International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 12, Issue 8 [August. 2023] PP: 110-115

The Application of Intelligent Monitoring Headbands in Medicine

Hou Yongmei*
Department of Psychology, School of Humanities and Management, Guangdong Medical University, Dongguan, Guangdong Province, China

Abstract: *Intelligent monitoring headbands are a type of wearable device that can automatically and continuously monitor, analyze, store, and transmit physiological parameters such as brain waves, blood pressure, pulse, blood oxygen saturation, and exercise status for a long period of time without affecting users' daily activities. They are a new technological means of preventing and controlling diseases and have been widely used in sports, healthcare and special occupation. Based on literature reports, this article reviews the research progress of intelligent monitoring headbands in evaluating and monitoring exercise status, sleep quality and dreams, sleep disorders, dynamic blood oxygen, dynamic blood pressure, guiding the blind, physiological information of people rushing to high altitude, and vital signal of soldiers.*

Keywords: *Wearable; Intelligent Monitoring Headband; Physiological Indicators; Parameters; Remote Monitoring*

Date of Submission: 12-08-2023 Date of acceptance: 28-08-2023

I. Introduction

The continuous automatic detection of physiological indicators is of great significance in fields such as healthcare, sports, and special professions. Although previous methods for detecting physiological indicators have high accuracy, they rely heavily on skills and require the use of invasive or non-portable instruments, which can only achieve intermittent time point detection. Long term physiological indicator monitoring equipment is a monitoring tool developed to address these issues. Among them, intelligent monitoring headbands have been recognized by various sectors of society for their portability, ease of use, non-impact on users' activities, continuous and accurate measurement and objective analysis, as well as long-term storage of data, and real-time follow-up, becoming the development direction of long-term physiological indicator monitoring equipment.

II. The Application of Intelligent Monitoring Headbands in Medicine

The intelligent monitoring headband is a physiological indicator detection instrument that can be worn on the head. It fixes the sensors used to collect data on physiological indicators such as heart rate, body temperature, and blood oxygen saturation on an elastic silicone headband. When used, the headband can be worn at a specific location on the head circumference to obtain the required data. Currently, the application of intelligent monitoring headbands in medicine is mainly reflected in the following seven aspects.

2.1 Application of Intelligent Monitoring Headband in Body Motion Monitoring

The monitoring of body motion status mainly involves wearing an acceleration sensor, collecting acceleration data of body motion, and identifying and monitoring the motion status by analyzing the data. Now, human movement status monitoring based on wearable devices is mainly used in the field of medicine and healthcare, and the monitoring of movement types are mostly used for activities such as falling, walking, and running.

Spree [1] has made smart tracking devices into headbands. This sports monitoring device called Spree integrates all its functions into a black soft headband. From a distance, it looks like a sporty headband with some special design or a fashionable headband worn by hippies, allowing people to free away from outdated heart rate bands and exercise more freely, and obtain equally accurate and detailed information. This intelligent monitoring headband is made of rubber and features various sensors such as motion sensors, heart rate sensors, and body temperature sensors attached to the wearer's forehead. A wireless performance optimization device is designed to track the wearer's movement performance, and corresponding Apps are also equipped. The wearer can synchronize their smart mobile device with the headband through Bluetooth 4.0, complete GPS positioning tracking, collect motion data such as route, distance, speed, and exercise time, and also obtain physiological data such as heart rate, body temperature and calorie consumption. After the exercise, wearers only need to open the

App to view their own exercise history, or use a USB cable to transfer the data to the computer. Like most heart rate monitoring devices, the body temperature monitoring function of Spree can only support IOS devices, while the heart rate monitoring function is applicable to all IOS and Android devices. Famous exercise recording Apps such as Runtastic, Runkeeper, and MapMyRun can use Spree to monitor and record heart rate data. Although Spree is lighter and more convenient in terms of weight and wearing method, compared to chest straps and wrist heart rate monitoring devices, Spree worn on the head cannot be easily accepted by some people, because it is not hidden under clothes like the latter two, but directly exposed to the outside, which is slightly stiff and unattractive, and it is not convenient to wear a sports protective helmet at the same time. In addition, Spree can only last 8 hours and is only suitable for wearing during exercise.

