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(54) **WEARABLE HEART ABNORMALITY SYMPTOM SENSING SMART WATCH AND HEALTH MANAGEMENT SYSTEM USING SAME**

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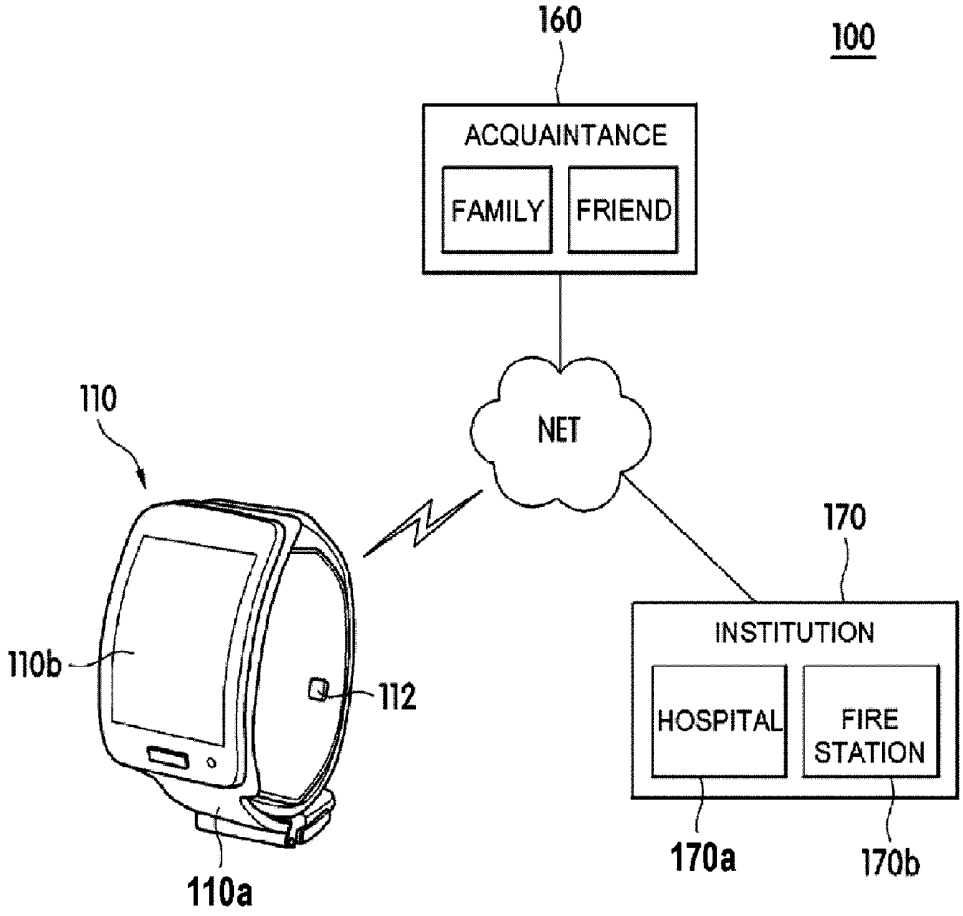
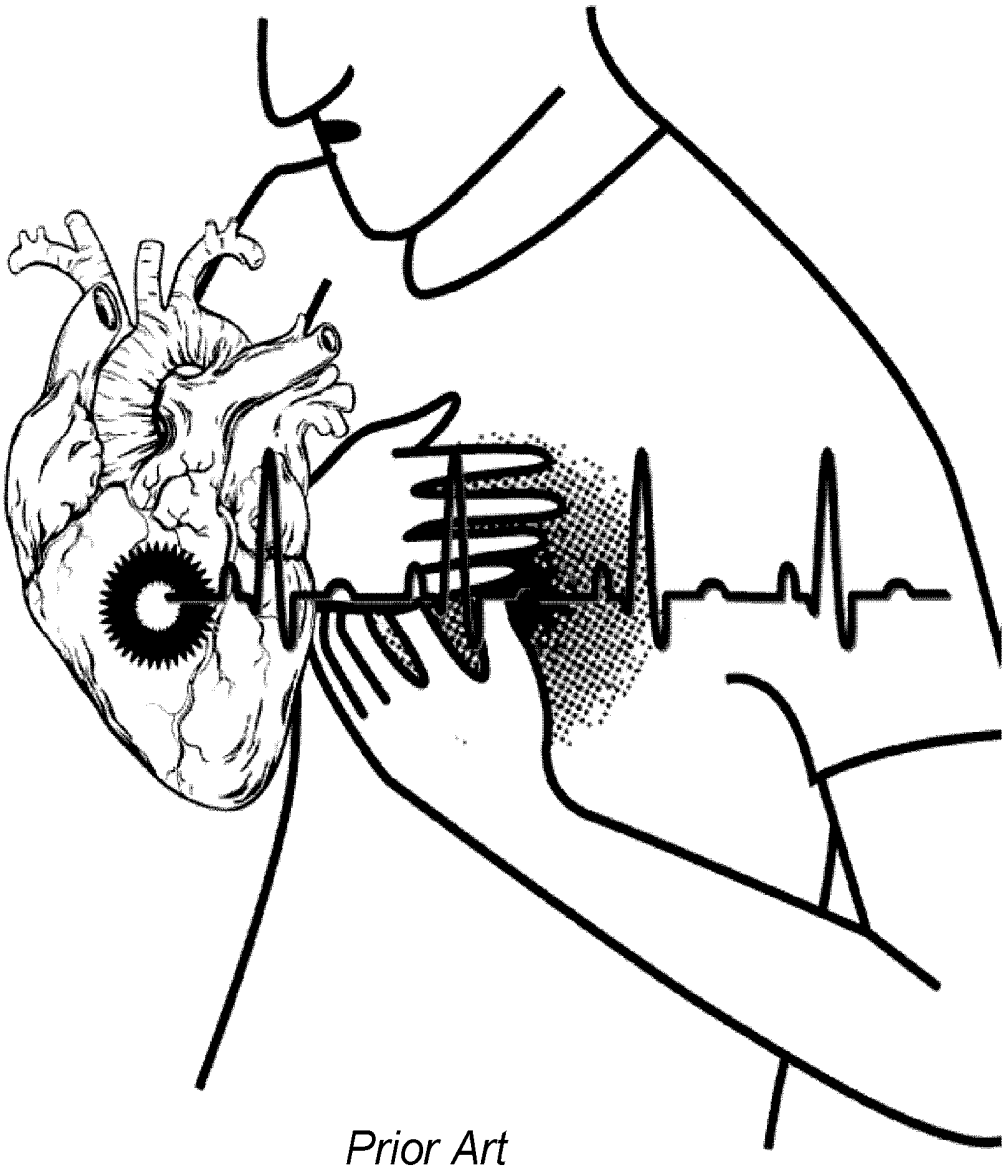
(57) **ABSTRACT**

Provided is a wearable heart abnormal symptom sensing smart watch including: a smart band to be worn on a wrist of a user; an electrocardiogram (ECG) measurement sensor installed in the smart band and come into contact with a wrist skin of the user, the ECG measurement sensor to repetitively measure an ECG signal from the user; and a smart device installed in the smart band and in electrical contact with the ECG measurement sensor through the smart band. The smart device includes: an ECG signal acquisition unit to receive, in real time, the ECG signal in a voltage wave form from the ECG measurement sensor; a database storing reference ECG coordinate information; an ECG signal processing unit to process, in real time, the ECG signal to obtain ECG PQRST (X, Y) coordinates, and compare, in real time, the ECG PQRST (X, Y) coordinates with the reference ECG coordinate information to determine user's heart condition; and a communication unit to communicate, in real time, with acquaintance of the user, a hospital, or a fire station.





