

A WEARABLE DEVICE TO MONITOR AN ECG SIGNAL

DESCRIPTION

FIELD OF INVENTION

[0001] Embodiments of the present disclosure relate generally to, designing a device and system which are used along with daily wear apparel and are more specifically to monitor various parameters such as ECG signal, heart rate, and fitness data.

RELATED ART

[0002] Electrocardiography is a process of producing and recording an electrocardiogram signal (ECG) in a graph having voltage variation with respect to time, when the electrical activity of the heart is detected using electrodes placed on the skin of the user. The electrodes detect small electrical changes which may be an outcome of cardiac muscle depolarization and repolarization during each and every cardiac cycle. An ECG signal can track heart rhythm and any change in usual ECG pattern can be a result for numerous heart related abnormalities such as atrial fibrillation, myocardial ischemia, myocardial infarction etc. Hence, an ECG carries a large amount of information about the structure of the heart and the function of its electrical conduction system. People usually take such ECG tests to detect any change in pattern of heart beat, and abnormalities, so that they can be treated at the initial stage itself, and to avoid severe heart related medical conditions in future.

[0003] In a conventional method, a 12-lead ECG is used wherein which ten electrodes are placed on the patient's limbs and on the surface of the chest, respectively. The total magnitude of the heart's electrical potential is measured from twelve different angles ("leads") and is recorded over a period of time, usually for a period of 10 seconds. Through this way, the overall magnitude and direction of the heart's electrical depolarization is captured at each moment throughout the cardiac cycle. Even though, this method provides an accurate ECG patterns, the use of adhesive gel electrodes, which are uncomfortable during long-term application and can even cause skin irritations and allergic reactions to the user and cannot be used in real time scenarios. There are many ECG modules with strap in market having two or more electrodes and rivets which can be placed at the hands or chest to receive the electrical signal and to determine the heart rate, however they are complex in design and does not provide flexibility in terms of wearing to the user to continuously wear it in real time.

[0004] In view of foregoing discussion, there exists a need for a smart wearable which is simple in design, provide a flexibility to user in terms of wearing (modules embedded in a t-shirt),

capable of adjusting the height of belt strap in the t-shirt, to provide a snug fit of belt strap, and to effectively capture the heart rate with two electrodes. The smart wearable may be a t-shirt, gown, innerwear, hospital wear, sportswear, swimwear etc.

SUMMARY

[0005] In one aspect, a wearable device for measuring heart rate comprising a t-shirt, a fabric inner shirt, a belt strap, an ECG module, an ECG base, an electronic module, a pair of nickel-plated rivets, a pair of nickel-plated washers, a pair of electrodes and a pair of pogo pins. In an embodiment, the ECG module is capable of measuring the heart rate of user. The ECG module further comprise an ECG base and an electronic module. The signal from a pair of electrodes is transmitted to the electronic module through the ECG base. The pair of electrodes are placed at the rear side of belt strap, which are in direct contact with the skin of the user at the abdomen area near the heart. In another embodiment, the fabric inner shirt which is sewed to the inner wall of the t-shirt which holds the belt strap, and has a vertical flexibility and user suitably can adjust and place the belt strap at the abdomen area.

BRIEF DESCRIPTION OF DRAWINGS

[0006] FIG. 1A and 1B, is example front and back inside-view of wearable t-shirt unit 110.

[0007] FIG.2A, 2B and 2C, illustrates different views of belt strap 220 along with ECG module 210.

[0008] FIG. 3A through 3F illustrates the various components of ECG module and belt strap 320 in an embodiment of the present invention.

[0009] FIG. 4A and 4B are the actual front side of t-shirt and fabric inner shirt in an embodiment of the present invention.

[0010] FIG. 4C illustrates the fabric inner shirt 410 with the belt strap 440 in an embodiment of present invention.

[0011] FIG. 5A, 5B and 5C illustrates the various positioning of the fabric inner shirt 410 in an embodiment of the present invention.

[0012] FIG. 6 is a system 600 for detection of heart rate, in accordance with an embodiment of the present disclosure.

[0013] FIG. 7 is a block diagram of a wearable t-shirt unit 610 and an electronic device 620 in communication, in accordance with an embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE PREFERRED EXAMPLES

[0014] Embodiments of the present disclosure relates generally to build a wearable device and its related system which are easy to use with daily wear apparel like t-shirts and gowns and can capable of monitoring various parameters like an ECG signal, Heartrate, fitness data etc. FIG.

