veterinary practice for diagnosis of diseases and for monitoring of the dynamics of the disease during the course of treatment.

[0002] In this application, the term "image of the object" and "image of the examined area of the object" includes: electronic image of received on photosensitive element of the photo camera, subsequent transfer of the electronic image to a personal computer in any conventional format, as well as an electronic model of a biological object with the image of the examined area in the format 2D or 3D.

[0003] It is widely known that a disease of organs of a biological object is accompanied by the change in temperature in the relevant to the disease areas of the body of the biological object. Information on the temperature field gives an indication of the presence of the pathology in the body of the biological object, herewith, diagnostics of the revealed pathology is performed based on known temperature signs.

[0004] Currently, expensive computer thermographs are used for the purpose of obtaining information about the temperature field of a person; thermographs register thermal (infrared) radiation from a person through infrared-sensitive sensor elements and display it on the computer screen in the form of a thermogram, which is the image of the thermal radiation of the person. However, due to the high cost and complexity of the service, not all medical facilities have thermographs, and for the same reasons, thermographs practically are not used in veterinary medicine.

[0005] These circumstances contribute to the development of methods that can display the temperature field of biological objects using widely used hardware: computers and temperature sensors.

[0006] There are ways to display the temperature field of a biological object, based on the use of contact temperature sensors connected to computer, where data from the sensors is used for construction of the image of the temperature field of the examined area on computer screen by means of a computer program (for instance, RU 2276965 C2, 27.05.2006; RU 2003127766 A, 20.03.2005; RU 2267982 C2, 20.01.2006). Presence of pathology is detected by the temperature deviation in the examined area of the body of a biological object from the standard value, which is used as the average value, typical for healthy objects or individual norm of the object obtained by averaging indicators of sensors by measuring the temperature at several points of the examined area on the body of the biological object.

[0007] The shortcoming of the known methods is connected to the fact that identification of the pathology is done by the displayed on-screen temperature field, which, specialist conducting the survey connects with a examined area only associatively, and consequently, subjective judgment significantly influences on identification of the pathology. Subjective judgment is aggravated by the fact that every biological object has its own specific physical structure. This reduces accuracy and hampers clarity of the examination. Moreover, accuracy of temperature field's reproduction depends on the characteristics of the employed contact thermometers, readings of which, in the given time, are determined by the condition of the skin of a biological object, in particular, by its humidity. This requires preliminary measurement of the dependence of the thermometer's readings on skin's characteristics and input of this dependence in the algorithm of the received data processing. In addition, the readings of a contact thermometer depend on the conditions of the readout procedure, for example, on the extent of pressure of the thermometer on the human body during measurement.

[0008] US 6,542,767 describes a method and system for using real-time closed loop feedback to control the delivery of heat energy. The energy delivery system includes a temperature detection system, a data processor and a heat generating device.

[0009] US 2009/0253978 describes a graphical user interface including a group of definition modules adapted to accept a user input defining groups, a data receiver operable to receive a plurality of individual measurement input data indicative of status of a substrate, a grouping module configured to assign each of said individual measurement input data into one of said groups to produce group data, and an output module adapted to output the group data.

[0010] JP 2010194073 describes an infrared thermograph device including an imaging part, an infrared detector, a first image generation means to generate a visible image, a second generation means to generate a thermography image, including a plurality of infrared rectangular regions and an image overlay treatment part.

[0011] RU 2007138079 A, 27.04.2009 describes a method of displaying of the temperature field of biological object includes temperature measurement of the object by contact temperature sensors in fixed points on the examined area, transfer of measurement results in each fixed point to the computer equipped with a specialized program, processing of measurement results by the computer, and the use of processed measurement results for creation of the image of temperature field of the examined area on the object, which is displayed on the computer screen. The method provides even distribution of contact of the sensors with the surface of the diagnosed area of the body of the biological object, for which purpose the examined area of the body surface of the object is tightly pressed out with an elastic suit. The time for output of the sensors in the steady-state condition is set, and, by using control logic, operative serial interrogation of temperature sensors is performed. The measured temperature values are used to form an array of temperature data,

which is transmitted to the computer; the array of data of measured temperature values is formed in the hard memory of the computer. Then, in accordance with a preinstalled computer program, that data is processed and displayed on the screen of the computer.