Prior Art

FIG.1

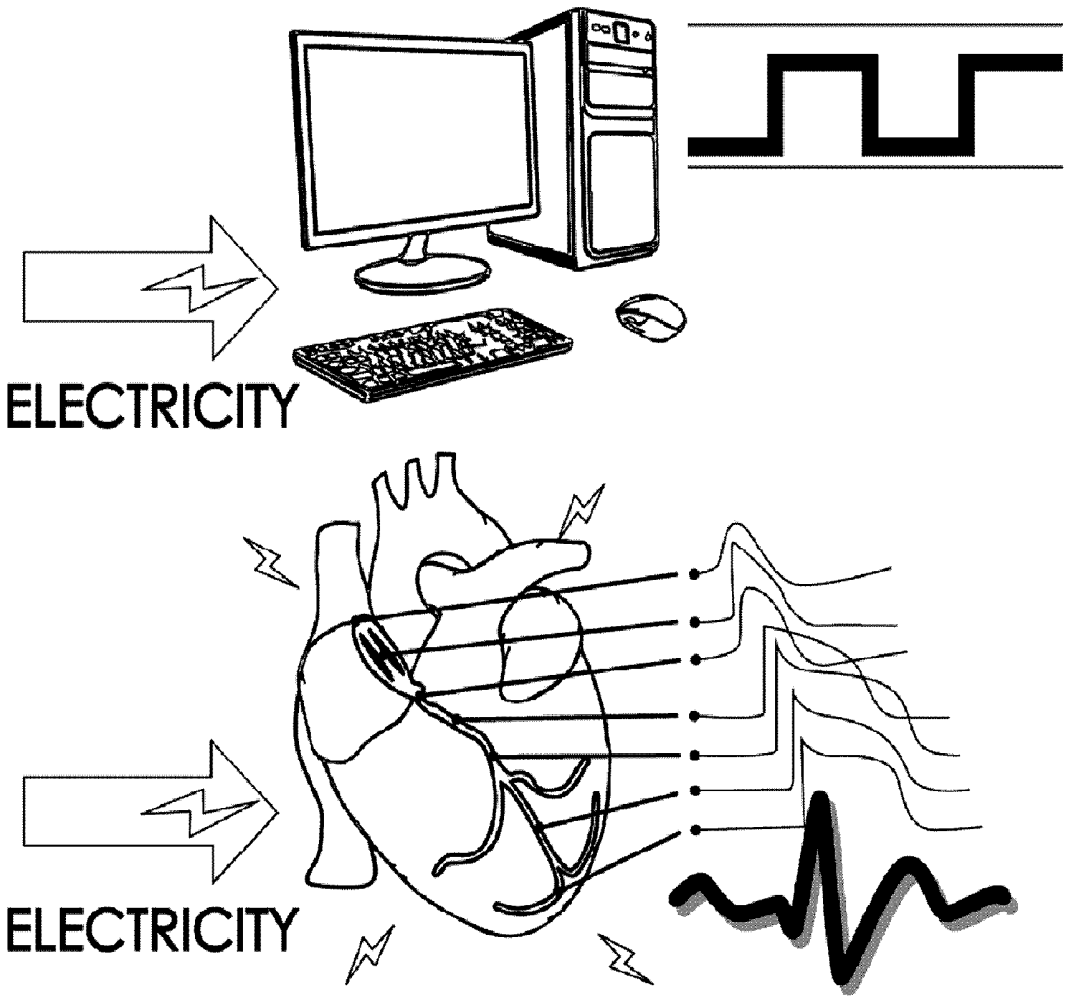


FIG.2

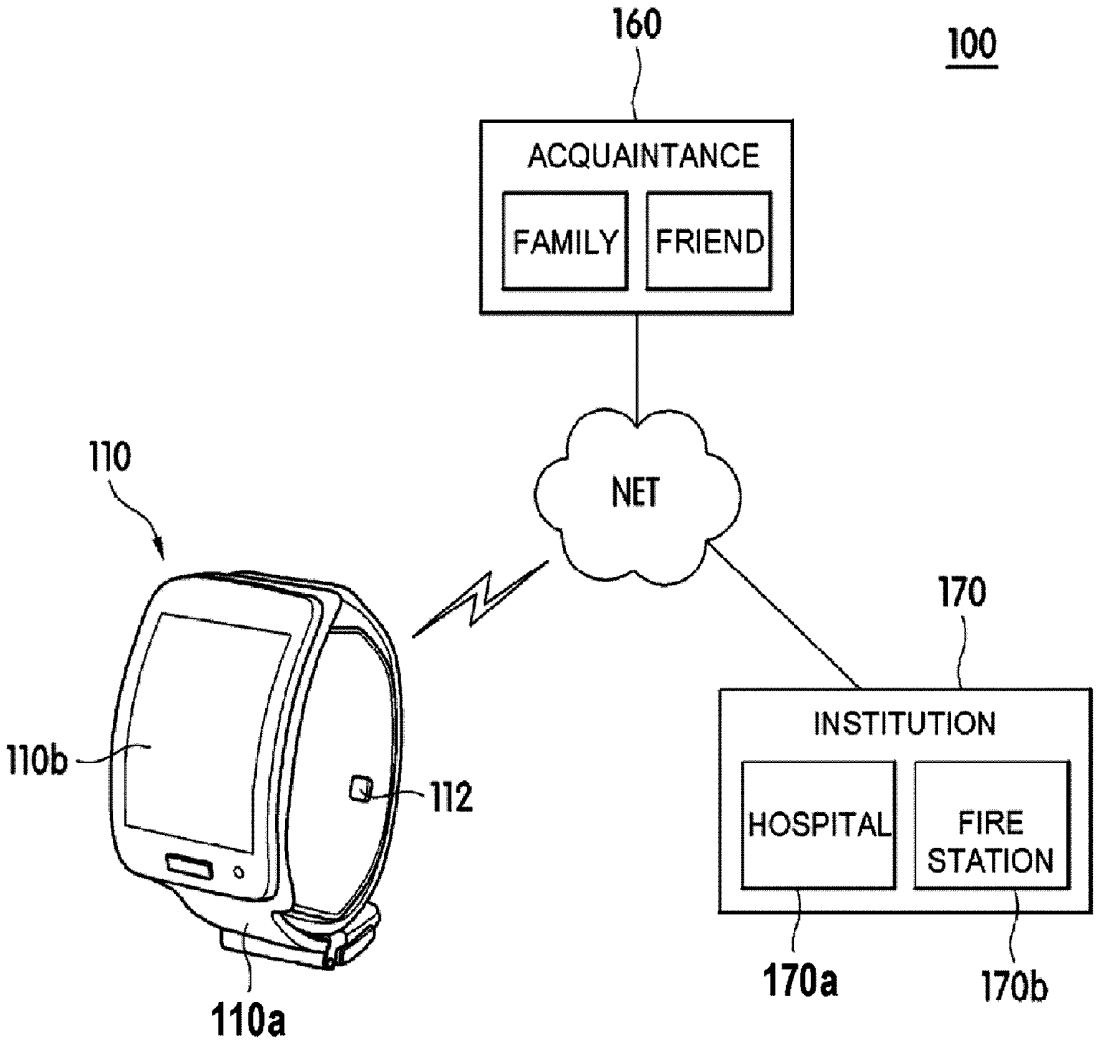

160
100
ACQUAINTANCE
FAMILY
FRIEND
NET
110
170
INSTITUTION
HOSPITAL
FIRE STATION
110b
112
110a
170a
170b

FIG.3

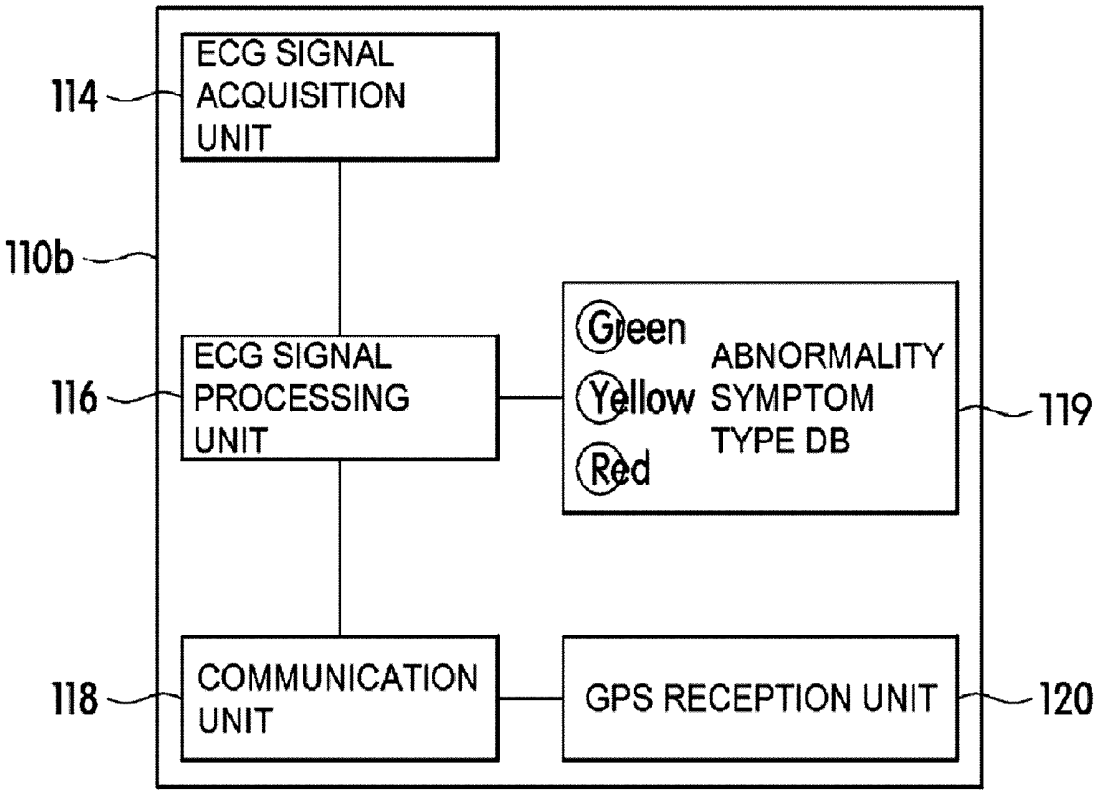

114
ECG SIGNAL ACQUISITION UNIT
110b
116
ECG SIGNAL PROCESSING UNIT
Green
Yellow
Red
