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(54) FEVER ALARM SYSTEM

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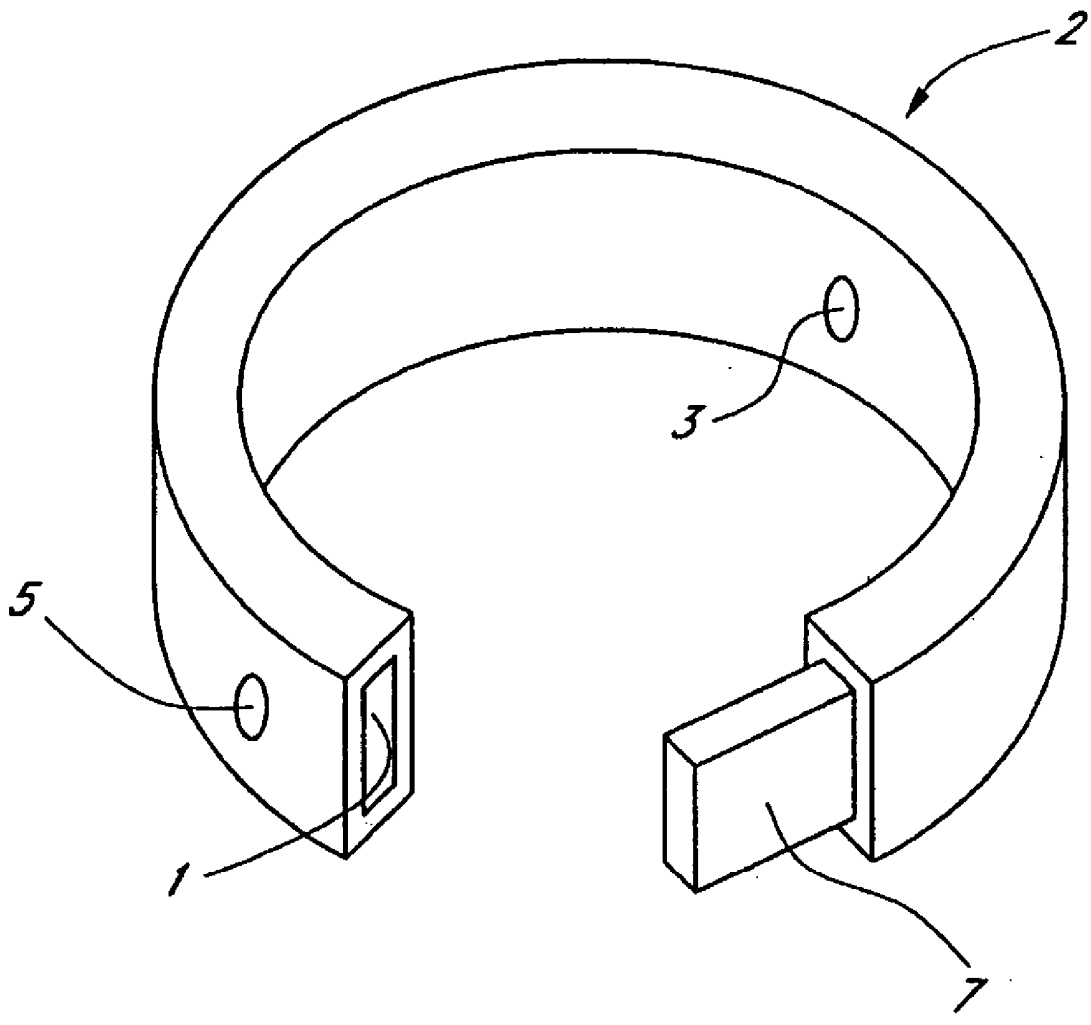
(57) **ABSTRACT**

A body temperature measurement device includes a unit that continually measures body temperature and transmits the measurement through an RF transmitter to a display unit. The display unit includes an RF receiver, a processor, and a display that shows the temperature. The display unit includes an adjustable threshold alarm circuit that turns on an alarm whenever the temperature rises above a defined threshold.