[0012] The disadvantage of this method as well as the methods described above is that the accuracy of displaying of temperature field depends on many parameters, reducing its self-descriptiveness, which results in the presence of significant subjective factor in identifying pathologies. In addition, the use of the resulting image deprives the examination of clarity. Disadvantages also include long duration and complexity of the procedure of measuring temperature because of the need for special measures for elimination of the dependence of the readings of the sensors on the skin condition of a biological object.

[0013] The technical result that is obtained by using the proposed method is to increase the accuracy of generated image of temperature field on the examined area of the object by fixing of the received image of the temperature field to the parameters of the examined area; and to increase the accuracy and clarity of identifying pathologies by using the present invention. The method is easy to implement, and it is carried out with the use of technical tools that are widely used today. In addition, the present invention allows a person to monitor his or her temperature field, save it in the database of the computer, and transmit this data to the appropriate specialist in a medical center for detection of pathologies and their diagnostics.

[0014] The technical result is achieved due to the fact that the way of displaying of the temperature field of the biological object (including temperature measurement of the object in the fixed points on the examined area, transfer of measurement result at each fixed point to computer with preinstalled computer program, processing of the results of measurements in the computer, and the use of processed results to form an image of temperature field of the examined area of the object) is characterized by the fact that the image of the examined area of the object is preliminary inputted in the computer database and displayed on the screen, herewith, temperature measurement points on the examined area of the object are displayed on the image of the object on the computer screen, and after making measurements and processing of the results of measurements, the image of temperature field of the examined area of the object is formed on the image of the examined area of the object by the computer program in the computer.

[0015] Temperature field of the examined area of the object can be formed in a computer by interpolating the temperatures measured at different points on the examined area of the object.

[0016] It is advisable to form the temperature field of the examined area of the object in the computer by linear interpolation of the temperatures measured at adjacent points on the examined area of the object.

[0017] The image of the temperature field of the object can be displayed on the computer screen in accordance to the color palette entered into the computer program, in which each temperature value corresponds to a particular color. It is advisable to measure the temperature by infrared thermometer or infrared pyrometer.

[0018] For increasing self-descriptiveness, it is appropriate to display the temperature (measured at a specific point of the examined area of the object) in digital form on the computer screen to the corresponding point on the image of the examined area of the object.

[0019] The invention is based on the proposal to display the temperature field of the object directly on the image of the examined area of the body of the biological object displayed on the computer screen, and to measure the temperature on the examined area at the points corresponding to the points selected and recorded on the image. When implementing the method, the points for measuring can be either immediately set on the image of the object or set sequentially, after each measurement in the previously selected point. The accuracy of the temperature field formation depends on the number of measurement points and the distances between them: the more points are set with lesser distance between them, the greater the accuracy of the formation of the temperature field.

[0020] Herewith, as the image of the examined area is used the electronic image of the examined area of the object received on the photosensitive element of the camera, which can be subsequently transferred to a personal computer in any conventional format, or the image of the examined area on a model of a biological object in 2D or 3D format.

[0021] Implementation of the method is carried out by using the computer program, including the algorithms that implement fixation of points for temperature measurement on outputted on computer screen image of the examined area; the results of measurements are reflected on the points, and the temperature distribution in a form of a thermogram is formed directly on the image of the examined area, that is receive the same image as the image of thermal radiation in thermography.

[0022] Different algorithms can be used for the formation of the temperature field of the object on the computer screen, however, rather simple and informative is the algorithm based on the interpolation of the measured temperatures at adjacent points for determining the temperature values between these points, herewith, the most simple algorithm is built on the principle of linear interpolation. The algorithm includes the step of constructing the convex surface based on the measured array of points that correspond to the points of temperature measurement, and the partition (triangulation) of the constructed surface to the sectors in the form of polygons, the angles of which coincide with the points of temperature measurements. Further, the algorithm provides determination of the temperature between the adjacent points by interpolation method, determination of the angles of

inclination of each polygon, and formation of the bit image data of the temperature field, which is superimposed on the image of the examined object.

[0023] The used algorithm also allows displaying the temperature measured at a specific point of the examined area of the object in a digital form on the screen in the corresponding point on the image of the examined object. Output of the temperatures measured in numerical terms increases the information content of the proposed method.

