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(54) **APPARATUS FOR RECEIVING DATA IN HUMAN BODY COMMUNICATION SYSTEM**

VORRICHTUNG ZUM DATENEMPFANG IN EINEM KOMMUNIKATIONSSYSTEM IM MENSCHLICHEN KÖRPER

APPAREIL PERMETTANT DE RECEVOIR DES DONNEES DANS UN SYSTEME DE COMMUNICATION ASSOCIE A UN CORPS HUMAIN

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Description

TECHNICAL FIELD

[0001] The present invention relates to an apparatus for receiving data in a human body communication system that can improve the quality of received information and grasp the position information of a sensor in the human body by using plural receiving electrodes.

BACKGROUND ART

[0002] Various sensors for collecting medical information in the human body have been developed and used, herein, not only a technique for collecting information in the human body but also a technique for transmitting collected information to the outside of the human body are very important.

[0003] In a general data transmitting method, there is a communication cable method applied to an endoscope developed for observing the stomach and intestines. In the communication cable method, a cable made of a conducting wire or an optic fiber is inserted into the human body through throat of a patient. The communication cable method has high reliability and high data quality, however, a patient may suffer from severe pain during an endoscope operation.

[0004] In order to solve the above-mentioned problem, Given Imaging LTD. in Israel has developed a capsule type endoscope called M2A. When a patient swallows the capsule type endoscope like a tablet, image data in the human body photographed by a camera of the endoscope is transmitted to a receiving unit located outside the human body, and then displayed in a monitor.

[0005] However, because the M2A employs a radio wave method as a signal transmitting method, power consumption is increased, an operational time is reduced, and receiving sensitivity is deteriorated due to interference of various electric waves from the outside of the human body. In addition, because the M2A requires a radio transmitter such as a converter circuit for converting an image signal into a high frequency and an antenna for signal transmission, a volume is increased and production cost is high, and also the high frequency may be harmful to the human body. Accordingly, the present applicant has developed a human body communication system capable of transmitting data about the inside of the human body to the outside of the human body with a low frequency current by using the human body as a conductor.

[0006] In the human body communication system, an electric potential difference between transmitting electrodes that are formed on the surface of the capsule type endoscope put in the human body generates a current. As the current flows through the human body, it induces the voltage between two receiving electrodes installed on the surface of the human body, and accordingly a receiving apparatus can receive data regarding the inside of the human body.

[0007] Figure 1 shows a human body communication system including a capsule type endoscope and two receiving electrodes. As depicted in Figure 1, a capsule type endoscope 10 is located inside the human body 1, and a receiving apparatus 20 is located outside the human body. A transmitting electrode 11 is formed on the surface of both ends of the capsule type endoscope 10, and the receiving apparatus 20 is connected with two receiving electrodes 30 contacted to the surface of the human body. After medical information collected by the capsule type endoscope 10 is signal-processed, when electric potential difference occurs between the two transmitting electrodes 11, a current flows through the human body 2 since the two transmitting electrodes 11 are contacted with each other through body fluids and form a closed-loop. The current flowing on the surface of the human body induces a voltage between the two receiving electrodes 30 installed on the surface of the human body. The induced voltage is in proportion to the current and distance between the two receiving electrodes 30. The receiving apparatus 20 located outside the human body senses a signal transmitted from the capsule type endoscope 10 in the human body by the induced voltage.

[0008] However, when only the two receiving electrodes are used, if a direction of the current is vertical to an aligning direction of the receiving electrodes, voltage is not induced or a small amount of voltage is induced in the receiving electrodes. Accordingly, the receiving apparatus outside the human body may not receive accurately a signal transmitted from the capsule type endoscope in the human body.

