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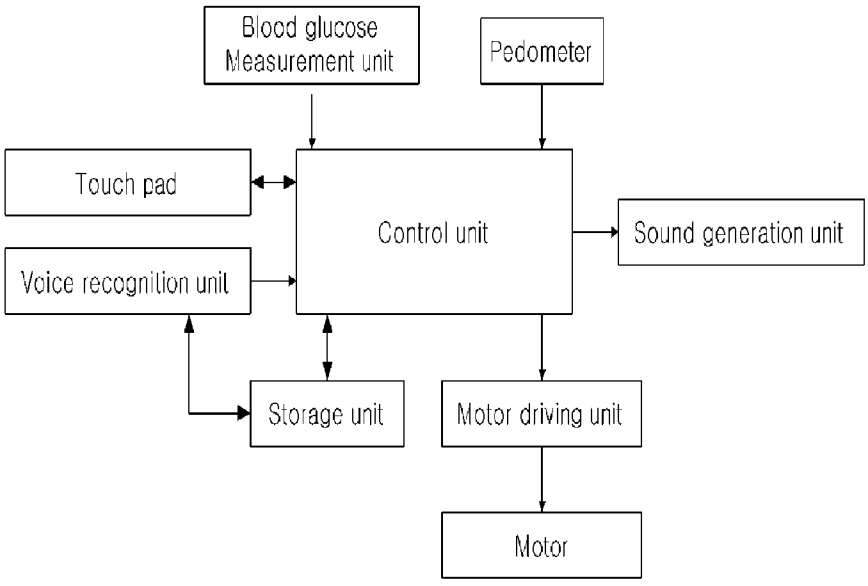
(54) **Title:** INSULIN INJECTION APPARATUS AND WORKING METHOD THEREOF

[Fig. 2]



(57) **Abstract:** There are provided an apparatus for injecting insulin and a method for operating the same that a diabetic or even a blind diabetic more or less lacking in cognitive ability can safely and conveniently use without a complicated operation of button but also can immediately use by simple directions of use, while removing a necessity to be familiar with a method of use through a hospitalization for a long time, and can automatically control an amount of insulin to be injected according to a change in the diabetic's condition, thereby more accurately controlling a blood glucose level of the diabetic.

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Description

INSULIN INJECTION APPARATUS AND WORKING METHOD THEREOF

Technical Field

[1] The present invention relates to an apparatus for injecting insulin and a method for operating the same and, more particularly, to an apparatus which is always connected to the body of a diabetic, for continuously injecting insulin into the body.

Background Art

[2] Diabetes mellitus (hereinafter, referred to as diabetic) is a disease caused by disordered metabolism resulting from an insufficient level of insulin which is the hormone produced in the pancreas. An excessively high blood glucose level abnormal in comparison to a normal blood glucose level is likely to cause various complications. Therefore, if a blood glucose level is not controlled, it may result in coma or death.

[3] As typical diabetic treatment, a diabetic keeps diet of restricting his/her food intake, takes appropriate exercise, and positively uses selectively or combinatory medication or/and an insulin injection.

[4] Among the aforementioned treatment, a method of injecting insulin has to be capable of properly injecting insulin according to a change in a blood glucose level of a diabetic. A blood glucose level considerably changes before and after taking a meal, before and after taking exercise, and the like. Thus, the amount of insulin may be insufficient after taking a meal or it may be too much on an empty stomach, to cause hypoglycemia.

[5] Due to the aforementioned reasons, the conventional art has provided a device, known as an insulin pump, which is used to properly inject insulin into a body of a diabetic according to a change in a blood glucose level of the diabetic.

[6] However, since the conventional insulin pump has the relatively small number of operation buttons, for example, 4~5 operation buttons, a user needs to search and operate an operation menu in the complicated and repeated manner. Consequently, the operability of the conventional device is very low.

[7]

[8] *Specifically, diabetics who are mostly old people more or less lack cognitive ability. Those people feel very uneasy about wrongly operating the device because it is to inject a drug into the body. Therefore, in many cases, diabetics feel difficulties in properly using the conventional device. Moreover, for the correct use of the conventional device, diabetics would enter hospital for a few to several days in order to be fully aware of its use method.

[9] Furthermore, in the conventional insulin pump, a display unit for displaying contents is relatively small and information being displayed is formed of implicative characters. As a result, it is difficult for a diabetic to perceive a variety of information provided by the insulin pump.

