

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 117 323 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
25.10.2006 Bulletin 2006/43

(51) Int Cl.:
A61B 1/045 ^(2006.01) **A61B 5/01** ^(2006.01)
G01K 13/00 ^(2006.01) **G01K 7/30** ^(2006.01)

(21) Application number: **00951811.9**

(86) International application number:
PCT/IL2000/000470

(22) Date of filing: **03.08.2000**

(87) International publication number:
WO 2001/010291 (15.02.2001 Gazette 2001/07)

(54) **SYSTEM FOR TEMPERATURE SENSING**

SYSTEM ZUR MESSUNG DER TEMPERATUR

SYSTEME DE DETECTION DE TEMPERATURE

(84) Designated Contracting States:
DE ES FR GB

- **MERON, Gavriel**
49556 Kfar Ganim, Petach Tikva (IL)
- **IDDAN, Gavriel**
34602 Haifa (IL)

(30) Priority: **04.08.1999 IL 13124299**

(43) Date of publication of application:
25.07.2001 Bulletin 2001/30

(74) Representative: **Gray, John James**
Murgitroyd & Company
165-169 Scotland Street
Glasgow G5 8PL (GB)

(73) Proprietor: **Given Imaging Ltd.**
20692 Yokneam Ilite (IL)

(72) Inventors:
• **GLUKHOVSKY, Arkady**
36790 Nesher (IL)

(56) References cited:
US-A- 4 646 724 **US-A- 5 604 531**
US-A- 5 640 235

EP 1 117 323 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description**FIELD OF THE INVENTION**

[0001] The present invention relates to a system for measuring the temperature of an environment, such as the interior of the body.

BACKGROUND OF THE INVENTION

[0002] In many circumstances it is important to measure the temperature inside a material body. Such circumstances may occur during industrial processes or exploration and analysis processes, such as in geophysical probing or in medical diagnostics and treatment of internal parts of the body.

[0003] Conventional thermometry and absolute thermometry are known methods for measuring temperature.

[0004] Conventional thermometry is based upon the temperature coefficient of properties of materials, such as resistance or mechanical expansion.

[0005] Absolute thermometry is a method which directly measures thermal energy of a sensor resistance. This method is based upon the known physical phenomenon of spontaneous thermal noise arising from the Brownian motion of ionized molecules within a resistance.

[0006] Thermal noise, which can be discussed in terms of thermal current, provides a direct measurement of temperature on a thermodynamic scale, thus the Boltzmann constant defines the temperature. The phenomenon of thermal noise is derived, for example, in the book: *CCD arrays cameras and displays* by Holst G.C., p. 128, 2nd edition, SPIE Press, 1998. The formula used to define thermal current is:

$$\langle i_n^2 \rangle = k T C$$

where k is the Boltzmann constant, T is the temperature of a sensor, and C is the capacitance of the sensor. Thus the magnitude of the signals produced by the thermal current is directly proportional to the square root of the temperature of the sensor. Experiments have indicated that the signal doubles with the increase of 7°C (degrees Centigrade), which means that a resolution better than 0.1°C is achieved.

[0007] In image sensors, the thermal current produced in an operating photodetector device, when no optical radiation impinges on the detector, is called "dark current". In CCD cameras dark current is basically charge which accumulates in the CCD pixels due to thermal noise. The effect of dark current is to produce an additive quantity to the electron count in each pixel.

[0008] US 3,937,086 to von Thuna, US 5,354,130 to Seppa et al. and US 5,098,197 to Shepard et al. all describe devices for measuring the absolute temperature of a body material by receiving and analyzing the thermal

noise of the body material.

[0009] US 4,246,784 to Bowen describes a method for noninvasive temperature measurement of the interior of a body using the acoustic thermal noise spectrum of the measured body.

[0010] US 5,640,235 discloses a photometric device comprising a photometric conversion section that converts light reflected from an object to signals. One of the registers of the photometric conversion section outputs a dark current component only and temperature of the photometric conversion section can be computed from the dark current output.

[0011] None of these temperature measurement methods utilize an image sensor to measure the temperature of a body material.

SUMMARY OF THE INVENTION

[0012] The present invention, defined in the appended claims, provides system for sensing the temperature of an environment, such as inside a body, by calculating the temperature of an image sensor in the environment and deducing the environment's temperature from the image sensor's calculated temperature. The temperature of the image sensor is calculated by measuring its generated dark current noise.