[0009] In more detail, as illustrated in Figure 1, when the capsule type endoscope 10 is located in an (A) direction, the aligning direction of the two receiving electrodes 30 is coincided with the direction of the transmitting electrode 11. In this case, a maximum current flows between the two receiving electrodes 30, so that the receiving apparatus 20 obtains good receiving sensitivity. However, when the capsule type endoscope 10 is located in a (B) direction, the aligning direction of the two receiving electrodes 30 is vertical to the direction of the transmitting electrode 11. In this case, a current does not flow between the two receiving electrodes 30, so that the receiving apparatus 20 can not receive a signal transmitted from the capsule type endoscope 10. Briefly, because the receiving electrode 30 is fixed and aligning direction of the transmitting electrode 11 is varied at any time, receiving sensitivity is varied as time elapses, a transmitted signal may be lost, and accordingly quality of receiving information is lowered.

[0010] In addition, when only the two receiving electrodes are used, position of the capsule type endoscope in the human body can not be detected, and accordingly the capsule type endoscope can not be used efficiently. For example, if we know a current position of the capsule type endoscope when the capsule type endoscope catches an abnormal symptom in the digestive organs, an accurate operation and remedy can be performed.

US4987897 describes a body bus medical device communication system.

WO00/22975 describes a method for delivering a device to a target location.

EP1260176 describes an array system and method for locating an *in vivo* signal source.

EP0667115 describes an *in vivo* video camera system and an autonomous video endoscope.

US4278077B describes a medical camera system.

US6240312 describes a remote controllable, micro-scale device for use in *in vivo* medical diagnosis and/or treatment.

KR200289669 describes a two-way communication telemetry capsule.

TECHNICAL GIST OF THE PRESENT INVENTION

[0011] The invention is as defined in the appended claims. In order to solve the above-mentioned problems, it is an object of the present invention to provide an apparatus for receiving data in a human body communication system, which are capable of receiving data with optimum sensitivity and extracting position information of a capsule type endoscope in the human body to use the position information as medical information.

[0012] An apparatus for receiving data in a human body communication system in accordance with the present invention comprises plural receiving electrodes installed on the surface of the human body, the plural receiving electrodes receiving data from a capsule type endoscope located inside the human body; a switching means for selecting a pair of receiving electrodes sequentially among the plural receiving electrodes; a processing means for processing a voltage value of a pair of receiving electrode selected by the switching means; a memory for storing the processed value; a comparing-operating means for calculating a maximum value among values stored in the memory; an image processing means for performing image processing for the maximum value; and a control means for controlling the switching

[0013] means and the comparing-operating means to provide the maximum value to the image processing means.

BRIEF DESCRIPTION OF DRAWINGS

[0014] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

[0015] In the drawings:

Figure 1 is a diagram for showing problems occurred in data receiving in the conventional human body communication system;

Figure 2 is an exemplary view illustrating plural receiving electrodes installed on the surface of the human body in accordance with the present invention; and

Figure 3 is a block diagram illustrating a receiving apparatus in accordance with the present invention.

DERAILED DESCRIPTION OF THE INVENTION

[0016] Hereinafter, the preferred embodiment of the present invention will be described with reference to accompanying drawings.

[0017] Figure 2 is a plane view illustrating plural receiving electrodes installed on the surface of the human body. As depicted in Figure 2, eight receiving electrodes are respectively installed on the surface of the human body, for example, the chest, the navel, an upper portion of the back, a lower portion of the back, the axillae and the sides. When current generated by electric potential difference between transmitting electrodes 11 of a capsule type endoscope 10 reaches plural receiving electrodes through the human body, a voltage is induced between the two receiving electrodes in proportion to the current and distance between the two receiving electrodes.

[0018] With reference to Figure 2, considering receiving electrodes 1 and 2 as a pair of receiving electrodes, the greatest voltage is detected between receiving electrodes 1 and 2. That is because an aligning direction of the transmitting electrode 11 is coincided with that of the receiving electrodes 1 and 2 and also distance between the capsule type endoscope 10 and the receiving electrodes is the shortest. On the other hand, considering receiving electrodes 3 and 4 or receiving electrodes 7 and 8 as a pair of receiving electrodes, a voltage is not detected between the receiving electrodes. That is because an aligning direction of the transmitting electrode 11 of the capsule type endoscope 10 is vertical to an aligning direction of the receiving electrodes. In addition, considering receiving electrodes 5 and 6 as a pair of receiving electrodes, voltage between the receiving electrodes 5 and 6 is less than that between the receiving electrodes 1 and 2. That is because an aligning direction of the transmitting electrode 11 of the capsule type endoscope 10 is coincided with an aligning direction of the receiving electrodes, but distance between the capsule type endoscope 10 and the receiving electrodes 5 and 6 is farther than that between the capsule type endoscope 10 and the receiving electrodes 1 and 2.