1A and 1B, is example front and back inside-view of wearable t-shirt unit 110. The device for detecting and recording ECG signal involves a wearable t-shirt unit (or a wearable t-shirt), fabric inner shirt (not shown), a belt strap 120 and an electronic module. The belt strap is sewed to the bottom edge of fabric inner shirt, which covers the abdomen or chest portion of the user. The belt strap has an ECG base, which may accommodate an electronic module. The front side of belt strap accommodates the ECG base, whereas the back side of belt strap has set of electrodes which touch the skin of the user at the abdomen or chest. In an embodiment, the belt strap is vertically adjustable in order to provide a snug fit to the user. The following paragraphs describe the implementation of wearable t-shirt in an embodiment of the present invention.

[0015] The fabric inner shirt has comparatively lesser shape and dimension of t-shirt unit, but suitably accommodates the size the user. The surface side of fabric inner shirt may be 5-7 inches. The belt strap which is circular in shape (when embedded in t-shirt), and matches the circumference of the fabric inner shirt. In an embodiment, the first side of circular fabric inner shirt is sewed with the inside portion or inner wall of the wearable t-shirt, above the abdomen. Further, the second side of the circular fabric inner shirt is sewed with the first side of the belt strap 120. In an embodiment, the side of belt strap 120 may be 1.5-3 inches. Belt strap 120 is made up of flexible material, for example, spandex and cotton, to firmly hold the abdomen or chest part of the user.

[0016] FIG.2A, 2B and 2C, illustrates different views of belt strap 220 along with ECG module 210. FIG. 2A is the example front side view of belt strap 220 along with ECG module 210. The ECG module 210 has two components namely, an electronic module and an ECG base.

[0017] FIG. 2B illustrates the example belt strap 220 and ECG module 210, wherein the two ends of belt strap 220 are attached and weaved together at 230 to form an elastic belt like structure. This elastic nature of belt strap 220 further provides a snug fit to the user.

[0018] FIG. 2C illustrates the example belt strap 220 in an embodiment of the present invention. The ends of belt strap 220 are attached together either through a button mechanism, or hook mechanism or any adhesion technique in order to keep belt strap snug fit for the user.

[0019] FIG. 3A through 3F illustrates the various components of ECG module and belt strap 320 in an embodiment of the present invention. FIG. 3A shows the position and arrangement of ECG base 305, on the first side (or front side) of the belt strap 320.

[0020] In another embodiment, the ECG base 305 is knitted or sewed with belt strap 320 and the electronic module 310 is attached with the belt strap 320 through the support, slot or cavity provided in ECG base 305 and with the help of the sliding mechanism constructed on the ECG base 305 and back side of electronic module 310. The ECG base 305 supports the vertical

insertion and removal of electronic module 310 from it. In an embodiment, the side edges of ECG base 305 and electronic module 310 are tapered. These tapered edges of ECG base 305 and electronic module 310 are so designed to provide a smooth sliding or placing of electronic module 310 within the cavity of the ECG base 305 and further, the cavity is also designed to hold the electronic module 310 firmly.

[0021] In an embodiment, the ECG base 305 is made of ABS and PU material and is attached to the belt strap 320 through a pair of nickel-plated rivets (340 and 345). In another embodiment, the ECG base 305 is accommodated through a pair of the nickel-plated washers (325 and 330) which make contact to the pair of electrodes (315 and 320) on the rear side of the belt strap 320.

[0022] In yet another embodiment, these pair of electrodes (315 and 320) are supported by two more electrodes to absorb better heart readings and to receive improved signal quality at the nickel-plated rivets (340 and 345). The electronic module 310 is attachable and can be conveniently inserted or housed in the slot provided in the ECG base 305 of belt strap 120. And, the electronic module 310 when attached with the belt strap 320 is specifically placed very near to the chest or abdomen portion of the user. The pair of electrodes (315 and 320) in combination with nickel-plated washers (325 and 330) are directly in contact with the skin of user and further transmits the heart rate signals to the ECG base 305 and to an electronic module 310.

[0023] In general, the ECG module and rear portion of belt strap (which touches the skin of the user) are hardware elements which combinedly act to sense and monitor the heart rate and heart rate exertion of the user in real-time.