[0024] The color palette is used for visualization of the temperature field; in the color palette, certain temperature corresponds to certain color. The algorithm of the computer program fills every pixel of the processed image of the temperature field in the appropriate color.

[0025] To display the temperature field of the object, contact as well as infrared (non-contact) thermometer or pyrometer can be used for temperature measurement of a biological object, however, the use of an infrared thermometer or pyrometer is preferred in virtue of the above described shortcomings of contact thermometers.

[0026] The use of the photographic image of the examined area of the object that is intrinsic to the specific object increases the accuracy of displaying the temperature field and excludes the impact of anatomical (physical) structure of the biological object on locating pathology in the body of the biological object. Visualization and increase of efficiency of identifying a wide range of pathological processes that can develop in humans and animals is achieved due to this technique. In addition, the claimed method allows visual assessment of the effectiveness of treatment of diseases. Using the proposed method allows to assess the effectiveness of each treatment procedure.

[0027] On figure 1 is shown a photographic image of the face of an individual, on which temperature measurement points are marked; Figure 2 shows the image of the temperature field, formed on the base of the temperatures measured at the points shown in the photographic image the person shown on Figure 1. Figure 3 shows a photographic image of the back of an individual, on which temperature measurement points are marked; Figure 4 shows the image of the temperature field, constructed based on the temperatures measured at the points indicated on the photographic image of the back shown on Figure 3.

[0028] An example of implementation of the claimed method is described below. First, pictures of an examined area are taken by photographic camera that has means for entering the photos into the database of the computer equipped with the program ensuring the algorithm of processing of the inputted data in the computer in accordance with the claimed method. The photo of the examined area of the biological object is displayed on the computer screen.

[0029] Points for temperature measurement are fixed on the image of the examined area of the biological object on the computer screen, then, by infrared thermometer, the temperature is consistently measured on the examined area at the points corresponding to the location of the points on the image of the object. The measurement results are transmitted to the computer, in which the measured data is processed and displayed on the screen to the corresponding point on the image of the surveyed area of the body of the biological object.

[0030] The received data of temperature measurements is outputted by the computer program to the screen in the form of thermogram that is superimposed on a photographic image of the examined area of the biological object. The method has been tested and used to detect inflammatory, vascular, and tumor pathologies in humans and animals.

Claims

1. A method of displaying a temperature field of a biological object, the method comprising the steps of:

obtaining temperature measurements of an area of a biological object;
obtaining an image of the area of the biological object;
generating an image of a temperature field of the area of the biological object and superimposing the image of the temperature field on the image of the area of the biological object;
displaying the superimposed image of the temperature field on the image of the area of the biological object on a computer screen, wherein an area of the biological object is an area of human skin surface;
an image of the area of the biological object is a photographic image of the area of the human skin surface; **characterized in that**:

before the temperature measurements are obtained:

obtaining and displaying on the computer screen a photographic image of the area of the human skin surface;
marking points by graphic indications on the photographic image displayed on the computer screen, the points marked by graphic indications on the photographic image correspond to the points on the area of the human skin surface on which measurements of temperature will take place;
displaying on the computer screen a photographic image with marked graphic indications of points marked on it; herewith obtaining temperature measurements by infrared thermometer or infrared pyrometer consistently at

the points of the area of the human skin surface in correspondence with the points marked by graphic indications on the photographic image, wherein temperature measurements are obtained by an infrared thermometer or an infrared pyrometer.

2. The method of claim 1, wherein the temperature field of the area of the human skin surface is formed by interpolation of temperatures, measured at the measurement points on the area of the human skin surface.

3. The method of claim 2, wherein the temperature field of the area of the human skin surface is formed by linear interpolation of temperatures, measured in adjacent measurement points on the area of the human skin surface.

4. The method of claim 2, wherein the image of the temperature field of the area of the human skin surface is displayed on the computer screen in accordance with a computer program color palette, in which each specific color corresponds to a temperature value.

5. The method of claim 1, wherein the temperature measurements are displayed in a numerical form on the screen of the computer at the corresponding measurement points on the image of the area of the human skin surface.

6. The method according to any previous claim, wherein the temperature measurements are obtained serially.

7. The method according to any previous claim further comprising the step of saving the temperature field in a database.

8. The method according to any previous claim, wherein each point where a temperature measurement is to be taken is displayed on the image sequentially following a temperature measurement of a previous point.