2.2 The Application of Intelligent Monitoring Headband in Sleep Medicine

2.2.1 The Application in Sleep Quality and Dream Control

The appearance of the Aurora intelligent monitoring headband [2] is very similar to the eye mask people wear when sleeping. The head wearing part adopts a low profile design, so that there is no uncomfortable feeling on the forehead. The forehead of the headband contains sensors that capture brain waves and eye movements, which can track the wearer's every movement. The integrated LED lights and speakers convey the wearer's voice and movement records, and restore the wearer's sleep state. In order to ensure that users wake up on time, Aurora is also equipped with a small alarm clock. When it detects that the user has rested, it will notify Aurora to make a sound to remind the user to wake up.

This intelligent monitoring headband can record the wearer's brainwaves and eye movements, as well as track their body movements. Through data analysis, it can determine whether the wearer is in deep sleep or dreaming. Once it is confirmed that the wearer is already asleep and dreaming, this intelligent monitoring headband with an audio and light player will emit a series of signals (including sound and light) to help users become aware of the content of their current dream and guide the wearer who is dreaming. After being guided, the wearer can freely create their own space to control their dreams. Not only can they have more vivid dreams in deeper sleep, but they can also wake up in perfect moments. At the same time, Aurora can help dreamers create imaginative creations and easily obtain inspiration. Just wear this intelligent monitoring headband on your head and have a beautiful sleep. You can find the right creativity in your dreams while relaxing and reducing stress. It can be seen that Aurora satisfies people's curiosity about dreaming, helps alleviate stress, reduce nightmares, improve sleep quality, achieve deep sleep, and strengthen certain skills in real life.

Aurora can be used alone or bundled with your phone. Simply install the corresponding App on your phone. Through the built-in Bluetooth and corresponding App, good dreams can be shared with friends, allowing them to also experience wonderful dreams.

2.2.2 The Application in Sleep Disorder Detection

Sleep disorder is a kind of disease with high incidence that seriously endangers human health. It not only affects people's work and study, but also will cause dysfunction of human organs after a long time, leading to endocrine disorders, memory decline, depression, anxiety, hypertension, stroke, diabetes, Alzheimer's and other diseases [3]. Polysomnography (PSG) is the gold standard for diagnosing sleep disorders, which can accurately distinguish various types of sleep disorders. However, this technology can only be developed in large hospitals, resulting in low awareness and detection rates of sleep disorders in China. Therefore, there is an urgent need to study and develop sleep disorder monitoring technologies and devices suitable for families. In recent years, some portable and small sleep monitoring devices have been developed both domestically and internationally [4-7], but there are still many problems in terms of professionalism, accuracy, ease of use, and comfort.

In response to the problems of current sleep detection products, Yan BW et al. [8] have developed a new type of multi-parameter sleep monitoring headband. It is designed based on sensing technologies such as surface electroencephalography, reflected blood oxygen saturation, pulse wave frequency conversion, infrared body temperature, three-dimensional acceleration, and Bluetooth communication, combined with micro and low-power requirements. It adopts a headband method to synchronously monitor multiple parameters such as EEG, blood oxygen saturation, activity, and body temperature in the forehead. The selection of the above four parameters is mainly based on: first, EEG is the most important indicator reflecting sleep status, which has been widely used in sleep staging and quality assessment; Second, blood oxygen saturation is directly related to the oxygen content in the blood. When a respiratory arrest event occurs, the body experiences hypoxia, and blood oxygen saturation will significantly decrease, making it a key indicator for diagnosing respiratory arrest syndrome. Therefore, simultaneously detecting EEG and blood oxygen saturation can achieve simultaneous identification of sleep staging and apnea events. Final, activity and body temperature parameters can assist in determining the depth of sleep. In addition, in order to meet the requirements of remote monitoring, a wireless communication module is added to the device, which uses Bluetooth to send the monitored data to the

smartphone for processing, or further send it to the remote sleep monitoring center for expert analysis. Experiments have shown that this headband can synchronously monitor multiple sleep parameters such as EEG, blood oxygen saturation, body temperature, activity, and posture. It is easy to use, comfortable to wear, portable, low load, low power consumption, and high sensitivity. It can be used for home sleep monitoring and building remote sleep monitoring systems, as well as in fields such as tourism, scientific research, sports, health management, and wartime casualty rescue.