[0024] FIG. 3B and 3C is the rear side of belt strap 320 illustrating the position and placement of pair of electrodes (315 and 320), nickel-plated washers (325 and 330), and a first sensor layer 335. In an embodiment, the first sensor layer 335 and pair of electrodes (315 and 320) are arranged or placed on the belt strap 320 one above the another. In other words, the first sensor layer 335 is placed between the pair of electrodes (315 and 320) and the belt strap 320 to ensure signal stability. The pair of electrodes (315 and 320) captures the electrical signal, which is transmitted to ECG module through pair of nickel-plated washers (325 and 330) and rivets (340 and 345). In an embodiment, one or more sensor layers may be placed between the pair of electrodes (315 and 320) and belt strap 320 to improve the signal quality.

[0025] The nickel-plated washers (325 and 330) and rivets (340 and 345) are made up of stainless steel and copper respectively. The pair of electrodes (315 and 320) are primarily made up of carbon or conductive carbon/rubber combination. The electrodes (315 and 320) become

conductive and transmit electrical signals, when comes in contact with water or saline or sweat or gel. The belt strap 320 is a combination of spandex fabric and cotton material.

[0026] FIG. 3D is an ECG base 305 in an embodiment of the present invention. The figure also shows the position and arrangement of nickel-plated rivets (340 and 345) which are capable of transmitting the electrical signals from the pair of electrodes (315 and 320) to the electronic module 310.

[0027] FIG. 3E and 3F is an example front side and rear side view of the electronic module 310 in an embodiment of the present invention. In one aspect, the electronic module 310 comprises a controller unit, a power supply unit, a pair of signal units, a pair of pins and a communication module. Further, the communication module, pair of signal units and power supply unit are connected to the controller unit. In an embodiment, the pair of pins (ex: pogo pins) are internally connected with the pair of signal units. When the electronic module 310 is placed in the ECG base 505, the nickel-plated rivets (340 and 345) and a pair of pins comes to direct contact and electrical signals generated from pair of electrodes (315 and 320) are transmitted to the pair of signal units of the electronic module 310, for processing. The signals at signal units are further transferred to the controller unit. The controller unit receives the signals from the pair of signal units for integration and further prepare them for transmission. The power supply unit provides electrical supply to the controller unit, communication module and other components of electronic module 310. In an embodiment, the power supply unit is a rechargeable battery and a port is provided in the electronic module 310 to increase the battery level time to time. The communication module transmits the data processed by the controller unit to the mobile device. And, a mobile application configured in the mobile device is capable of analysing the heart rate value, exertion rate, fatigue condition of user. In an embodiment, the electronic module 310 is made up of ABS and PC material.

[0028] FIG. 3F is an example rear side view of the electronic module 310, illustrating the position and arrangement of pogo pins (350 and 355) in an embodiment of the present invention. These pogo pins (350 and 355) are used to transmit the electrical signals from nickel-plated rivets (340 and 345) to the pair of signal units.

[0029] In one aspect of present invention, a wearable device for measuring heart rate comprising a t-shirt, a fabric inner shirt, a belt strap, an ECG module, an ECG base, an electronic module, a pair of nickel-plated rivets, a pair of nickel-plated washers, a pair of electrodes and a pair of pogo pins. The following paragraphs describes above components in detail.

[0030] The fabric inner shirt is internal additional layer of fabric sewed with the inner side of the t-shirt. In an embodiment, the fabric inner shirt is like a fabric cloth which equally matches the size of the t-shirt and is used to accommodate a belt strap. In another embodiment, the top side edge of fabric inner shirt is completely sewed to the inner wall of t-shirt at the upper abdomen level. The fabric inner shirt forms a hanging type cloth inside the t-shirt. The bottom side edges of fabric inner shirt are completely with the top side edges of the belt strap, making the belt strap attached with the fabric inner shirt. The belt strap is circular in shape and equal to the actual circumference of fabric inner shirt. In an embodiment, the belt strap is closed ended and side edges of belt are knitted, and do not allow user to adjust it horizontal manner, that is horizontal tightening or loosening of the belt strap is not possible. The bottom edge of belt strap is free and not attached to cloth material or any component.

[0031] In an embodiment, the belt strap may be adjustable in the vertical manner only, moving upwards and downwards till to the position where, fabric inner shirt is sewed with the t-shirt. In an embodiment, the belt strap has an ECG module which is capable of measuring heart rate of the user. The vertical adjustability of fabric inner shirt provides a greater flexibility to the user. The user can anytime adjust the fabric inner shirt to place the belt strap nearer to the heart and at the abdomen area. In an embodiment, the ECG module is separated into two parts, namely ECG base and electronic module. The ECG base has a slot like cavity structure, attached firmly with the belt strap on the one end. In one example, the cavity structure completely accommodates the electronic module. The belt strap has two sides, namely front and back side. The ECG base is attached to the belt strap at the front side of belt strap. The back side of belt strap having a pair of electrodes which are in direct contact with the skin of the user, near the heart in the abdomen area. The pair of electrodes are embedded and arranged as a conductive layer in the back side of belt strap and are capable of detecting and recording an electrical activity at the heart and transmitting the electrical signal to the pair of nickel-plated washers.