[0019] As described-above, by measuring and comparing voltages between each pair of receiving electrodes, we select the receiving electrodes 1 and 2 to obtain better receiving sensitivity from the fact that the voltage between the receiving electrodes 1 and 2 is the greatest. In addition, we know the capsule type endoscope is located closer to the receiving electrodes 1 and 2 from the fact that a voltage of the receiving electrodes 1 and

2 is greater than that of the receiving electrodes 5 and 6.

[0020] An accurate position of the capsule type endoscope 10 in the human body can be extracted by comparing and operating voltages sensed in each pair of receiving electrodes at predetermined time-intervals. Also, a moving path, speed and direction, etc. of the capsule type endoscope in the human body can be known by processing an extracted position of the capsule type endoscope 10 sequentially.

[0021] In the embodiment of the present invention, flat-arranged plural receiving electrodes are described, however, the present invention is not limited by that. It is possible to extract three-dimensional position and direction of the capsule type endoscope 10 by distributing plural receiving electrodes onto the up/down, front/back and left/right of the human body.

[0022] Figure 3 is a block diagram illustrating a receiving apparatus having plural receiving electrodes in accordance with the present invention. As depicted in Figure 3, N receiving electrodes are respectively connected to a first switching circuit 21 and a second switching circuit 22 of a receiving apparatus 30. An output line of the first switching circuit 21 is connected to a plus (+) terminal of a differential amplifier 23, and an output line of the second switching circuit 22 is connected to a minus (-) terminal of the differential amplifier 23. Under the control of a control circuit 28, the switching circuits 22, 23 respectively select only one among inputs from the N receiving electrodes.

[0023] The operation of the receiving apparatus 30 will be described in detail. First, when the first switching circuit 21 selects the receiving electrode 1 and the second switching circuit 22 selects the receiving electrode 2, a signal voltage between the receiving electrodes 1 and 2 is transmitted to the differential amplifier 23 to be amplified. The amplified signal passes a band pass filter 24 where noise is removed. The signal passing the band pass filter 24 is converted into a digital signal in an A/D converter 25 and is stored in a memory 27. Next, as the first switching circuit 21 maintains the receiving electrode 1, the second switching circuit 22 selects the receiving electrode 3. And then a signal voltage between the receiving electrodes 1 and 3 is stored in a different address of the memory 27 through the above-mentioned process. Continuously, as the first switching circuit 21 maintains the receiving electrode 1, the second switching circuit 22 selects the receiving electrode 4, 5, ... and N, and then signal voltages between the receiving electrode 1 and the other receiving electrodes are sequentially stored in the memory 27.

[0024] Likewise, as the first switching circuit 21 maintains selection of the receiving electrode 2, the second switching circuit 22 selects the other receiving electrodes 1, 3, ... and N sequentially, and then signal voltages between the receiving electrode 2 and the other receiving electrodes are sequentially stored in the memory 27. As described above, if the first switching circuit 21 selects the receiving electrode 3, 4, ... and N sequentially and the second switching circuit 22 selects the other receiving electrodes sequentially, finally the $(N=1)^2$ number of signal voltages are stored in the memory 27. Of course, signal voltages between the receiving electrodes may be sampled several times (more than two times) for an average value to be stored. Or, an average value of a voltage waveform for a certain time may be stored. In addition, in order to reduce memory capacity and processing time, once-selected pair of receiving electrodes is no longer selected and the only ${}_nC_2$ number of a pair of receiving electrodes may be selected.

