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(54) WEARABLE JACKET FOR DIAGNOSIS AND ENDOSCOPE SYSTEM EMPLOYING WEARABLE JACKET

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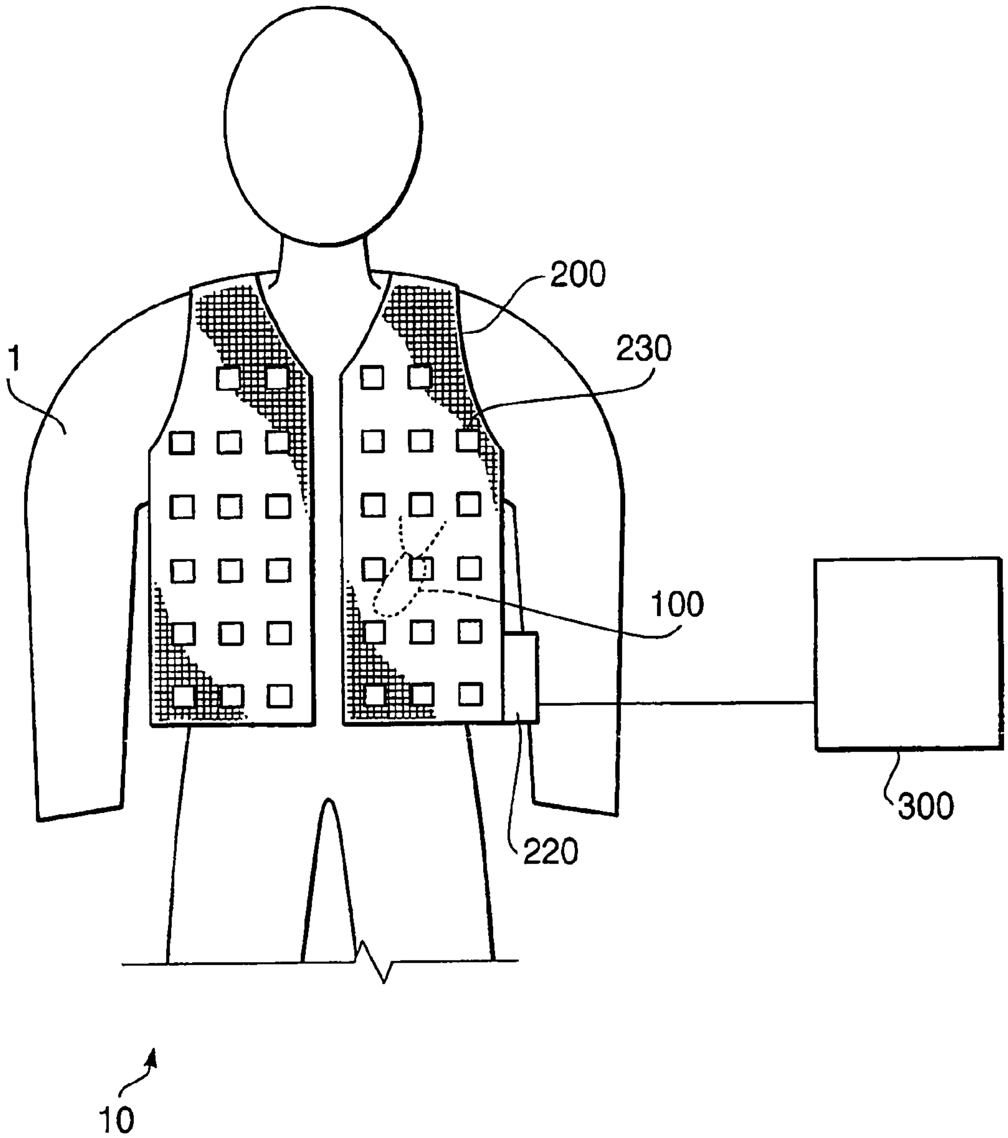
(57) **ABSTRACT**

A wearable jacket includes a 2D-DST substrate shaped to cover a body of a subject person. The 2D-DST substrate include a conductive sheet, and a plurality of communication modules distributed on the conductive sheet. At least one communication module is provided with a connector portion to which one of a predetermined types of functional unit is electrically connected.