[0032] A pair of nickel-plated washers are attached to the belt strap are in connection with or arranged around the pair of electrodes at the back side of belt strap, which are capable of receiving the electrical values from pair of electrodes to the pair of nickel-plated rivets. The pair of nickel-plated rivets are part of ECG base, and are placed inside the cavity of ECG base and further make a connection with the electronic module. The gap between the pair of nickel-plated washers is 1 to 1.5 inches. Similarly, the gap between the pair of nickel-plated rivets is 0.75 to 1.25 inches. The pair of nickel-plated rivets and washers may internally associated by a conductivity component; hence, the electrical signals are passed without any loss. In an

embodiment, the belt strap may have two holes wherein which the nickel-plated rivets on one side and nickel-plated washers on the other side are placed and directly attached with each other.

[0033] The electronic module is placed in the cavity in the ECG base, wherein, the electronic module picks up the signal through a pair of pogo pins placed outside the electronic module and which are in direct contact with the pair of nickel-plated washers in the ECG base. The electrical signal is processed by the electronic module and transmitted to the mobile device for further processing through a communication module.

[0034] FIG. 4A and 4B are the actual front side of t-shirt and fabric inner shirt in an embodiment of the present invention. The fabric inner shirt 410 is sewed to the front side inner portion and side edges of t-shirt. As shown there, the fabric inner shirt 410 is knitted at first and second edge (420 and 430) of t-shirt. Further, the belt strap 440 is sewed to the bottom side of fabric inner shirt 410.

[0035] FIG. 4C illustrates the fabric inner shirt 410 with the belt strap 440 in an embodiment of present invention. As shown there, the belt strap 440 is entirely sewed with the bottom side of fabric inner shirt 410 as shown at 460. Further, the top side of fabric inner shirt is entirely sewed with the inner portion of front side of t-shirt as shown at 450. The fabric inner shirt 410 is vertically flexible and made up of a material having combination of spandex and cotton. Hence, the fabric inner shirt 410 can move freely upwards and downwards. The fabric inner shirt 410 can be moved up to the level where it is sewed with the t-shirt. Further, the bottom side of belt strap 440 is not attached to t-shirt.

[0036] FIG. 5A, 5B and 5C illustrates the various positioning of the fabric inner shirt 410 in an embodiment of the present invention. The fabric inner shirt 410 is designed to provide a flexibility to the user, when he wears the t-shirt. When the user wears the t-shirt, the belt strap may not be nearer to the heart and due to that module may produce inappropriate values. However, to avoid this, the fabric inner shirt (along with belt strap) is flexibly designed to move vertically upwards and downwards to provide a possibility to place the belt strap very near to the heart. The figure also shows example three positions of fabric inner shirt 410, illustrated based on the user preference and location of heart and with respect to the size chosen by the user. In an embodiment, the t-shirt may have a chest size of 48 inches (small), 51 inches (medium), 54 inches (large) and 58 inches (extra-large). In another embodiment, the size of fabric inner shirt is lesser compared to the t-shirt and proportional. In yet another embodiment, the fabric inner shirt may have a chest size of 47.5 inches (small), 50.5 inches (medium), 53.5 inches (large) and 57.5 inches (extra-large). The smart t-shirt or t-shirt or a smart apparel

(wearable device) can be worn by all people including male and females. Further, vertical adjustment of fabric inner shirt helps the female users to be worn along with under garments.

[0037] FIG. 6 is a system 600 for detection of heart rate, in accordance with an embodiment of the present disclosure. The figure is shown comprising components that include a wearable t-shirt unit (or a vest) 610, an electronic device 620 such as a mobile device, a first communication network 630, an application server 640 and a database 650. The following paragraphs describe the above components in detail. The wearable t-shirt unit 610, when in operation, is configured to generate a first data. The first data comprises a plurality of parameters associated with the user. The wearable t-shirt unit 610 which is worn by the user is connected to the electronic device 620, through a second communication network (not shown), for example, Bluetooth or BLE or any near field communication standards. The wearable t-shirt unit 610 covers the chest portion wherein which consists of one or more sensors to primarily monitor the heart rate, step data and other activities of the user. The sensors include heart rate monitoring sensor, an accelerometer or pedometer, and a gyroscope. In an embodiment, one or more similar type of sensors is used to accurately detect any movement, and appropriately capture and record the variation during the user activities.