[0025] A comparing-operating circuit 29 compares signal voltage values stored in the memory 27 and obtains the greatest value. From that result of the comparing-operating circuit 29, it can be known a direction of the capsule type endoscope 10 is similar to an aligning direction of the pair of receiving electrodes in which the greatest value occurs. In addition, the comparing-operating circuit 29 may extract a three-dimensional position of the capsule type endoscope 10 by comparing and operating signal voltage values stored in the memory 27 and store it again in the memory 27.

[0026] The control circuit 28 selects the pair of receiving electrodes in which the greatest voltage occurs as communication electrodes, and accordingly a signal transmitted from the capsule type endoscope 10 in the human body can be received with the best receiving sensitivity. In more detail, a signal of the pair of receiving electrodes in which the greatest receiving voltage occurs is processed in an image processing circuit 26.

[0027] The above-described a pair of receiving electrodes combining procedure, signal voltage processing procedure, comparing-operating procedure and optimum pair of receiving electrodes selecting procedure, etc. are proceeded at a very quick speed (within 10msec) and repeated at regular time-intervals (per 5 seconds). Accordingly, information transmitted from the capsule type endoscope 10 can be always received through an optimum pair of receiving electrodes. In addition, a moving path, a speed and a direction of the capsule type endoscope 10 in the human body can be measured by storing calculated position information in the memory 27 sequentially.

INDUSTRIAL APPLICABILITY

[0028] In the present invention, information transmitted from a capsule type endoscope using the human body as a communication conductor can be received with optimum receiving sensitivity to a receiving apparatus having plural receiving electrodes. Accordingly, it is possible to improve quality of received information, grasp a moving path, a speed and a direction of the capsule type endoscope in the human body and use them as medical information.

[0029] The embodiments aspects and examples which do not fall within the scope of the claims are provided for illustrative purpose only and do not form part of the present invention.

[0030] The invention is defined in the claims as follows: 11

Claims

1. An apparatus (30) for receiving data in a human body communication system, comprising:

    a) plural receiving electrodes installed on the surface of the human body, the plural receiving electrodes receiving data from a capsule type endoscope located inside the human body;
    b) a switching means for selecting a pair of receiving electrodes (1, 2) sequentially among the plural receiving electrodes;
    c) a processing means for processing a voltage value of a pair of receiving electrode (1, 2) selected by the switching means;
    d) a memory (27) for storing the processed values;
    e) a comparing-operating means (28) for calculating a maximum value among the values stored in the memory (27);
    f) an image processing means (26) for performing image processing for the pair of receiving electrodes having the maximum value; and
    g) a control means (28) for controlling the switching means and the comparing-operating means to provide the maximum value to the image processing means.

2. The apparatus of claim 1, wherein the switching means includes a first switching circuit (21) and a second switching circuit (22) to which the plural receiving electrodes are connected respectively.

3. The apparatus of claim 1 or claim 2, wherein the processing means includes:

    a) a differential amplifier (23) for amplifying a voltage output from the switch means;
    b) a band pass filter (24) for removing noise in the amplified signal; and
    c) an A/D converter (25) for converting the noise-removed analog signal into a digital signal.

4. The apparatus of any of claims 1 to 3, wherein the values stored in the memory (27) are averages of voltage values sampled more than two times or are averages of voltage waveforms for a certain time.

5. The apparatus of any of claims 1 to 4, wherein the comparing-operating means calculates position information of a sensor from the position of a pair of receiving electrodes (1, 2) corresponding to the maximum value and stores it in the memory (27) sequentially.

6. The apparatus of claim 5, wherein a moving path, a speed and a direction of the sensor can be extracted from the position information.