ABNORMALITY SYMPTOM TYPE DB
119
118
COMMUNICATION UNIT
GPS RECEPTION UNIT
120

FIG.4

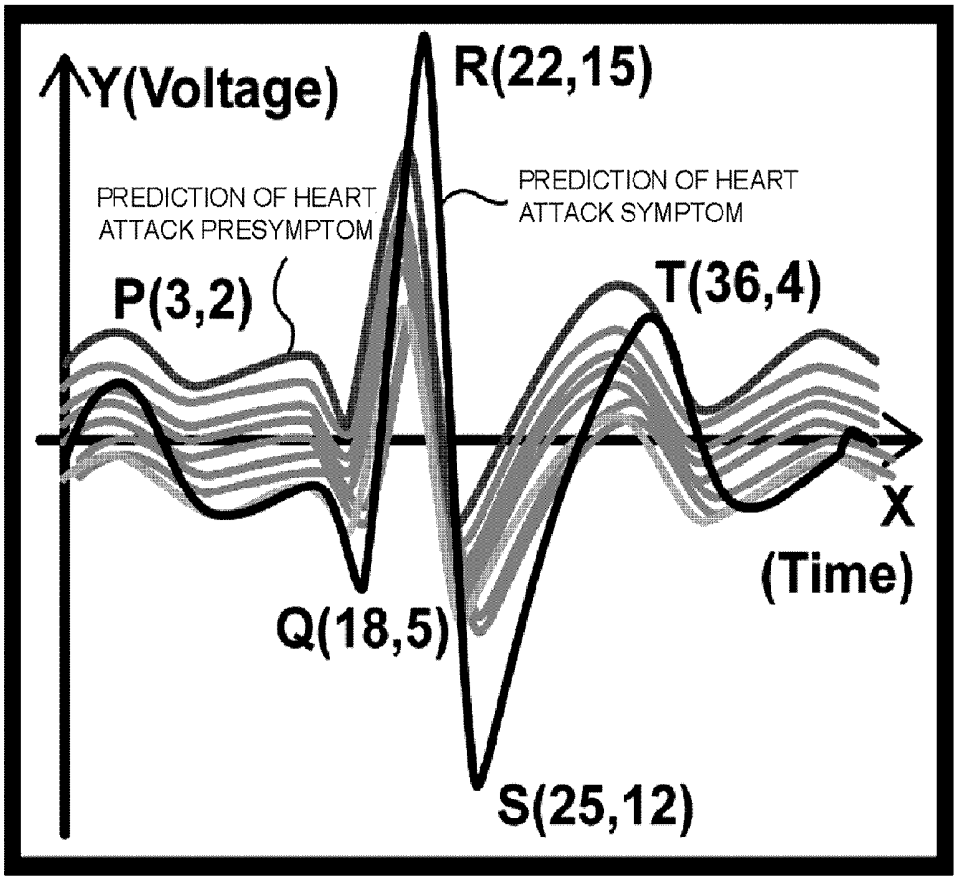


FIG.5

P Amp.	Q Amp.	R Amp.	S Amp.	T Amp.	DIAGNOSIS
0.004	0.001	0.010	-0.002	0.004	NORMAL
0.005	-0.003	0.009	-0.004	0.005	NORMAL
0.001	0.002	0.004	-0.005	0.006	NORMAL
0.002	-0.005	0.015	-0.012	0.004	ABNORMAL
-0.001	-0.002	0.007	-0.006	0.003	NORMAL