[10] Although the conventional insulin pump injects a predetermined amount of insulin, based on the conditions being preset by manual operation, it does not automatically reflect any changes in a diabetic's health condition on an amount of insulin to be injected.

[11] Therefore, even if a diabetic's health condition changes, the conventional insulin pump injects the predetermined amount of insulin until the settings of the insulin pump are artificially modified. Consequently, the conventional insulin pump is difficult to continuously inject a proper amount of insulin into a diabetic.

Disclosure of Invention

Technical Problem

[12] Therefore, the present invention has been made to solve the above problems, and it is an object of the present invention to provide an apparatus for injecting insulin and a method for operating the same that a diabetic or even a blind diabetic more or less lacking in cognitive ability can safely and conveniently use without a complicated operation of button but also can immediately use by simple directions of use, while removing a necessity to be familiar with a method of use through a hospitalization for a long time, and can automatically control an amount of insulin to be injected according to a change in the diabetic's condition, thereby more accurately controlling a blood glucose level of the diabetic.

Technical Solution

[13] In accordance with an aspect of the present invention, the above and other objects can be accomplished by an apparatus for injecting insulin comprising: a blood glucose measurement unit for measuring a blood glucose level from a blood sample of a user; a pedometer for measuring an amount of exercise of the user; a touch pad for displaying a screen to the user and receiving a user input; a voice recognition unit for receiving and recognizing a user voice input; an insulin injection unit for injecting insulin into a body of the user; a sound generation unit for providing information in sound to the user; a storage unit for storing and retrieving information; and a control unit for receiving information from the blood glucose measurement unit, the pedometer and the voice recognition unit, for exchanging information with the touch pad and the storage unit and driving the sound generation unit and the insulin injection unit.

[14] Further, in accordance with another aspect of the present invention, there is provided a method for operating the apparatus for injecting insulin, comprising: a blood glucose

measurement step of measuring a blood glucose level from a blood sample of a user; an exercise amount measurement step of measuring an amount of exercise of the user; a visual interface step of displaying an image on a screen of a touch pad and receiving a user input from the touch pad; a voice recognition step of receiving and recognizing a user voice input; a calculation step of calculating an amount of insulin to be injected, based on the information of the measured blood glucose level and the measured amount of exercise, the user input from the touch pad, and the user voice input; an insulin injection step of injecting the calculated amount of insulin into a body of the user; a sound generation step for providing information in sound to the user; and a storage unit driving step of storing the information of the measured blood glucose level and the measured amount of exercise, the user input from the touch pad, the user voice input, and the amount of insulin injected into the body of the user in a storage unit, or retrieving the information from the storage unit.

Advantageous Effects

[15] In accordance with the present invention, a diabetic or even a blind diabetic more or less lacking in cognitive ability can safely and conveniently use without a complicated operation of button but also can immediately use by simple directions of use, while removing a necessity to be familiar with a method of use through a hospitalization for a long time, and can automatically control an amount of insulin to be injected according to a change in the diabetic's condition, thereby more accurately controlling a blood glucose level of the diabetic.

Brief Description of the Drawings

[16] These and other aspects and advantages of the present invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings, in which:

[17] FIG. 1 is a view of the external shape of an apparatus for injecting insulin according to an embodiment of the present invention;

[18] FIG. 2 is a block diagram illustrating the apparatus for injecting insulin according to the embodiment of the present invention; and

[19] FIG. 3 is a flow chart illustrating an example of operating a control unit in a method for operating the apparatus for injecting insulin according to the embodiment of the present invention.

Best Mode for Carrying Out the Invention

[20] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[21] Referring to FIGS. 1 and 2, an apparatus for injecting insulin according to an embodiment of the present invention comprises: a blood glucose measurement unit for

measuring a blood glucose level from a blood sample of a user; a pedometer for measuring an amount of exercise of the user; a touch pad 5 for displaying a screen to the user and receiving a user input; a voice recognition unit for receiving and recognizing a user voice input; an insulin injection unit for injecting insulin into a body of the user; a sound generation unit for providing information in sound to the user; a storage unit for storing and retrieving information; and a control unit for receiving information from the blood glucose measurement unit, the pedometer and the voice recognition unit, for exchanging information with the touch pad 5 and the storage unit and driving the sound generation unit and the insulin injection unit.

[22] The storage unit has a voice information database built of user voice information in relation to driving instructions of the apparatus for injecting insulin.

[23] The voice recognition unit comprises a microphone 1 for receiving the user voice input, and a voice input button 3 operated by the user to input the voice input. When the voice input button 3 is operated, the voice recognition unit searches the voice input from the voice information database and provides the driving instruction corresponding to the voice input to the control unit.