[0013] The system of the present invention has the advantage of utilizing an image sensor, in which thermal noise is easily detectable, for deducing the temperature of a material body. Furthermore, according to the invention, a single sensor is utilized for obtaining visual data and data relating to the temperature of the environment. Thus, diverse information about an environment can be obtained utilizing a single sensing device.

[0014] The system of the present invention can be used in a method for sensing the temperature of an environment comprising the steps of introducing into an environment an image sensor having an image sensing module, sensing the dark current noise of the image sensor, calculating the temperature of the image sensor, calculating the temperature of the environment and optionally displaying the calculated environment temperature.

[0015] It will be appreciated that the term "environment" in the present invention relates to a space enclosed within walls in which it is desired to measure the temperature of the space and/or of the walls.

[0016] The temperature of the image sensor is indicative of the temperature of its immediate surroundings and, relying on known factors such as heat distribution, distance from the image sensor, etc., the temperature of further areas can also be calculated.

[0017] The image sensors utilized in the invention can be digital cameras or video cameras such as vidicon, CCD cameras or CMOS cameras.

[0018] The present invention further provides a system for sensing the temperature of an environment. The system comprises an image sensor having an image sensing module in communication with an integrating unit for de-

tecting the dark current of the image sensor image sensing module and for calculating the temperature of the image sensor. The integrating unit may further calculate the temperature of the environment or the temperature of the environment may be calculated, based on data from the integrating unit, by a separate unit that is in communication with the integrating unit.

[0019] The integrating unit may have an amplifying function for amplifying signals received from the image sensor.

[0020] The communication between the image sensor and integrating unit can be optionally controlled according to the illumination conditions, optionally through a switch which enables communication only during periods in which the sensor is not illuminated.

BRIEF DESCRIPTION OF THE FIGURES

[0021] The present invention will be understood and appreciated more fully from the following detailed description taken in conjunction with the figures in which:

Figure 1 is a block diagram representing an embodiment of the method according to the invention;

Figure 2 is a schematic illustration of an embodiment of the system according to the invention;

Figure 3 is a schematic illustration of a functional block layout of the image sensor according to the invention; and

Figure 4 is a schematic illustration of a medical device comprising the system according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] Analytical and diagnostic processes which utilize image sensors to monitor environments could benefit from obtaining information relating to the temperature of the environment, as a local change of temperature can indicate an irregular event.

[0023] For example, US 5,604,531, which is assigned to the common assignees of the present application, describes a swallowable capsule that can pass through the entire digestive tract and operate as an autonomous video endoscope. The swallowable capsule includes a) a camera system, b) an optical system for imaging an area of interest onto the camera system and c) a transmitter which transmits the video output of the camera system. Visual data obtained by the swallowable capsule can indicate, inter alia, the location of pathologies in the gastrointestinal tract. Also a local change of temperature in the gastrointestinal tract can be indicative of a pathology. Thus, the information obtained by visual means can be complemented and focussed by information relating to local temperature in the gastrointestinal tract.

[0024] The present invention enables contemporary visual monitoring and temperature sensing.

[0025] The method is schematically described by a

block diagram shown in Fig. 1. An image sensor, such as in the above mentioned swallowable capsule, is inserted 10 into an environment, such as the gastrointestinal tract.

[0026] Illumination is provided intermittently, either by elements connected to the image sensor itself or by external sources. When illumination is provided 12 only visual data is obtained 14 and displayed 16. A process for obtaining and displaying visual data is described, for example, in the above mentioned US 5,604,531.

[0027] In an intermittent dark period 11 an integrating unit 100 is activated to obtain dark current data 13 from the image sensor, though it is not imperative to shut off illumination in order to obtain data relating to dark current noise, as will be discussed in more detail below.

[0028] The integrating unit 100 is a processor capable of amplifying the obtained data 15, if necessary, and calculating the image sensor temperature 17 using the known equations derived for thermal noise. It will be appreciated that these equations are an approximation of a complex phenomenon and that calibration should be employed in order to deduce the actual calculations that will be applied.

[0029] The environment temperature is then calculated 19, either by the integrating unit 100 or by a separate unit in communication with the integrating unit 100. Calculations of the environment temperature are based on the existence of thermal equilibrium between the image sensor and environment. These calculations take into account energy dissipation from the image sensor. Local temperature or the average temperature within the environment may be calculated, depending on specific requirements. The calculated temperature may then be displayed 18.