FIG.6

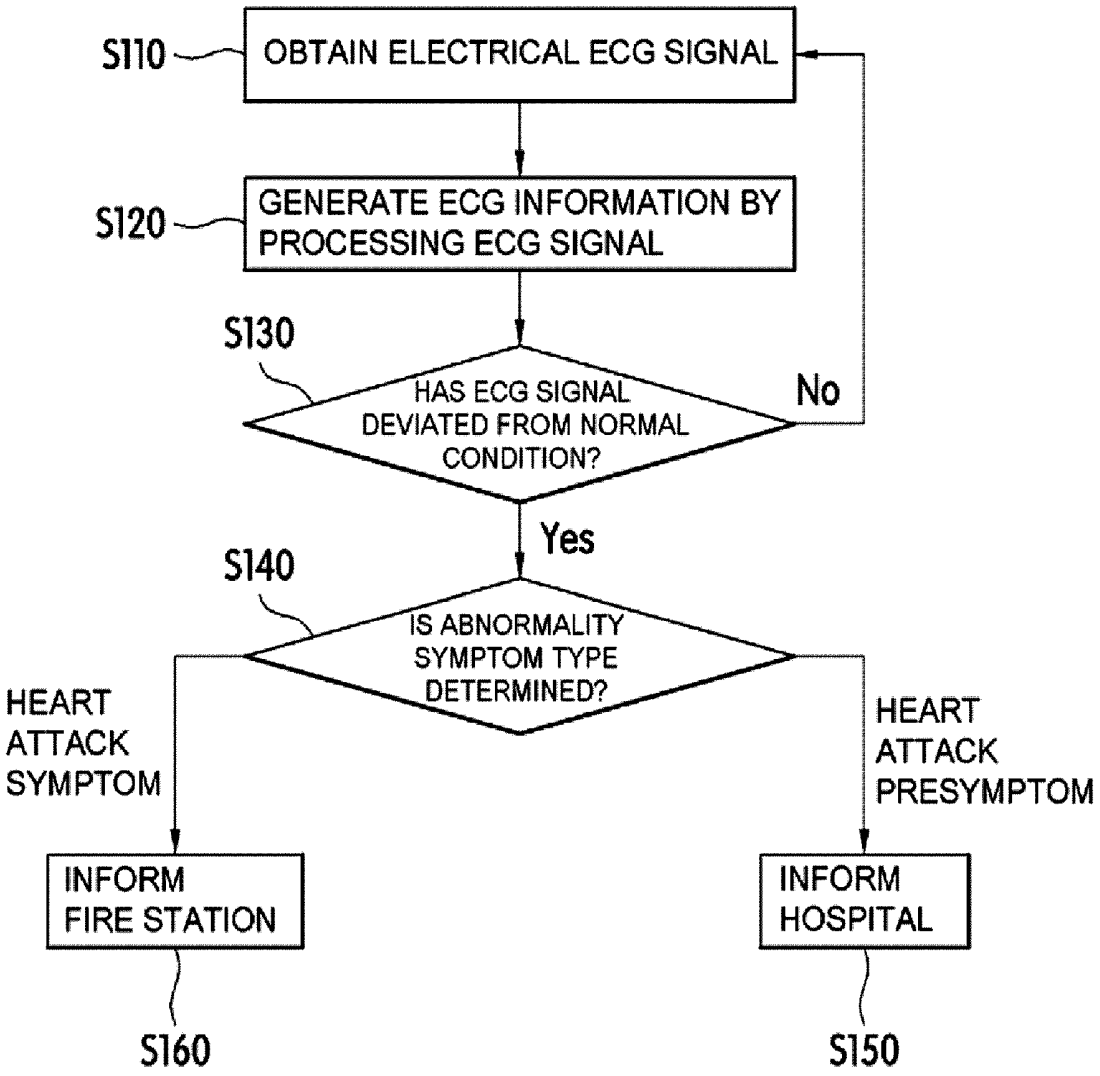

S110
OBTAIN ELECTRICAL ECG SIGNAL
S120
GENERATE ECG INFORMATION BY PROCESSING ECG SIGNAL
S130
HAS ECG SIGNAL DEVIATED FROM NORMAL CONDITION?
No
Yes
S140
IS ABNORMALITY SYMPTOM TYPE DETERMINED?
HEART ATTACK SYMPTOM
HEART ATTACK PRESYMPTOM
INFORM FIRE STATION
INFORM HOSPITAL
S160
S150

FIG.7

WEARABLE HEART ABNORMALITY SYMPTOM SENSING SMART WATCH AND HEALTH MANAGEMENT SYSTEM USING SAME

BACKGROUND

1. Field of the Invention

[0001] The present invention relates to a wearable heart abnormality symptom sensing smart watch and a system and method including the wearable smart watch for immediately sensing an abnormal pattern using a digital electrocardiogram (ECG) (X, Y) pattern coordinate database (DB) and preventing a sudden heart attack, and more particularly, to a wearable smart watch which immediately senses/warns of a heart abnormality symptom by processing an entire analog ECG waveform as a time axis X-coordinate and a cardiac voltage axis Y-coordinate (for example, ECG PQRST (X, Y) coordinates) in a digital method when storing the entire analog ECG waveform of the wearable smart watch, storing the processed digital coordinates in the wearable smart watch as a DB, and processing and thus storing the processed digital coordinates using a minimum memory capacity and a simple program. Also, in a normal case, a High-Low pattern stored in an ECG DB of the wearable smart watch is sensed, but in an abnormal case, the present invention relates to a sudden heart attack prevention system and method using digital ECG coordinates for determining whether normal (X, Y) coordinates of a heart have deviated from the High-Low pattern by performing ECG PQRST (X, Y) coordinate processing and comparing the High-Low pattern and an abnormality symptom ECG (X, Y) coordinate, further determining whether the High-Low pattern is similar to an ECG Yellow pattern, which is a heart attack presymptom, or an ECG Red pattern, which is a sudden heart attack symptom, when corresponding to the abnormality symptom, providing ECG information to a hospital in the former case and providing the ECG information to an emergency ambulance (a fire station) in the latter case.

2. Discussion of Related Art

[0002] Recently, many people are suddenly dying. Surprisingly, more than 50% of patients that had a sudden heart attack thought that they are healthy. This case is often called sudden death. Since sudden death means that a person who normally does not have abnormalities has a heart attack and dies within one hour of any symptom occurring, it is almost impossible to estimate when the symptom will occur.

[0003] About 80 to 90% of sudden deaths are caused by heart disease, and about 10 to 20% are caused by an unknown circumstance, for example, death from overwork. About 80% of causes of a sudden heart dysfunction leading to death are arteriosclerosis of coronary arteries, and a myocardial infarction, and a heart attack which are caused by the arteriosclerosis of coronary arteries. In addition, diseases (cardiomyopathy and myocarditis) of the cardiac muscle itself, an arrhythmia, and a heart valve disease are also causes of a sudden heart dysfunction.

