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Internet-Based Student Physical Exercise Monitoring System

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Abstract

Internet-based student physical exercise monitoring system: Comprises an acquisition module for acquiring physiological parameters of students in real time; The storage module is used for storing the physiological parameters acquired by the acquisition module; The display module is used for displaying ECG, heart rate, respiration and movement parameters of the human body; The processing module is used for receiving the physiological parameters collected by the collection module,And process the physiological parameters, on the one hand, store the physiological parameters in the storage module, on the other hand, display the parameters of human ECG, heart rate, respiration and movement in the display module; Wireless transmitting module, which is used to send ECG, heart rate, respiration and movement parameters of human body to the user terminal. This design collects and monitors the acceleration of human body in real time,Real-time grasp of the movement state of the human body can be realized, and the situation that the human body falls can be detected.

Keywords

Internet, students' physical fitness, exercise, monitoring.

1. Purpose and significance of project implementation

Students, especially middle school students, are learning and living faster and faster with the increasing learning pressure, and the physical and mental pressure is also increasing. So the fast-paced learning life requires higher and higher physical quality of students, and the usual exercise is the best way to improve students' physical quality.

As far as the current social situation is concerned, with the increase of students' pressure and the existence of food hazards, more and more people are taking physical exercise. With the rapid development of science and technology today, how to detect and discover students' health changes and establish intelligent health monitoring systems, such as wearable monitoring system and telemedicine monitoring, have become the development direction of intelligent monitoring in the future.

In the existing technical field of student health monitoring, wearable monitoring system is large in size and single in function, which is far from meeting the needs of life.

2. Research contents of the project and problems to be solved

In order to overcome the above technical defects in the prior art, this design provides a student physical exercise monitoring system based on the Internet, which can effectively solve the problems in the background technology.

In order to solve the above technical problems, the technical scheme provided by this design is as follows:

This design embodiment discloses an Internet-based student physical exercise monitoring system, which includes:

The acquisition module is used for acquiring physiological parameters of students in real time, wherein the physiological parameters include human ECG, heart rate, respiration and movement parameters;

The storage module is used for storing the physiological parameters acquired by the acquisition module;

The display module is used for displaying ECG, heart rate, respiration and movement parameters of the human body;

The processing module is used for receiving the physiological parameters collected by the collecting module and processing the physiological parameters, on the one hand, storing the physiological parameters in the storage module, and on the other hand, displaying the ECG, heart rate, respiration and movement parameters of the human body in the display module;

Wireless transmitting module, which is used to send ECG, heart rate, respiration and movement parameters of human body to the user terminal.

Also comprises a mobile terminal, wherein the acquisition module, the storage module and the display module are all arranged on the mobile terminal, and the processing module is arranged on the user terminal.

The mobile terminal can be a portable small-sized acquisition device such as smart bracelet and smart watch. By setting sensors in the small-sized acquisition device, real-time acquisition of ECG, heart rate, respiration and movement parameters of users can be realized.

The fixed terminal can be an intelligent device with a processor, such as a mobile phone, a computer, a tablet computer, etc. The fixed terminal is connected with the mobile terminal through a network, so that the physiological parameters collected by the mobile terminal can be processed and viewed through the fixed terminal.

The acquisition module includes a blood pressure sensor, an electrocardiosignal sensor, a temperature sensor and an acceleration sensor, wherein the blood pressure sensor is used to acquire the blood pressure parameters of the human body, the electrocardiosignal sensor is used to acquire the electrocardiosignal signals of the human body, the temperature sensor is used to monitor the body temperature parameters of the human body, and the acceleration sensor is used to acquire the motion parameters of the human body.

There are three groups of acceleration sensors, which are used to collect the acceleration of human body in three directions respectively. The collection module also includes angular acceleration sensors, which are used to collect the angular acceleration parameters of human body.

The acquisition module also includes a microphone, a speaker and a GPS positioning device, wherein the microphone is used for acquiring the sound signal of the mobile terminal and transmitting it to the fixed terminal through the wireless transmission module, and the speaker is used for playing the sound signal transmitted by the fixed terminal through the wireless transmission module.