[0030] It will be appreciated that the various calculations are carried out by software or software means executable on computing means such as a computer or similar data processors, microprocessors, embedded processors, microcomputers, microcontrollers etc.,

[0031] The integrating unit 100 may comprise separate processors, which need not all be physically connected. Some of the functions carried out by integrating unit 100, such as calculating the image sensor temperature 17 and calculating the environment temperature 19, can be carried out in processors that are external to the environment and that are fed with data from the integrating unit 100 by communication such as by IR or radio. Indeed, if an operator is to note the temperature of the environment, at least the function of displaying the calculated temperature 18 must be performed externally to the environment.

[0032] Integrating unit 100 may be in communication with other units to further process and use the data obtained by it. For example, a swallowable capsule, such as described in US 5,604,531, may comprise a sample chamber for collecting samples from the environment of the digestive tract. The process of collecting a sample can be controlled by integrating unit 100, such that sam-

ples are collected only in locations along the digestive tract in which a predetermined temperature is prevalent.

[0033] Reference is now made to Fig. 2 which is a schematic illustration of the system according to an embodiment of the invention. The system comprises an image sensor 20 having an image sensing module which includes a pixel array (as demonstrated in Fig. 3) in communication with an integrating unit 22. Communication is enabled by temperature sense switch 24 which is controlled by illumination indicator 26, such that communication is enabled only during dark periods.

[0034] When communication between the image sensor 20 and integrating unit 22 is established, integrating unit 22 receives dark current data from image sensor 20.

[0035] As will be discussed below, it is possible to calculate the image sensor's 20 temperature based on dark current data obtained from a single pixel of the image sensor pixel array, though data obtained from a higher number of pixels will achieve more accurate results. It is therefore possible to keep a portion of the image sensor's 20 pixels of the pixel array, constantly unexposed to illumination, and obtain dark current data from the unexposed pixels, without having to shut off the illumination.

[0036] Thus, dark current data can be obtained also during constant illumination by either covering a portion of the pixels of the pixel array or by having a portion of the pixel array pixels outside of the image field, e.g. the pixels in the periphery of the pixel array.

[0037] The integrating unit 22 is a processor capable of amplifying the dark current signal and calculating the image sensor temperature from the dark current signal. It is further capable of calculating the environment temperature from the image sensor temperature and is capable of displaying the calculated environment temperature 21. Integrating unit 22 may control different temperature sensitive units 28, such as the sample chamber described above, in correspondence with predetermined temperatures.

[0038] Reference is now made to Fig. 3 which is a schematic illustration of a functional block layout of the image sensor according to the invention. The image sensor comprises a single chip 40 having an image sensing module 42 and a control circuits area 44. The image sensing module 42 includes a pixel array 48 for capturing an image. The control circuits area 44 includes the timing and logic circuitry 47 and A/D circuitry 46.

[0039] Signals can be received from all the pixels of the pixel array 48. Dark current is received from pixels that are not illuminated or from pixels during a dark period whereas current signals received from an illuminated pixel are the summation of the dark current and light current of the pixel. The accumulation of signals from all the pixels is converted to data which is communicated through a transmitter to the integrating unit for decoding and for displaying a visual representation and /or the temperature derived from the data.

[0040] The system of the invention will be further described and demonstrated by Fig. 4 which is a schematic

illustration of a medical device comprising a system according to the invention.

[0041] The medical device illustrated in Fig 4 is a swallowable capsule, generally referenced 30, such as that described in the above mentioned US 5,604,531. Swallowable capsule 30 comprises a CMOS camera 32, that is in communication with integrating unit 34. The swallowable capsule 30 further comprises illuminating elements 36 that are in communication with illumination indicator 33. The gastrointestinal tract walls 31 are illuminated by illuminating elements 36, in intermittent pulses, capturing consecutive images of the gastrointestinal tract walls 31 by camera 32, enabling an operator to view the gastrointestinal tract walls. Communication between camera 32 and integrating unit 34 is enabled in between illumination pulses when illumination indicator 33, sensing the lack of illumination, activates the temperature sense switch (not shown) to an ON position.

[0042] Alternatively, the illumination indicator 33 may be activated by the operator to simultaneously turn off the illumination elements 36 and switch the temperature sense switch to an ON position.

[0043] Once communication is established between camera 32 and integrating unit 34 dark current signals generated from camera 32 are received and processed, as described above, by integrating unit 34. The calculated gastrointestinal temperature is displayed on a display unit external to the gastrointestinal tract.