2.3 Application of Intelligent Monitoring Headband in Dynamic Blood Oxygen Monitoring

Cerebral oxygen saturation is a percentage that reflects the balance between oxygen consumption and supply in brain tissue. It is a key indicator of human brain physiological signals and has important significance in scientific research and clinical medicine. Real time monitoring and timely intervention of cerebral blood oxygen status can reduce the probability of stroke occurring in patients during or after surgery, and can shorten the hospitalization time of patients in intensive care units and general wards. At present, most of the clinical tests for cerebral oxygen saturation in China use invasive detection methods, while foreign devices that use near-infrared spectroscopy technology for non-invasive detection of cerebral oxygen saturation were not allowed to enter China until 2015, and the prices are expensive.

The Brain Network Research Center of the Institute of Automation, Chinese Academy of Sciences [9] has independently developed a wireless and wearable brain blood oxygen monitoring headband suitable for free walking patients or people with daily activities, which can realize real-time monitoring of brain blood oxygen saturation. It is easy to use, covers a wide range of people, and has a relatively low cost.

This brain blood oxygen monitoring headband is designed based on near-infrared spectroscopy technology, and the key component is the packaging module located at the front, which is composed of a light source, probe, and processor. Users can wear a headband and attach the module to their forehead to detect cerebral oxygen saturation and heart rate signals in real-time. Then, they can view and browse the data collection process in real-time through their mobile phone or any Bluetooth terminal device. This product can be used in four collection modes: sleep, squat, exercise, and normal mode. In the sleep mode, data can be collected continuously for 24 hours to fully record the changes in cerebral blood oxygen saturation before, after, and during sleep; The squat mode can be used to evaluate the cardiovascular and cerebrovascular function of users, that is, the ability to recover brain oxygen when the body undergoes drastic changes in blood oxygen due to postural changes; The exercise mode allows athletes to promptly know their cerebral oxygen saturation and remind them in case of any discomfort.

When designing this brain blood oxygen monitoring headband, researchers combined the zoning information of the human brain function map and comprehensively considered the characteristics of Chinese skull related tissues, such as skull thickness, absorption factor of oxygen-containing hemoglobin, and other parameter, to derive a more accurate brain oxygen calculation model, making this headband more suitable for the physiological conditions of Chinese and obtaining more accurate brain blood oxygen data. In addition researchers are also working to make this headband suitable for other races of people.

2.4 The Application of Intelligent Monitoring Headband in Ambulatory Blood Pressure Monitoring

Ambulatory blood pressure monitoring (ABPM) is a diagnostic technique that automatically and intermittently measures blood pressure under daily living conditions with instruments. Due to overcoming the limitations of fewer measurements in clinics, the "white coat effect", and observation errors, ABPM can more objectively reflect the actual level and fluctuation of human blood pressure. It can also screen early asymptomatic mild or borderline hypertension patients, improve the detection rate of these two types of diseases and enable patients to receive timely treatment, which has important guiding significance for the monitoring and treatment of hypertension. At present, most ambulatory blood pressure monitors measure blood pressure by oscillographic methods, such as cuff type and wrist type blood pressure measuring instruments [10]. Although such instruments are commonly used, there are still some shortcomings, such as the inability to continuously measure, the use of a charging and discharging pump, high power consumption, long measurement time, inconvenience in carrying, and affecting daily activities.