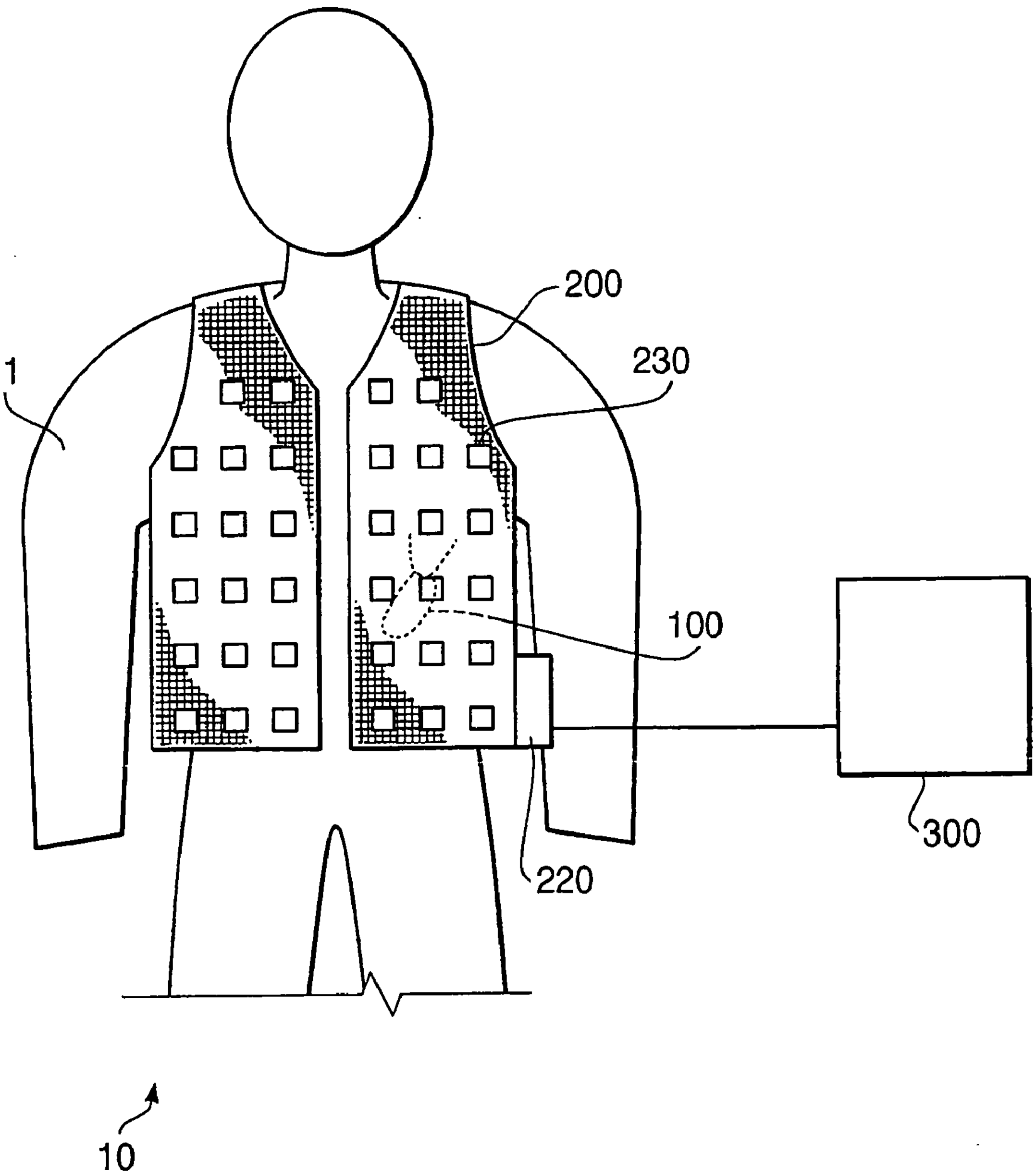


FIG. 1

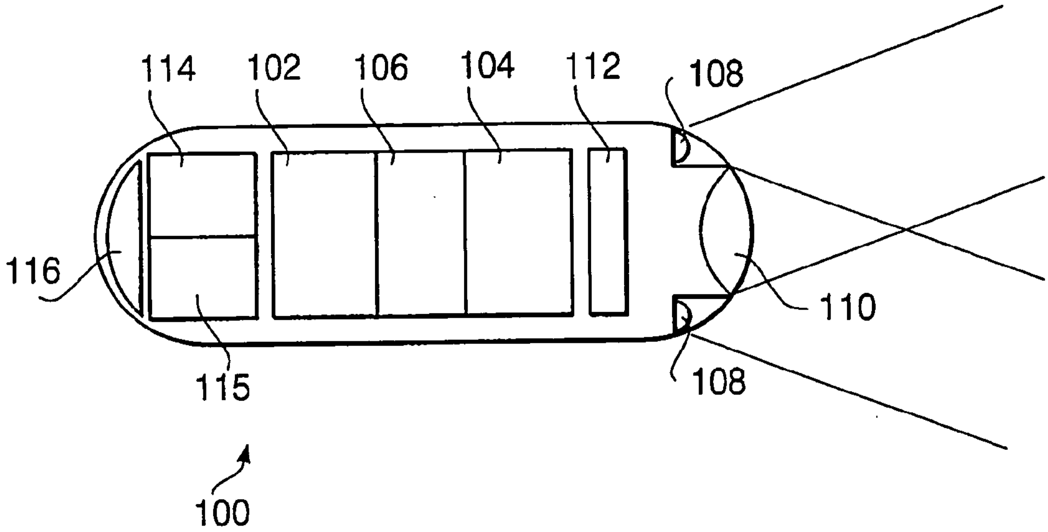

114
102
106
104
112
108
116
110
108
115
100

FIG. 2

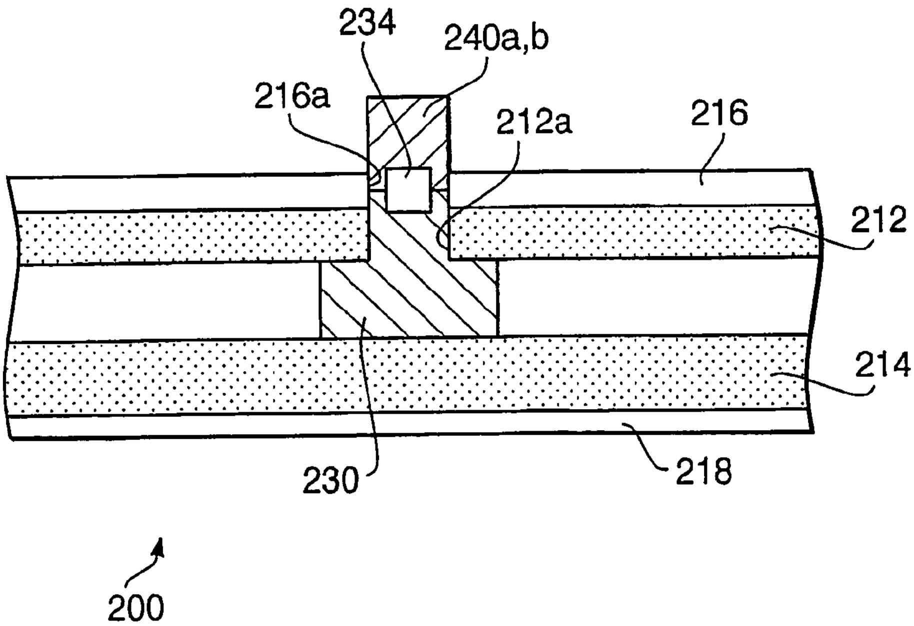

234
240a,b
216a
212a
216
212
214
230
218
200

FIG. 3

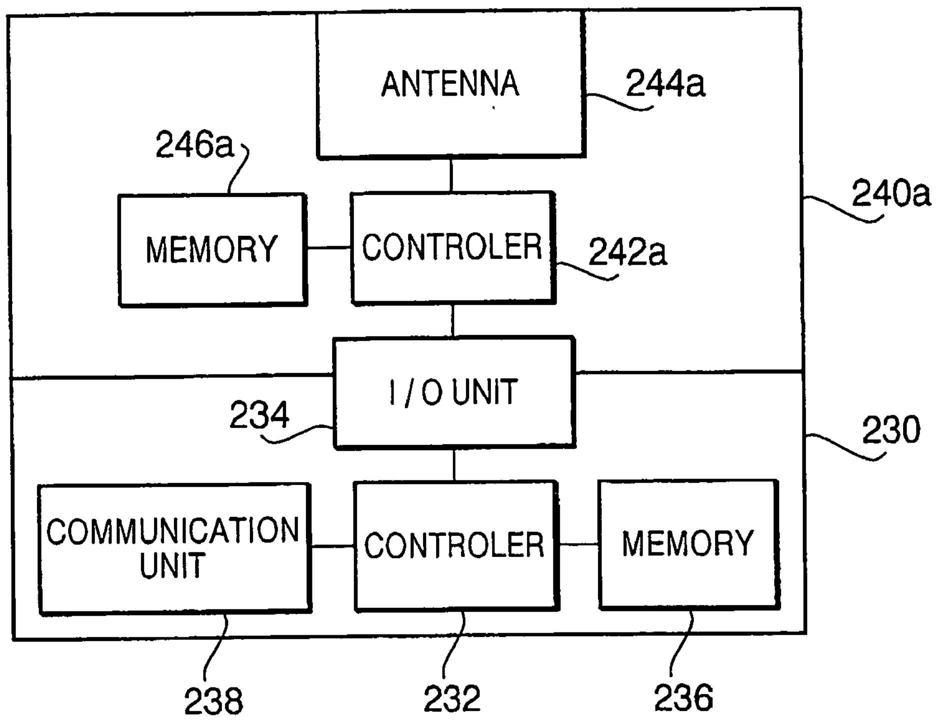

ANTENNA
244a
246a
240a
MEMORY
CONTROLER
242a
I / O UNIT
234
230
COMMUNICATION UNIT
CONTROLER
MEMORY
238
232
236

FIG. 4

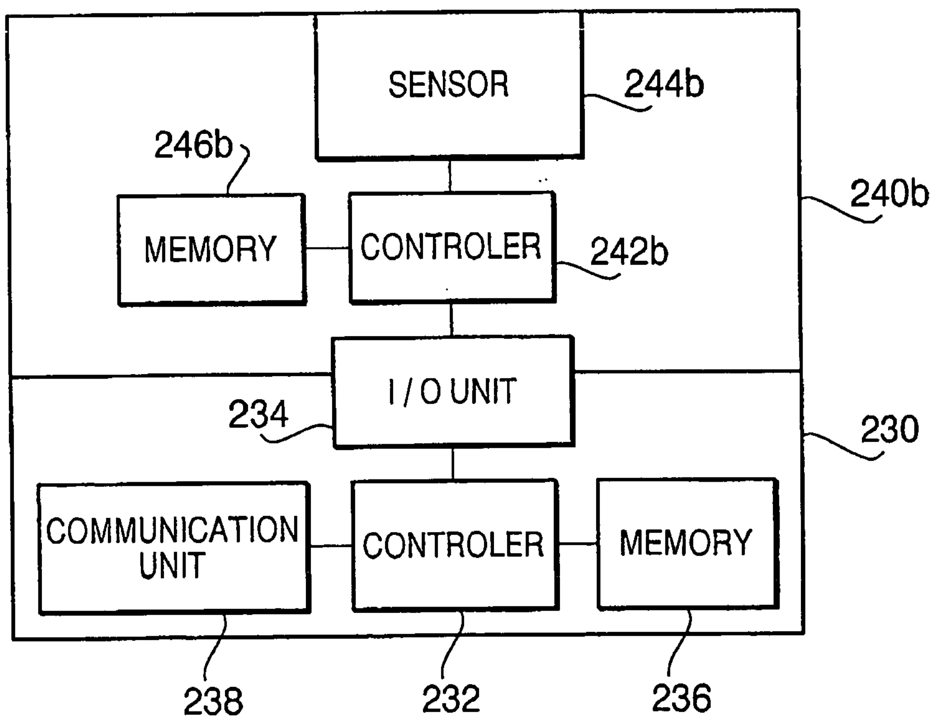

SENSOR
244b
246b
240b
MEMORY
CONTROLER
242b
I / O UNIT
234
230
COMMUNICATION UNIT
CONTROLER
MEMORY
238
232
236

FIG. 5

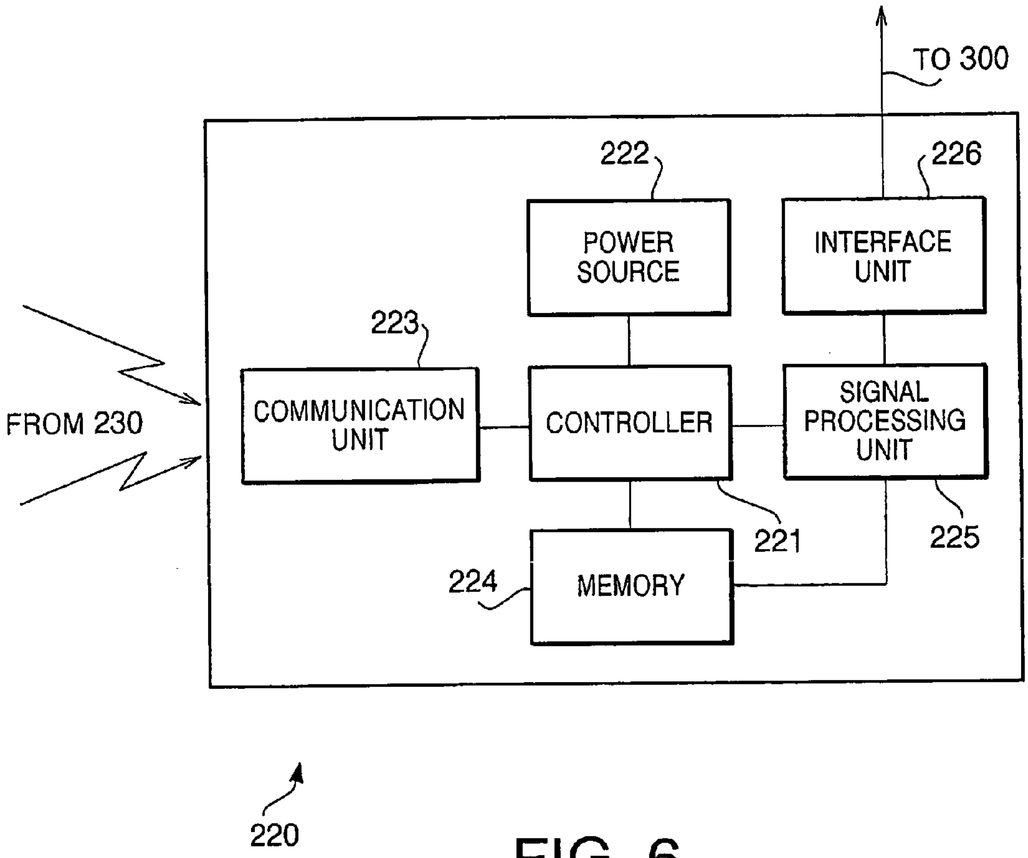

TO 300
222
226
POWER SOURCE
INTERFACE UNIT
223
FROM 230
COMMUNICATION UNIT
CONTROLLER
SIGNAL PROCESSING UNIT
221
225
224
MEMORY
220