9. A computer program comprising program instructions that, when executed on a computer cause the computer to perform the method of any of claims 1 to 8.

Patentansprüche

1. Verfahren zum Anzeigen eines Temperaturfelds eines biologischen Objekts, wobei das Verfahren die Schritte aufweist:

Erhalten von Temperaturmessungen eines Gebiets eines biologischen Objekts;
Erhalten eines Bilds des Gebiets des biologischen Objekts;
Erzeugen eines Bilds eines Temperaturfelds des Gebiets des biologischen Objekts, und Überlagern des Bilds des Temperaturfelds auf das Bild des Gebiets des biologischen Objekts;
Anzeigen des überlagerten Bilds des Temperaturfelds auf dem Bild des Gebiets des biologischen Objekts auf einen Computerbildschirm, wobei ein Gebiet des biologischen Objekts ein Gebiet einer menschlichen Hautoberfläche ist; ein Bild des Gebiets des biologischen Objekts ein fotografisches Bild des Gebiets der menschlichen Hautoberfläche ist;
gekennzeichnet durch:

bevor die Temperaturmessungen erhalten werden:

Erhalten und Anzeigen eines fotografischen Bilds des Gebiets der menschlichen Hautoberfläche auf dem Computerbildschirm;
Markieren von Punkten **durch** graphische Indikationen auf dem am Computerbildschirm angezeigten fotografischen Bild, wobei die **durch** die graphischen Indikationen auf dem fotografischen Bild markierten Punkte den Punkten auf dem Gebiet der menschlichen Hautoberfläche entsprechen, auf denen Temperaturmessungen stattfinden werden;
Anzeigen eines fotografischen Bilds mit den darauf markierten graphischen Punktindikationen auf dem Computerbildschirm; hiermit Erhalten von Temperaturmessungen **durch** ein Infrarotthermometer oder Infrarotpyrometer konsistent an den Punkten des Gebiets der menschlichen Hautoberfläche entsprechend den Punkten, die **durch** graphische Indikationen auf dem fotografischen Bild markiert sind, wobei Temperaturmessungen **durch** ein Infrarotthermometer oder ein Infrarotpyrometer erhalten werden.

2. Das Verfahren von Anspruch 1, wobei das Temperaturfeld des Gebiets der menschlichen Hautoberfläche durch Interpolation von Temperaturen durchgeführt wird, die an den Messpunkten auf dem Gebiet der menschlichen Hautoberfläche gemessen werden.

3. Das Verfahren von Anspruch 2, wobei das Tempe-

raturfeld des Gebiets der menschlichen Hautoberfläche durch lineare Interpolation von Temperaturen gebildet wird, die in benachbarten Messpunkten auf dem Gebiet der menschlichen Hautoberfläche gemessen werden.

4. Das Verfahren von Anspruch 2, wobei das Bild des Temperaturfelds auf dem Gebiet der menschlichen Hautoberfläche auf dem Computerbildschirm gemäß einer Computerprogramm-Farbpalette angezeigt wird, worin jede spezifische Farbe einem Temperaturwert entspricht.

5. Das Verfahren von Anspruch 1, wobei die Temperaturmessungen in numerischer Form auf dem Computerbildschirm an den entsprechenden Messpunkten auf dem Bild des Gebiets der menschlichen Hautoberfläche angezeigt werden.

6. Das Verfahren nach einem vorhergehenden Anspruch, wobei die Temperaturmessungen seriell erhalten werden.

7. Das Verfahren nach einem vorhergehenden Anspruch, das ferner den Schritt aufweist, das Temperaturfeld in einer Datenbank zu sichern.

8. Das Verfahren nach einem vorhergehenden Anspruch, wobei jeder Punkt, wo eine Temperaturmessung vorgenommen werden soll, auf dem Bild, einer Temperaturmessung eines vorangehenden Punkts folgend, sequenziell angezeigt wird.

9. Computerprogramm, das Programmanweisungen aufweist, die, wenn sie auf einem Computer ausgeführt werden, bewirken, dass der Computer das Verfahren von einem der Ansprüche 1 bis 8 durchführt.