[0038] The heart rate monitoring sensor (for example, ECG module) records the heart rate of the user, during any activity such as walking, running, jogging and so forth. In another embodiment, the wearable t-shirt unit 610 transmits the first data from one or more sensors to the electronic device 620 for further processing. The first data includes heart rate, accelerometer data and gyroscope data. The electronic device 620 communicatively coupled to the wearable t-shirt unit 610 is configured to analyse each parameter of the plurality of parameters in the first data. Optionally, the plurality of parameters of the first data includes at least one of: a heart rate exertion of the user, a pace of the user, the GPS location of the user. The plurality of other parameters includes, a heart rate with blood pressure data and breathing pattern of a person, and the like.

[0039] Moreover, the electronic device 620 detects a deviation in a value of at least one of the parameters of the plurality of parameters from a predefined range of each parameter. The predefined range of each parameter may be standard range of parameters in accordance with medical norms. For example, a predefined range for heart rate of a person may be 60 to 100 beats per minute. Furthermore, the electronic device 620 alert the user in reference to the detected abrupt deviation in the value of at least one of the said parameters, indicative of a level of fatigue. The electronic device 620 is configured with an application to receive and read the first data from the wearable t-shirt unit 610. The mobile application configured in the electronic

device 620 process and analyse the first data with one or more algorithms and methods to find any change in pattern.

[0040] The heart rate of the user is typically analysed to determine average heart rate and number of beats per minute. The heart rate may vary person to person, and activity to activity. The variation in heart rate is due to one or more internal or external parameters that include, stress, fatigue, anxiety, walking, jogging, running, or any physical activity or mental state of the user. Further, heart rate sensor is used to identify any abrupt variation in the heart rate and further helps to alert the user or share the information with the network through the electronic device 620, immediately.

[0041] In an embodiment, the algorithms of subject invention are primarily capable of identifying determine heart rate in a user, while performing any activity. Any abrupt value in heart rate value is immediately identified and user is alerted to pause or stop the ongoing task. In another embodiment, the electronic device 620 further adds a GPS location value to the first data and prepares the second data. The electronic device 620 (for example, a mobile device) transmits the second data to the application server 640, through a first communication network 630. The first communication network 630 communicatively coupled to the application server 640 configured to receive a second data from the electronic device 620, Notably, the second data comprises a partially processed first data and a Global Positioning System (GPS) value associated with the GPS location of the user. The first and second data which is being captured by the wearable t-shirt unit 610 and electronic device 620 are transmitted to the application server 640 for additional processing, wherein the application server 640 is configured to analyse the second data received from the first communication network.

[0042] The application server 640 further invoke a critical status associated with the user, if the level of heart rate level exceeds a threshold limit and generate an alert notification for at least one care personnel based on the critical status of the user. The one or more adverse heart rate conditions of one or more users are shared in a safety network or groups or closed contacts or hospitals for identification of adverse condition, monitoring of user and to provide timely assistance.

[0043] Optionally, the application server 640 compares the second data with the threshold limit for determination of the critical status of the user and provide the GPS value associated with the user to the at least one care personnel based on the determined critical status of the user. The threshold limit may be a minimum or a maximum value associated with each parameter, such that if any parameter of the user falls below the minimum value or rise above the maximum value generates a critical status, so the user may receive medical assistance. For

example, if a heart rate of a person rises to 130 beats per minute, which is one of the indications of fatigue, the application server 640 invokes the critical status and alerts the user and at least one care personnel. The application server 640 manages all data in the network, process them in a particular manner with the help of one or more algorithms and ultimately analyse health data to invoke a critical status with alert notifications.

[0044] The application server 640 stores all such processed data in the database 650. The database 650 maintains all data related to users, connected devices, emergency contact details in one or more tables. The database 650 is configured to store the first data, the second data, contact information of the at least one care personnel. Optionally, the database 650 is further configured to store a profile of the user, and wherein the profile of the user comprises at least one of: a wearable t-shirt unit identifier (ID), a name of the user, an age of the user, a location of the user, a height of the user, a weight of the user, a mobile number, an emergency contact number, a blood group and a medical history if any. The database 650 further indexes the data for faster retrieval, and revert when requested by the application server 640. Optionally, the application server 640 is further configured to monitor a plurality of users, and wherein the monitoring of each user of the plurality of users is based on at least one of: an age, a health history, a type of activity performed by a user at a moment of monitoring, a level of heart rate, a location of each user.