Patentansprüche

1. Vorrichtung (30) zum Datenempfang von in einem Kommunikationssystem für den menschlichen Körper, die Folgendes umfasst:

    a) mehrere empfangende Elektroden, die auf der Oberfläche des menschlichen Körpers angebracht sind, wobei die mehreren empfangenden Elektroden Daten von einem kapselartigen Endoskop empfangen, das im Inneren des menschlichen Körpers vorliegt;
    b) ein Schaltmittel zur sequenziellen Auswahl eines Paars von empfangenden Elektroden (1,2) unter den mehreren empfangenden Elektroden;
    c) ein Verarbeitungsmittel zur Verarbeitung eines Spannungswerts eines Paars von empfangenden Elektroden (1, 2), die von dem Schaltmittel ausgewählt wurden;
    d) einen Speicher (27) zur Speicherung der verarbeiteten Werte;
    e) ein vergleichendes Betriebsmittel (28) zur Berechnung eines maximalen Werts unter den im Speicher (27) gespeicherten Werten;
    f) ein Bildverarbeitungsmittel (26) zur Durchführung von Bildverarbeitung für das Paar von empfangenden Elektroden, die den maximalen Wert aufweisen; und
    g) ein Steuerungsmittel (28) zur Steuerung des Schaltmittels und des vergleichenden Betriebsmittels, um den maximalen Wert für das Bildverarbeitungsmittel bereitzustellen.

2. Vorrichtung nach Anspruch 1, wobei das Schaltmittel einen ersten Schaltkreis (21) und einen zweiten Schaltkreis (22) einschließt, mit denen die mehreren empfangenden Elektroden (N) jeweils verbunden sind.

3. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei das Verarbeitungsmittel Folgendes einschließt:

    a) einen Differenzverstärker (23) zur Verstärkung eines Spannungsausgangs von dem Schaltmittel;
    b) einen Bandpassfilter (24) zur Entfernung von Rauschen in dem verstärkten Signal;

    und

c) einen A/D-Wandler (25) zur Umwandlung des rauschfreien analogen Signals in ein digitales Signal.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, wobei die in dem Speicher (27) gespeicherten Werte Durchschnittswerte von Spannungswerten sind, die mehr als zweimal aufgenommen wurden, oder Durchschnittswerte von Spannungswellenformen für eine bestimmte Zeit sind.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, wobei das vergleichende Betriebsmittel Positionsinformation eines Sensors von der Position eines Paars von empfangenden Elektroden (1, 2) entsprechend dem maximalen Wert berechnet und diese in dem Speicher (27) sequenziell speichert.

6. Vorrichtung nach Anspruch 5, wobei ein Bewegungsweg, eine Geschwindigkeit und eine Richtung des Sensors aus der Positioninformation gewonnen werden können.

Revendications

1. Appareil (30) servant recevoir des données dans un système de communication associé à un corps humain, comportant :

   a) plusieurs électrodes de réception installées sur la surface du corps humain, lesdites plusieurs électrodes de réception recevant des données en provenance d'un endoscope du type capsule endoscopique se trouvant à l'intérieur du corps humain ;
   b) un moyen de commutation servant à sélectionner une paire d'électrodes de réception (1, 2) de manière séquentielle parmi lesdites plusieurs électrodes de réception ;
   c) un moyen de traitement servant à traiter une valeur de tension d'une paire d'électrodes de réception (1, 2) ayant été sélectionnée par le moyen de commutation ;
   d) une mémoire (27) servant à stocker les valeurs traitées ;
   e) un moyen de comparaison et d'opération (28) servant à calculer une valeur maximum parmi les valeurs stockées dans la mémoire (27) ;
   f) un moyen de traitement d'image (26) servant à effectuer un traitement d'image pour la paire d'électrodes de réception ayant la valeur maximum ; et
   g) un moyen de commande (28) servant à commander le moyen de commutation et le moyen de comparaison et d'opération pour fournir la valeur maximum au moyen de traitement d'image.

2. Appareil selon la revendication 1, dans lequel le moyen de commutation comprend un premier circuit de commutation (21) et un deuxième circuit de commutation (22) auxquels lesdites plusieurs électrodes de réception (N) sont connectées respectivement.