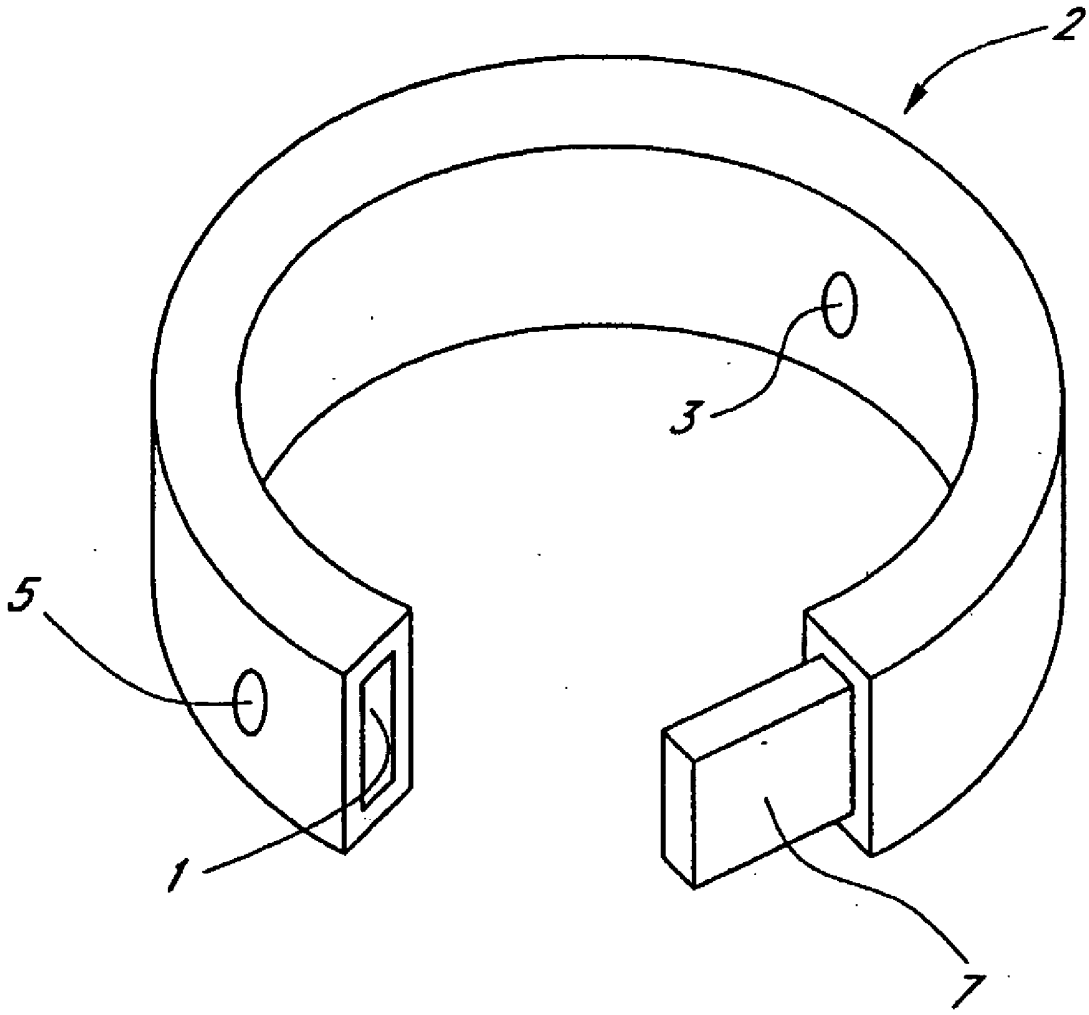


FIG. 1

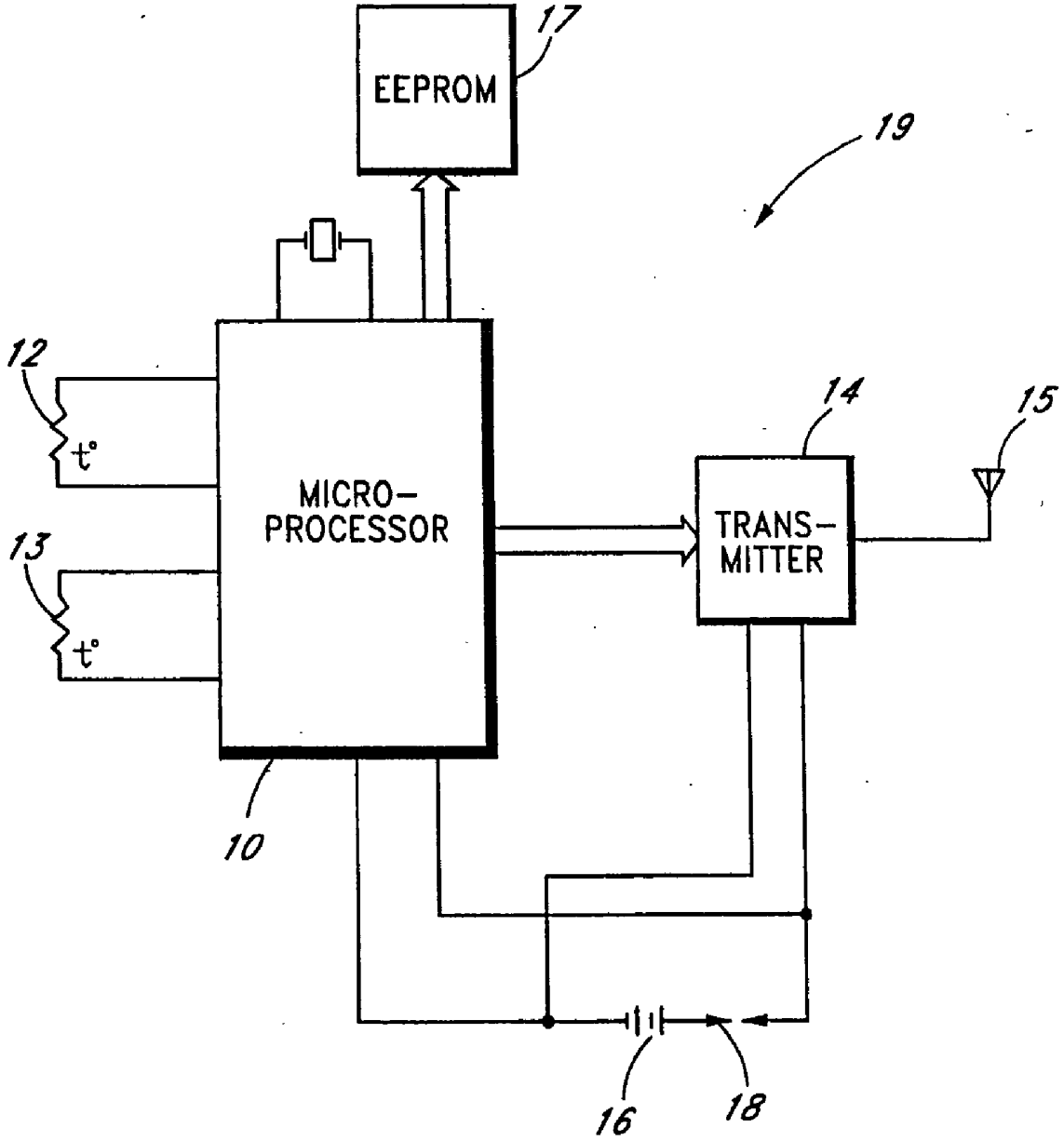

EEPROM
17
19
12
t°
13
t°
MICRO-
PROCESSOR
10
14
TRANS-
MITTER
15
16
18

FIG. 2

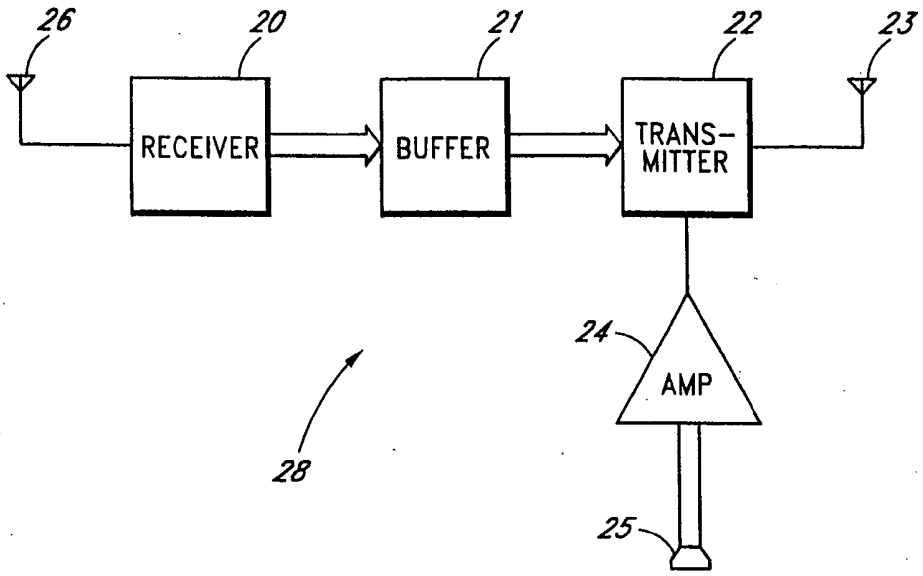

26
20
21
22
23
RECEIVER
BUFFER
TRANS-
MITTER
24
AMP
28
25

FIG. 3

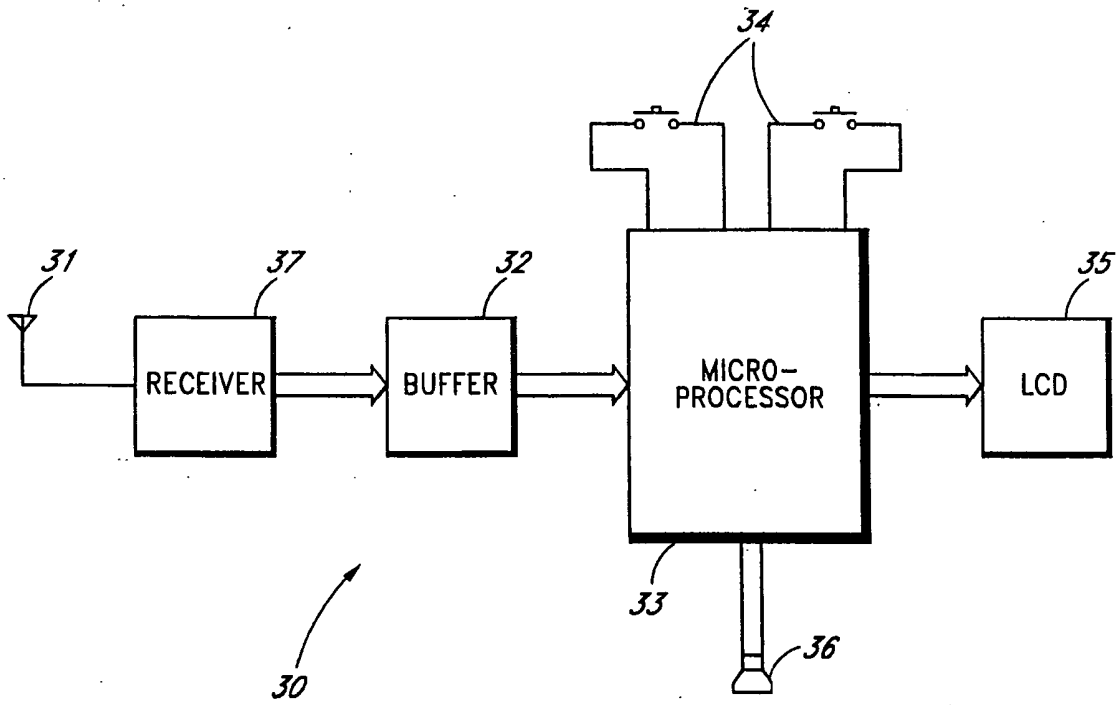

34
31
37
32
35
RECEIVER
BUFFER
MICRO-
PROCESSOR
LCD
33
36
30

FIG. 4

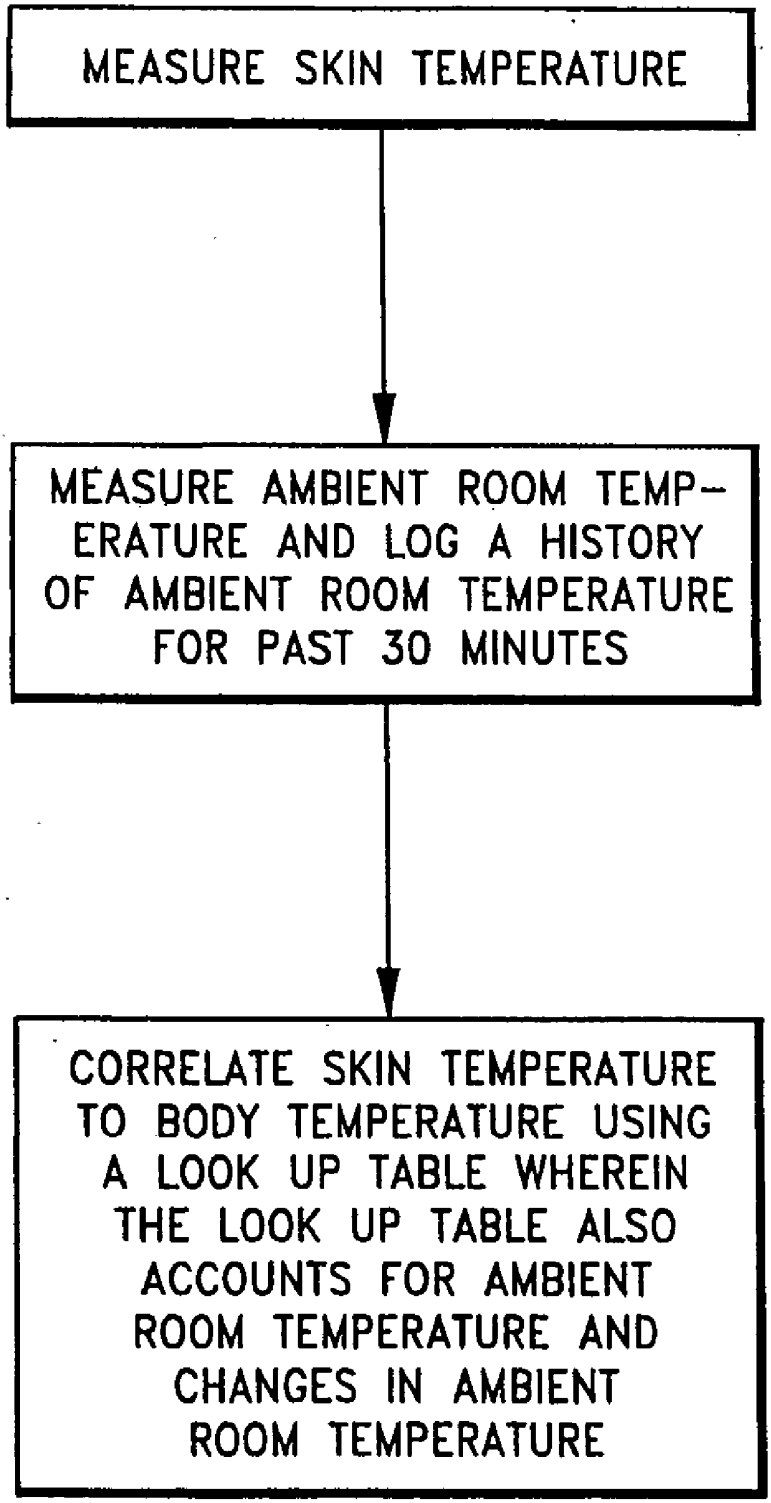

MEASURE SKIN TEMPERATURE
MEASURE AMBIENT ROOM TEMP-ERATURE AND LOG A HISTORY OF AMBIENT ROOM TEMPERATURE FOR PAST 30 MINUTES
CORRELATE SKIN TEMPERATURE TO BODY TEMPERATURE USING A LOOK UP TABLE WHEREIN THE LOOK UP TABLE ALSO ACCOUNTS FOR AMBIENT ROOM TEMPERATURE AND CHANGES IN AMBIENT ROOM TEMPERATURE

FIG. 5

FEVER ALARM SYSTEM

CLAIM OF PRIORITY

[0001] This application is a continuation application of, and claims priority from U.S. Patent Application No. 10/348,205, filed Jan. 20, 2003, which