[24] The user builds the voice information database by pronouncing each of the driving instructions of the apparatus for injecting insulin as written in the directions thereof or by help of a salesman of the apparatus.

[25]

[26] *The control unit stores data of the blood glucose level measured by the blood glucose measurement unit and information of date and time of measuring the blood glucose level in the storage unit and displays a change in the blood glucose level with the passage of time in a graph on the touch pad 5.

[27] Types of the graph as displayed may be set in various ways. The amount of insulin per time, the blood glucose level and the amount of exercise measured by the pedometer may be graphed on the one screen. The information indicated by the graph can be displayed by selecting a time unit, for example, day, week or month.

[28] Further, blood glucose may be periodically measured (for 24 hours) to be recorded in ordinal numbers, for example, 1st to 7th measurements. Based on these measurements, weekly and monthly average blood glucose levels are graphed for each ordinal number of measuring a blood glucose level.

[29] As illustrated in FIG. 1, since the touch pad 5 used in the apparatus for injecting insulin is big enough in size to almost occupy one side surface of a case 7, it is easy to display the graph information, and preferably it may be easy for the user to visually perceive the graph information.

[30] The storage unit includes a number of flash files having a guidance image data and a guidance voice data to guide the user a user action of operation. When an operation in-

struction requiring the user action of operation is input from the touch pad 5 or the voice recognition unit, the control unit outputs the guidance image data of the flash files by the touch pad 5 so as to be displayed in screen and outputs the guidance voice data of the flash files to the sound generation unit so as to be generated in sound.

[31] Therefore, when there is the need for the user action, for example, to replace insulin injection liquid in the insulin injection unit, the control unit reads the relevant flash files in the storage unit stored by steps of the relevant act. Then, the flash files are displayed on the touch pad 5 and the voice guidance is performed by the sound generation unit, to guide the user each action by steps easy to follow.

[32] The display of the flash files and the output of the voice guidance data may be set to be selectively omitted.

[33] The blood glucose measurement unit uses the conventional art of measuring a blood glucose level from the blood sample, using a sensor 11 inserted into a sensor socket 9 and an electrical signal from the sensor 11 illustrated in FIG. 1. The sound generation unit includes a speaker 15 illustrated in FIG.1.

[34] The pedometer uses the conventional well-known art of recognizing the user's motions in four directions, i.e., up and down, and left and right. The insulin injection unit is not different from the conventional well-known art of injecting insulin through an injection tube 13 connected to the body of the user as a piston is operated by the driving of a motor.

[35] The control unit classifies a predetermined amount of insulin to be injected into a basal dose and a bolus dose. The control unit increases or decreases the basal dose and the bolus dose, within their respective ranges with a predetermined upper limit and a predetermined lower limit, based on information of the blood glucose level measured by the blood glucose measurement unit and the amount of exercise measured by the pedometer.

[36] Generally, the amount of insulin to be injected includes the basal dose and the bolus dose. The basal dose means that a small amount of insulin is continuously injected into the body of the user by regular time periods. The bolus dose means that, at mealtime, if the user inputs the information that he/she (will) eat(s) meal, an increased amount of insulin is injected into the body of the user, considering that a blood glucose level becomes higher by taking a meal. The control unit presets the upper limit and the lower limit with respect to each of the basal dose and the bolus dose. When the information indicates that the blood glucose level measured by the blood glucose measurement unit is high, the control unit increases the amount of insulin by a predetermined amount. When the information indicates that the amount of exercise of the user measured by the pedometer is large, the control unit decreases the amount of insulin by a predetermined amount.

[37] The upper limit and the lower limit of each of the basal dose and the bolus dose are predetermined at a medically proper level, taking the safety of the user into consideration. It is preferable to set the increase/decrease rate or increase/decrease value in the amount of insulin to be injected depending on the increase/decrease in the measured blood glucose level and the increase/decrease in the measured amount of exercise, by medically, experimentally and statistically considering the safety of the user.

[38] When an instruction regarding a low blood glucose level is input by the touch pad or the voice recognition unit, the control unit stops driving the insulin injection unit to stop injecting insulin. The control unit further stores in the storage unit a fact that the instruction regarding a low blood glucose level is input and information of date and time when the instruction regarding a low blood glucose level is input.

[39] The apparatus for injecting insulin may additionally include an element, such as a button, for inputting the instruction regarding a low blood glucose level.