[0044] Swallowable capsule 30 further comprises a sample chamber 35 for collecting samples from the gastrointestinal tract environment. The collected sample may be cells from the gastrointestinal tract walls or a liquid sample from the gastrointestinal tract environment. The mechanism for collecting samples, which can be any suitable mechanism known in the art, is controlled by integrating unit 34, such that it is activated in accordance with the gastrointestinal tract environment calculated temperature. Alternatively, the mechanism can be controlled by the operator based on the displayed temperature.

Claims

1. A system for sensing the temperature of an environment comprising an image sensor (20) in communication with an integrating unit (22), said image sensor being introducible into an environment; and said integrating unit being arranged to obtain dark current noise from the image sensor, to calculate (17) from the dark current noise the temperature of the image sensor, and hence to calculate (19) the temperature of the environment.
2. A system according to claim 1 wherein the integrating unit amplifies (15) the received dark current noise prior to calculating the temperature of the image sen-

- sor, and calculating the temperature of the environment.
3. A system according to claim 1 or 2 further comprising a separate unit, optionally locatable outside of the environment, that is in communication with the integrating unit for performing any of calculating the temperature of the image sensor, calculating the temperature of the environment or displaying the calculated environment temperature. 5
 4. A system according to claim 2 or 3 further comprising a separate unit that is in communication with the integrating unit, said separate unit performing any of amplifying the received dark current noise, calculating the temperature of the image sensor or calculating the temperature of the environment. 10
 5. A system according to claim 1, 2, 3 or 4 further comprising a switch (24) which is in communication with an illumination indicator (26) for receiving indication of illumination, said switch enabling communication between the image sensor and integrating unit only during one or more periods in which the image sensor is unexposed to illumination. 15
 6. A system according to claim 1, 2, 3 or 4 further comprising a switch (24) which controls illumination elements (36) for exposing the image sensor to intermittent illuminated and dark periods (11), said switch enabling communication between the image sensor and integrating unit only during one or more dark periods. 20
 7. A system according to any preceding claim wherein said integrating unit is locatable outside of the environment. 25
 8. A system according to any preceding claim wherein said integrating unit is locatable with the image sensor within the environment. 30
 9. A system according to any preceding claim further comprising means for displaying the calculated temperature of the environment. 35
 10. A system for contemporary visual monitoring and temperature sensing of an environment comprising the image sensor and the integrating unit of any preceding claim, said image sensor being further arranged for obtaining images of the environment. 40
 11. A system according to any preceding claim wherein the image sensor is a digital or video camera (32). 45
 12. A system according to any preceding claim adapted for use where the environment is a body cavity. 50
 13. A system according to any preceding claim wherein the integrating unit is in communication with functional units of a medical device for operating said functional units in accordance with a predetermined temperature. 55
 14. A medical device including the system according to any preceding claim.
 15. A medical device according to claim 14 wherein the device is a swallowable autonomous imaging capsule (30).
 16. A medical device including the system according to claim 13 and said functional units, in which the functional units are units that enable the collection of samples from the environment.
- 20 Patentansprüche**
1. System zum Erfühlen der Temperatur einer Umgebung, umfassend einen Bildsensor (20) in Kommunikation mit einer Integriereinheit (22), wobei der Bildsensor in eine Umgebung einführbar ist und die Integriereinheit angeordnet ist, um ein Dunkelstromrauschen vom Bildsensor zu erhalten, um aus dem Dunkelstromrauschen die Temperatur des Bildsensors zu berechnen (17) und damit die Temperatur der Umgebung zu berechnen (19). 25
 2. System nach Anspruch 1, wobei die Integriereinheit das empfangene Dunkelstromrauschen vor der Berechnung der Temperatur des Bildsensors und der Berechnung der Temperatur der Umgebung verstärkt (15). 30
 3. System nach Anspruch 1 oder 2, ferner eine separate Einheit umfassend, die sich wahlweise außerhalb der Umgebung befinden kann und die in Kommunikation mit der Integriereinheit steht, um eine der Operationen des Berechnens der Temperatur des Bildsensors, des Berechnens der Temperatur der Umgebung oder des Anzeigens der berechneten Umgebungstemperatur auszuführen. 35
 4. System nach Anspruch 2 oder 3, ferner eine separate Einheit umfassend, die in Kommunikation mit der Integriereinheit steht, wobei die separate Einheit eine der Operationen des Verstärkens des empfangenen Dunkelstromrauschens, des Berechnens der Temperatur des Bildsensors oder des Berechnens der Umgebungstemperatur ausführt. 40
 5. System nach Anspruch 1, 2, 3 oder 4, ferner einen Schalter (24) umfassend, der in Kommunikation mit einem Beleuchtungsanzeiger (26) steht, um eine An-

zeige von Beleuchtung zu empfangen, wobei der Schalter die Kommunikation zwischen dem Bildsensor und der Integriereinheit nur während einer oder mehrerer Perioden ermöglicht, in denen der Bildsensor keiner Beleuchtung ausgesetzt ist.