is incorporated in its entirety by referenced herein and which is a continuation application of, and claims priority from U.S. Patent Application No. 09/602,232, filed Jun. 23, 2000, now U.S. Pat. No. 6,547,745, which is incorporated in its entirety by reference herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention is related to a clinical thermometer, and more particularly to a skin thermometer, which performs calculation of oral or rectal temperature. The thermometer is connected to an RF transmitter/receiver system to display the temperature in a remote place and to raise an alarm when the temperature is above a predetermined threshold.

[0004] 2. Description of the Related Art

[0005] Numerous devices for body temperature measurement are known. Some devices measure temperature continuously. U.S. Pat. Nos. 4,509,533, 4,333,477, 4,232,684, 4,030,483 describe skin fever thermometers, but the disclosed thermometers use liquid crystal which changes color according to temperature range. The prior art does not suggest a method for accurate reading and calculation of body (oral and rectal) temperature. The prior art also does not provide a solution for remote reading and remote alarm system when the fever rises above a certain threshold.

SUMMARY OF THE INVENTION

[0006] It is the first objective of this invention to provide a solution for accurate, continuous measurement of skin temperature and to accurately calculate body temperature. The temperature measurement device preferably comprises two thermistors. The first thermistor is attached to the skin and is thermally isolated from the surroundings. The other thermistor is thermally isolated from the skin and measures the room ambient temperature. A look-up correlation table in the processor correlates the temperature readings to oral or rectal temperature while taking into consideration the room temperature.