[40] When a blood glucose level is low in using the apparatus for injecting insulin, the supply of insulin into the body of the user must be stopped. In the conventional art, the insulin injection is stopped by turning off the power of an insulin pump. In this case, the insulin pump has no information of the reason for stopping the operation of the insulin pump or no information of date and time thereof. However, in the present invention, when the apparatus for injecting insulin receives the input of the instruction regarding a low blood glucose level, it does not turn off the power immediately. The apparatus for injecting insulin stops the operation of the insulin injection unit and simultaneously stores, in the storage unit, the information of the date and time when the instruction regarding a low blood glucose level is input and the operation of the insulin injection unit is stopped, to be used for the medical information in the future.

[41] A method for operating an apparatus for injecting insulin according to another embodiment of the present invention comprises: a blood glucose measurement step of measuring a blood glucose level from a blood sample of a user; an exercise amount measurement step of measuring an amount of exercise of the user; a visual interface step of displaying an image on a screen of a touch pad 5 and receiving a user input from the touch pad 5; a voice recognition step of receiving and recognizing a user voice input; a calculation step of calculating an amount of insulin to be injected, based on information of the measured blood glucose level and the measured amount of exercise, the user input from the touch pad 5, and the user voice input; an insulin injection step of injecting the calculated amount of insulin into a body of the user; a sound generation step for providing information in sound to the user; and a storage unit driving step of storing the information of the measured blood glucose level and the measured amount of exercise, the user input from the touch pad 5, the user voice input,

and the amount of insulin injected into the body of the user in a storage unit, or retrieving the information from the storage unit.

[42] Since the storage unit includes a voice information database built of user voice information in relation to driving instructions of the apparatus for injecting insulin, the voice recognition step searches the voice input from the voice information database and recognizes the driving instruction corresponding to the voice input.

[43] The voice information database is built by performing: a step of directly recording and inputting a voice of the user corresponding to a limited number of the driving instructions of the apparatus for injecting insulin; a step of forming a standard sample waveform by arranging a waveform of a voice wave corresponding to the each driving instruction in a rectangular coordinate system expressed by a time axis and an amplitude axis which cross at right angle, adjusting a total length of the voice wave to be same as a specific length of the time axis, and taking an absolute value of a waveform part positioned at the negative amplitude axis under the time axis among the waveform of the voice wave to convert into the positive amplitude axis so that the standard sample waveform includes the converted waveform part and a waveform part originally positioned in the positive amplitude axis; and a step of making a recognition reference data by finding an array of whether the standard sample waveform passes through each crossing point which crosses the time axis and the amplitude axis each divided equally in a specific number.

[44] The voice recognition step comprises: a step of converting the voice wave being input when the voice input button is operated into a search sample waveform by operating the input voice wave in the same manner as the step of forming the standard sample waveform; and a step of recognition (recognizing the input voice wave) finding an array of whether the search sample waveform passes through each crossing point which crosses the time axis and the amplitude axis each divided equally in the specific number, comparing the array from the search sample waveform with the array of the recognition reference data, and recognizing the driving instruction corresponding to the array closest to the array of the recognition reference data including the agreed array (identical with the array of the recognition reference data) as the user voice instruction.

[45] As described above, if the one closest driving instruction is selected by the user through judging whether the array from the search sample waveform made of the input voice wave agrees with the array from the recognition reference data corresponding to the limited number of driving instructions usable in the apparatus for injecting insulin, the voice recognition rate is significantly improved. In the conventional voice recognition technology, each language of, for example, Korean, English, Chinese and others, needs its separate database, and voice is recognized by complicated algorithms. However, according to the technology of the present invention, it does not need a

separate voice database per language, regardless of the kinds of languages and it enables accurate voice recognition.

[46] The storage unit driving step is to store in the storage unit the information of the measured blood glucose level and the measured amount of exercise and the information of the date and time of measuring the blood glucose level and the amount of exercise. The information stored in the storage unit is used as the basic materials when the control unit performs a blood glucose level change displaying step of displaying a change in the blood glucose level with the passage of time by days, weeks or months depending on the user's selection, in a graph on the touch pad 5.

[47] The storage unit includes a number of flash files having a guidance image data and a guidance voice data to guide the user a user action of operation. When the operation instruction requiring the user action of operation is input in the visual interface step or the voice recognition step, the control unit displays the guidance image data of the flash files in screen of the touch pad 5 and generates the guidance voice data of the flash files in sound.