Wang Yanxiang et al. [11] designed a headband device based on pulse wave conduction time that can continuously measure blood pressure for a long time. Unlike traditional signal acquisition methods, the signal collection location of this device is located on the head. The electrocardiogram (ECG) and photoplethysmography (PPG) signals are collected separately by the ECG electrode sensor and the reflected pulse wave sensor embedded in the headband, and feature points are extracted from the two. Measure the time difference between the R-wave peak of the electrocardiogram signal and the maximum point of the pulse wave signal to obtain the pulse wave conduction time (PTT). Then, based on a linear model between arterial blood pressure and pulse wave conduction time (PTT), regression analysis is conducted using pulse wave conduction time and systolic and diastolic blood pressure measured by a mercury sphygmomanometer to obtain the

calculation formula for systolic and diastolic blood pressure. The experimental results on the human body indicate that the error between the data measured by this device and the mercury sphygmomanometer is within 10mmHg, which can meet the requirements of AAMI international standards for non-invasive blood pressure monitoring error.

The wearable blood pressure measurement headband developed by Wang Puling et al. [12] based on the pulse wave propagation delay method [13-15] can perform non-invasive continuous measurement of human blood pressure. This headband consists of four parts: an electrocardiogram acquisition module, a pulse wave acquisition module, a data processing unit, and a wireless transceiver, achieving functions such as multi signal acquisition, processing, and wireless transmission. The entire device is worn on the head and communicates with the outside world through wireless transmission and reception. The specific detection process is as follows: a high-resolution electrocardiogram acquisition chip ADS1292R is used to collect weak electrocardiogram (ECG) signals from the head [16], while a reflective photoelectric sensor is used to collect photocapacitance pulse wave signals (PPG) that are strictly synchronized in time at the eyebrow bone. Then, locate the feature points of ECG and PPG separately, calculate the pulse wave transit time (PWTT) of PPG signal, and perform correlation and regression analysis with the blood pressure values at the same time. The next step is to establish a blood pressure measurement model, and then calculate the blood pressure based on PWTT [17]. Due to the strict requirements for the effectiveness of the collected raw signals in the processing of weak human body signals, in order to improve the stability of the headband and the accuracy of blood pressure calculation results, researchers combined the detection results of human posture to screen the body signal in the initial stage of signal collection. The experiment results show that compared with traditional non-invasive blood pressure measurement methods, the error of this device is maintained within 5%, and the detection results are reliable. The innovation of this headband is improving the acquisition method of electrocardiogram signals and pulse waves. The traditional method for obtaining electrocardiogram signals is to measure the chest lead I, while the traditional method for measuring pulse waves is to use a transmissive optical frequency converter to obtain stable signals from the fingertips. Although these two methods are relatively easy, they cannot achieve the characteristics of portability. The operating system of this detection headband adopts micro and low-power digital chips, greatly reducing the circuit board area and reducing circuit power consumption, and signal collection is completed on the head, with accurate detection [18], sensitive response, small size, light weight, low cost, low power consumption, convenient use, and strong comfort. It can be said that this device is a feasible portable non-invasive continuous blood pressure monitor. At the same time, the detection results can be transmitted to the user's mobile phone or PDA device for real-time display and storage through Bluetooth devices, completing long-term uninterrupted dynamic blood pressure monitoring.

2.5 The Application of Intelligent Monitoring Headbands in Guiding the Blind

Visually impaired individuals may encounter various difficulties when walking outdoors or indoors. An intelligent Monitoring headband [19] is designed to help them identify hazards and move autonomously. The hardware structure is as follows: the Arduino main control board, sensor, SIM card module, and battery module are placed in the main control case, all controlled through corresponding switches. The switch slot is connected to the power module, which is connected to a USB charging port. The main control board is connected to the sensor through a ribbon cable. The cover of the main control board is engraved with braille, and the sensor shell is composed of the outer edge of the sensor, the sensor base, and the sensor cover. When using, we can put a headband on the head and turn on the operation switch on the main control panel, the three sonar ranging modules measure at a 90 degree angle. When the user walks forward, each module reminds the user to move forward, left, or right based on the distance measured. For example, when there is an obstacle, each sensor has different vibration frequencies, and the sound sensor emits a prompt sound, the SIM800 module will send the walking location to the upper computer at regular intervals during the operation of the card machine, and the upper computer will display the path based on the uploaded data.