[0007] Another objective of this invention is to provide a remote reading of the temperature through a wireless communication link and to sound or activate an alarm whenever the temperature rises above a predetermined threshold.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] **FIG. 1** is a drawing of the wrist temperature measurement device of the preferred embodiment.

[0009] **FIG. 2** is a schematic electronic drawing of the measurement unit of the preferred embodiment.

[0010] **FIG. 3** is a schematic electronic drawing of the intermediate unit of the preferred embodiment.

[0011] **FIG. 4** is a schematic electronic drawing of the remote display and monitoring unit of the preferred embodiment.

[0012] **FIG. 5** illustrates a method for calculating body temperature.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] **FIG. 1** illustrates the general construction of the part of the skin temperature measurement device attached to the body. According to the preferred embodiment, this unit **2** has the shape of the wrist and is made of a soft material with a very low thermal conductivity, such as foamed polyurethane. The unit incorporates a flexible electronic board **1** with a connector **7** that turns the unit on when it closes. Two thermistors **3**, **5** are assembled on the electronic board. The thermistor **3** faces the skin side and is attached to the skin while being thermally isolated from the ambient room temperature by the polyurethane. The thermistor **5** faces away from the wrist and is thermally isolated from the skin in order to measure the immediate ambient temperature surrounding the skin. The flexible printed board **1** also has an RF antenna printed on the board itself. A soft disposable pad can be attached to the inner side of the unit in order to keep the unit hygienically clean.