[48] The calculation step classifies a predetermined amount of insulin to be injected into a basal dose and a bolus dose and increases/decreases each of the basal dose and the bolus dose within respective ranges having given upper limit and lower limit, based on information of the blood glucose level and the amount of exercise. Since the detailed description thereof has been presented above, it will be omitted.

[49] FIG. 3 illustrates an example of the operation of the control unit. The control unit determines whether it has reached a period for measuring the amount of exercise and stores in the storage unit the information of the date and time of measuring the amount of exercise from the pedometer.

[50] When the blood glucose level of the user is measured, the control unit stores in the storage unit the information of the measured blood glucose level from the blood glucose measurement unit and the information of the date and time of measuring the blood glucose level and simultaneously displays the information in the form of a graph on the screen of the touch pad 5.

[51] When a manual operation instruction is input from the touch pad 5 of the user and the operation corresponding to the instruction requires the user action, the control unit reads the flash files stored in the storage unit, displays it on the touch pad 5 and generates in sound through the sound generation unit.

[52] The control unit continuously determines whether it has reached a period for injecting the basal dose of insulin. When the basal dose is needed, the control unit calculates the basal dose by increasing/decreasing the dose, based on the information of the blood glucose level and the amount of exercise. According to the result of calculation, the control unit injects the basal dose of insulin into the body of the user

through the insulin injection unit.

[53] When the user inputs an instruction regarding the bolus dose, the control unit calculates the bolus dose by increase/decrease, based on the stored information of the measured blood glucose level and the measured amount of exercise. According to the result of calculation, the control unit injects the bolus dose of insulin into the body of the user.

[54] For reference, since FIG. 3 explains one example of the operating method of the control unit according to the exemplary embodiment of the present invention, it is to be understood that the scope of the invention is not limited to the disclosed embodiments. On the contrary, the scope of the invention is intended to include various modifications and alternative arrangements within the capabilities of persons skilled in the art using presently known or future technologies and equivalents. The scope of the claims, therefore, should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

Industrial Applicability

[55] A diabetic or even a blind diabetic more or less lacking in cognitive ability can safely and conveniently use without a complicated operation of button but also can immediately use by simple directions of use, while removing a necessity to be familiar with a method of use through a hospitalization for a long time, and can automatically control an amount of insulin to be injected according to a change in the diabetic's condition, thereby more accurately controlling a blood glucose level of the diabetic.

Claims

[1] An apparatus for injecting insulin comprising:
a blood glucose measurement unit for measuring a blood glucose level from a blood sample of a user;
a pedometer for measuring an amount of exercise of the user;
a touch pad for displaying a screen to the user and receiving a user input;
a voice recognition unit for receiving and recognizing a user voice input;
an insulin injection unit for injecting insulin into a body of the user;
a sound generation unit for providing information in sound to the user;
a storage unit for storing and retrieving information; and
a control unit for receiving information from the blood glucose measurement unit, the pedometer and the voice recognition unit, for exchanging information with the touch pad and the storage unit, and driving the sound generation unit and the insulin injection unit.

[2] The apparatus for injecting insulin according to claim 1, wherein the storage unit comprises a voice information database built of user voice information corresponding to driving instructions of the apparatus for injecting insulin, and
the voice recognition unit comprises:
a microphone to receiving the user voice input; and
*a voice input button operated by the user to input the voice input, wherein, when the voice input button is operated, the voice recognition unit searches the voice input from the voice information database and provides the driving instruction corresponding to the voice input to the control unit.

[3] The apparatus for injecting insulin according to claim 1, wherein the control unit stores, in the storage unit, data of the blood glucose level measured by the blood glucose measurement unit and information of date and time of measuring the blood glucose level and displays a change in the blood glucose level with the passage of time in a graph on the touch pad.

[4] The apparatus for injecting insulin according to claim 1, wherein the storage unit includes a number of flash files having a guidance image data and a guidance voice data to guide the user a user action of operation,
and when an operation instruction requiring the user action of operation is input from the touch pad or the voice recognition unit, the control unit outputs the guidance image data of the flash files by the touch pad so as to be displayed in screen and outputs the guidance voice data of the flash files to the sound generation unit so as to be generated in sound.

[5] The apparatus for injecting insulin according to claim 1, wherein the control unit

classifies a predetermined amount of insulin to be injected into a basal dose and a bolus dose and increases/decreases each of the basal dose and the bolus dose within respective ranges having given upper limit and lower limit, based on information of the blood glucose level measured by the blood glucose measurement unit and the amount of exercise measured by the pedometer.