FIG. 6

FIG. 7

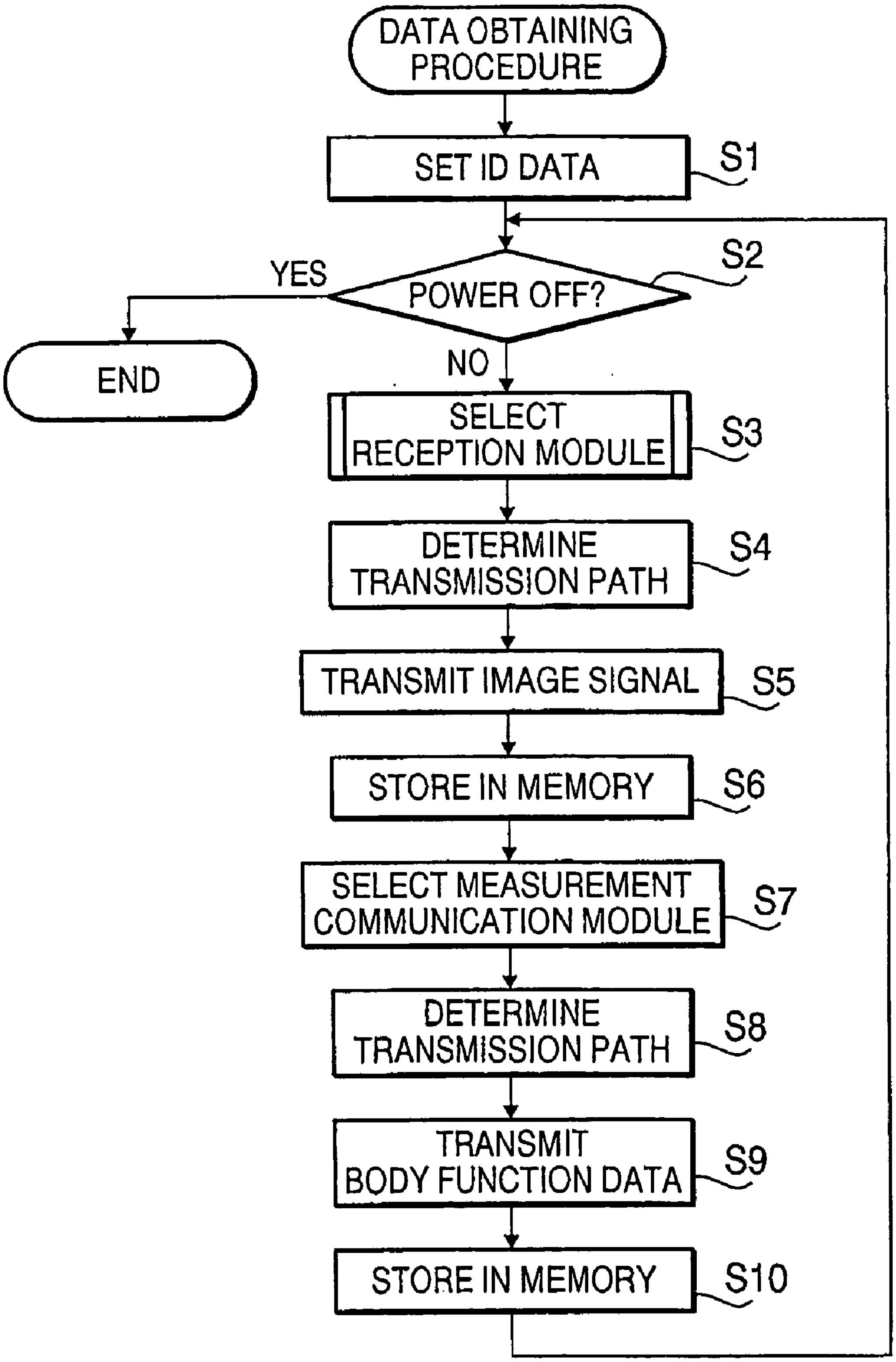
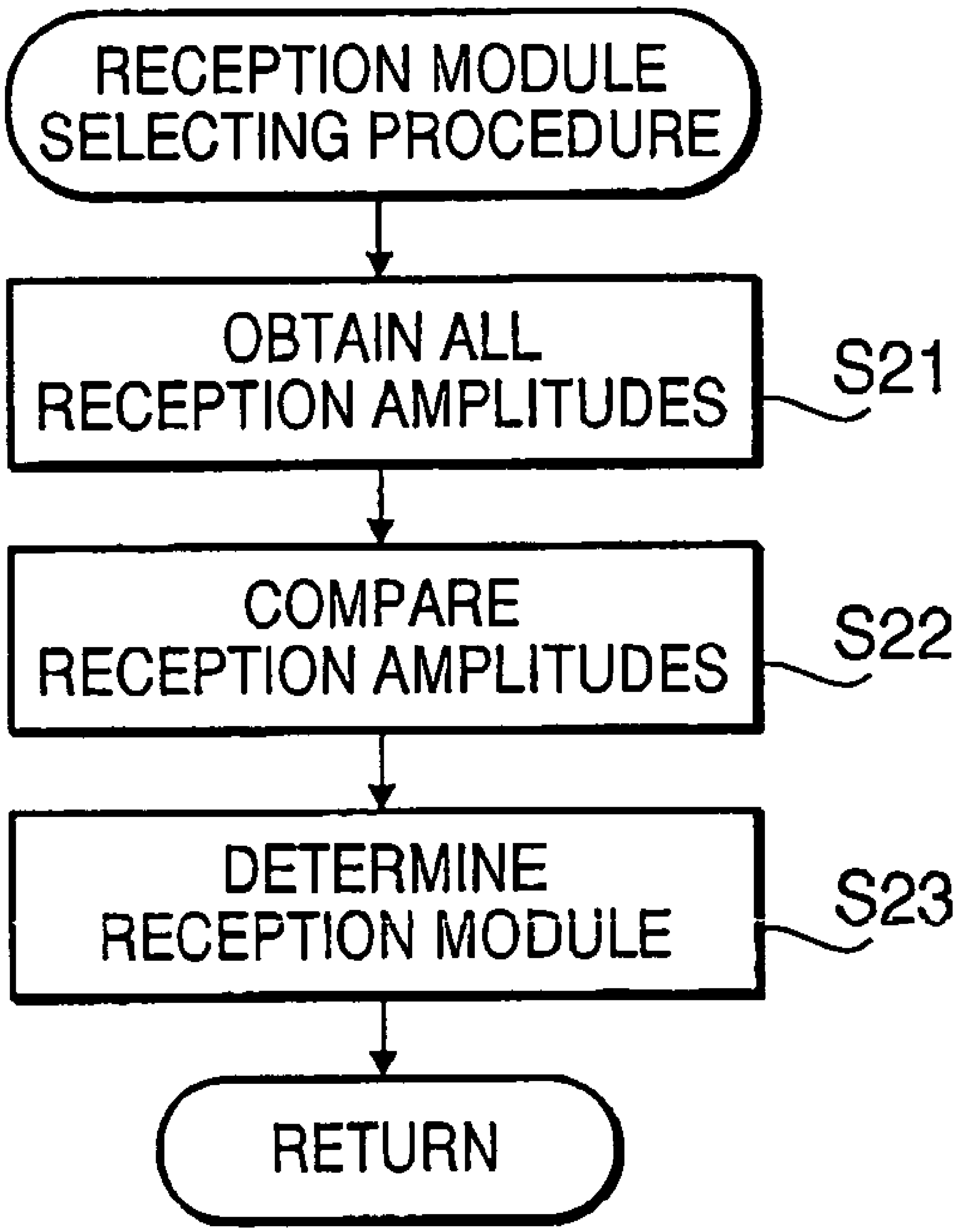

DATA OBTAINING PROCEDURE
SET ID DATA
S1
S2
POWER OFF?
YES
END
NO
SELECT RECEPTION MODULE
S3
DETERMINE TRANSMISSION PATH
S4
TRANSMIT IMAGE SIGNAL
S5
STORE IN MEMORY
S6
SELECT MEASUREMENT COMMUNICATION MODULE
S7
DETERMINE TRANSMISSION PATH
S8
TRANSMIT BODY FUNCTION DATA
S9
STORE IN MEMORY
S10

FIG. 8


RECEPTION MODULE SELECTING PROCEDURE
OBTAIN ALL RECEPTION AMPLITUDES
S21
COMPARE RECEPTION AMPLITUDES
S22
DETERMINE RECEPTION MODULE
S23
RETURN