The acquisition module also includes a pedometer, which is used to record the steps of the human body.

The acquisition module also includes SpO2 detection sensor, two groups of light emitting diodes (LEDs) and photocell elements. The two groups of LEDs are red LEDs with 660nm wavelength and infrared LEDs with 940nm wavelength respectively.

When the processing module processes the ECG signals collected by the acquisition module, it includes the following steps:

Step 1, amplifying the collected ECG signal by using an operational amplifier AD620, wherein the amplification gain of the operational amplifier AD620 is set to 10;

Step 2, filtering the amplified ECG signal by RC filter circuit and amplifying it by operational amplifier;

Step 3: extract the characteristic values of the amplified and filtered ECG signals.

When the processing module processes the blood pressure signal collected by the acquisition module, it includes the following steps:

Step 1, establishing a time-pressure histogram according to a blood pressure signal obtained by a blood pressure sensor;

Step 2, extracting the characteristic value of the blood pressure signal according to the obtained time-pressure histogram, wherein the extracted characteristic value is the maximum value O0 of each detected pulse wave;

Step 3: Calculate the average pressure OM, systolic pressure OS and diastolic pressure OD of human body according to the extracted maximum value O0 of each pulse wave.

Calculate the mean blood pressure OM, systolic blood pressure OS and diastolic blood pressure OD of human body by formula and. Where, and are constants.

When the processing module processes the acceleration and angular acceleration collected by the acquisition module, it includes the following steps:

Step 1, establishing a motion model according to the obtained acceleration parameters and angular acceleration parameters;

Step 2, calculating the combined acceleration A according to the obtained acceleration, and calculating the combined angular acceleration G according to the obtained angular acceleration;

Step 3, judging the motion information of the human body according to the combined acceleration, the combined angular acceleration, the acceleration in all directions and the angular acceleration in all directions;

Step 4, the movement information of the human body is sent to the user end through the wireless transmission module and reminded.

Calculate the acceleration parameters of human body by formula; Among them, it is the combined acceleration of human body; Is the acceleration of human body in the forward direction of human body; Is the lateral acceleration of human body; Is the acceleration of human body in the vertical direction.

Calculate the angular acceleration parameters of human body by formula; Among them, it is the angular acceleration of human body; Is the angular acceleration of the human body along the forward direction of the human body as the axis; Is the angular acceleration of the human body along the lateral direction of the human body as the axis; Is the angular acceleration of the human body along the vertical direction as the axis.

When the processing module judges the motion information of human body, it includes the following steps:

Step 1, judging the combined acceleration, and if the combined acceleration of the human body is less than a threshold value A at time T, performing the next step operation;

Step 2, judging whether the combined acceleration of the human body is greater than a threshold value B at the time t+T, and if so, performing the next operation;

Step 3, judging whether the angular acceleration of the human body is greater than the threshold C in the time of t+T+T', and if it is greater than the threshold C, the human body is in a falling state.

Threshold A, threshold B and threshold C are all obtained through experiments.

It also includes an analysis module and a data collection module, wherein the data collection module is used to collect and sort out the physiological parameters of patients and the treatment suggestions of doctors, and the analysis module is used to compare and analyze the

physiological parameters of human body collected by the collection module with the data in the data collection module, and give suggestions on exercise and diet.

It also includes a diagnosis module, which is used to receive the human body parameter information sent by the wireless transmission module, realize the doctor's reading and diagnosis of the patient's physiological parameters, and send the diagnosis result to the analysis module.

The mobile terminal includes a smart watch, which includes a watch body, a display component, a power supply component and a sensing component, wherein the power supply component and the sensing component are both arranged inside the watch body, the display component is arranged on the upper surface of the watch body, and the sensing module is used for collecting ECG, heart rate, breathing and movement parameters of the human body.The display component is used to display ECG, heart rate, respiration and movement parameters of human body, and the power component is used to provide energy for the display component and the sensing component.