2.6 Application of Intelligent Monitoring Headbands in Tracking Physiological Information of Personnel Rushing to High Altitude

After rushing to the plateau, people from the plain will experience varying degrees of altitude reactions. The incidence rate of altitude sickness is related to climbing speed, altitude, living time and physical fitness. Among them, mild cases can manifest as physical discomfort, while severe cases can endanger life [20-21]. Therefore, it is particularly important to timely understand the physical condition and physiological parameters of personnel who rush to high altitude, and provide corresponding guidance and treatment [22]. The simplest method for testing physiological parameters in the past was often using a nail oximeter. The disadvantage of this instrument is that it requires one hand of the testee, has few monitoring indicators, and lacks trend analysis and remote monitoring of data [22-24].

Wu Feng et al. [25] developed a headband or hat-type wearable physiological information monitoring

system for high-altitude operations. This instrument is based on sensing technologies such as blood oxygen, pulse, body temperature, body acceleration, ambient temperature, and latitude and longitude. It uses Bluetooth 4.0 as the communication method and uses a headband or cap-type physiological signal acquisition terminal. It utilizes the mobile Android platform to develop a platform for physiological signal receiving, reporting, displaying, historical playback, parameter setting, transmission, and processing, and develops corresponding cloud based remote monitoring platforms using mobile Internet as communication methods. When users wear headbands for high-altitude operations, their physiological information can be transmitted to remote data servers through 3G, 4G, and Wi-Fi wireless networks. And then, the remote monitoring center located in the cloud can monitor the users' physical condition, alarm information, and geographical location in real-time, and provide guidance and rescue, thereby ensuring the physical health of users during high-altitude operations. A reflective pulse oximetry measurement method is adopted for blood oxygen detection, with detection light sources (LEDs) and photodiodes (PD) set on the same side. By using this method, sensors can be placed in many parts of the body, such as the forehead, chin, wrist, palm, etc. The sensors can be placed in hats or gloves, which have a faster response to aortic blood hypoxia and can achieve blood oxygen saturation and pulse wave measurement during exercise and work, making up for the limitations of sensor placement location of the transmission method. The temperature sensor is made of a thermistor with a resolution of 0.1°C and an ambient temperature resolution of 0.5°C. Pressure sensor MS5611-01BA is used for the altitude measurement, with an accuracy of up to 1m.The three-dimensional sensor MMA7361L is adopted for acceleration testing, with a detection range of ±1.5g. Bluetooth 4.0 is used for the communication between the hat strap and the phone, which has the characteristics of power saving and long transmission distance, making it particularly suitable for wearable devices. Through multiple preliminary on-site trials, it has been proven that the system has the characteristics of low load, easy to use, no interference on work, accurate and reliable results, long-term data storage, and remote cloud monitoring. It can be used for physiological monitoring of various high-altitude workers, as well as in various fields such as tourism, scientific research, medical treatment, sports, and health management.

2.7 Application of Intelligent Monitoring Headbands in Soldier Vital Signal Monitoring

Compared with traditional warfare, modern warfare has undergone significant changes. The development of technology has transformed modern warfare into high-tech warfare, with increasing emphasis on battlefield perception, including detection of the battlefield environment, enemy weapons, and combat effectiveness of soldiers. In modern warfare, the level of individual combat capability directly determines the overall combat effectiveness. Therefore, timely and accurate understanding of the health and injury status of soldiers, analyzing their combat effectiveness, is of great significance for the deployment of commanders and the rescue of soldiers [26].