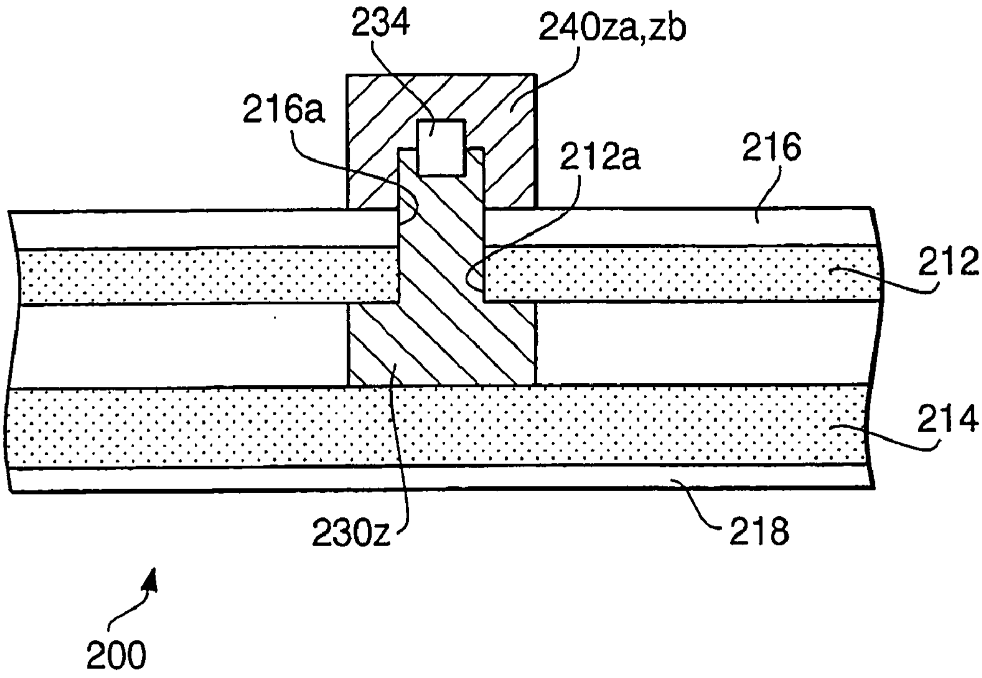

234
240za,zb
216a
212a
216
212
214
230z
218
200

FIG. 9

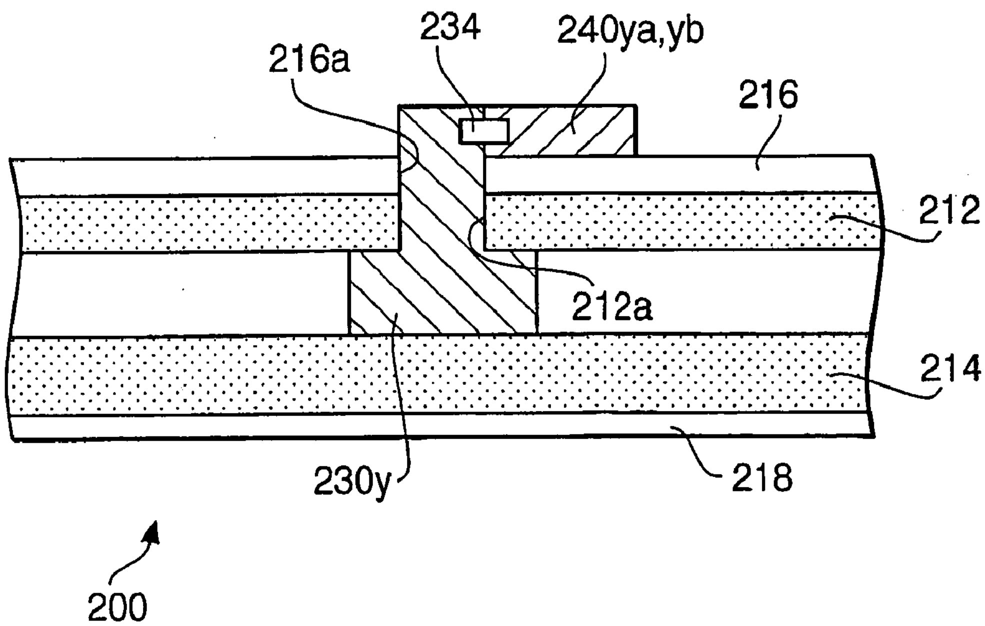

234
240ya,yb
216a
216
212
212a
214
230y
218
200

FIG.10

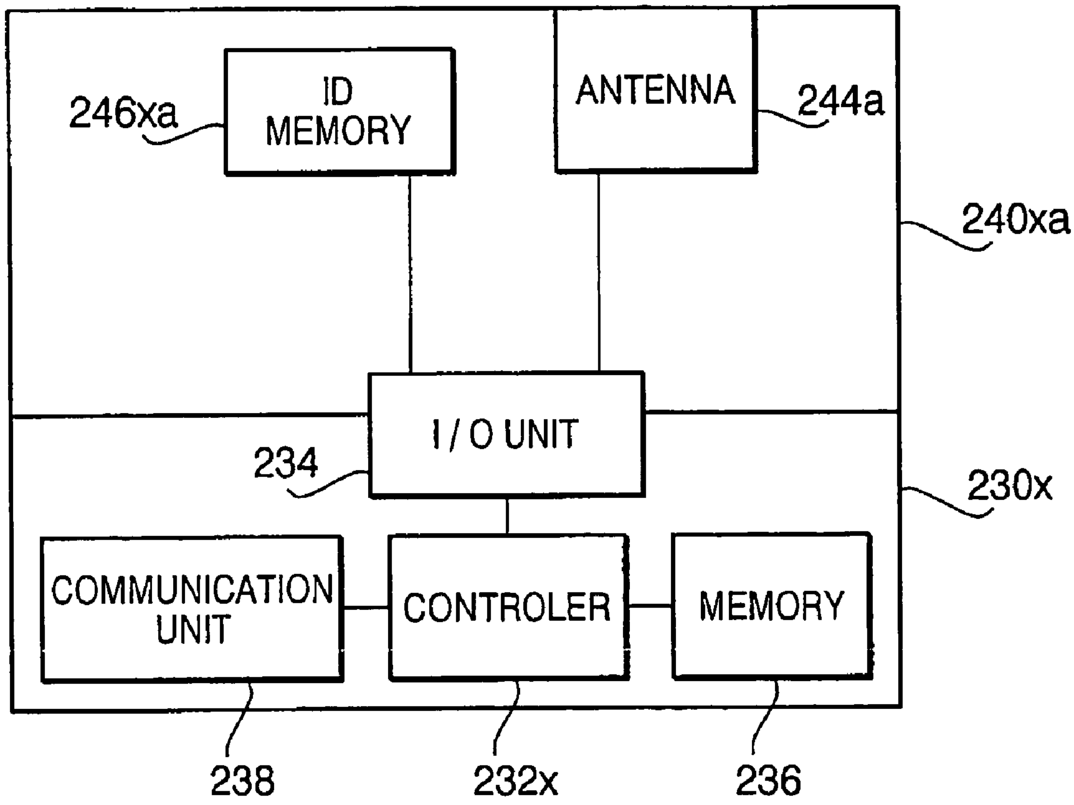

246xa
ID MEMORY
ANTENNA
244a
240xa
I / O UNIT
234
230x
COMMUNICATION UNIT
CONTROLER
MEMORY
238
232x
236

FIG.11

FIG.12

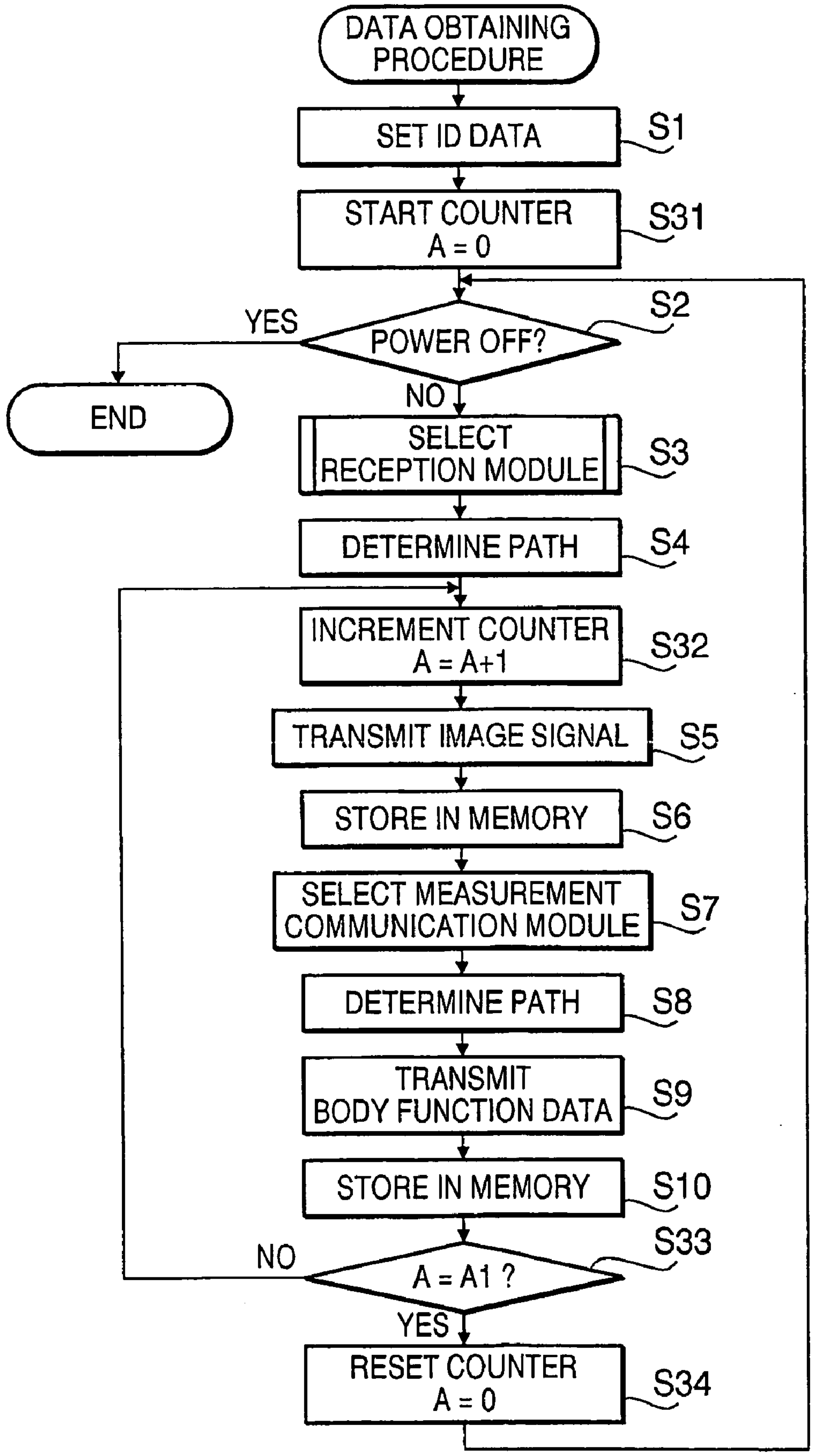
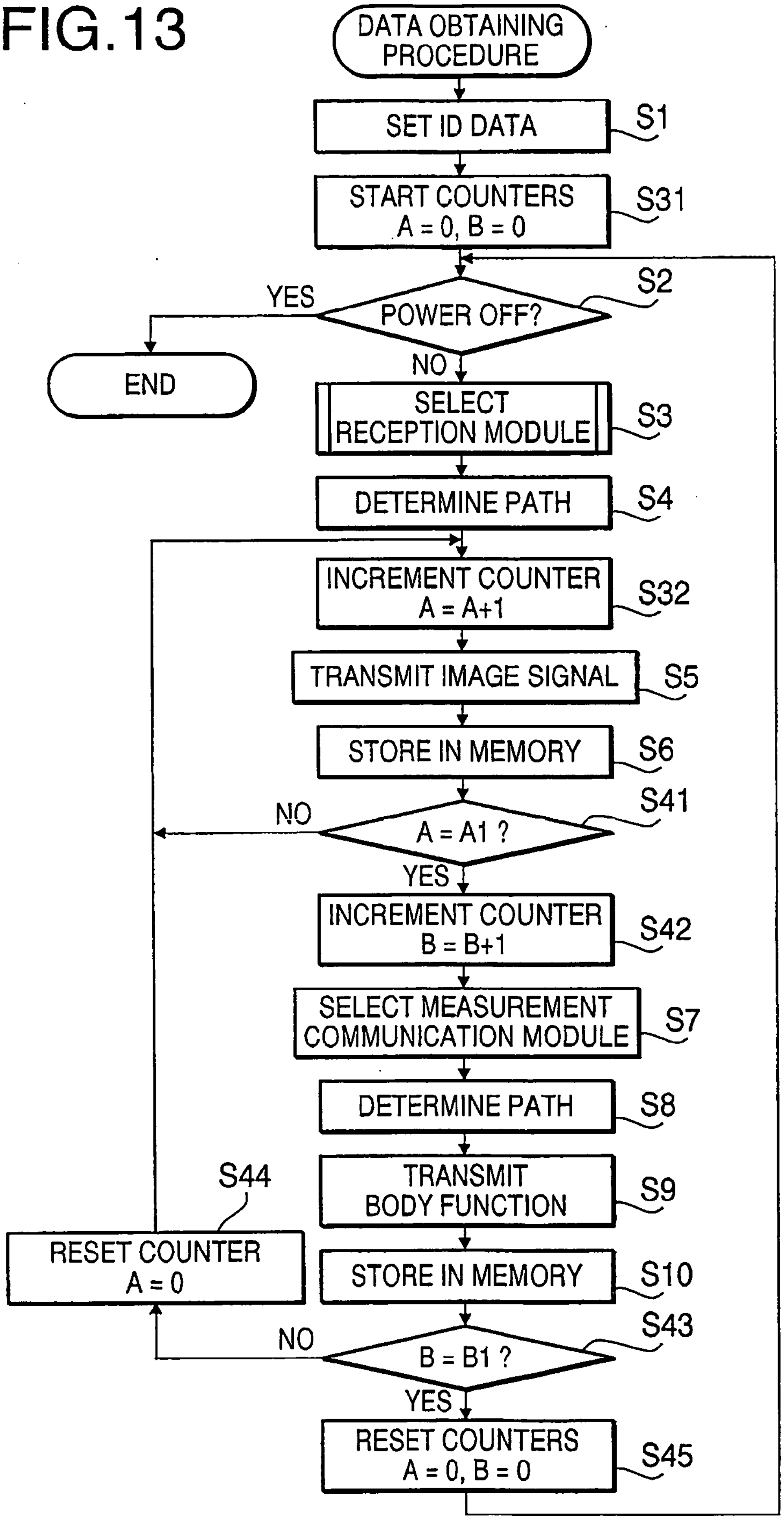

DATA OBTAINING PROCEDURE
SET ID DATA
S1
START COUNTER
A = 0
S31
POWER OFF?
S2
YES
END
NO
SELECT RECEPTION MODULE
S3
DETERMINE PATH
S4
INCREMENT COUNTER
A = A+1
S32
TRANSMIT IMAGE SIGNAL
S5
STORE IN MEMORY
S6
SELECT MEASUREMENT COMMUNICATION MODULE
S7
DETERMINE PATH
S8
TRANSMIT BODY FUNCTION DATA
S9
STORE IN MEMORY
S10
A = A1 ?
S33
NO
YES
RESET COUNTER
A = 0
S34

FIG.13


DATA OBTAINING PROCEDURE
SET ID DATA
S1
START COUNTERS A = 0, B = 0
S31
S2
YES
POWER OFF?
END
NO
SELECT RECEPTION MODULE
S3
DETERMINE PATH
S4
INCREMENT COUNTER A = A+1
S32
TRANSMIT IMAGE SIGNAL
S5
STORE IN MEMORY
S6
S41
NO
A = A1 ?
YES
INCREMENT COUNTER B = B+1
S42
SELECT MEASUREMENT COMMUNICATION MODULE
S7
DETERMINE PATH
S8
S44
TRANSMIT BODY FUNCTION
S9
RESET COUNTER A = 0
STORE IN MEMORY
S10
S43
NO
B = B1 ?
YES
RESET COUNTERS A = 0, B = 0
S45

WEARABLE JACKET FOR DIAGNOSIS AND ENDOSCOPE SYSTEM EMPLOYING WEARABLE JACKET

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a wearable jacket for diagnosing a subject person and an endoscope system employing such a wearable jacket.

[0002] Conventionally, when a human body of the subject is observed, an electronic endoscope is typically used. The electronic endoscope is provided with cables and optical fibers inside a flexible tube section of a scope, and at a tip thereof, an imaging element such ac a CCD (Charge Coupled Device) is fixed. Such an endoscope is configured such that a relatively long flexible tube is inserted in the human cavity. Therefore, observation using such an endoscope is burden to the subject (examinee). Further, it is difficult to insert such an endoscope in a thin, long and meandering portion such as intestine.

[0003] Recently, in order to decrease the burden to the subject, a system employing a capsule type endoscope has been suggested. With use of such a capsule type endoscope, it becomes easy to observe the intestine or the like.

[0004] An example of the endoscope system employing the capsule endoscope is described in Japanese Patent Provisional Publication P2003-19111A. According to the endoscope system disclosed in the above publication, a belt having a plurality of antennas is wound around the subject (examinee). The capsule type endoscope outputs a radio wave and the belt is configured to receive the radio wave, which is used for detecting a location of the capsule type endoscope. In this publication, the capsule type endoscope is described to measure condition inside the human cavity or to capture images of inner walls of the human cavity.

[0005] According to the above publication, each antenna mounted on the belt is fixed to the belt when the belt is released as a product. In such a configuration, however, the problems as indicated below would arise.

[0006] Depending on subject people (i.e., depending on a symptom), a portion to be observed specifically by use of the capsule endoscope is different. If the antennas are fixed to the belt, for a certain subject person, the belt (i.e., the arrangement of the antennas thereon) may be appropriate, however, for another subject person, the belt, or the arrangement of the antennas may be inappropriate. If the antennas are appropriately arranged (i.e., the number of the antennas are relatively small or arrangement does not meet the observation), the radio wave transmitted by the capsule endoscope may not be received by the antennas. In such a case, an image may not be displayed clearly on a display device. Therefore, the belt as described in the publication cannot be used for various subject persons having various symptoms.