The display components are commercially available display screens, and the power components are commonly used batteries or button cell.

Sensing components include pressure sensor, ECG signal sensor, GPS positioning device and temperature sensor.

It also includes functional components, and the collection components are all arranged inside the watch body, and the collection components include a pedometer, a microphone and a speaker.

Watchbands are connected at both ends of the watch body, and the watchbands are used for users to wear the watch body on their arms.

The side wall of the body is provided with a charging socket and a card slot socket, wherein the charging socket is connected with the power supply component, and the card slot socket is used for installing the SIM card.

The mobile terminal also includes a monitoring pendant, and the monitoring necklace includes a shell, a motion collection component and a health care component, both of which are arranged inside the shell, the health care component is used for nursing the human body, and the motion collection component is used for collecting the motion parameter information of the human body.

The motion acquisition assembly includes an acceleration sensor and an angular acceleration sensor.

The health care component comprises a storage bag and a spraying device, wherein the storage bag is arranged in the shell, and the shell is provided with a button, the button is used for squeezing the storage bag, and the storage bag is used for storing medicaments.

The shell is connected with a rope or a metal chain to enable the user to wear it.

3. Features and innovations of the project

1. By collecting and monitoring the acceleration of the human body in real time, this design can grasp the movement state of the human body in real time and detect the fall of the human body.

2. By collecting the angular acceleration of human body, this design can prevent misjudgment of human body falling caused by running or other movements, and increase the accuracy of the device.

3. This design can effectively monitor the health problems of human body through real-time monitoring of ECG, blood pressure and blood oxygen saturation.

4. By setting the storage bag and button, this design can carry the first-aid medicine with you and is convenient to use.

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4. Project implementation plan

This design embodiment discloses an Internet-based student physical exercise monitoring system, which includes:

The acquisition module is used for acquiring physiological parameters of students in real time, wherein the physiological parameters include human ECG, heart rate, respiration and movement parameters;

The storage module is used for storing the physiological parameters acquired by the acquisition module;

The display module is used for displaying ECG, heart rate, respiration and movement parameters of the human body;

The processing module is used for receiving the physiological parameters collected by the collecting module and processing the physiological parameters, on the one hand, storing the physiological parameters in the storage module, and on the other hand, displaying the ECG, heart rate, respiration and movement parameters of the human body in the display module;

Wireless transmitting module, which is used to send ECG, heart rate, respiration and movement parameters of human body to the user terminal.

Furthermore, it also includes a mobile terminal, where the acquisition module, the storage module and the display module are all arranged on the mobile terminal, and the processing module is arranged on the user terminal.

The mobile terminal can be a portable small-sized acquisition device such as smart bracelet and smart watch. By setting sensors in the small-sized acquisition device, real-time acquisition of ECG, heart rate, respiration and movement parameters of users can be realized.

The fixed terminal can be an intelligent device with a processor, such as a mobile phone, a computer, a tablet computer, etc. The fixed terminal is connected with the mobile terminal through a network, so that the physiological parameters collected by the mobile terminal can be processed and viewed through the fixed terminal.

The acquisition module includes a blood pressure sensor, an electrocardiosignal sensor, a temperature sensor and an acceleration sensor, wherein the blood pressure sensor is used to acquire the blood pressure parameters of the human body, the electrocardiosignal sensor is used to acquire the electrocardiosignal signals of the human body, the temperature sensor is used to monitor the body temperature parameters of the human body, and the acceleration sensor is used to acquire the motion parameters of the human body.

There are three groups of acceleration sensors, which are used to collect the acceleration of human body in three directions respectively. The collection module also includes angular acceleration sensors, which are used to collect the angular acceleration parameters of human body.

The acquisition module also includes a microphone, a speaker and a GPS positioning device, wherein the microphone is used for acquiring the sound signal of the mobile terminal and transmitting it to the fixed terminal through the wireless transmission module, and the speaker is used for playing the sound signal transmitted by the fixed terminal through the wireless transmission module.