Wu Baoming et al. [27] designed a multi-vital sign monitoring headband which integrates ECG, EEG, pulse wave, body temperature, and posture measurements from a portable perspective, targeting the battlefield environment. The headband can continuously monitor soldiers' vital signals of combatting, injury, treatment, and transportation, and send real-time information on the physical signals and location of the wounded, with important value in quickly treating the injured and reducing their mortality and disability rates. The MSP430 microcontroller with ultra-low power consumption is used as the main control chip, the ADS1292R with low power consumption is used as the dual electrode ECG and EEG acquisition chip, and conductive silicone is used as the electrode to measure ECG and electroencephalogram (EEG) signals from the head. A reflective light frequency conversion probe is used to measure the photocapacitance pulse wave (PPG) and body surface temperature of the eyebrow bone (rectangle). acceleration sensors is used to distinguish the movement status, and vital signals of soldiers in the stationary state are collected for processing, ensuring the accuracy of measurement results [28]. A reflective optical frequency converter is used to collect the pulse wave of PPG, a medical specific negative temperature coefficient (NTC) thermistor is used as the temperature sensor, and an MMA7660 digital triaxial accelerometer is used as the attitude measurement sensor. By transmitting the collected information to individual PDAs through Bluetooth, the monitoring of multiple vital signals is achieved, which is characterized by small size, light weight, low power consumption, low cost, and portability and comfort. Effectively overcoming the influence of various interference information on collecting physical signals in diverse activity states, such as standing still, sitting down, lying down, walking, running, falling. At the same time, it also avoids the skin allergies, itching, etc. that are easily caused by sticking electrodes used in traditional sign monitoring, and the inconvenience caused by measuring electrocardiogram signals from chest lead 1 and pulse wave signals from fingers to soldiers' normal activities.

III. Prospect

As a new technology product, the intelligent monitoring headband makes automated and continuous monitoring of physiological indicators a reality, but it is still in the stage of new development and there are some problems. First is the wearing area. For example, as mentioned earlier, the intelligent monitoring headband is

not hidden under clothing, but is worn on the head and directly exposed to the outside. This feature cannot be easily accepted by some people, because it appears dull and unattractive, which can easily give others the stereotype of "fever" and "illness". Second, it is not convenient to wear protective helmets. Final, collecting and analyzing data through remote monitoring centers in the cloud can also lead to issues such as the leakage of users' privacy.