Revendications

1. Procédé d'affichage d'un champ de température d'un objet biologique, le procédé comprenant les étapes consistant :

à obtenir des mesures de température d'une zone d'un objet biologique ;
à obtenir une image de la zone de l'objet biologique ;
à générer une image d'un champ de température de la zone de l'objet biologique et à superposer l'image du champ de température sur l'image de la zone de l'objet biologique ;
à afficher l'image superposée du champ de température sur l'image de la zone de l'objet biologique sur un écran d'ordinateur, où
une zone de l'objet biologique est une zone de surface de peau humaine ;
une image de la zone de l'objet biologique est une image photographique de la zone de la surface de peau humaine ; **caractérisé par** le fait :

avant que les mesures de température ne soient obtenues :

d'obtenir et d'afficher sur l'écran d'ordinateur une image photographique de la zone de la surface de peau humaine ;
de marquer des points par des indications graphiques sur l'image photographique affichée sur l'écran d'ordinateur, les points marqués par des indications graphiques sur l'image photographique correspondent aux points sur la zone de la surface de peau humaine sur laquelle les mesures de température auront lieu ;
d'afficher sur l'écran d'ordinateur une image photographique avec des indications graphiques marquées de points marqués sur celle-ci ; d'obtenir ci-joint des mesures de température par un thermomètre à infrarouge ou un pyromètre à infrarouge de manière constante à des points de la zone de la surface de peau humaine en correspondance avec les points marqués par des indications graphiques sur l'image photographique, où des mesures de température sont obtenues par un thermomètre à infrarouge ou un pyromètre à infrarouge.

2. Procédé de la revendication 1, dans lequel le champ de température de la zone de la surface de peau humaine est formé par interpolation de températures, mesurées à des points de mesure sur la zone de la surface de peau humaine.

3. Procédé de la revendication 2, dans lequel le champ de température de la zone de la surface de peau humaine est formé par interpolation linéaire de températures, mesurées dans des points de mesure adjacents sur la zone de la surface de peau humaine.

4. Procédé de la revendication 2, dans lequel l'image du champ de température de la zone de la surface de peau humaine est affichée sur l'écran d'ordinateur conformément à une palette de couleurs de programme informatique, dans laquelle chaque couleur spécifique correspond à une valeur de température.

5. Procédé de la revendication 1, dans lequel les mesures de température sont affichées sous une forme numérique sur l'écran de l'ordinateur à des points de mesure correspondants sur l'image de la zone

de la surface de peau humaine.

6. Procédé selon l'une des revendications précédentes, dans lequel les mesures de température sont obtenues en série.

7. Procédé selon l'une des revendications précédentes, comprenant en outre l'étape consistant à sauvegarder le champ de température dans une base de données.

8. Procédé selon l'une des revendications précédentes, dans lequel chaque point où une mesure de température doit être prise est affiché sur l'image de manière séquentielle après une mesure de température d'un point précédent.

9. Programme informatique comprenant des instructions de programme qui, lorsqu'elles sont exécutées sur un ordinateur amènent l'ordinateur à effectuer le procédé de l'une des revendications 1 à 8.