6. System nach Anspruch 1, 2, 3 oder 4, ferner einen Schalter (24) umfassend, der Beleuchtungselemente (36) steuert, um den Bildsensor abwechselnden beleuchteten und dunklen Perioden auszusetzen (11), wobei der Schalter die Kommunikation zwischen dem Bildsensor und der Integriereinheit nur während einer oder mehreren dunklen Perioden ermöglicht.
7. System nach einem der vorhergehenden Ansprüche, wobei sich die Integriereinheit außerhalb der Umgebung befinden kann.
8. System nach einem der vorhergehenden Ansprüche, wobei sich die Integriereinheit mit dem Bildsensor in der Umgebung befinden kann.
9. System nach einem der vorhergehenden Ansprüche, ferner Mittel zum Anzeigen der berechneten Umgebungstemperatur umfassend.
10. System zum zeitnahen visuellen Überwachen und Temperaturfühlen einer Umgebung, umfassend den Bildsensor und die Integriereinheit nach einem der vorhergehenden Ansprüche, wobei der Bildsensor ferner angeordnet ist, um Bilder der Umgebung zu erhalten.
11. System nach einem der vorhergehenden Ansprüche, wobei es sich bei dem Bildsensor um eine Digital- oder Videokamera (32) handelt.
12. System nach einem der vorhergehenden Ansprüche, das für eine Verwendung eingerichtet ist, bei der die Umgebung eine Körperhöhle ist.
13. System nach einem der vorhergehenden Ansprüche, wobei die Integriereinheit in Kommunikation mit Funktionseinheiten eines medizinischen Geräts steht, um die Funktionseinheiten gemäß einer vorbestimmten Temperatur zu betreiben.
14. Medizinisches Gerät, welches das System nach einem der vorhergehenden Ansprüche umfasst.
15. Medizinisches Gerät nach Anspruch 14, wobei das Gerät eine schluckbare autonome Bildgebungskapsel (30) ist.
16. Medizinisches Gerät, welches das System nach Anspruch 13 und die Funktionseinheiten umfasst und in dem die Funktionseinheiten Einheiten sind, die

das Sammeln von Proben aus der Umgebung ermöglichen.

5 Revendications

1. Système pour capter la température d'un environnement comprenant un capteur d'images (20) en communication avec une unité d'intégration (22), ledit capteur d'images pouvant être introduit dans un environnement ; et ladite unité d'intégration étant agencée de manière à obtenir du capteur d'images un bruit de courant d'obscurité, à calculer (17) à partir du bruit de courant d'obscurité la température du capteur d'images et donc à calculer (19) la température de l'environnement.
2. Système selon la revendication 1, dans lequel l'unité d'intégration amplifie (15) le bruit de courant d'obscurité reçu avant de calculer la température du capteur d'images et de calculer la température de l'environnement.
3. Système selon la revendication 1 ou 2, comprenant en outre une unité séparée, pouvant être située en option à l'extérieur de l'environnement, laquelle est en communication avec l'unité d'intégration afin d'effectuer une des opérations de calcul de la température du capteur d'images, calcul de la température de l'environnement ou affichage de la température d'environnement calculée.
4. Système selon la revendication 2 ou 3, comprenant en outre une unité séparée laquelle est en communication avec l'unité d'intégration, ladite unité séparée effectuant une des opérations d'amplification du bruit de courant d'obscurité reçu, calcul de la température du capteur d'images ou calcul de la température de l'environnement.
5. Système selon la revendication 1,2,3 ou 4, comprenant en outre un commutateur (24) lequel est en communication avec un indicateur d'illumination (26) afin de recevoir une indication d'illumination, ledit commutateur permettant la communication entre le capteur d'images et l'unité d'intégration uniquement pendant une ou plusieurs périodes pendant lesquelles le capteur d'images n'est pas exposé à l'illumination.
6. Système selon la revendication 1,2,3 ou 4, comprenant un commutateur (24) qui commande les éléments d'illumination (36) afin d'exposer le capteur d'images à des périodes illuminées et obscures (11) par intermittences, ledit commutateur permettant la communication entre le capteur d'images et l'unité d'intégration uniquement pendant une ou plusieurs

périodes obscures.

