HEALTH MONITORING AND MANAGEMENT SYSTEM IN PLATFORM SPORTS TOURISM BASED ON CELL PHONES AND INTERNET OF THINGS

ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

SISTEMA DE MONITORAMENTO E GESTÃO DE SAÚDE NO TURISMO ESPORTIVO DE PLATAFORMA BASEADO EM CELULARES E INTERNET DAS COISAS

SISTEMA DE MONITORIZACIÓN Y GESTIÓN DE LA SALUD EN LA PLATAFORMA DE TURISMO DEPORTIVO BASADO EN TELÉFONOS MÓVILES E INTERNET DE LAS COSAS

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ABSTRACT

Introduction: The prospect of high income brought about by economic development has made it possible for more people to join platform sports tourism to maximize their quality of life and spiritual experience. However, health problems in this modality are frequent. Objective: To verify the impacts of a cloud-based health monitoring and management system, using mobile devices and the Internet of Things, on the health problems of platform sports tourism. Methods: Systematic technical research combined with technology preceded the design of the functional module of the platform sports tourism health monitoring and management system through analysis of the demand for health monitoring and management. Finally, the platform sports tourism health monitoring was validated through system testing. Results and Conclusion: The effectiveness and test results of the management system show that the accuracy of physiological signals reaches 90%. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Sanitary Monitoring; Internet of Things; Cell Phone; Tourism Industry.

RESUMO

Introdução: A perspectiva de alta renda trazida pelo desenvolvimento econômico tem proporcionado a mais pessoas aderirem ao turismo esportivo de plataformas visando maximizar a qualidade de vida e sensação de experiência espiritual. Porém, os problemas de saúde nessa modalidade são frequentes. Objetivo: Verificar os impactos de um sistema para monitoramento e gestão de saúde baseado na nuvem, utilizando dispositivos móveis e internet das coisas, proporcionados nos problemas de saúde do turismo esportivo de plataformas. Métodos: Pesquisas técnicas sistemáticas combinadas com tecnologia precederam o desenho do módulo funcional do sistema de monitoramento e gestão da saúde no turismo esportivo de plataformas através da análise na demanda de monitoramento e gestão da saúde. Finalmente, o monitoramento da saúde do turismo esportivo de plataformas foi validado através do teste no sistema. Resultados e Conclusão: A eficácia e os resultados dos testes do sistema de gerenciamento mostram que a precisão dos sinais fisiológicos chega a 90%. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Monitoramento Sanitário; Internet das Coisas; Telefone Celular; Indústria do Turismo.*

RESUMEN

Introducción: La perspectiva de altos ingresos traída por el desarrollo económico ha hecho que más personas se unan a la plataforma de turismo deportivo con el objetivo de maximizar la calidad de vida y el sentido de la experiencia espiritual. Sin embargo, los problemas de salud en esta modalidad son frecuentes. Objetivo: Verificar los impactos de un sistema de monitorización y gestión de la salud basado en la nube, utilizando dispositivos móviles e Internet de las cosas, proporcionados en los problemas de salud del turismo deportivo de las plataformas. Métodos: La investigación técnica sistemática combinada con la tecnología precedió al diseño del módulo funcional del sistema de monitorización y gestión de la salud en el turismo deportivo de plataforma a través del análisis sobre la demanda de monitorización y gestión de la salud. Por último, la plataforma de vigilancia de la salud del turismo deportivo se validó mediante pruebas del sistema. Resultados y conclusión: La eficacia y los resultados de las pruebas del sistema de gestión muestran que la precisión de las señales fisiológicas alcanza el 90%. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Monitorización de la Salud; Internet de las Cosas; Teléfono Celular; Industria del Turismo.*

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INTRODUCTION

With the development of society, the improvement of life quality is accompanied by the increase in tourist life, especially plateau sports tourism. The desire to experience more high-end sports tourism products has become a reality.[1] However, when people have more and more travel experience and hope to have a smooth experience, the health problems of their plateau tourism sports are becoming more and more prominent, and health monitoring and management have become the focus of plateau sports tourism at this stage. The combination of the resources of the Internet of Things and sensors, and the realization of the device access of the Internet of Things through the embedded system, has become an important development direction of the future intelligent system.[2,3] Also with the rise of cloud service technology, cloud services enable users to quickly use network resources to complete the development of custom applications.[4] Cloud servers have also attracted the attention of many Internet giants in the commercial field.[5] It can not only avoid system paralysis due to server hardware failure, but also build personalized applications on an open cloud service platform, expand according to needs, and provide flexible services.[6,7] Therefore, using the combination of IOT development platform, mobile phone equipment and cloud services is the focus of this paper. The design of cloud service applications determines the function and performance of the system.[8,9]

Related Content

The ubiquity of the Internet of Things (IOT) and the ability to collect and analyze data that can be turned into information has inspired many IOT applications. In order to successfully deploy and manage these applications, cloud computing technologies are essential because they provide high computing power and large storage capacity. Hou L studied several potential application scenarios of iot cloud and discussed the functional architecture of each component.[10] Ge Q shows that in most plateau areas, annual UTCI increases with decreasing latitude.[11] His research results can provide help for optimizing plateau tourism and the development of Tourism destinations in China.[12-14] But his data are not specific enough and not very practical. Vandawaker RM is working in this area to track the health of different users and has introduced a complete and scalable HMMS.[15] He built different frameworks and techniques for his HMM to check the health of students.[16,17] However, the system he built was only for health testing, not health management.