SUMMARY OF THE INVENTION

[0007] The present invention is advantageous in that an improved endoscope system employing a capsule endoscope and overcoming the above problems is provided. That is, according to the improved endoscope system, a wearable jacket is provided. The wearable jacket mounts thereon a plurality of antennas, arrangement thereof can be changed in accordance with a subject person. The present invention is further advantageous in that a wearable jacket used for diagnosing various subjects can be provided.

[0008] According to an aspect of the invention, there is provided a wearable jacket, which includes a 2D-DST substrate shaped to cover a body of a subject person. The 2D-DST substrate include a conductive sheet, and a plurality of communication modules distributed on the conductive sheet, at least one communication module being provided with a connector portion to which one of predetermined types of a functional unit is electrically connected.

[0009] According to another aspect of the invention, there is provided a wearable jacket system, which is provided with a 2D-DST substrate shaped to cover a body of a subject person, the 2D-DST substrate including a conductive sheet and a plurality of communication modules distributed on the conductive sheet, at least one communication module being provided with a connector portion, and a plurality of types of functional units, any one of predetermined types of functional unit being electrically connected to the connector portion of the at least one communication module.

[0010] Optionally, the plurality of types of functional units may include one of a body temperature sensor, a sensor for measuring a breathing rate, a cardiac rate or blood pressure, a blood flow sensor, a sensor for measuring oxygen saturation degree, a sensor for detecting sweat, a sensor detecting uric acid level, a sensor for detecting occurrence of bleeding, electrodes for cardiographic measurement, and a communication unit that receives a signal transmitted by an external device.

[0011] Further optionally, the wearable jacket system may include a controlling system that determines a transmission path of data in accordance with a 2D-DST technology, the controlling system storing the data received via the transmission path to a predetermined recording medium.

[0012] In a particular case, the controlling system may include a data conversion system that converts the received data so as to be displayed on a display device.

[0013] Optionally, the controlling system may further include an interface to which a removable recording medium is connected, the controlling system storing the data in the removable recording medium via the interface.

[0014] Further optionally, the controlling system may be capable of communicating an external device via a wireless communication, the data being transmitted to the external device via the wireless communication.

[0015] Still optionally, the plurality of types of units may have different pieces of ID information, and the at least one of the plurality of communication modules may obtain the ID information of a unit connected to the at least one of the plurality of communication modules and transmit the obtained ID information along with ID information of the at least one of the plurality of communication modules.

[0016] Optionally, if at least one of the plurality of communication modules is connected with a communication unit capable of receiving signal transmitted by an external device, the controlling system may control the at least one of the plurality of communication modules to transmit the signal received from the external device and body information other than the signal transmitted by the external device at every predetermined period.

[0017] Alternatively, if at least one of the plurality of communication modules is connected with a communication unit capable of receiving signal transmitted by an external device, the controlling system may control the at least one of the plurality of communication modules to transmit the signal received from the external device and body information other than the signal transmitted by the external device periodically at different timings, respectively.

[0018] Further, the controlling system may control the at least one of the plurality of communication modules to transmit the signal received from the external device at every first predetermined period and to transmit the body information other than the signal transmitted from the external device at every second predetermined period, which is longer than the first predetermined period.

[0019] In a particular case, the controlling system may select an optimum communication module mounting a communication unit from among the plurality of communication modules at every third predetermined period which is longer that the predetermine period.

[0020] Still optionally, the plurality of types of functional units may include a communication unit that is capable of at least one of a function of transmitting a signal carrying predetermined information to an external device and another function of receiving a signal transmitted by the external device.

[0021] In the above case, the predetermined information may include at least one of a signal that supplies an electrical power to the external device and a signal that controls tan operation of the external device.

[0022] According to another aspect of the invention, there is provided an endoscope system which includes a capsule endoscope having a communication function and a wearable jacket system. The capsule endoscope may include an imaging device that captures an image, and a wireless communicating system that transmits image data representing the captured image toward the wearable jacket. The wearable s jacket ystem may include a 2D-DST substrate shaped to cover a body of a subject person, the 2D-DST substrate including a conductive sheet and a plurality of communication modules distributed on the conductive sheet, at least one communication module being provided with a connector portion, a plurality of types of functional units, any one of predetermined types of functional unit is electrically connected to the connector portion of the at least one communication module, the at least one communication module including a reception module which is a communication module connected with a communication unit via the connector portion, the communication unit being capable of receiving the image data transmitted by the wireless communicating system of the capsule endoscope, and a displaying system that displays an image represented by the signal received by the communication module.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

[0023] **FIG. 1** schematically shows a configuration of an endoscope system according to an embodiment of the invention;

[0024] **FIG. 2** schematically shows a configuration of a capsule endoscope employed in the endoscope system according to the embodiment of the invention;

[0025] **FIG. 3** shows a cross sectional structure of a part of a diagnosis jacket employed in the endoscope system according to the embodiment of the invention;

[0026] **FIG. 4** is a block diagram showing a configuration of a communication module and an antenna unit coupled to the communication module;

[0027] **FIG. 5** is a block diagram showing a configuration of a communication module and a sensor unit coupled to the communication module;

[0028] **FIG. 6** is a block diagram showing a control unit employed in the endoscope system shown in **FIG. 1**;

[0029] **FIG. 7** is a flowchart illustrating a data obtaining procedure executed by the control unit shown in **FIG. 6** according to the embodiment of the invention;

[0030] **FIG. 8** is a detailed flowchart illustrating a reception module selecting procedure which is executed in the flowchart shown in **FIG. 7**;

[0031] **FIG. 9** shows a cross sectional structure of a jacket according to a modification of the first embodiment of the invention;

[0032] **FIG. 10** shows a cross sectional structure of a jacket according to another modification of the first embodiment of the invention;

[0033] **FIG. 11** is a block diagram showing a configuration of a communication module and another antenna unit coupled to the communication module;

[0034] **FIG. 12** is a flowchart illustrating a data obtaining procedure executed by the control unit shown in **FIG. 6** according to a second embodiment of the invention; and

[0035] **FIG. 13** is a flowchart illustrating a data obtaining procedure executed by the control unit shown in **FIG. 6** according to a third embodiment of the invention.

DETAIL DESCRIPTION OF THE EMBODIMENTS

[0036] Referring now to the accompanying drawings, embodiments and modifications of the endoscope system will be described.

[0037] General Overview

[0038] The endoscope system according to the invention includes a diagnosis jacket. The diagnosis jacket is provided with circuitry to obtain various data of a subject person, or examinee without using lead wires, cables or copper patterns. The obtainable data may include body functions (e.g., pulse, blood pressure, temperature etc.) of the subject and images of body cavities. The diagnosis jacket is configured to be flexible and have durability, light weight, and further realizes freedom of design, higher density of antenna arrangement, and enhances the acquisition of image signals with a high S/N ratio.

First Embodiment

[0039] **FIG. 1** schematically shows a configuration of the endoscope system **10** according to an embodiment of the invention. The endoscope system **10** is used, for example, to obtain the body functions (e.g., pulse, blood pressure, temperature etc.) and/or image information of body cavities and the like of a subject **1**. Such data is used for diagnosing the subject **1**.

[0040] As shown in **FIG. 1**, the endoscope system **10** includes a capsule endoscope **100** which is inserted (swallowed) inside the subject **1**, the diagnosis jacket **200**, and a personal computer (PC) **300**. The capsule endoscope **100** captures images inside the subject **1** and outputs image data by radio. The diagnosis jacket **200** is provided with a plurality of antennas and circuits, and receives the image data output by the capsule endoscope **100**. The diagnosis jacket **200** transmits the obtained signal and data related to the body functions to the PC **300**. The PC **300** is provided with a display, which displays the data (e.g., image data) received from the diagnosis jacket **200**. In this specification, a term body function information includes information related to the body function of the subject **1** such as the body temperature, blood pressure, and the like, while a term body information includes at least one of image information captured by the capsule endoscope **100** and the body function information. Acquisition of the body function information will be described in detail later.

[0041] **FIG. 2** is a block diagram of the capsule endoscope **100** employed in the endoscope system **10** according to the embodiment. The capsule endoscope **100** has a shape of very small capsule, which can enter thin, long and meandering portions (e.g., a bowel) easily and capture images thereof. The capsule endoscope **100** is provided with a power unit **102** supplying power to each component of the capsule endoscope **100**, a control unit **104** that controls entire operation of the capsule endoscope **100**, a memory **106** that stores various pieces of data, a pair of illuminating units **108** used for illuminating walls of body cavity, an objective optical system **110** that converges received light to form an image on a solid-state imaging device **112** that captures images of the body cavity, a transmitting unit **114** for transmitting a radio wave carrying image data, a receiving unit **115** for receiving a radio wave transmitted from external devices, and antenna unit **116** from which the radio wave propagates.

[0042] When powered on and put into a body cavity of the subject **1**, the capsule endoscope **100** illuminates inside the body cavity with the pair of illuminating units **108**. The light reflected by walls of the body cavity is incident on the objective optical system **110**. The objective optical system **110** and the solid sate imaging device **112** are arranged such that the objective optical system **110** forms an image on the light receiving surface of the solid state imaging device **112**. The solid state image receiving device **112** applies a photoelectric conversion to the received optical image to generate an image signal corresponding to the optical image. The control unit **104** controls the transmitting unit **114** to superimpose the thus generated image signal onto a predetermined frequency signal by modulation, and transmit the modulated signal to outside through the antenna unit **116**. According to the embodiment, the signal output from the antenna unit **116** is received by the diagnosis jacket **200**.

[0043] It should be noted that the receiving unit **115** receives the radio wave from an external device, and based on signals represented by the received radio wave, the control unit **104** controls the illuminating units **108** (e.g., ON/OFF control) and other operations of the capsule endoscope **100**.

[0044] Next, the structure and operation of the diagnosis jacket **200** will be described in detail.

[0045] The diagnosis jacket **200** is a wearable jacket which is formed to cover a part of the upper body of the subject **1**. It should be noted that the diagnosis jacket **200** may be formed in various shapes and designs. For example, in **FIG. 1**, a vest type jacket **200** is shown, which is only exemplary design, and a so-called jacket having sleeves can also be used. Since the diagnosis jacket **200** is used for receiving the radio wave transmitted from the capsule endoscope **100** and further used for measuring body functions, it is important that the jacket **200** fits the outer shape of the subject **1**.

[0046] The diagnosis jacket **200** is provided with a plurality of communication modules **230** distributed therein, which constitute a circuitry for obtaining the image signal transmitted by the capsule endoscope **100**, a circuitry for transmitting electromagnetic waves for supplying electrical power and for transmitting control signals, and a circuitry for obtaining body functions of the subject **1**. The diagnosis jacket **200** also has a control unit **220** which is located at a waist portion of the subject **1** when wore, and controls the entire operation of the circuitries provided to the diagnosis jacket **200**.

[0047] **FIG. 3** is a partial cross-sectional side view of the diagnosis jacket **200**. The diagnosis jacket **200** employs a 2D-DST (two-dimensional diffusive signal transmission) technology, which is laid open in a web site <http://www.utri.co.jp/venture/venture2.html>, in Japanese Patent Provisional Publication No. P2003-18882A. According to the 2D-DST technology, a 2D-DST substrate is configures such that a plurality of chips are distributed between two signal layers so that adjacent chips are locally and electrically connected with each other. Then, data is relayed across the plurality of chips from an origin to a destination by packets. According to the embodiment, the diagnosis jacket **200**, which is the 2D-DST substrate in this case, is provided with two conductive sheets **212** and **214**, and insulating sheets **216** and **218** for insulating the two conductive sheets **212** and **214** from outside. Between the conductive sheets **212** and **214**, a plurality of communication modules **230** are distributed as schematically shown in **FIG. 1**.