7. Système selon l'une quelconque des revendications précédentes, dans lequel ladite unité d'intégration peut être située à l'extérieur de l'environnement. 5
8. Système selon l'une quelconque des revendications précédentes, dans lequel ladite unité d'intégration peut être située avec le capteur d'images à l'intérieur de l'environnement. 10
9. Système selon l'une quelconque des revendications précédentes, comprenant en outre un moyen pour afficher la température calculée de l'environnement. 15
10. Système de surveillance visuelle contemporaine et captage de température d'un environnement comprenant le capteur d'images et l'unité d'intégration selon l'une quelconque des revendications précédentes, ledit capteur d'images étant en outre agencé de manière à obtenir des images de l'environnement. 20
11. Système selon l'une quelconque des revendications précédentes, dans lequel le capteur d'images est une caméra vidéo ou numérique (32). 25
12. Système selon l'une quelconque des revendications précédentes, adapté à une utilisation dans le cas où l'environnement est une cavité corporelle. 30
13. Système selon l'une quelconque des revendications précédentes, dans lequel l'unité d'intégration est en communication avec des unités fonctionnelles d'un dispositif médical afin de mettre en fonctionnement lesdites unités fonctionnelles en fonction d'une température prédéterminée. 35
14. Dispositif médical incluant le système selon l'une quelconque des revendications précédentes. 40
15. Dispositif médical selon la revendication 14, moyennant quoi le dispositif est une capsule d'imagerie autonome à avaler (30). 45
16. Dispositif médical incluant le système selon la revendication 13 et lesdites unités fonctionnelles, moyennant quoi les unités fonctionnelles sont des unités qui permettent la collecte d'échantillons de l'environnement. 50