[0004] A coronary artery which is narrowed by about 30 to 40% by arteriosclerosis does not usually cause any symptoms, but the arteriosclerosis may be the cause of a cardiac infarction which is a representative disease capable of causing the heart attack. A cardiac infarction is caused by bursting of oil deposits that stick to the inside of blood vessels that are narrowed by about 30 to 40% by arteriosclerosis. Components inside the blood vessels exposed by the bursting of oil deposits and components of the blood come into contact with each other and cause a coagulation reaction, as a result, a sudden thrombus interferes with the flow of blood and completely blocks blood circulation of the coronary artery. A cardiac infarction abruptly occurs in people usually has no symptom of heart disease and in which a result of an electrocardiogram (ECG) taken during a medical examination is normal, and results in death.

[0005] Meanwhile, a service which provides health management information by transmitting analog waveform biometric information measured by a mobile sensor module to a management center through a mobile terminal and providing the health management information is disclosed in Korean Patent Publication No. 10-2015-0014411. The service can manage diseases by continuously monitoring a condition of a patient by obtaining an analog biometric signal using a biometric signal measurement module and transmitting the obtained analog biometric signal to a health management center using wired or wireless communication technology.

[0006] However, a conventional analog waveform transmission method is a method of monitoring only an ECG waveform and has difficulty immediately predicting a heart attack in a wearable terminal, and there are problems in that analog waveforms which are continuously generated are continuously transmitted from the terminal to a server and are stored and it is difficult to store many of the ECG waveforms which are continuously generated in the wearable terminal.

[0007] Accordingly, death by a sudden heart attack can be prevented by storing only an ECG PQRST (X, Y) pattern, sensing an abnormal pattern in a currently generated ECG digital pattern, and the problem of the conventional method can be solved by storing the ECG digital pattern in the wearable device in the form of a High-Low pattern of the ECG PQRST (X, Y) pattern and digitizing an analog monitoring problem.

[0008] For example, a computer uses a digital method of transmitting a binary number 010101 by digitizing a high voltage as a binary number 1. Accordingly, a heart is recognized as operating by a voltage, and digitization of applying the digital method of the computer to the ECG PQRST pattern is needed. General doctors monitor an entire flow of a waveform using an ECG X-axis waveform, and determine an abnormality symptom of a patient in an empirical method.

[0009] An ECG digital method using the PQRST (X, Y) pattern using a Y-axis voltage in an ECG waveform is needed. That's because that the digital (X, Y) pattern has less storage, can be used for predicting various sudden heart attacks, and can be used for diagnosis.

[0010] Further, a heart attack presymptom appears several hours to several days before an emergency. When an actual sudden heart attack occurs, it is not easy to rescue a patient within a short time since oxygen is not supplied to the patient's brain. Accordingly, it is necessary to determine a symptom of each step of a heart attack and suitably respond to the heart attack. Further, it is necessary to cope with a heart attack by closely cooperating with acquaintances or rescue institutions in the vicinity of a patient.

CONVENTIONAL ART

Patent Document

[0011] (Patent Document 1) Korea Patent Publication No. 10-2015-0014411

SUMMARY OF THE INVENTION

[0012] The present invention is directed to providing a sudden heart attack prevention system and method using digital electrocardiogram (ECG) coordinates which may immediately sense a heart abnormality symptom by performing an ECG PQRST (X, Y) coordinate processing on a time axis X-coordinate and a heart voltage axis Y-coordinate in a digital method instead of a method of storing an entire analog ECG waveform, and storing a small amount of digital coordinates in a wearable terminal, and the system may perform first-aid treatment without missing the so-called "golden time" when an emergency such as a heart attack occurs.

[0013] Further, the present invention is directed to providing a sudden heart attack prevention system and method using digital ECG coordinates which may prevent a sudden heart attack by cooperating closely with an acquaintance or a related hospital of a user of a wearable device, and which may immediately rescue the user with help of an emergency rescue institution even when a sudden heart attack occurs.

[0014] Moreover, the present invention is directed to providing a sudden heart attack prevention system and method using digital ECG coordinates which may determine and cope with a heart abnormality symptom by classifying a heart abnormality symptom of each step using a digital ECG coordinate deviating from a currently sensed pattern in a normal heart ECG pattern database (DB).

[0015] According to one aspect of the present invention in order to achieve the purpose described above, there is provided a sudden heart attack prevention system using digital ECG coordinates including: a system for normally learning using repetitive heart biometric voltage information changed according to a heart health condition of a user and predicting and sensing a sudden heart attack, wherein the sudden heart attack prevention system uses a plurality of wearable heart abnormality symptom sensing smart watches which are installed on a wrist of the user and provide heart biometric voltage information of the user, and the wearable heart abnormality symptom sensing smart watch provides biometric voltage (X, Y) pattern information using the heart biometric voltage information, and the biometric voltage (X, Y) pattern information includes ECG PQRST (X, Y) coordinates as a time axis X-coordinate and a heart voltage axis Y-coordinate.

[0016] According to another aspect of the present invention in order to achieve the purpose described above, there is provided a sudden heart attack prevention method using ECG coordinates including: obtaining a digital ECG electrical signal; generating digital ECG (X, Y) pattern information by processing the digital ECG electrical signal; sensing whether the digital ECG (X, Y) pattern information deviates from a normal condition; when the digital ECG (X, Y) pattern information deviates from the normal condition, comparing the digital ECG (X, Y) pattern information and an abnormality symptom type; and when the digital ECG (X, Y) pattern information is determined to be a heart attack presymptom, informing an acquaintance and a hospital of the digital ECG (X, Y) pattern information.

[0017] According to still another aspect of the present invention in order to achieve the purpose described above, there is provided a wearable heart abnormality symptom sensing smart watch including: a smart band in which an electrocardiogram (ECG) measurement sensor is installed, and which is configured to measure an ECG signal by coming into contact with a wrist of a user; and a smart device fixed on the wrist using the smart band, configured to process and provide the ECG signal by being in electrical contact with the ECG measurement sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above and other objects, features and advantages of the present invention will become more apparent to those of ordinary skill in the art by describing exemplary embodiments thereof in detail with reference to the accompanying drawings, in which:

[0019] FIG. **1** is a photograph for describing a relationship between an electrocardiogram (ECG) and a heart attack according to a conventional art;

[0020] FIG. **2** is a heartbeat generated by an electric shock and an ECG digital (X, Y) pattern waveform displayed as a result thereof according to the present invention;

[0021] FIG. **3** is a block diagram illustrating a configuration of a sudden heart attack prevention system using an ECG according to the present invention;

[0022] FIG. **4** is a block diagram illustrating a configuration of a wearable heart abnormality symptom sensing smart watch according to the present invention shown in FIG. **3**;

[0023] FIG. **5** is an ECG waveform illustrating an ECG pattern representing whether to deviate from a normal condition according to the present invention;

[0024] FIG. **6** is a Y-axis voltage table illustrating an abnormality symptom representing whether to deviate from a normal condition according to the present invention; and

[0025] FIG. **7** is a flowchart illustrating a method of preventing a sudden heart attack using an ECG according to the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0026] Advantages and features of the present invention, and a method achieving the advantages and features will be apparent from embodiments of the present invention which will be described hereinafter together with the accompanying drawings. However, the present invention is not restricted by the embodiments which will be described hereinafter and may be implemented in various forms, but the embodiments of the present invention are provided to completely disclose the present invention and are provided to fully illustrate the scope of the present invention to those of ordinary skill in the art, and the scope of the present invention is merely defined by the appended claims. In the accompanying drawings, dimensions and relative sizes of layers and regions may be exaggerated for clarity of description. Throughout the specification, like reference numerals refer to like components.