[0014] **FIG. 2** shows a schematic circuit diagram of the electronic unit **19** of the device attached to the skin. A microprocessor or processing unit **10** preferably includes two resistance-to-frequency converters, such as series 6200 made by Epson, Japan. The two thermistors **12** and **13**, which respectively correspond to the thermistors **3** and **5**, are preferably directly connected to the microprocessor. The thermistor **12** measures the skin temperature continuously and is thermally isolated from the surrounding ambient temperature. The thermistor **13** continuously measures the ambient surrounding temperature and is thermally isolated from the skin. The microprocessor **10** continuously reads the values of the thermistors and calculates oral or rectal body temperature, taking into consideration the skin temperature and the temperature of the ambient surroundings. There is typically a delay between the change of the ambient temperature and the sensing of this change by the thermistor **12** due to the isolation of the thermistor **12** from the ambient temperature and the thermal mass of the device. The length of this delay has been measured and can be up to 30 minutes. In order to improve measurement accuracy, the microprocessor stores the ambient temperature changes measured by thermistor **13** and takes into consideration the changes of ambient temperature, or in other words, the history of the ambient temperature measurements, while calculating the body temperature. An EEPROM **17** contains look-up tables taken out of experimental data of body temperature versus skin temperature, ambient temperature and changes of ambient temperature over time. The microprocessor **10** uses the look-up tables in calculating body temperature based upon the measured parameters. A method for calculating body temperature is illustrated in **FIG. 5**. The calculated body temperature is transmitted through a transmitter **14** (**FIG. 2**) and a printed antenna **15**, to a remote circuit. The unit is powered by a battery **16**, which is preferably a lithium battery that has a stable voltage and a long life. The battery power supply is connected to the circuit through connector **18**.

[0015] **FIG. 3** is a schematic electronic diagram of an intermediate transmitter/receiver unit **28** incorporated in the apparatus according to the preferred embodiment. The inter-

mediate unit **28** is preferably placed close to the subject whose temperature is to be measured. The intermediate unit is used in order to save power of the measurement unit, which transmits the data to the intermediate unit. The data transmitted from the skin temperature measurement unit (shown in **FIG. 2**) is received through an antenna **26** and a receiver **20**. The receiver **20** is connected through a buffer **21** to a transmitter **22** and an antenna **23** that transmit the data to a display and a monitoring unit (shown in **FIG. 4**). The intermediate unit **28** may also include a microphone **25** and an amplifier **24** to collect and transmit vocal data, in which case the system can also operate as a "Baby Monitor." All the electronic components such as the receiver **20**, the buffer **21**, the transmitter **22**, the amplifier **24** and the microphone **25** are standard electronic components used for baby monitoring devices and are known to persons skilled in the art.

[**0016**] **FIG. 4** shows the electronic schematic diagram of the display and monitoring unit **30**. The unit **30** receives body temperature data and vocal data from the intermediate unit (shown in **FIG. 3**) through an antenna **31** and a receiver **37**. The receiver **37** is connected to a microprocessor **33** through a buffer **32**. The microprocessor **33** processes the data and displays the temperature on the liquid crystal display (LCD) **35** and also activates the speaker **36** in case of vocal data. Two momentary push-buttons **34** are connected to the microprocessor **33** to adjust the required temperature level for an alarm. When the temperature measurement is above the alarm level, an alarm will sound through the speaker **36**. The LCD **35** preferably continuously displays the subject's temperature and the alarm threshold level.

[**0017**] In one alternative embodiment, the microprocessor or processing unit **10** that calculates temperature can be incorporated into either the intermediate transmitter/receiver unit **28** or the monitoring unit **30**. The transmitter **14** in this case can transmit raw data obtained from the sensors **12** and **13**.