The acquisition module also includes a pedometer, which is used to record the steps of the human body.

The acquisition module also includes a sensor for detecting SpO2, two groups of LEDs and photocell elements, and the two groups of LEDs are red LEDs with a wavelength of 660nm and infrared LEDs with a wavelength of 940nm respectively.

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When in use, the red light diode with 660nm wavelength and the infrared light diode with 940nm wavelength are alternately lit according to a certain time sequence. When the capillary of fingertip is repeatedly congested with the pumping blood of the heart, the light of the LED is absorbed by blood vessels and tissues and then projected onto the photocell, which can sense the light intensity changing with the pulse blood in the form of changing electrical signals.

When the processing module processes the ECG signals collected by the acquisition module, it includes the following steps:

Step 1, amplifying the collected ECG signal by using an operational amplifier AD620, wherein the amplification gain of the operational amplifier AD620 is set to 10;

Step 2, filtering the amplified ECG signal by RC filter circuit and amplifying it by operational amplifier;

Step 3: extract the characteristic values of the amplified and filtered ECG signals.

When the processing module processes the blood pressure signal collected by the acquisition module, it includes the following steps:

Step 1, establishing a time-pressure histogram according to a blood pressure signal obtained by a blood pressure sensor;

Step 2, extracting the characteristic value of the blood pressure signal according to the obtained time-pressure histogram, wherein the extracted characteristic value is the maximum value O0 of each detected pulse wave;

Step 3: Calculate the average pressure OM, systolic pressure OS and diastolic pressure OD of human body according to the extracted maximum value O0 of each pulse wave.

Calculate the mean blood pressure OM, systolic blood pressure OS and diastolic blood pressure OD of human body by formula and. Where, and are constants.

When the processing module processes the acceleration and angular acceleration collected by the acquisition module, it includes the following steps:

Step 1, establishing a motion model according to the obtained acceleration parameters and angular acceleration parameters;

Step 2, calculating the combined acceleration A according to the obtained acceleration, and calculating the combined angular acceleration G according to the obtained angular acceleration;

Step 3, judging the motion information of the human body according to the combined acceleration, the combined angular acceleration, the acceleration in all directions and the angular acceleration in all directions;

Step 4, the movement information of the human body is sent to the user end through the wireless transmission module and reminded.

Calculate the acceleration parameters of human body by formula; Among them, it is the combined acceleration of human body; Is the acceleration of human body in the forward direction of human body; Is the lateral acceleration of human body; Is the acceleration of human body in the vertical direction.

Further, the angular acceleration parameters of human body are calculated by formula. Among them, it is the angular acceleration of human body; Is the angular acceleration of human body along the forward direction of human body; Is the angular acceleration of the human body along the lateral direction of the human body; Is the angular acceleration of the human body in the vertical direction.

As shown in Figure 2, when the processing module judges the motion information of human body, it includes the following steps:

Step 1, judging the combined acceleration, and if the combined acceleration of the human body is less than a threshold value A at time T, performing the next step operation;

Step 2, judging whether the combined acceleration of the human body is greater than a threshold value B at the time t+T, and if so, performing the next operation;

Step 3, judging whether the angular acceleration of the human body is greater than the threshold C in the time of t+T+T', and if it is greater than the threshold C, the human body is in a falling state.

Threshold A, threshold B and threshold C are all obtained through experiments.

It also includes an analysis module and a data collection module, wherein the data collection module is used to collect and sort out the physiological parameters of patients and the treatment suggestions of doctors, and the analysis module is used to compare and analyze the physiological parameters of human body collected by the collection module with the data in the data collection module, and give suggestions on exercise and diet.

It also includes a diagnosis module, which is used to receive the human body parameter information sent by the wireless transmission module, realize the doctor's reading and diagnosis of the patient's physiological parameters, and send the diagnosis result to the analysis module.