[6] The apparatus for injecting insulin according to claim 1, wherein, when an instruction regarding a low blood glucose level is input from the touch pad or the voice recognition unit, the control unit stops driving the insulin injection unit to stop injecting insulin and stores in the storage unit a fact that the instruction regarding a low blood glucose level is input and information of date and time when the instruction regarding a low blood glucose level is input.

[7] A method for operating an apparatus for injecting insulin, comprising:
a blood glucose measurement step of measuring a blood glucose level from a blood sample of a user;
an exercise amount measurement step of measuring an amount of exercise of the user;
a visual interface step of displaying an image on a screen of a touch pad and receiving a user input from the touch pad;
a voice recognition step of receiving and recognizing a user voice input;
a calculation step of calculating an amount of insulin to be injected, based on information of the measured blood glucose level and the measured amount of exercise, the user input from the touch pad, and the user voice input;
an insulin injection step of injecting the calculated amount of insulin into a body of the user;
a sound generation step for providing information in sound to the user; and
a storage unit driving step of storing the information of the measured blood glucose level and the measured amount of exercise, the user input from the touch pad, the user voice input, and the amount of insulin injected into the body of the user in a storage unit, or retrieving the information from the storage unit.

[8] The method according to claim 7, wherein the storage unit comprises a voice information database built of user voice information corresponding to driving instructions of the apparatus for injecting insulin, and
the voice recognition step comprises a step of searching the voice input from the voice information database, to recognize the driving instruction corresponding to the voice input.

[9] The method according to claim 8, wherein
the voice information database is built by performing:
a step of directly recording and inputting a voice of the user corresponding to a

limited number of the driving instructions of the apparatus for injecting insulin;
a step of forming a standard sample waveform by arranging a waveform of a voice wave corresponding to the each driving instruction in a rectangular coordinate system expressed by a time axis and an amplitude axis which cross at right angle, adjusting a total length of the voice wave to be same as a specific length of the time axis, and taking an absolute value of a waveform part positioned at the negative amplitude axis under the time axis among the waveform of the voice wave to convert into the positive amplitude axis so that the standard sample waveform includes the converted waveform part and a waveform part originally positioned in the positive amplitude axis; and
a step of making a recognition reference data by finding an array of whether the standard sample waveform passes through each crossing point which crosses the time axis and the amplitude axis each divided equally in a specific number,
and the voice recognition step comprises:
a step of converting the voice wave being input when the voice input button is operated into a search sample waveform, by operating the input voice wave in the same manner as the step of forming the standard sample waveform; and
a step of recognition (recognizing the input voice wave) by finding an array of whether the search sample waveform passes through each crossing point which crosses the time axis and the amplitude axis each divided equally in the specific number, comparing the array from the search sample waveform with the array of the recognition reference data, and recognizing the driving instruction corresponding to the array closest to the array of the recognition reference data including the agreed array (identical with the array of the recognition reference data) as the user voice instruction.

[10] The method according to claim 7, wherein the storage unit driving step stores, in the storage unit, the information of the measured blood glucose level and the measured amount of exercise and the information of the date and time of measuring the blood glucose level and the amount of exercise.

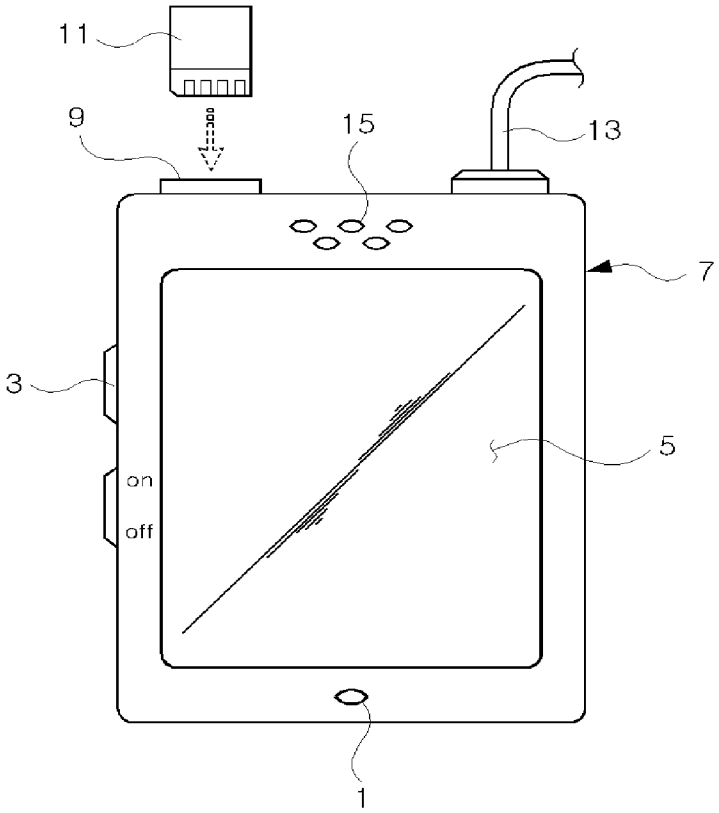
[11] The method according to claim 10, wherein the storage unit driving step further comprises: a blood glucose level change displaying step of displaying a change in the blood glucose level with the passage of time in a graph on the touch pad.