[**0018**] In one alternative embodiment, the transmitter **14** can be configured to transmit data directly to the monitoring unit **30**. In this case, the intermediate unit **28** is not necessary.

[**0019**] Although the invention has been described in terms of certain preferred embodiments, other embodiments that are apparent to those of ordinary skill in the art, including embodiments which do not provide all of the features and advantages set forth herein, are also within the scope of this invention. Accordingly, the scope of the invention is defined by the claims that follow.

1-12. (canceled)

13. A temperature measurement apparatus comprising:

a first sensor which generates a signal related to skin temperature;

a second sensor which generates a signal related to ambient room temperature, the second sensor thermally insulated from the first sensor;

a processing unit in communication with the first and second sensors, the processing unit calculating body temperature based at least upon signals provided by the first and second sensors; and

a flexible printed circuit board, wherein the processing unit is disposed on the printed circuit board.

14. The apparatus of claim 13, further comprising an insulating barrier disposed between the first sensor and the second sensor.

15. The apparatus of claim 13, wherein the first sensor and the second sensor are disposed on the printed circuit board.

16. The apparatus of claim 13, further comprising an insulating barrier disposed between the first sensor and the second sensor and wherein the printed circuit board is embedded within the insulating barrier.

17. The apparatus of claim 13, wherein the processing unit is configured to store a plurality of readings from the second sensor.

18. The apparatus of claim 13, wherein the processing unit calculates the body temperature based at least upon a reading from the first sensor and upon a reading from the second sensor obtained before the reading from the first sensor.

19. The apparatus of claim 13, wherein the processing unit calculates body temperature by at least referencing empirical data stored in a lookup table.

20. The apparatus of claim 13, wherein the body temperature is oral temperature.

21. The apparatus of claim 13, wherein the body temperature is rectal temperature.

22. The apparatus of claim 13, wherein the first sensor and the second sensor are thermistors.

23. The apparatus of claim 13, further comprising:

a transmitter which transmits temperature data; and

a monitoring unit which receives the temperature data and which displays body temperature, wherein the body temperature is related to the temperature data.

24. The apparatus of claim 23, wherein the temperature data is the body temperature.

25. The apparatus of claim 23, wherein the transmitter transmits the temperature data directly to the monitoring unit.

26. The apparatus of claim 23, further comprising an antenna printed on the flexible printed circuit board.

27. The apparatus of claim 23, wherein the processing unit is disposed in the monitoring unit.

28. A temperature measurement apparatus comprising:

a first sensor which generates a signal related to skin temperature;

a second sensor which generates a signal related to ambient room temperature;

an insulating barrier disposed between the first sensor and the second sensor;

a processing unit in communication with the first and second sensors, the processing unit calculating body temperature based at least upon signals provided by the first and second sensors;

a transmitter which transmits temperature data;

a monitoring unit which receives the temperature data and which displays body temperature, wherein the body temperature is related to the temperature data; and

an intermediate receiving and transmitting unit which receives the temperature data transmitted by the transmitter and which retransmits the temperature data to the monitoring unit.

29. The apparatus of claim 28, wherein the processing unit is disposed in the intermediate receiving and transmitting unit.

30. The apparatus of claim 28, wherein the intermediate receiving and transmitting unit comprises a microphone, and wherein the intermediate receiving and transmitting unit transmits audio signals captured by the microphone to the monitoring unit.

31. The apparatus of claim 28, wherein the monitoring unit comprises a speaker, and wherein the monitoring unit reproduces, through the speaker, audio signals received from the intermediate receiving and transmitting units.

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摘要(译)

体温测量装置包括连续测量体温并通过RF发射器将测量值传输到显示单元的单元。显示单元包括RF接收器，处理器和显示温度的显示器。显示单元包括可调节的阈值警报电路，当温度上升到高于限定的阈值时，该电路接通警报。