[0048] Each of the two layers of conductive sheets **212** and **214** has flexibility and conductivity. Each of the conductive sheets **212** and **214** is formed to be a vest type jacket covering the chest and waist portion and back portion of the subject **1**. The conductive sheets **212** and **214** are spaced from each other with a predetermined clearance, having the communication module **230** provided therebetween, not shown insulating layer and/or insulating sheet stacked therebetween. Thus, the conductive sheets **212** and **214** are stacked with electrically insulated from each other. The conductive sheet **212** is on the subject side, while the conductive sheet **214** is on the outer side. In other words, the conductive sheet **212** is a backside sheet of the diagnosis jacket **200**, while the conductive sheet **214** is a front side sheet of the diagnosis jacket **200**.

[0049] The insulating sheet **216** is a flexible sheet having an insulating property. The insulating sheet **216** is shaped and provided to cover the outer surface (i.e., a surface opposite to the surface facing the conductive sheet **214**) of the conductive sheet **212**. The insulating sheet **216** is made of insulating rubber, insulating film or cloth having an insulating property. Insulating sheet **218** is also a flexible sheet having the insulating property, similar to the insulating sheet **216**. The insulating sheet **218** is shaped and provided to cover the outer surface (i.e., a surface opposite to the surface facing the conductive sheet **212**) of the conductive sheet **214**. Since the insulating sheets **216** and **218** are provided, even if an electrical current flows through the conductive sheet **212** or **214**, the outside of the diagnosis jacket **200** is insulated from the conductive sheets **212** and **214**, and no electrical currents leak outside.

[0050] Next, the communication module **230**, and an antenna unit **240***a* and a sensor unit **240***b*, each of which can be detachably attached to the communication module, will be described.

[0051] **FIG. 4** is a block diagram showing a configuration of the antenna-attached communication module **230** with antenna unit **240***a* being attached (hereinafter, such a communication module will be occasionally referred to as an antenna-attached communication module **230**). **FIG. 5** is a block diagram showing configuration of the antenna-attached communication module **230** with sensor unit **240***b* being attached (hereinafter, such a communication module will be occasionally referred to as a sensor-attached communication module **230**).

[0052] The communication module **230** includes a controller **232** that controls an entire operation of the communication module **230**, an I/O unit **234** that allows a connection (mechanically and electrically) of the communication module **230** with the antenna unit **240***a* or the sensor unit **240***b*, a memory **236** for storing various pieces of data including ID information of the communication module **230** and the attached antenna unit **240***a* or the sensor unit **240***b*, and a communication unit **238** that executes a communication with adjacent communication modules.

[0053] The communication module **230** to which the antenna unit **240***a* or the sensor unit **240***b* is not attached functions as a relaying point when a signal (packets) is transmitted in accordance with the 2D-DST technology to a destination. That is, the communication module **230** itself does not have a function to obtain data from the subject **1**, but only to relay signals.

[0054] According to the first embodiment, the communication module **230**, which basically functions as a relaying device, is provided with the I/O unit **234** that allows the communication module **230** to be coupled to various functional units. When an appropriate unit is coupled to the communication module **230** through the I/O unit **234**, a corresponding function is implemented. Thus, the operator can customize the diagnosis jacket **200** (i.e., the circuitry in the diagnosis jacket **200**) by attaching various units to respective communication modules **230** of the diagnosis jacket **200**. Therefore, the operator can construct the circuitries of the diagnosis jacket **200** so that a necessary diagnosis can be performed for each subject **1**. It should be noted that, by attaching a functional unit to a communication module **230**, the function is added to the communication module **230**, and it also functions as the relaying device.

[0055] Next, the antenna unit **240***a* will be described in detail. As shown in **FIG. 4**, the antenna unit **240***a* includes a controller **242***a* that control the entire operation of the antenna unit **242***a*, an antenna **244***a* that transmits/receives a radio wave having a predetermined frequency, and a memory **246***a* that stores various pieces of data including the ID information of itself.

[0056] The antenna unit **240***a* mainly functions to receive an image signal transmitted by the capsule endoscope **100** and to transmit a power supply signal that generates an electrical power inside the capsule endoscope **100** and a control signal carrying control information reflecting the operator's intention to the capsule endoscope **100**, through the antenna **244***a*. Since the antenna unit **240***a* can transmit the power supply signal, the capsule endoscope **100** can operate for a relatively long period although it mounts only a small battery. Further, by transmitting the control signal, the operator can remotely control the operation of the capsule endoscope **100**.

[0057] According to the embodiment, the antenna unit **240***a* has a function of an A/D converter for converting the received signal (analog signal) to a digital signal, and a function of a D/A converter for converting a digital signal to be transmitted into an analog signal to be applied to the antenna **244***a*. Although the antenna unit **240***a* according to the embodiment has both the signal receiving and transmitting functions, the invention need not be limited to such a configuration, and only one of receiving and transmitting functions may be used.

[0058] It should be noted that, since the capsule endoscope **100** is mainly used for capturing images inside the bowel, it is preferable that a plurality of antenna units **240***a* are concentrically arranged at a stomach area of the subject **1** (i.e., a plurality of antenna units **240***a* are attached to the communication modules **230** located at the stomach area of the subject **1**).

[0059] As shown in **FIG. 3**, at a position of each communication module **230**, the conductive sheet **212** is formed with an opening **212***a*. Further, on the insulating sheet **216**, an opening **216***a* is formed at a position corresponding to each of the opening **212***a*. Therefore, through the openings **216***a* and **212***a*, the I/O unit **234** is exposed to outside the diagnosis jacket **200**. As a result of the structure, the antenna unit **240***a* can easily be attached to the communication module **230**. Since the antenna **244***a* as attached to the communication unit **230** is exposed to the subject **1**, good transmission/reception of the radio wave between the antenna **244***a* and the capsule endoscope **100** is achieved.

[0060] It should be noted that the antenna **244***a* should be exposed to the subject **1** (i.e., the capsule endoscope side). Since the layer **212** is a conductive layer, if the antenna **244***a* is not exposed, the radio wave is shielded by the conductive layer **212** and cannot be transmitted to or received from the capsule endoscope **100**.

[0061] Further, according to the diagnosis jacket **200** configured as above, each antenna **244***a* is exposed to the subject **1**, while the conductive sheet **214** is provided on the opposite side. Therefore, the conductive sheet **214** serves as a shield for the radio wave which is transmitted from a direction opposite to the direction in which the radio wave is transmitted from the capsule endoscope **100** (i.e., from an external device located around the subject **1**). Thus, unexpected noise directed to the antenna **244***a* can be shielded by the conductive sheet **214**. According to another aspect, the radio wave transmitted from the antenna **244***a* only propagates toward the capsule endoscope **100**, and does not affect devices around the subject **1**. Therefore, the antenna **244***a* can receive the radio wave (image signal) transmitted from the capsule endoscope **100** at a relatively high S/N ratio. Further, the conductive sheet **214** also shields the radio wave transmitted by the capsule endoscope **100** from propagating toward external devices around the subject **1**.

[0062] In the above-described embodiment, the antenna unit **240***a* is capable of receiving and transmitting the radio wave. However, the invention need not be limited to such a configuration, and the antenna unit **240***a* may be modified to have only one of receiving and transmitting functions.

[0063] In the embodiment described above, the capsule endoscope **100** and the antenna unit **240***a* communicate with each other using a radio wave having a predetermined frequency. It is possible to modify this configuration such that the communication is performed using another spatially propagating signal. For example, light waves may be used for communication by employing a photo diode, LED (light emitting diode) or LD (laser diode). In such a case, the antenna **244***a* may be replaced with the photo diode for receiving the light wave. For the transmission function, the antenna **244***a* may be replaced with the LED or LD. Of course, if both the transmission/reception functions are implemented, both the photo diode and the LED or LD are to be employed instead of the antenna **244***a*.

[0064] Alternatively, an audio wave may be used as another form of the spatially propagating wave. When the audio wave is utilized, the antenna **244***a* may be replaced with a supersonic wave receiver. For transmitting the audio wave, the antenna **244***a* may be replaced with a supersonic transmitter. For reception/transmission, both the supersonic receiver/transmitter may replace the antenna **244***a*.

[0065] Next, the sensor unit **240***b* will be described in detail with reference to **FIG. 5**. As shown in **FIG. 5**, the sensor unit **240***b* includes a controller **242***b* that controls the entire operation of the sensor unit **242***b*, a sensor **244***b* that obtains body function information, and a memory **246***b* that stores various pieces of data including the ID information of itself.

[0066] The sensor unit **240***b* mainly serves to obtain body function information, such as the body temperature, breathing rate, cardiac rate and the like using a corresponding sensor. With the function of the sensor unit **240***b*, the operator can check the body function of the subject **1** while observing the image of the body cavity by use of the capsule endoscope **100**. Therefore, if the body condition of the subject **1** turns bad during the observation, it is immediately recognized by the operator, and thus can be treated quickly.

[0067] As the sensor **244***b*, various types of sensors can be used. For example, a temperature sensor for measuring the body temperature, a pressure sensor for measuring the breathing rate, cardiac rate or blood pressure, a Ph sensor for measuring a hydrogen-ion concentration, a uric acid sensor for measuring a uric acid value of sweat, a light sensor for measuring existence/unexistence of bleeding, a supersonic sensor for measuring a blood flow volume, a photo sensor for measuring an oxygen saturation degree, electrodes for cardiology measurement, and the like. The plurality of sensor units **240***b* have the above sensors, respectively, and arranged at appropriate positions of the diagnosis jacket **200**. Further, since the sensor unit **240***b* can be repositioned easily (simply by detaching from a communication module **230** and attaching to another communication module **230**), the senor units **240***b* can be located at optimum positions for the subject **1**.

[0068] For example, when the sensor units **240***b* having the pressure sensor for measuring the cardiac rate are used, they are attached to the communication modules **230** provided at positions of the diagnosis jacket **200** facing a left thorax (close to the heart) of the subject **1**.

[0069] The sensor unit **240***b* mounting the temperature sensor is configured such that the sensor **244***b* in **FIG. 5** serves as the temperature sensor such as one using a thermistor. Such a temperature sensor is mainly used for measuring the body temperature (strictly speaking, the body surface temperature) of the subject **1**.

[0070] The sensor unit **240***b* mounting the pressure sensor is configured such that the sensor **244***b* in **FIG. 5** serves as the pressure sensor (e.g., a diaphragm type or semiconductor type pressure sensor). When the breathing rate is measured, the pressure of the body surface of the subject **1** is measured with a measuring frequency of 10 through 20 times/minute, and the number of breathing is calculated. When the cardiac rate is measured, the pressure of the body surface is measured with a measuring frequency of 50 through 100 times/minute, and the number of heart beat is obtained. It should be noted that the diagnosis jacket **200** is elasticated so that the sensors mounted thereon are press-contacted against the body surface of the subject **1**. With this elasticated configuration, it is possible to press the pressure sensor against a blood vessel running close to the surface of the body to measure the blood pressure.

[0071] The sensor unit **240***b* mounting the supersonic wave sensor is configured such that the sensor **244***b* in **FIG. 5** serves as the supersonic wave sensor, which includes a supersonic wave receiver and transmitter (in this example, the supersonic sensor includes an integrally combined supersonic receiver/transmitter). The supersonic sensor emits a supersonic wave into the body cavity of the subject **1**, and detects a Doppler shift (i.e., a change of frequency in accordance with the Doppler effect) to calculate the blood flow.