3. Appareil selon la revendication 1 ou la revendication 2, dans lequel le moyen de traitement comprend :

   a) un amplificateur différentiel (23) servant à amplifier une sortie de tension en provenance du moyen de commutation ;
   b) un filtre passe-bande (24) servant à éliminer le bruit dans le signal amplifié ; et
   c) un convertisseur analogique-numérique (25) servant à convertir le signal analogique exempt de bruit en un signal numérique.

4. Appareil selon l'une quelconque des revendications 1 à 3, dans lequel les valeurs stockées dans la mémoire (27) sont des moyennes de valeurs de tension échantillonnées plus de deux fois ou sont des moyennes de formes d'ondes de tension pendant un certain temps.

5. Appareil selon l'une quelconque des revendications 1 à 4, dans lequel le moyen de comparaison et d'opération calcule des informations de position d'un capteur depuis la position d'une paire d'électrodes de réception (1, 2) correspondant à la valeur maximum et les stocke dans la mémoire (27) de manière séquentielle.

6. Appareil selon la revendication 5, dans lequel une trajectoire de mouvement, une vitesse et une direction du capteur peuvent être extraites en provenance des informations de position.

FIG. 1

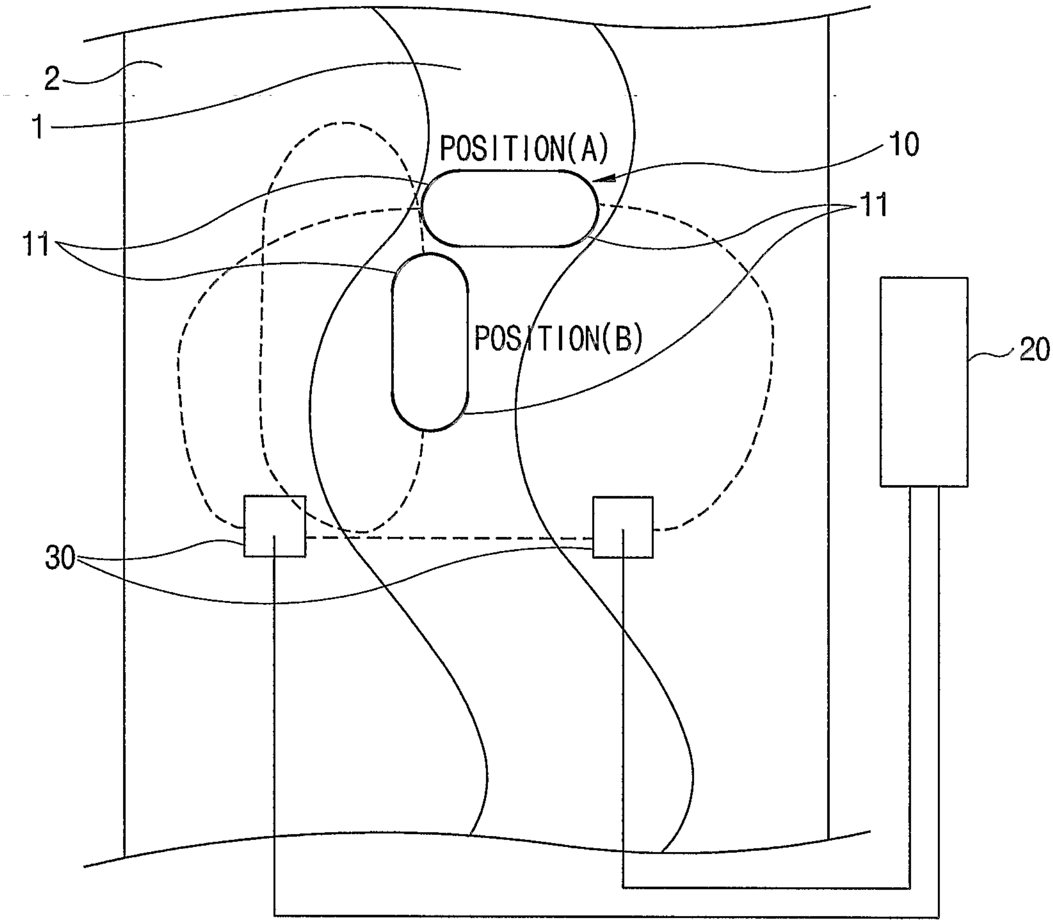


FIG. 2

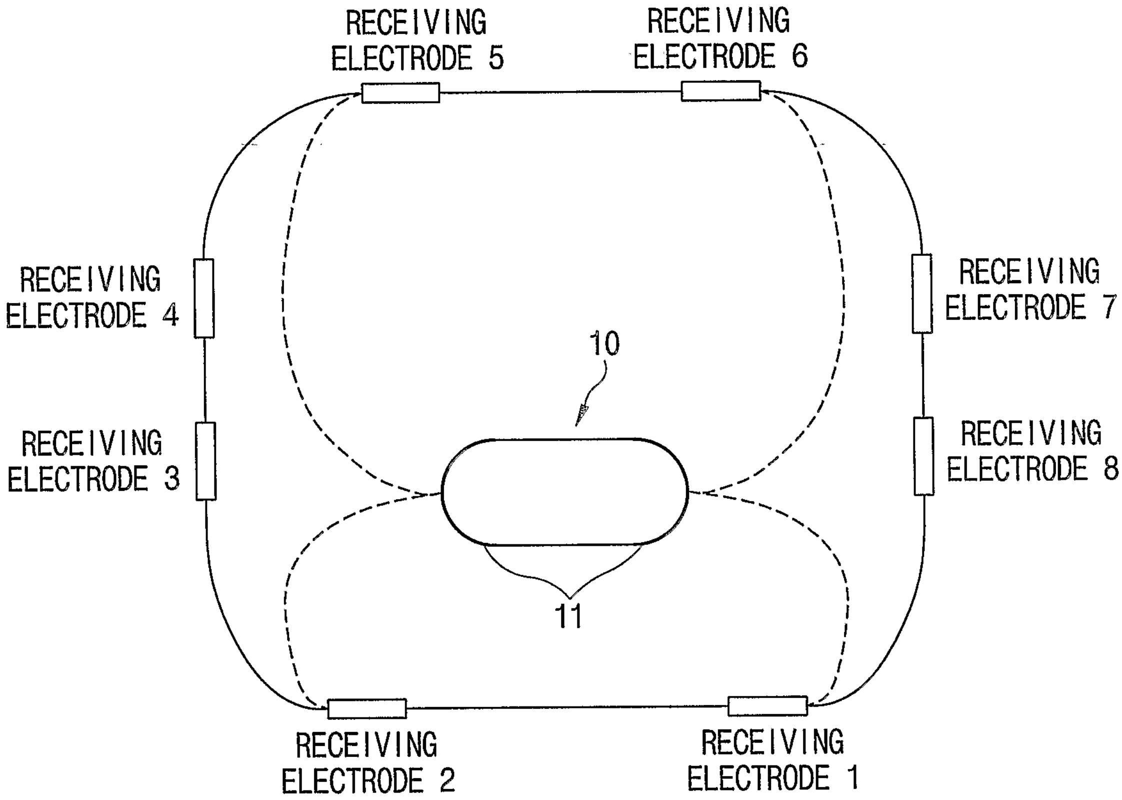
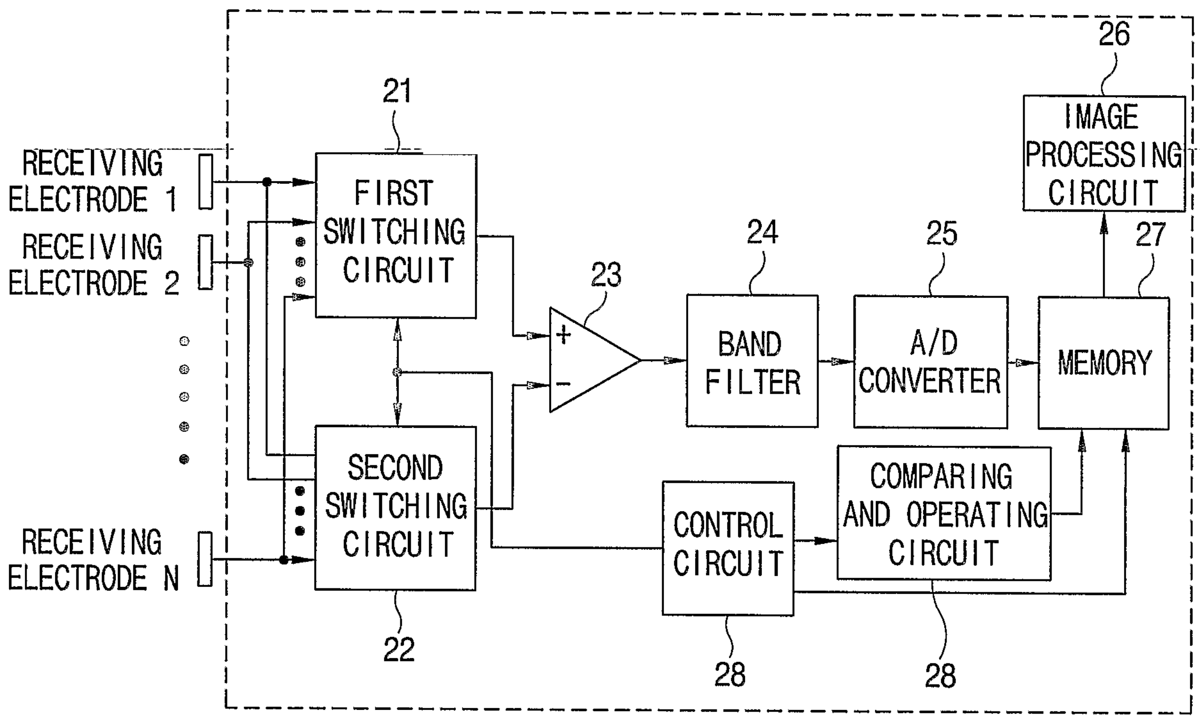