Fig. 1

Fig. 2

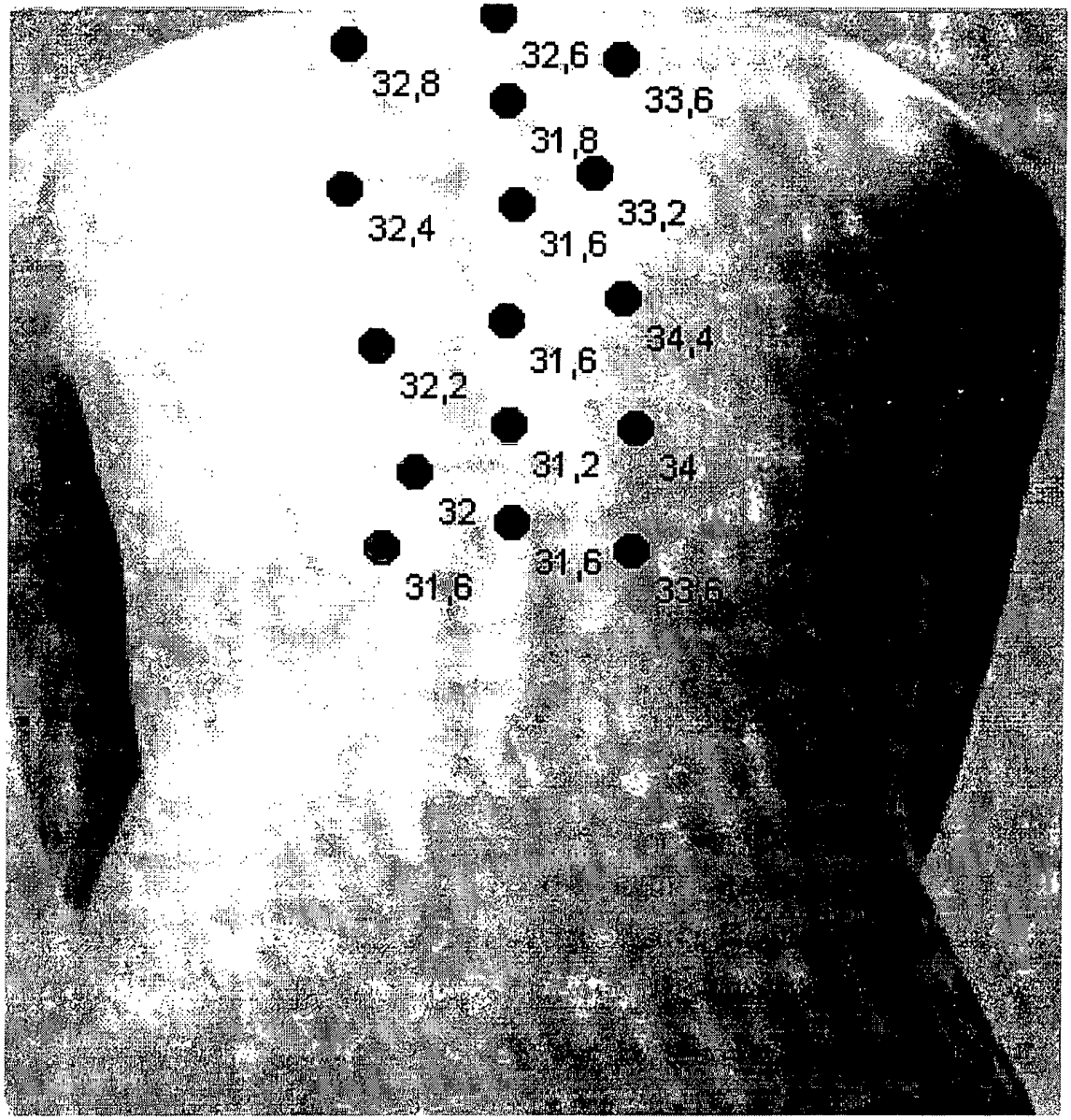

Fig. 3

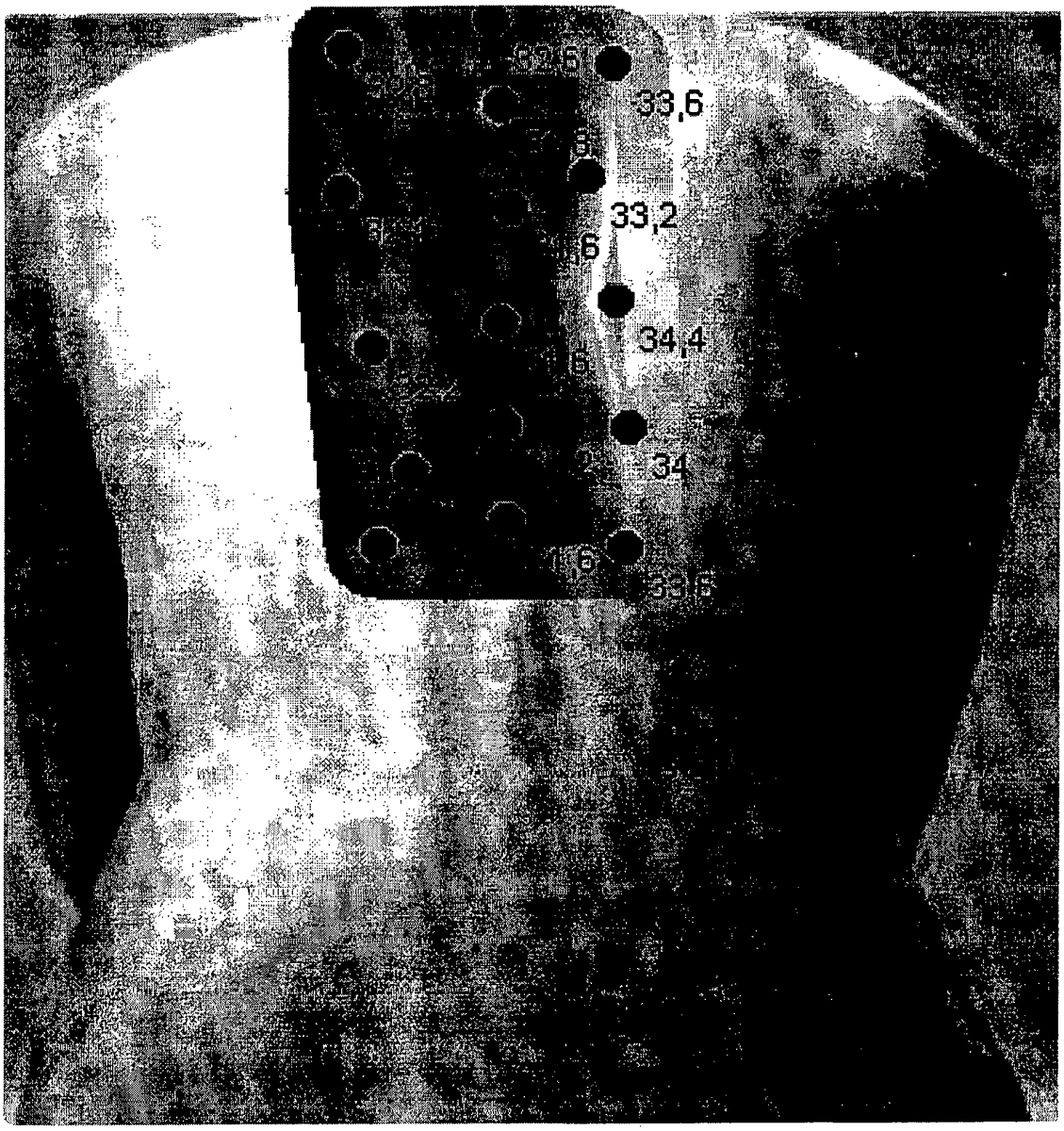

Fig. 4

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专利名称(译)	显示生物体的温度场的方法		
公开(公告)号	EP2591718B1	公开(公告)日	2014-11-05
申请号	EP2011838303	申请日	2011-09-09
[标]申请(专利权)人(译)	ZAKRYTOE AKTSIONERNOE OBSHCHESTVO SEM TEHNOLODZHI		
申请(专利权)人(译)	ZAKRYTOE AKTSIONERNOE OBSHCHESTVO“SEM TEHNOLODZHI”		
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IPC分类号	G01J5/08 A61B5/01 G01J5/02 G01J5/00 G06T11/20 A61B5/00		
CPC分类号	A61B5/015 A61B5/743 G01J5/0025 G01J5/025 G01J5/0846 G01J5/0859 G06T11/206 G06T2207/10048 G06T2207/30088 A61B5/00 A61B5/01 G01J5/48 A61B5/0075 A61B5/0077 A61B5/7425		
代理机构(译)	博尔特WADE TENNANT		
优先权	2010144628 2010-11-02 RU		
其他公开文献	EP2591718A4 EP2591718A1		
外部链接	Espacenet		

摘要(译)

本发明涉及医学和兽医学，并且具体地涉及通过测量身体部位的温度来进行诊断目的的测量，并且可以用于医疗实践中用于诊断疾病和用于监测治疗期间疾病的动态。使用所要求保护的方法时获得的技术结果在于提高准确性和清晰度并简化技术实现。该方法包括将被调查的生物对象的身体区域的图像输入到计算机数据库中，其中所述图像被输出到计算机的监视器，其中用于测量受试者的区域中的温度的测量点。调查显示在监视器屏幕上的主体图像中，并且一旦进行了测量并且已经在计算机中处理了测量结果，则通过计算机程序使用图像生成温度场的图像。被调查对象的地区。

Fig. 1