[12] The method according to claim 7, wherein the storage unit includes a number of flash files having a guidance image data and a guidance voice data to guide the user a user action of operation,
and when an operation instruction requiring the user action of operation is input at the visual interface step or the voice recognition step, the control unit displays the guidance image data of the flash files in screen and generates the guidance

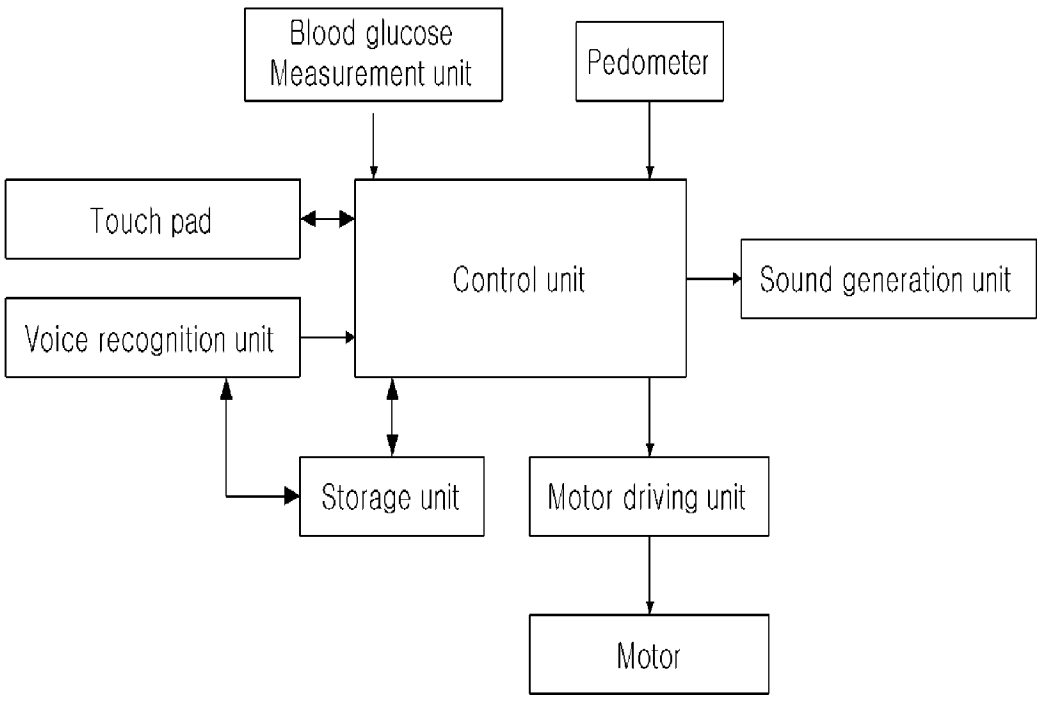
voice data of the flash files in sound.

[13] The method according to claim 7, wherein the calculation step classifies a pre-determined amount of insulin to be injected into a basal dose and a bolus dose and increases/decreases each of the basal dose and the bolus dose within respective ranges having given upper limit and lower limit, based on information of the blood glucose level and the amount of exercise.