[0027] Hereinafter, a sudden heart attack prevention system using an electrocardiogram (ECG) according to the

present invention having a configuration described above will be described in detail with reference to the accompanying drawings.

[0028] A sudden heart attack is caused by an electrical problem of a heart. Accordingly, a heartbeat abruptly quickens, and a convulsion occurs instead of blood and oxygen being provided to the brain by the heart pumping.

[0029] Accordingly, the present invention may determine, in real time, a health condition of a heart using an ECG among biometric signals.

[0030] FIG. **2** illustrates a heartbeat generated by an electric shock and an ECG waveform displayed as a result of the electric shock.

[0031] An ECG may refer to a recording of an electrical signal generated in a heart. A part called a sinoauricular node may be located in the heart, and the sinoauricular node may be a specific part of the heart controlling a heartbeat by periodically generating electricity and inducing a contraction of the heart.

[0032] An electrical signal generated by the sinoauricular node may be transmitted to the entire heart along an electrical conduction system in the heart. A cell consisting of a heart muscle may be contracted by the electrical signal transmitted to each part of the heart, and thus the heart may beat. In this case, a recording of the electrical signal transmitted to the heart by an electrode attached to skin may be called an ECG. The electrode may be attached to various parts of a body, and an electrical phenomenon of each part of the heart may be well recognized.

[0033] A system and method for predicting a heart attack presymptom or determining a heart attack symptom, in real time, and immediately preventing and treating the heart attack using an ECG will be provided.

[0034] FIG. **3** is a block diagram illustrating a configuration of a sudden heart attack prevention system using an ECG. FIG. **4** is a block diagram illustrating a configuration of a smart watch shown in FIG. **3**.

[0035] Referring to FIGS. **3** and **4**, a sudden heart attack preventing system **100** using an ECG according to the present invention may include a plurality of wearable heart abnormality symptom sensing smart watches **110** which generate ECG biometric information.

[0036] The wearable heart abnormality symptom sensing smart watch **110** may be provided in the form of a smart watch capable of being worn on a wrist.

[0037] The wearable heart abnormality symptom sensing smart watch **110** may include a smart band **110***a* in which an ECG measurement sensor **112** is installed, and comes into contact with the wrist of a user and measures an ECG signal, and a smart device **110***b* which is installed in the smart band **110***a*, is electrically connected to the ECG measurement sensor **112**, and processes the ECG signal.

[0038] The ECG measurement sensor **112** may be installed in the form of a biometric electrode inside the smart band **110***a* which comes into direct contact with the user's wrist skin.

[0039] The smart band **110***a* may be a closed ring type which is flexible and shrinkable. The smart band **110***a* may be an open ring type which is hard and resilient. Optionally, the smart band **110***a* may be a fastening type which may be opened or closed.

[0040] Accordingly, the smart band **110***a* may most effectively detect an effect of depolarization and repolarization of a heart, and may be provided in the form of a patch so as to come into close contact with the skin. The smart band **110***a* may surround the wrist of a user, and the biometric electrode may be installed to face the wrist.

[0041] The smart device **110***b* may be a smart phone, a personal digital assistant (PDA), a handheld personal computer (PC), a hand phone, a home server PC, etc.

[0042] The wearable heart abnormality symptom sensing smart watch **110** may include the ECG measurement sensor **112**, an ECG signal acquisition unit **114**, an ECG signal processing unit **116**, and a communication unit **118**.

[0043] Among the components of the wearable heart abnormality symptom sensing smart watch **110**, the ECG measurement sensor **112** may be installed in the smart band **110***a*. The ECG signal acquisition unit **114**, the ECG signal processing unit **116**, and the communication unit **118**, which collect, process, and communicate an ECG signal, may be installed in the smart device **110***b*, and the ECG measurement sensor **112** and the ECG signal acquisition unit **114** may be in electrical contact with each other and perform wired communication with each other through the smart band **110***a*.

[0044] The smart device **110***b* may further include a database (DB) **119** and a GPS reception unit **120**, which will be detailed hereinafter.

[0045] The ECG measurement sensor **112** may be configured to include one or more biometric electrodes, and the one or more biometric electrode may be configured as a snap electrode which may be used for a long time without stimulating skin of a user.

[0046] The ECG signal acquisition unit **114** may be connected to the ECG measurement sensor **112** by a wire and collect and process a digital ECG signal from the ECG measurement sensor **112**, in real time. The ECG signal collected by the ECG signal acquisition unit **114** may be a digital electrical signal. As shown in FIG. **2**, an electrical signal having a specific voltage waveform may be provided from the biometric electrode.

[0047] The ECG signal processing unit **116** may process a waveform having an amplitude (a voltage level) (a Y axis) which continuously changes on a continuous time axis (an X axis) as a digital ECG (X, Y) coordinate pattern, and may classify the processed digital ECG (X, Y) coordinate pattern into various ECG patterns.

[0048] An ECG Green coordinate information representing a normal condition, an ECG Yellow coordinate information representing a sudden heart attack presymptom, and an ECG Red coordinate information representing generation of a sudden heart attack may be separately stored in an abnormality symptom type database (DB) **119** as reference information. The ECG signal processing unit **116** may compare, in real time, the processed ECG pattern and reference information stored in the abnormality symptom type DB and determine, in real time, whether the processed ECG pattern has deviated from the normal condition.

[0049] More specifically, the electrocardiogram (ECG) signal processing unit **116** is configured to process, in real time, the received ECG signal from the ECG measurement sensor **112** and obtain ECG PQRST (X, Y) coordinates where the X is a time axis and the Y is a heart voltage axis. Further, the electrocardiogram (ECG) signal processing unit **116** may compare, in real time, the ECG PQRST (X, Y) coordinates with the ECG green coordinate information, the ECG yellow coordinate information, and the ECG red coordinate information stored in the database **119** to deter-

mine as to whether the user is under a normal condition, a sudden heart attack presymptom condition, or a sudden heart attack condition.

[0050] FIG. **5** is an ECG waveform illustrating an ECG pattern representing whether to deviate from a normal condition, and FIG. **6** is a Y-axis voltage table illustrating an abnormality symptom which has deviated from a normal condition according to the present invention.

[0051] Referring to FIGS. **5** and **6**, the ECG signal processing unit **116** may first amplify an amplitude of a digital electrical signal through signal amplification. The ECG signal processing unit **116** may process the amplified digital electrical signal as a digital electrical signal having a specific waveform. The digital electrical signal may be classified based on a predetermined voltage level, and may be displayed as a continuous ECG pattern having a P waveform, a Q waveform, an R waveform, an S waveform, and a T waveform.

[0052] The ECG signal processing unit **116** may process the P waveform, the Q waveform, the R waveform, the S waveform, and the T waveform into ECG P (X, Y) coordinates, ECG Q (X, Y) coordinates, ECG R (X, Y) coordinates, ECG S (X, Y) coordinates, and ECG T (X, Y) coordinates, respectively.

[0053] Meanwhile, according to FIG. **6**, it may be seen that a value of change is high in the Q, R, and S (QRS) coordinates among the P, Q, R, S, and T coordinates. The present invention may mainly use the Q (X, Y) coordinates, the ECG R (X, Y) coordinates, and the ECG S (X, Y) coordinates.