[0072] The sensor unit **240***b* mounting the photo sensor is configured such that the sensor **244***b* in **FIG. 5** serves as the photo sensor, which includes a light source (e.g., LED or LD) and the photo diode. In this embodiment, the sensor provided with both the light source and photo diode will be referred to as the photo sensor.

[0073] The photo sensor is used for measuring the degree of oxygen saturation in the blood, making use of the characteristic of the blood such that an absorption factor for infrared light of hemoglobin varies as the oxygen saturation degree of the hemoglobin in the blood changes. Specifically, the photo sensor functions as a reflection type photo interrupter. For example, from the LED, light is emitted to the blood inside the body cavity. Then, the reflected light is received by the photo diode to determined the status of the reflected light. Based on the detection result, the oxygen saturation degree is calculated.

[0074] According to the structure of the sensor unit **240***b* and the communication module **230**, since the sensor **244***b* is slightly protruded toward the subject **1** from the surface of the diagnosis jacket **200**, excellent adhesiveness of the sensor **244***b* with respect to the subject **1** is obtained. In particular, when the pressure sensor is used as the sensor **244***b*, it is ensured that the pressure sensor contacts the surface of the subject **1**, and accurate measurement can be performed.

[0075] When the antenna unit **240***a* (or the sensor unit **240***b*) is connected to the communication module **230**, the controller **232** of the communication module **230** accesses the memory **246** of the antenna unit **240***a* (or the memory **246***b* of the sensor unit **240***b*) via the I/O unit **234** to retrieve the data including the ID information of the unit. With this configuration, the controller **232** of the communication module **230** recognizes the type of the unit attached thereto. Further, the retrieved data can be transmitted together with the ID information of the communication module **230** to the control unit **220** in accordance with the 2D-DST technology. Therefore, the control unit **220** can recognize the functions added to the communication modules **230**, respectively.

[0076] Next, the configuration of the control unit **220** that controls the entire operation of the diagnosis jacket **200** will be described. The control unit **220** mainly has a function of controlling the entire operation of the diagnosis jacket **200**, and a function as an interface.

[0077] **FIG. 6** is a block diagram showing a configuration of the control unit **220**. The control unit **220** has a controller **221** which functions as a controller for the entire operation of diagnosis jacket **221**, a power source **222** that supplies electrical power to the diagnosis jacket **200**, a communication unit **223** that communicates, through the conductive sheet **212** or **214**, with the communication modules **230** located close to the control unit **220**, a memory **224** for storing various data including control programs and data including the obtained image signal and body information, a signal processing unit **225** that processes the obtained image signal to display an image on the display of the PC **300**, and an interface unit **226** through which the control unit **220** is connected with external device and outputs data (e.g., image data and body function data) to the external device. The data obtained by respective communication modules **230** are collected by the control unit **220**, which transmits the collected data to the PC **300** so that the operator can view the same on the display of the PC **300**.

[0078] **FIG. 7** is a flowchart illustrating a data obtaining procedure which is executed by the control unit **220** (i.e., the controller **221**) to obtain various pieces of data including the image data and body function data. In the following description, as an example, it is assumed that a plurality of antenna units **240***a* and a plurality of sensor units **240***b* are mounted to the diagnosis jacket **200**.

[0079] When a power switch (not shown) of the control unit **220** is turned ON, the power source **222** supplies the electrical power to the control unit **220**, thereby the control unit **220** starts its operation. Then, the controller **221** can communicate with the communication modules **230** in accordance with the 2D-DST technology. Each communication module **230** operates in accordance with the algorithm (i.e., program) stored in the controller **232** to obtain the ID information, and transmits the ID information to the control unit **220** (S1). The controller **221** can distinguish respective communication modules based on the ID information.

[0080] When the ID information setting process (S1) is finished in each communication module **230**, the controller **221** judges whether the power source is switched ON or OFF (S2). If the power switch is switched OFF (S2: YES), the controller **221** finishes the procedure shown in **FIG. 7**. When the power switch is ON (S2: NO), controller **221** advances the procedure to S3.

[0081] In S3, the controller **221** selects an antenna-attached communication module **230** that receives the radio wave output by the capsule endoscope **100**. In the following description, the antenna-attached communication module **230** that receives the radio wave is occasionally referred to as a reception module.

[0082] **FIG. 8** shows a flowchart illustrating the reception module selecting procedure which is a subroutine called in S3 of the flowchart shown in **FIG. 7**.

[0083] When the reception module selecting operation is called, the controller **221** obtains reception amplitude data representing a signal reception amplitude by each antenna-attached communication module **230** (i.e., by the antenna **244***a*) regarding the image signal transmitted by the capsule endoscope **100** (S21). In S22, the signal reception amplitude data of all the antenna-attached communication modules **230** distributed over the diagnosis jacket **200** are compared to determined the antenna-attached communication module **230** having the greatest amplitude. In S23, the controller **221** selects the antenna-attached communication module **230** that has determined to have the greatest signal reception amplitude in S21 is selected as the module to receive the image signal transmitted from the capsule endoscope **100**. Then, the controller **221** controls the selected antenna-attached communication module **230** to received the radio wave transmitted from the capsule endoscope **100**. When the antenna-attached communication module **230** to receive the signal is determined in S23, the reception module selecting procedure is finished, and process proceeds to S4 of **FIG. 7**. It should be noted that the antenna-attached communication module **230** that receives the radio wave from the capsule endoscope **100** demodulates the received signal to obtain the image signal carried by the radio wave.

[0084] The antenna-attached communication module **230** which is currently set to serve as the reception module transmits, under control of the controller **221**, a radio wave for supplying electrical power to the capsule endoscope **100** at a predetermined timing. Since the capsule endoscope **100** is supplied with the electrical power, it can operate for a relatively long period. It should be noted that, although the reception module is used to transmit the radio wave for supplying the electrical power to the capsule endoscope in the embodiment, it is possible that another communication module is used for this purpose that is not currently used for receiving the radio wave from the capsule endoscope **100**. Alternatively, the antenna-attached communication modules **230** may include modules only for supplying the electrical power to the capsule endoscope **100**.

[0085] In S4, the controller **221** determines a minimum signal transmission path which is one of paths defined by connecting the communication modules **230** from the selected reception module to the controller **221**, and having the shortest path length. When the transmission path is determined, the image signal demodulated and obtained by the reception module is transmitted along the determined path and reaches the control unit **220** (S5). The controller **221** stores the thus received image signal in the memory **224** (S6). The image signal stored in the memory **224** is, under control of the controller **221**, processed by the signal processing unit **225** and converted into a video signal, which is transmitted to the PC **300** via the interface **226**. Thus, on the display of the PC **300**, the image of the body cavity of the subject **1** is displayed.

[0086] The controller **221** selects sensor-attached communication modules **230** to obtain body functions of the subject **1** (S7). The sensor-attached communication modules **230** are selected in accordance with a predetermined order. For example, when step S7 is executed first time, a sensor-attached communication module **230** having the temperature sensor is selected, and thereafter, at each execution of step S7, sensor-attached communication modules **230** having the pressure sensor, supersonic wave sensor, photo sensor, and electrodes are selected respectively.

[0087] Alternatively, the surface of the diagnosis jacket **200** is divided into a plurality of areas (e.g., chest area, stomach area, etc.), and the sensor-attached communication modules **230** in different area may be selected at every execution of step S7.

[0088] Further alternatively, if the total number of the sensor-attached communication modules **230***b* provided on the diagnosis jacket **200** is relatively small, all the sensor-attached communication module **230** may be selected at a time.

[0089] The controller **232** of the selected sensor-attached communication module **230** calculates a measurement value based on the value detected by the sensor **244***b*, and stores the measurement value in the memory **236** as body function data of the subject **1**.

[0090] In S8, the controller **221** determines a minimum transmission path that connects the communication modules **230** from the selected sensor-attached communication module **230** to the controller **221**. When the minimum transmission path is determined, the body function data is retrieved form the memory **236**, and transmitted along the determined transmission path through the communication modules **230**, and reaches the control unit **220** (S9). The body function data as received is stored in the memory **224** (S10). After storing the received body function data, the controller **221** returns to step S2, and thereafter, repeats the above-described steps S2-S10.

[0091] According to the embodiment, the body function data stored in the memory **224** is converted into character signal by the processing unit **225**, and superimposed on the video signal which is also processed by the processing unit **225**. Then, the video signal is transmitted to the PC **300** via the interface unit **226**. Thus, on the display of the PC **300**, characters indicating the body functions of the subject **1** as well as the image of the body cavity.

[0092] When the operator operates an operable member (not shown) for controlling the capsule endoscope **100**, the antenna-attached communication module **230** currently selected reception module transmits, under control of the controller **221**, a control signal corresponding to the operation of the operable member to the capsule endoscope **100**. With this configuration, the operator can control the operation of the capsule endoscope **100**. It should be noted that the module that transmits the control signal to the capsule endoscope **100** need not be limited to the currently selected reception module **230**, but another antenna-attached communication module **230** which is not currently receiving image signal can be used. Alternatively, a dedicated communication module only for transmitting the control signal may be employed.

[0093] It should be noted that the invention need not be limited to the configurations of the above-described embodiment and its modifications, but can be modified further in various ways without departing from the scope of the invention.

[0094] For example, in the embodiment, the control unit **220** and the PC **300** are connected with a cable (see **FIG. 1**). This can be modified such that a wireless connection may be utilized instead of the cable.

[0095] **FIG. 9** shows another structure of the diagnosis jacket **200** according to a modification of the above-described embodiment. **FIG. 10** shows another modification of the diagnosis jacket **200**. In these modifications, structures for connecting the antenna/sensor unit and the communication module **230** are different from that of the above-described embodiment. In the description on the modifications, the elements/structures same as those in the above-described embodiment are referred to using the same reference numbers, which will not be described in detail for the brevity.

[0096] In **FIG. 9**, a communication module **230***z* is indicated. The communication module **230***z* is configured such that a part thereof protrudes toward the subject **1** with respect to the outer surface of the insulating sheet **216**, and the I/O unit **234** is provided at the tip of the protruded part of the communication module **230***z*. Further, an antenna unit **240***za* or a sensor unit **240***zb* coupled to the communication module **230***z* is formed to fully cover the protruded part of the communication module **230***z*. When the antenna unit **240***za* (or the sensor unit **240***zb*) is coupled to the communication module **230***z*, as show in **FIG. 9**, the protruded part is covered by the coupled unit **240***za* (or **240***zb*) in all the directions. Therefore, the antenna unit **240***za* (or the sensor unit **240***zb*) is fixed in all the directions except the coupling direction (i.e., up-and-down direction in **FIG. 9**). With this structure, even if a force is applied to the antenna unit **240***za* (or the sensor unit **240***zb*) in the direction other than the up-and-down direction, the antenna unit **240***za* (or the sensor unit **240***zb*) will not be detached. That is, with this structure, the mechanical connection between the communication module **230***z* with the antenna unit **240***za* (or the sensor unit **240***zb*) is strengthened. Further, by employing such a structure, it is possible to use a wider antenna, which enhances the signal reception degree.

[0097] **FIG. 10** shows a communication module **230***y*. The communication module **230***y* is configured such that a part thereof protrudes toward the subject **1** with respect to the outer surface of the insulating sheet **216**, and the I/O unit **234** is provided at the tip of the protruded part of the communication module **230***y*. According to this modification, the I/O unit **234** is protruded sideward (i.e., protruded from the protruded part of the communication module **230**_y_ in a direction parallel to the surface of the insulating sheet **216**). Therefore, according to this structure, an antenna unit **240**_ya_ or a sensor unit **240**_yb_ is coupled to the I/O unit **234** from the sideward direction. With this structure, it is possible to suppress the thickness (i.e., the length in up-and-down direction in **FIG. 10**) of the diagnosis jacket **200** when the antenna units **240**_ya_ and/or sensor units **240**_yb_ are attached.