It also includes a privacy protection module for encrypting and protecting the personal information of users to prevent others from stealing and illegally using the personal information of users. The privacy protection module includes an independent memory, a processor and a cloud memory, wherein the independent memory stores the personal information of users,The processor is used to encrypt the user's personal information. The cloud storage user stores the user's physiological parameter information. The independent storage is only connected with the processor through LAN or data transmission line, but not with the outside.

The internal working steps of the privacy protection module include the following steps:

Step 1: Read the personal information input by the user when registering, randomly generate the user code in the processor, and transmit the personal information and user code of the user to the independent storage for archiving.

When the processor transmits the user's personal information to the independent storage, it first encrypts the user's personal information by encryption algorithm.

Further, the encryption algorithm can be DES encryption algorithm.

Step 2: Give the user code to the user, and use the user code when transmitting the user information.

Step 3: calculate the user code, bind it with the geographic location information of the user, and store it in the cloud storage.

It also includes an environment sensing module, which is used to monitor the temperature and humidity parameters of the user's environment, and when the temperature and humidity of the user's environment are abnormal, the fixed end will give an alarm.

It also includes an identity identification module, which is used to identify the identity information of the user according to the collected ECG signals.

The identification module includes the following steps when identifying the user's identity information:

Step 1: preprocess the collected ECG signal, first decompose the ECG signal by wavelet, then denoise it by default threshold method, then find the nth low frequency coefficient after wavelet decomposition, set it to zero, and then reconstruct the ECG signal;

Step 2, feature extraction is carried out on the preprocessed ECG signal, and the extracted features include R wave peak point, QRS wave template and heartbeat template;

Step 3: Analyze the correlation of ECG signals by using the extracted features of ECG signals, and use DTW algorithm to carry out dynamic time regulation to obtain the optimal matching object.

It also includes a sleep recording module, which is used to record and analyze the user's sleep status and time.

Furthermore, sleep states of users are divided into three states: awakening period, rapid eye movement sleep and non-rapid eye movement sleep.

The sleep recording module includes the following steps when analyzing the user's sleep state:

Step 1, extracting the preprocessed user electrocardiosignal, and calculating the heart rate ai of the user in the first minute according to the user electrocardiosignal;

Step 2, calculate the heart rate a0 of the user in normal state, when $ai<(0.8*a0+5)$, judge that the user is in sleep state, and record the sleep time V;

Step 3, according to the motion information of the human body collected by the collection module, judging whether the user flips during sleep, and recording;

Step 4, when the time interval Tj between two times when the human body turns over in sleep is greater than the threshold Tb, it is judged that the user enters deep sleep and the sleep time Va is recorded;

Step 5, calculate the sleep efficiency of human body $\eta=Va/V$, when $\eta<\eta0$, the sleep quality of the user is poor, and send information to the fixed terminal for reminding.

The mobile terminal includes a smart watch, which includes a watch body, a display component, a power supply component and a sensing component, wherein the power supply component and the sensing component are both arranged inside the watch body, the display component is arranged on the upper surface of the watch body, and the sensing module is used for collecting ECG, heart rate, breathing and movement parameters of the human body.The display component is used to display ECG, heart rate, respiration and movement parameters of human body, and the power component is used to provide energy for the display component and the sensing component.

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The side wall of the body is provided with a charging socket and a card slot socket, wherein the charging socket is connected with the power supply component, and the card slot socket is used for installing the SIM card.

The mobile terminal also includes a monitoring pendant, and the monitoring necklace includes a shell, a motion collection component and a health care component, both of which are arranged inside the shell, the health care component is used for nursing the human body, and the motion collection component is used for collecting the motion parameter information of the human body.

The motion acquisition assembly includes an acceleration sensor and an angular acceleration sensor.

The health care component comprises a storage bag and a spraying device, wherein the storage bag is arranged in the shell, and the shell is provided with a button, the button is used for squeezing the storage bag, and the storage bag is used for storing medicaments.

The shell is connected with a rope or a metal chain to enable the user to wear it.

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