RECEIVING
ELECTRODE 5
RECEIVING
ELECTRODE 6
RECEIVING
ELECTRODE 4
RECEIVING
ELECTRODE 7
10
RECEIVING
ELECTRODE 3
RECEIVING
ELECTRODE 8
11
RECEIVING
ELECTRODE 2
RECEIVING
ELECTRODE 1

FIG. 3


RECEIVING ELECTRODE 1
RECEIVING ELECTRODE 2
RECEIVING ELECTRODE N
21
FIRST SWITCHING CIRCUIT
SECOND SWITCHING CIRCUIT
22
23
24
BAND FILTER
25
A/D CONVERTER
26
IMAGE PROCESSING CIRCUIT
27
MEMORY
COMPARING AND OPERATING CIRCUIT
CONTROL CIRCUIT
28
28

REFERENCES CITED IN THE DESCRIPTION

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- EP 0667115 A **[0010]**
- US 4278077 B **[0010]**
- US 6240312 B **[0010]**
- KR 200289669 **[0010]**

patsnap

专利名称(译)	用于在人体通信系统中接收数据的装置		
公开(公告)号	EP1596711B1	公开(公告)日	2016-11-23
申请号	EP2003781096	申请日	2003-12-31
[标]申请(专利权)人(译)	韩国科学技术研究院		
申请(专利权)人(译)	韩国学院科技		
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优先权	1020030005058 2003-01-25 KR		
其他公开文献	EP1596711A4 EP1596711A1		
外部链接	Espacenet		

摘要(译)

本发明提供一种用于在人体通信系统中接收数据的方法和装置。包括多个接收电极的接收设备在接收数据时选择最佳的一对接收电极，从而可以提高接收信息的质量并获得人体中传感器的位置信息。

FIG. 1