[0054] For example, a heart has two atria and two ventricles. The heart generates micro electricity every predetermined period with energy obtained from food, and beats in a sequence of P, QRS, and T waveforms. As such, the heart may have a cardiac cycle which is from a predetermined heartbeat to a next heartbeat, and the cardiac cycle may be divided into atrial systolic, ventricular systolic, and atrial/ventricular diastolic phases. A left atrium and a right atrium may contract and a left ventricle and a right ventricle may relax in the atrial systolic phase, the left atrium and the right atrium may relax and the left ventricle and the right ventricle may contract in the ventricular systolic phase, and all of the left and right atria and the left and right ventricles may relax in the atrial/ventricular diastolic phase.

[0055] An ECG may be expressed as a wave frequency in which an activity current and an activity potential difference according to a cardiac contraction are recorded as a wave curve. An ECG waveform may include an upward pulse and a downward pulse which are alternately repeated, and the pulses may be referred to as a P waveform, a Q waveform, an R waveform, an S waveform, and a T waveform described above in order.

[0056] Here, the P waveform may be a waveform recording a contraction procedure of the left and right atria, the QRS waveform may be a waveform recording a contraction procedure of the left and right ventricles, and the T waveform may be a waveform recording a relaxation procedure of the left and right ventricles. The P waveform may be generated during depolarization of the atria, the QRS waveforms may be generated during depolarization of ventricles, and the T waveform may be generated during repolarization of the ventricles.

[0057] Depolarization of the atria and the ventricles and repolarization of the ventricles of the heart may be measured at the skin of a user. Accordingly, the present invention may measure an effect of the depolarization and the repolarization using the ECG measurement sensor **112** and the smart device **110***b*.

[0058] As an example, ECG P (X, Y) coordinates, ECG Q (X, Y) coordinates, ECG R (X, Y) coordinates, ECG S (X, Y) coordinates, and ECG T (X, Y) coordinates may be extracted at an vertex point at which an upward pulse changes to a downward pulse (or at which the downward pulse is changed to the upward pulse) in the ECG pattern, and may be displayed as an (X, Y) coordinate value by extracting the vertex point (feature point). For example, as shown in FIG. **5**, a coordinate value (for example, P(3, 2), Q(18, 5), R(22, 15), S(25, −12), T(22, 15), and T(36, 4)) of each pulse value may be expressed using a grid box.

[0059] A health condition of the user may be determined using a coordinate value by extracting a feature point of an ECG pattern extracted from a digital ECG waveform and representing the extracted feature point as the coordinate value, and the coordinate value may be used as information for determining whether the health condition is normal, whether medical care of a doctor is needed, or whether immediate first-aid treatment is needed as an emergency situation by comparing the coordinate values with each reference coordinate information stored in the abnormality symptom type DB.

[0060] The communication unit **118** may have various communication functions such as communication through a mobile network or near field wireless communication, and a real-time heart health learning and predicting management system including a wireless communication module such as a Bluetooth module, an infrared communication module, a ZigBee module, etc. which can perform wireless data communication may store and communicate data in its own wearable smart watch.

[0061] A GPS reception unit **120** may receive satellite information including a position of a satellite and time information, and calculate its own position. Since position accuracy is decreased when using only a basic function of receiving and calculating a current position from the satellite, position accuracy may be improved by receiving a correction signal through the communication unit **118**.

[0062] Although not shown in the drawings, the sudden heart attack prevention system **100** may further include a relay system for relaying a communication of the wearable heart abnormality symptom sensing smart watch **110**. The relay system may collect various kinds of information input from the wearable heart abnormality symptom sensing smart watch **110** of a user, communicate with the real-time heart health learning and predicting management system or receive various kinds of health information that periodically provide various notifications at a hospital server, and transmit the information to each wearable heart abnormality symptom sensing smart watch **110**.

[0063] Further, the relay system may use a cloud server and a DB operating in a cloud computing environment.

[0064] Heart health condition information of a user may be provided to an acquaintance **160** or an institution **170**. The acquaintance **160** may include a family member, a guardian, or a friend. The institution **170** may include a hospital **170***a* or a fire station **170***b*.

[0065] Hereinafter, a method of predicting and sensing an emergency condition according to a sudden heart attack using an ECG according to the present invention will be described.

[0066] A notification/first-aid treatment method of a heart health condition of a user of the wearable heart abnormality symptom sensing smart watch **110** according to the present invention may be implemented using a sudden heart attack prediction and detection application APP installed in the wearable heart abnormality symptom sensing smart watch **110** described above. The sudden heart attack prediction and detection application APP may be executed based on Android or iPhone.

[0067] Accordingly, according to the method of predicting and sensing an emergency condition according to a sudden heart attack using an ECG of the present invention, the method may be autonomously learned by the APP, and may predict and determine an abnormality symptom.

[0068] More than 70% of patients may have a presymptom of a heart attack one hour to four weeks before a heart attack occurs even in a sudden heart attack. Usually, presymptoms such as chest pain, dyspnea, nausea and dizziness occur. The presymptom may be expressed by an ECG pattern representing a sudden heart attack preliminary condition.

[0069] In this case, heart condition information of a user may be transmitted to the hospital **170***a*, and a doctor may provide a notification so that the user visits the hospital **170***a* him/herself if possible or looks for stability by communicating with the user. Further, the heart condition information of the user may be transmitted to a family member, a guardian, or the acquaintance **160**.

[0070] When a sudden heart attack occurs, cardiopulmonary resuscitation (CPR) should be performed within five minutes. When a heart attack occurs, oxygen supply to the brain is stopped since the heart stops, and first-aid treatment should be performed during the so-called "golden time" since the brain can endure oxygen deprivation for only a few minutes.

[0071] Further, the smart device **110***b* may guide the use of an electric defibrillator installed in the vicinity by informing a person present in the vicinity of the fact (a notification in which a heart attack occurs and first-aid treatment is needed for the user) using a speaker, a light emitting diode (LED), etc.

[0072] When a heart attack symptom is present and an ECG pattern is recognized as an emergency, the wearable heart abnormality symptom sensing smart watch **110** may immediately transmit this fact to the fire station **170***b*. The fire station **170***b* may detect a position of the wearable heart abnormality symptom sensing smart watch **110** using GPS information and track a current position of the user. The fire station **170***b* which is closest to the user may immediately go to the user and perform CPR.

[0073] As such, since a heart attack presymptom and a heart attack symptom are recognized using the ECG pattern, the sudden heart attack prevention system **100** using an ECG may request cooperation of the acquaintance **160** and the institution **170** so that the user immediately visits the hospital **170***a* or first-aid treatment is performed even when there is no rescue request of the user.

[0074] For example, when the ECG Yellow pattern type representing a heart attack preliminary condition stored in the abnormality symptom type DB is found, the sudden heart attack prevention system **100** using the ECG may recognize that the heart health condition is abnormal and may cause the user to visit the hospital **170***a* through the user himself/herself or the acquaintance **160** or to take a rest.

[0075] When the ECG Red pattern type representing a sudden heart attack generation condition is found, the sudden heart attack prevention system **100** using the ECG may recognize that the heart health condition is an emergency and cause the fire station **170***b* to immediately perform first-aid treatment for the user.