55

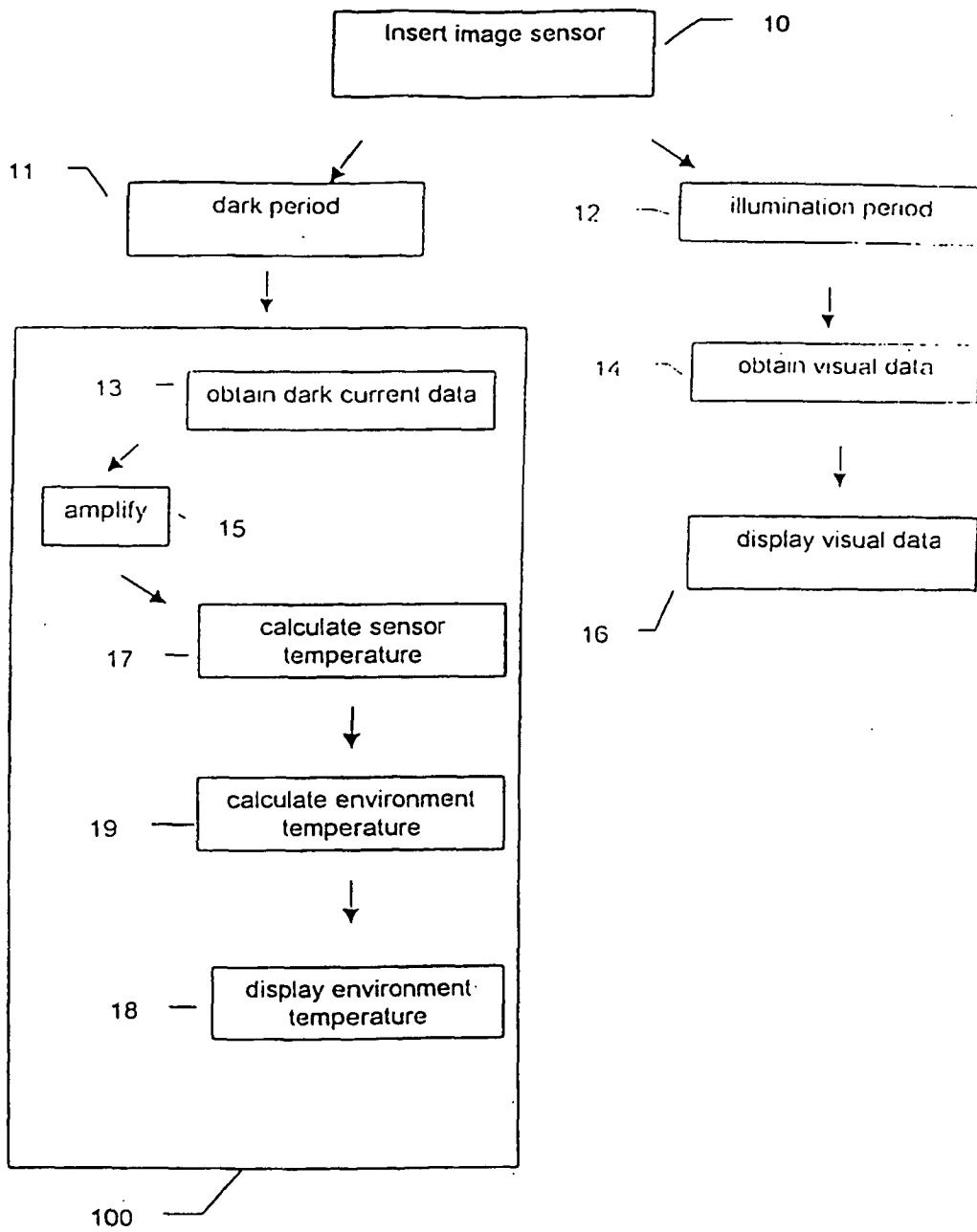


FIGURE 1

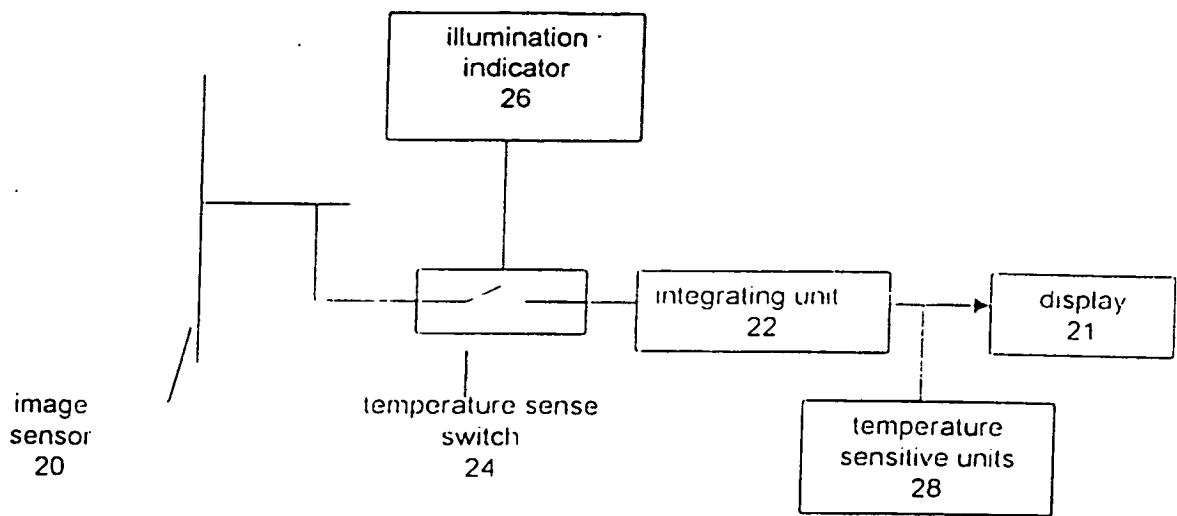


FIGURE 2

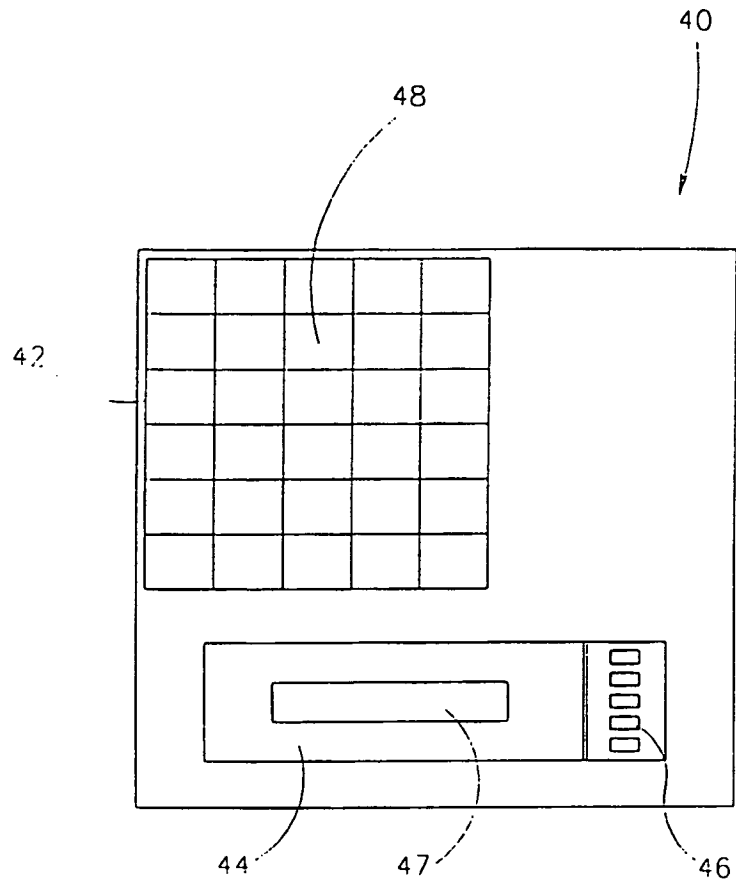


FIG. 3

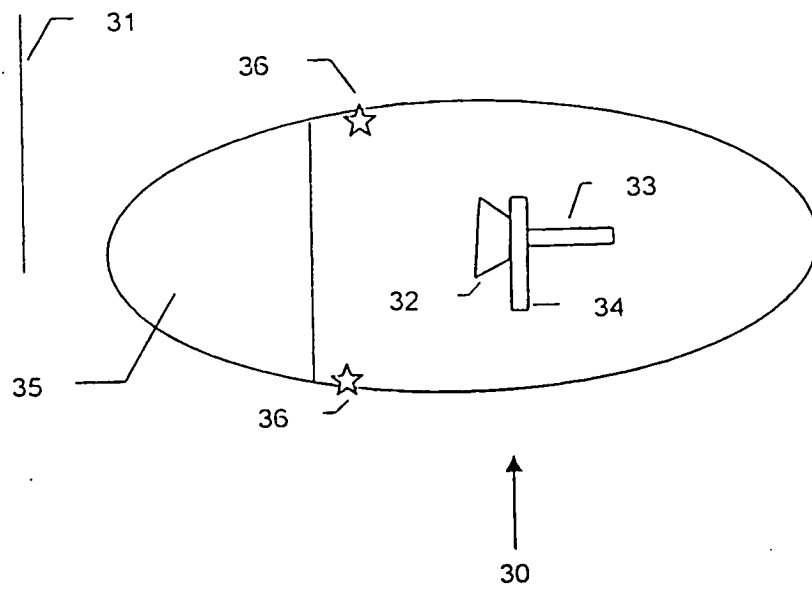


FIGURE 4

专利名称(译)	温度传感系统		
公开(公告)号	EP1117323B1	公开(公告)日	2006-10-25
申请号	EP2000951811	申请日	2000-08-03
[标]申请(专利权)人(译)	基文影像公司		
申请(专利权)人(译)	基文影像有限公司.		
当前申请(专利权)人(译)	基文影像有限公司.		
[标]发明人	GLUKHOVSKY ARKADY MERON GAVRIEL IDDAN GAVRIEL		
发明人	GLUKHOVSKY, ARKADY MERON, GAVRIEL IDDAN, GAVRIEL		
IPC分类号	A61B1/045 A61B5/01 G01K13/00 G01K7/30 A61B1/00 A61B1/05 A61B5/00 A61B5/07 H04N5/335 H04N5/374		
CPC分类号	A61B1/041 A61B5/0008 G01K7/30		
优先权	131242 1999-08-04 IL		
其他公开文献	EP1117323A4 EP1117323A1		
外部链接	Espacenet		

摘要(译)

一种用于感测环境温度的方法和系统。将具有图像感测模块 (42) 的图像传感器 (20) 引入环境中。根据感测到的图像传感器的暗电流噪声计算图像传感器的温度。计算并可选地显示环境温度。该系统和方法也在医疗设备 (30) 中实现。

$$\langle i_n^2 \rangle = kTC$$