[0098] **FIG. 11** shows an antenna unit **240**_xa_ which is a further modification of the antenna unit **240**_a_ shown in **FIG. 4**. According to this modification, the antenna unit **240**_xa_ has an antenna **244**_a_ and an ID memory **246**_xa_ storing the ID information thereof. As is appreciated, the antenna unit **240**_xa_ does not include a controller such as the controller **242**_a_ shown in **FIG. 4**. Since the controller is not included, the antenna unit **240**_xa_ can be manufactured at a relatively low cost. When this type of antenna unit **240**_xa_ is used, the procedure executed by the controller **242**_a_ in the above-described embodiment is executed by a controller **232**_x_ of a communication module **230**_x_. For example, the radio wave received by the antenna **240**_a_ is transmitted to the communication module **230**_x_ via the I/O unit **234**. Then, the controller **232**_x_ converts the received signal into a digital signal. Further, a signal for supplying the electrical power to the capsule endoscope **100** is converted from the analogue to digital by the controller **232**_x_, and is transmitted to the antenna **244**_a_ via the I/O unit **234**.

[0099] It is of course possible to modify the configuration shown in **FIG. 11** such that the antenna **244**_a_ may have only the transmitting or receiving function. Further, as the spatially propagating signal, light wave or sonic wave may be used instead of the radio wave.

[0100] The configuration shown in **FIG. 11** is also applicable to a sensor unit. That is, instead of the antenna **244**_a_, sensor **244**_b_ may be used in the structure shown in **FIG. 11**.

[0101] Optionally, the control unit **220** may be provided with a memory card slot so that image data and/or body function data can be stored in a memory card inserted in the card slot.

[0102] In the embodiment, the communication modules are arranged on the jacket shaped wearable. The shape of the wearable jacket need not be limited to the vest shape, but the wearable jacket may have various shapes, such as a shape of a belt.

Second Embodiment

[0103] **FIG. 12** shows a flowchart illustrating a data obtaining procedure executed by the control unit **220** according to a second embodiment. According to the procedure shown in FIG. **7**, the reception module is selected every time the obtained image and the body function data is stored in the memory **224**. According to the second embodiment, the reception module is selected at very predetermined timings. In the following description on **FIG. 11**, the steps which are the same as those in **FIG. 7** will be assigned with the same step numbers and description thereof will be omitted for the brevity.

[0104] When the power switch of the control unit **220** is ON and the ID data setting process is executed in **S1**, controller **221** starts a counter A (which has an initial value of zero) in **S31**. The counter A is referred to in **S33**, which will be described later. After controller **221** judges whether the power source is OFF in **S2**, and steps **S3** and **S4** are executed, the controller **221** increments the counter A by one.

[0105] After steps **S5** through **S10** are executed (i.e., the image signal and the body function data are transmitted to the control unit **220** and stored in the memory **224**), the controller **221** judges whether the value of the counter A is equal to a predetermined value A1, which corresponds to a predetermined timing. If the value of the counter A is not equal to A1 (**S33**: NO), the controller **221** returns the process to **S32**, increments the counter A by one, and repeats the steps **S5** through **S10** again.

[0106] If the value of the counter A is equal to A1 (**S33**: YES), the controller **221** resets the counter A (i.e., sets the counter to zero) in **S34**, and the controller returns to **S2**.

[0107] According to the second embodiment, as described above, a period for selecting the reception module is longer than a period for transmitting the image signal and body function data to the control unit **220**.

[0108] According to the procedure shown in **FIG. 11**, the reception module is not selected every time when the image data and body function data are stored in the memory **224**, but the selection is made at every predetermined period, which is longer than the period for storing the image data and body function data in the memory **224**. Therefore, according to the second embodiment, the reception module selection procedure is executed less frequently and the burden to the controller **221** is decreased in comparison with the first embodiment.

[0109] The configuration of the second embodiment is particularly effective when the capsule endoscope **100** moves at a relatively low speed, since it is not necessary to change the reception module so frequently.

Third Embodiment

[0110] **FIG. 13** is a flowchart of the data obtaining procedure according to a third embodiment. According to the procedure shown in **FIG. 13**, acquisition of the image data, acquisition of the body function data and selection of the reception module are executed at different timings. It should be noted that the steps that are the same as those in **FIG. 7** or **FIG. 12** will be assigned with the same step numbers and description thereof will be omitted for the brevity.

[0111] When the power switch (not shown) is turned ON and the 1D data setting process is executed in **S1**, controller **221** starts the counters A (initial value=0) and B (initial value=0) in **S31**. After judgment in **S2**, reception module selection procedure in **S3** and path determining procedure in **S4** are finished, the controller **221** increments the counter A by one (**S32**).

[0112] When steps **S5** and **S6** are finished (i.e., the image signal is transmitted to the control unit **220** and stored in the memory **224**), the controller **221** judges whether the value of the counter A is equal to A1 in **S41**. If the value of the counter A is not A1 (**S41**: NO), the controller **221** returns to **S32**, where the counter A is incremented by one (**S32**), and steps **S5** and **S6** are executed again to receive the image signal again and stores the received image signal in the memory **224**.

[0113] If the value of the counter A is equal to A1 (S41: YES), the controller 221 increments the counter B by one (S42), and executes steps S7 through S10 (i.e., the body function data is transmitted to the control unit 220 and stored in the memory 224).

[0114] When step S10 is executed, the controller 221 judges whether the value of the counter B is equal to B1 (S43). If the value of the counter B is equal to B1 (S43: YES), the controller 221 resets the values of the counters A and B to the initial values (=0) in S45, and the controller 221 returns the process to S2. In the above example, the interval of transmitting the body function data to the control unit 220 is longer than the interval of transmitting the image signal to the control unit 220, and further the interval of selecting the reception modules is longer than the interval of the selection of the reception module.

[0115] According to the third embodiment, the image signal and the body function data are not obtained at the same timing. The interval for obtaining the body function data is longer than the interval for obtaining the image signal. Further, according to the procedure shown in FIG. 12, the interval for selecting the reception module is longer than the timing for storing the body function data in the memory 224.

[0116] That is, according to the third embodiment, acquisition of the image data, acquisition of the body function data and selection of the reception module are executed at different timings. In particular, according to the third embodiment, emphasis is laid on the acquisition of the image data, the image data is obtained most frequently. Depending on a situation, it is possible to execute the acquisition of the body function data most frequently.

[0117] The present disclosure relates to the subject matter contained in Japanese Patent Application No. 2004064144, filed on Mar. 8, 2004, which is expressly incorporated herein by reference in its entirety.

What is claimed is:

1. A wearable jacket, comprising:

a 2D-DST substrate shaped to cover a body of a subject person,

the 2D-DST substrate including:

a conductive sheet; and

a plurality of communication modules distributed on the conductive sheet, at least one communication module of the plurality of communication modules being provided with a connector portion to which one of predetermined types of functional unit is electrically connected.

2. A wearable jacket system, comprising:

a 2D-DST substrate shaped to cover a body of a subject person,

the 2D-DST substrate including a conductive sheet and a plurality of communication modules distributed on the conductive sheet, at least one communication module of the plurality of communication modules being provided with a connector portion; and

a plurality of types of functional units, any one of the plurality of predetermined types of functional unit is electrically connected to the connector portion of the at least one communication module.

3. The wearable jacket system according to claim 2, wherein the plurality of types of functional units include one of a body temperature sensor, a sensor for measuring a breathing rate, cardiac rate or blood pressure, a blood flow sensor, a sensor for measuring oxygen saturation degree, a sensor for detecting sweat, a sensor for detecting uric acid level, a sensor for detecting an occurrence of bleeding, electrodes for cardiographic measurement, and a communication unit that receives a signal transmitted by an external device.

4. The wearable jacket system according to claim 2, comprising a controlling system that determines a transmission path of data in accordance with a 2D-DST technology, the controlling system storing data received via the transmission path to a predetermined recording medium.

5. The wearable jacket system according to claim 4, wherein the controlling system includes a data conversion system that converts the received data so as to be displayed on a display device.

6. The wearable jacket system according to claim 4, wherein the controlling system further includes an interface to which a removable recording medium is selectively connected, the controlling system storing the data in the removable recording medium via the interface.

7. The wearable jacket system according to claim 6, wherein the controlling system is capable of communicating an external device via a wireless communication, the data being transmitted to the external device via the wireless communication.

8. The wearable jacket system according to claim 4,

wherein the plurality of types of units have different pieces of ID information,

wherein the at least one communication module of the plurality of communication modules obtains the ID information of a unit connected to the at least one communication module of the plurality of communication modules and transmits the obtained ID information along with ID information of the at least one communication module of the plurality of communication modules.

9. The wearable jacket system according to claim 8,

wherein when at least one communication module of the plurality of communication modules is connected with a communication unit capable of receiving a signal transmitted by an external device, the controlling system controls the at least one communication module of the plurality of communication modules to transmit the signal received from the external device and body information other than the signal transmitted by the external device at every predetermined period.

10. The wearable jacket system according to claim 8,

wherein when at least one communication module of the plurality of communication modules is connected with a communication unit capable of receiving a signal transmitted by an external device, the controlling system controls the at least one communication module of the plurality of communication modules to transmit the signal received from the external device and body information other than the signal transmitted by the external device periodically at different timings, respectively.

11. The wearable jacket system according to claim 10,

wherein the controlling system controls the at least one communication module of the plurality of communication modules to transmit the signal received from the external device at every first predetermined period and to transmit the body information other than the signal transmitted from the external device at every second predetermined period, which is longer than the first predetermined period.

12. The wearable jacket system according to claim 9, wherein the controlling system selects an optimum communication module mounting a communication unit from among the plurality of communication modules at every third predetermined period which is longer that the predetermine period.

13. The wearable jacket system according to claim 2, wherein the plurality of types of functional units include a communication unit that is capable of at least one of a function of transmitting a signal carrying predetermined information to an external device and another function of receiving a signal transmitted by the external device.

14. The wearable jacket system according to claim 13, wherein the predetermined information includes at least one of a signal that supplies electrical power to the external device and a signal that controls an operation of the external device.

15. An endoscope system comprising a capsule endoscope having a communication function and a wearable jacket system,

the capsule endoscope comprising:

an imaging device that captures an image; and

a wireless communicating system that transmits image data representing the captured image toward the wearable jacket system,

the wearable jacket system comprising:

a 2D-DST substrate shaped to cover a body of a subject person, the 2D-DST substrate including a conductive sheet and a plurality of communication modules distributed on the conductive sheet, at least one communication module being provided with a connector portion;

a plurality of types of functional units, any one of the predetermined types of functional units being electrically connected to the connector portion of the at least one communication module, the at least one communication module including a reception module which is a communication module connected with a communication unit via the connector portion, the communication unit being capable of receiving the image data transmitted by the wireless communicating system of the capsule endoscope; and

a displaying system that displays an image represented by the signal received by the communication module.

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专利名称(译)	用于诊断的可穿戴夹克和使用可穿戴夹克的内窥镜系统		
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摘要(译)

可穿戴夹克包括2D-DST基底，其形状覆盖主体的身体。 2D-DST基板包括导电片，以及分布在导电片上的多个通信模块。至少一个通信模块设置有连接器部分，预定类型的功能单元之一电连接到该连接器部分。