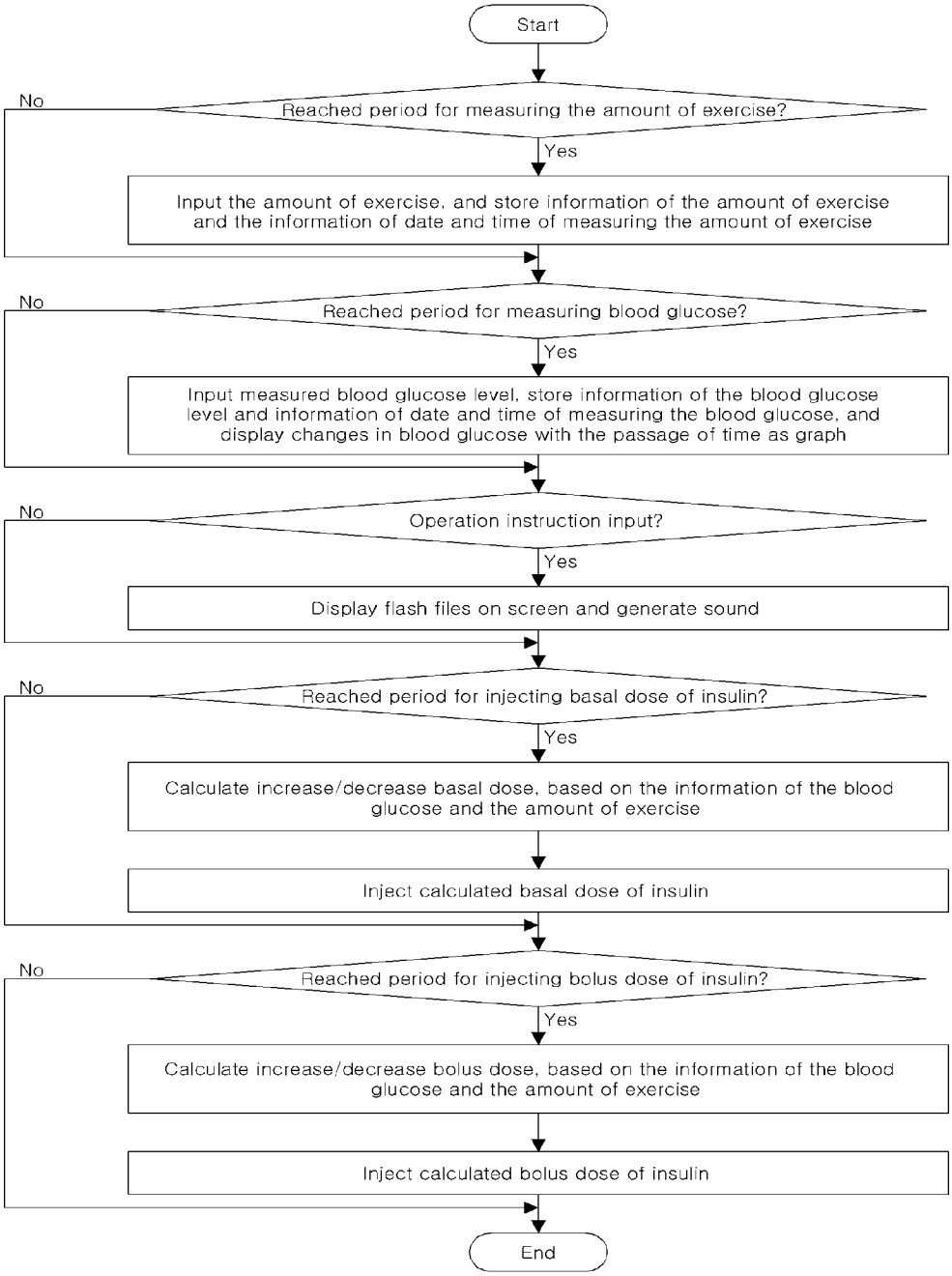
[Fig. 1]


11
9
15
13
7
3
5
on
off
1

[Fig. 2]


Blood glucose Measurement unit
Pedometer
Touch pad
Control unit
Sound generation unit
Voice recognition unit
Storage unit
Motor driving unit
Motor

[Fig. 3]


Start
Reached period for measuring the amount of exercise?
No
Yes
Input the amount of exercise, and store information of the amount of exercise and the information of date and time of measuring the amount of exercise
Reached period for measuring blood glucose?
No
Yes
Input measured blood glucose level, store information of the blood glucose level and information of date and time of measuring the blood glucose, and display changes in blood glucose with the passage of time as graph
Operation instruction input?
No
Yes
Display flash files on screen and generate sound
Reached period for injecting basal dose of insulin?
No
Yes
Calculate increase/decrease basal dose, based on the information of the blood glucose and the amount of exercise
Inject calculated basal dose of insulin
Reached period for injecting bolus dose of insulin?
No
Yes
Calculate increase/decrease bolus dose, based on the information of the blood glucose and the amount of exercise
Inject calculated bolus dose of insulin
End