[0076] For example, amplitude of an ECG pattern may be measured. That is, a voltage value generated by depolarization of the heart may be measured, and a corresponding voltage value may be determined as excessively great by being compared to a reference value. A vertex point of an R waveform and a vertex point of an S waveform may be measured among P, Q, R, S, and T waveforms, and a heart health condition may be determined by comparing the measured values and reference values.

[0077] FIG. **7** is a flowchart for describing a method of determining a heart abnormality condition.

[0078] Referring to FIG. **7**, the ECG signal acquisition unit **114** may collect a digital electrical ECG signal through the ECG measurement sensor **112** (S**110**). The ECG signal processing unit **116** may process the digital electrical ECG signal, and generate digital ECG information (S**120**). Next, whether the digital ECG information deviates from a normal condition may be detected (S**130**). When the digital ECG information deviates from the normal condition, the digital ECG information may be compared with an abnormality symptom type (S**140**). When the digital ECG information is determined to be a heart attack presymptom, an acquaintance and a hospital may be informed of the digital ECG information (S**150**). On the other hand, when the digital ECG information is determined to be a heart attack symptom, a fire station may be informed of the digital ECG information (S**160**).

[0079] As described above, the following effects may be obtained according to the configuration of the present invention.

[0080] First, since a user always carries the wearable heart abnormal symptom sensing terminal on his or her wrist, a sudden heart attack occurring while sleeping or taking a bath may be prevented. Particularly, since infants cannot express their heart condition in words, the present invention may be more useful for infants.

[0081] Second, according to the sudden heart attack prevention system using an ECG, a rescue institution such as a hospital or a fire station may be connected to through a network, a fire station which is closest to a user using GPS may be called when an abnormality symptom occurs, first-aid treatment for a sudden heart attack, which has a very short golden time, may be performed, rescue of a person in the vicinity may be requested using a speaker or a LED, etc. of a corresponding terminal, and a heart electric defibrillator arranged in the vicinity may be suitably used.

[0082] As described above, the present invention may perform ECG informatization so as to be able to be compared with a heart attack presymptom or a sudden heart attack symptom stored in an abnormality symptom type DB by processing a digital electrical ECG signal, and a hospital or a fire station may be informed of each symptom when the digital ECG information is included in the abnormality symptom type. Various modifications by those of ordinary

skill in the art may be possible without departing from the technical scope of the present invention.

What is claimed are:

1. A wearable heart abnormal symptom sensing smart watch comprising:

a smart band configured to be worn on a wrist of a user;

an electrocardiogram (ECG) measurement sensor installed in the smart band and configured to come into contact with a wrist skin of the user, the ECG measurement sensor configured to repetitively measure an electrocardiogram (ECG) signal from the user; and

a smart device installed in the smart band and in electrical contact with the ECG measurement sensor through the smart band,

wherein the smart device comprises:

an electrocardiogram (ECG) signal acquisition unit configured to receive, in real time, the ECG signal in a voltage wave form from the ECG measurement sensor;

a database storing an electrocardiogram (ECG) green coordinate information representing a normal condition, an electrocardiogram (ECG) yellow coordinate information representing a sudden heart attack presymptom, and an electrocardiogram (ECG) red coordinate information representing generation of a sudden heart attack;

an electrocardiogram (ECG) signal processing unit configured to process, in real time, the received ECG signal to obtain ECG PQRST (X, Y) coordinates where the X is a time axis and the Y is a heart voltage axis, and compare, in real time, the ECG PQRST (X, Y) coordinates with the ECG green coordinate information, the ECG yellow coordinate information, and the ECG red coordinate information to determine as to whether the user is under a normal condition, a sudden heart attack presymptom condition, or a sudden heart attach condition; and

a communication unit configured to communicate, in real time, with acquaintance of the user, a hospital, or a fire station to inform of the user's sudden heart attack presymptom condition, or the user's the sudden heart attack condition.

2. The wearable heart abnormal symptom sensing smart watch of claim **1**, further comprising: a GPS reception unit configured to receive satellite information and calculate a position information of the user.

3. The wearable heart abnormal symptom sensing smart watch of claim **2**, wherein the communication unit is further configured to inform the acquaintance of the user, the hospital, or the fire station of the position information of the user.

4. The wearable heart abnormal symptom sensing smart watch of claim **1**, wherein the electrocardiogram (ECG) signal processing unit is further configured to process, in real time, the voltage wave form into a digital ECG (X, Y) coordinate wave form to obtain the ECG PQRST (X, Y) coordinates.

5. The wearable heart abnormal symptom sensing smart watch of claim **1**, wherein the ECG PQRST (X, Y) coordinates include ECG P (X, Y) coordinates, ECG Q (X, Y) coordinates, ECG R (X, Y) coordinates, ECG S (X, Y) coordinates, and ECG T (X, Y) coordinates.

6. The wearable heart abnormal symptom sensing smart watch of claim **5**, wherein the electrocardiogram (ECG) signal processing unit is further configured to process the voltage wave form into a P waveform, a Q waveform, an R waveform, an S waveform, and a T waveform and obtain the ECG P (X, Y) coordinates, the ECG Q (X, Y) coordinates, the ECG R (X, Y) coordinates, the ECG S (X, Y) coordinates, and the ECG T (X, Y) coordinates, respectively.

7. The wearable heart abnormal symptom sensing smart watch of claim **5**, wherein the ECG P (X, Y) coordinates, the ECG Q (X, Y) coordinates, the ECG R (X, Y) coordinates, the ECG S (X, Y) coordinates and the ECG T (X, Y) coordinates are calculated from vertex points of a P waveform, a Q waveform, an R waveform, an S waveform, and a T waveform, respectively.

8. The wearable heart abnormal symptom sensing smart watch of claim **1**, wherein the ECG PQRST (X, Y) coordinates include ECG Q (X, Y) coordinates, ECG R (X, Y) coordinates, and ECG S (X, Y) coordinates.

9. The wearable heart abnormal symptom sensing smart watch of claim **1**, wherein the ECG measurement sensor includes: one or more biometric electrodes.

10. The wearable heart abnormal symptom sensing smart watch of claim **1**, wherein the smart band is flexible and shrinkable.

11. The wearable heart abnormal symptom sensing smart watch of claim **1**, wherein the smart band has an open ring shape, a closed ring shape, or a patch form.

* * * * *

专利名称(译)	可穿戴式心脏异常症状感应智能手表及其健康管理系统		
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摘要(译)

提供一种可穿戴式心脏异常症状感应智能手表，包括：佩戴在用户手腕上的智能腕带； 安装在智能手环中并与用户的手腕皮肤接触的心电图（ECG）测量传感器，该ECG测量传感器重复地测量来自用户的ECG信号； 智能设备安装在智能频段中，并通过智能频段与ECG测量传感器电接触。 该智能设备包括：ECG信号获取单元，用于实时地从ECG测量传感器接收电压波形的ECG信号；以及 存储参考心电图坐标信息的数据库； ECG信号处理单元对ECG信号进行实时处理以获得ECG PQRST（X，Y）坐标，并将ECG PQRST（X，Y）坐标与参考ECG坐标信息进行实时比较以确定 用户的心脏状况； 以及与用户，医院或消防局的熟人实时通信的通信单元。