References

[1]. Love Burning Net. Can you measure your heart rate with a tight mantra?------ Spree smart headband [EB/OL]. http://trial.iranshao.com/ articles/717- spring-heart-rate.
[2]. Aurora. Intelligent headband can control dreams [J]. China's Information Industry (eMedicine). 2014, (2): 13.
[3]. Yu MS, Zhang HJ. A New Mode of Sleep Medical Monitoring [J]. China Medical Device Information, 2003, 9(3): 4-6.
[4]. Wang NY, Zhang J. Development status of portable sleep monitors [J]. Chinese Medical Abstracts Otolaryngology, 2010, 25(6): 302-304.
[5]. Wu D, Xu XW, Wang L, et al. Design of a wearable dynamic sleep breathing monitoring system [J]. Journal of Sensing Technology, 2010, 23(3): 322-325.
[6]. Wu F, Zhou YB, Cheng QM, et al. Development of a portable sleep monitoring system [J]. Medical and Health Equipment, 2008, 29(11): 20-22.
[7]. Zhu YY, Yang J, Liu CC, et al. Sleep respiratory event discrimination based on the characteristic information of photocapacitance pulse wave [J]. Chinese Journal of Biomedical Engineering, 2008, 27(5): 679-683.
[8]. Yan BW, Wu BM, Gao DD, et al. Development of a new multi-parameter sleep monitoring headband [J]. Life Science Instruments, 2017, 15(4): 47-51.
[9]. Institute of Automation, Chinese Academy of Sciences. Wearable brain oxygen monitoring headband [J]. Sensor World, 2016, (12): 66.
[10]. Bao FR. A comparative study on effects between wrist blood pressure monitor and upper arm cuff sphygmomanometer measurements [J]. Clinical Medicine & Engineering, 2011, 18(2): 271-272.
[11]. Wang YX, Wu J, Pang Y, et al. Design of a headband continuous blood pressure detection [J]. Device Life Science Instruments, 2015, 13(12): 36-41.
[12]. Wang PL, Pang Y, Wu BM, et al. A study on a continuous non-invasive blood pressure monitoring headband [J]. Journal of Chongqing University of Posts and Telecommunications (Natural Science Edition), 2015, 27(2): 250-254.
[13]. LAN F, LIU HP, ZHAGN X, et al. Study of pulse wave velocity and cardiovascular event correlation [J]. Chinese Journal of Integrative Medicine on Cardio-/Cerebrovascular Disease, 2014, 12(2): 182-183.
[14]. Meng XP, Liu B, Deng BY, et al. Research on arterial blood pressure estimation with pulse wave transit time [J]. Chinese Journal of Biomedical Engineering, 2011, 30(4): 509-513.
[15]. YANG XL, HU W, YAN H, et al. Research progress of noninvasive continuous blood pressure measurements based on pulse wave velocity [J]. Space Medicine & Medical Engineering, 2011, 24(6): 467-472.
[16]. He DD, Winokur ES, Heldt T, et al. The ear as a location for wearable vital signs monitoring [C]//Engineering in Medicine and Biology Society (EMBC), 2010 Annual International Conference of the IEEE. Buenos Aires, Argentina: IEEE, 2010: 6389-6392.
[17]. He D, Winokur ES, Sodini CG. A continuous, wearable, and wireless heart monitor using head ballistocardiogram (BCG) and head electrocardiogram (ECG) [C] / /Engineering in Medicine and Biology Society, EMBC, 2011 Annual International Conference of the IEEE. Boston, MA, USA: IEEE, 2011: 4729-4732.
[18]. Liu YY, Yun MS, Xiang HY, et al. Design of head-up tilt experimental system for measuring head blood pressure and its dynamic process [J]. Space Medicine & Medical Engineering, 2007, 20(6): 422-426.
[19]. Sun JF, Cao JF, Zhao Y, et al. Design and implementation of a tactile headband device for disabled people [J]. Computer Knowledge and Technology, 2019, 15(3): 251-253.
[20]. Hackett PH, Roach RC. High-altitude illness [J]. N Engl Med, 2001, 345(2): 107-114.
[21]. Wu F, Luo YC, Cao ZT. Comparison of the effects of different hypoxic exposure methods on high-altitude acclimatization [J]. Chinese Journal of Aeronautics and Astronautics, 2013, 24(4): 252-255.
[22]. Duan JF, Pu W, Wu F, et al Research on the application of remote physiological parameter monitoring in high altitude health security [J]. China Digital Medicine, 2012, 7(7): 83-86.
[23]. Zhou YB, Cheng QM, Wu F, et al. The development of a remote real-time monitoring system based on a wide area network [J]. Compilation of Papers from the Biomedical Branch of the Chinese Society of Stereology, 2012: 102-108.
[24]. Yu YQ, Deng JG, Zhang PH, et al. Design and implementation of a low power mobile ECG monitoring system based on Android [J]. The Electronic World, 2013, (21): 130-131.
[25]. Wu F, Zhou YB, Cheng QM, et al. High altitude physiological information monitoring system based on intelligent monitoring headband [J]. Digital Medicine in China, 2015, (3): 35-37.
[26]. Yan QG, Wu BM, Zhuo Y, et al. Progress in research on wearable individual life monitoring systems [J]. Chinese Journal of Medical Devices, 2006, 30(5): 345-348.
[27]. Wu BM, Wang PL, Pang Y, et al. Design of a multi vital signal monitoring headband for battlefield soldiers [J]. Sensor and Microsystem Technologies, 2015, 34(2): 109-113.
[28]. Wang ZH, Wu BM, Yin J, et al. Development of a wearable electrocardiogram monitor with human activity scene recognition [J]. Journal of Biomedical Engineering, 2012, 29 (5): 941-947.