[0045] FIG. 7 is a block diagram of a wearable t-shirt unit 610 and an electronic device 620 in communication, in accordance with an embodiment of the present disclosure. The figure is shown comprising the components of wearable t-shirt unit 610 and the electronic device 620. As shown there, the components of wearable t-shirt unit 610 include a micro controller unit 705, a battery unit 710, a second communication module 715 and sensor modules 720. The sensor modules further include, an accelerometer or a pedometer 725, a gyroscope 730, and a heart rate monitor (HRM) 735. The components of electronic device 620 include, a first communication module 755, a GPS module 765 and primary controller unit 760. The first communication module 755 of the electronic device 620 and the second communication module 715 of wearable t-shirt unit 610 are connected through a second communication network (not shown). The first data from wearable t-shirt unit 610 is transmitted through the second communication network, to the electronic device 620.

[0046] Hence, the components of wearable shirt are simple in design, provide a greater flexibility to the users in terms of wearing (modules embedded in t-shirt), and can able to adjust the belt strap vertically in the t-shirt. The belt strap also provides a snug fit to the user, and to effectively capture the heart rate with two electrodes. The fabric inner shirt, belt strap, ECG

base, and electronic module of wearable unit can also be implemented in all wearable clothing but not limited t-shirt, gown, innerwear, hospital wear, sportswear, swimwear etc.

[0047] While various embodiments of the present disclosure have been described above, it should be understood that they have been presented by way of example only, and not limitation. Thus, the breadth and scope of the present disclosure should not be limited by any of the above-discussed embodiments but should be defined only in accordance with the following claims and their equivalents.

Claims

We claim,

1. A wearable device for measuring heart rate comprising:
 - a t-shirt;
 - a fabric inner shirt, wherein, the top side edges of fabric inner shirt are sewed to the inner wall of the t-shirt;
 - a belt strap, wherein, top side edges of belt strap are sewed to the bottom side edges of the fabric inner shirt; and
 - an ECG module, is capable of measuring a heart rate of user, wherein, the belt strap accommodates the ECG module.
 - an ECG base having a first slot, to accommodate an electronic module and attached to the front side of the belt strap;
 - an electronic module inserted in the slot provided in the ECG base, through a sliding mechanism;
 - a pair of nickel-plated rivets, arranged inside the ECG base and is capable of transmitting an electrical signal to the electronic module;
 - a pair of nickel-plated washers, arranged on the rear side of the belt strap and capable of transmitting the electrical signal to the pair of nickel-plated rivets;
 - a pair of electrodes, arranged as a conductive layer on the rear side of the belt strap, around the pair of nickel-plated washers, wherein, the pair of electrodes are capable of detecting an electrical activity at the heart and transmits the electrical signal to the pair of nickel-plated washers; and
 - a pair of pogo pins capable of receiving the electrical signal transmitted by the pair of nickel-plated washers.
2. The wearable device of claim 1, wherein, the pair of nickel-plated rivets and the pair of nickel-plated washers are part of ECG base.
3. The wearable device of claim 1, wherein, the pair of electrodes and the pair of pogo pins are part of belt strap and electronic module respectively.
4. The wearable device of claim 1, wherein, the fabric inner shirt is vertically adjustable irrespective of t-shirt and allow the belt strap to freely move upwards and downwards in the chest and abdomen area.
5. The wearable device of claim 1, wherein, the size of fabric inner shirt is proportional to the size of the t-shirt;

6. The wearable device of claim 4, wherein, the fabric inner shirt is adjusted and kept at three different positions to keep the belt strap and ECG base nearer to the heart.
7. The wearable device of claim 1, wherein, the nickel-plated washers and nickel-plated rivets are made up of stainless steel and copper respectively.
8. The wearable device of claim 1, wherein, the pair of electrodes and pair of nickel-plated washers are in direct contact with the skin of the user.
9. The wearable device of claim 1, wherein, the edges of the electronic module are tapered to accommodate and fit to the tapered edges of the slot in the ECG base.
10. The wearable device of claim 1, further comprises, a first sensor layer, wherein, the first sensor layer is placed between the pair of electrodes and the belt strap to improve the quality of electrical signal passed to the electronic module.
11. The wearable device of claim 1, wherein, the fabric inner shirt is sewed only to the front-inner side of t-shirt, and maximum size of fabric inner shirt is 6 inches.