Main Content and Innovation

The main content of this article is to design the plateau sports tourism health monitoring and management system through the combination of the Internet of Things framework and cloud service technology. First, this article through the analysis of the health needs of plateau sports tourism to collect temperature, blood oxygen and psychological collection, etc. The physiological signal collection function is designed, and then the health information management function design of the mobile phone cloud plus terminal is carried out through the transmission technology after the physiological information is collected, and finally the system is tested and implemented. The innovation of this paper is to use the embedded technology of the Internet of Things to design a wearable health monitoring device to collect physiological information, which has a certain degree of innovation and expanded research significance.

METHODS

Study type

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Cloud service is actually a service form based on related services on the Internet.[18,19] With the popularization and deepening of the concept of cloud services, the current application of cloud services is mainly reflected in three aspects: cloud Internet of things, cloud security and cloud storage.[20,21] In this paper, the health monitoring and management system constructs a server system based on cloud platform, and forms a cloud Internet of things system with mobile devices. All operation data and terminal data of the system are stored in the virtual disk of the cloud platform. With the strong security support provided by the cloud service provider, a series of protection measures are taken within the system to ensure the absolute security of the system and data.[22,23]

The cloud has a relatively complete Internet of things Architecture.[24,25] The specific structure is shown in Figure 1.

System Requirements and Design Principles

1. Portable

With the development of electronic technology, various monitoring products are gradually miniaturized, and monitoring products are no longer unique equipment in hospitals. During travel, people can perform health self-checks through the portable device.

2. Networking

The whole system has two transmission modes: wired and wireless. The collection terminal can transmit data through a network cable, and can also use a wireless network for transmission.

3. Multifunctional

The plateau tourism health system not only needs to collect the human body's blood oxygen saturation, body temperature, heart rate and other physiological parameters, but also needs remote assistance and connection with mobile devices such as mobile phones.

4. Popularization

The system adopts a high-performance controller and is equipped with an embedded Linux system. The whole system is low in cost and practical, and it is helpful to people's health monitoring and management.

5. System design principles

The overall design idea of the system is: on the basis of familiarity with the basic work process, research on basic theoretical knowledge, find a practical and feasible technical foundation, improve management efficiency, health monitoring automation, etc., and provide safety and efficiency for related equipment managers.

System design principles include safety principles, system scale applicability principles, system continuity and maintainability principles, and system reliability.

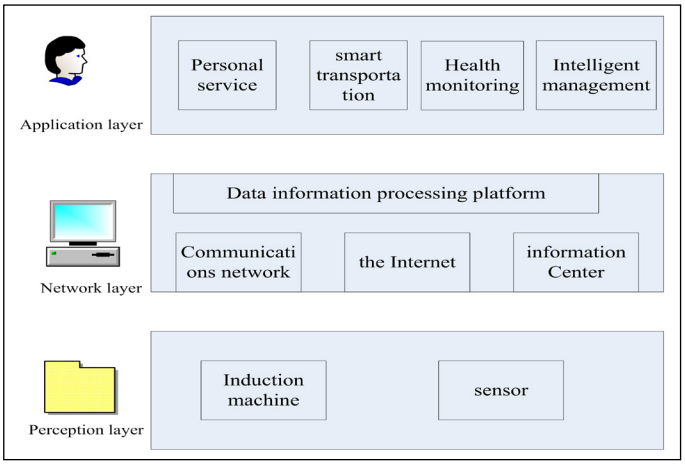

Figure 1. Cloud plus terminal IOT architecture.

The Overall Design of the System

The Internet of things has introduced a series of new technologies such as sensor, radio frequency identification and bar code identification to complete the perception and collection of information from the perspective of information collection.[26,27] Wearable terminals are playing a more and more important role in the portable tourism information collection, especially in the portable tourism applications. Wearable IOT terminal is located in the perception layer of the three-tier architecture of IOT system, which is an important way of information collection.[28] The wearable machine transmission module (2G / 3G, WLAN, etc.) submits the information to the application data information processing center through simple filtering and packaging. The application layer completes the corresponding processing, and the processing results are fed back to the wearable Internet of things terminal through the network layer.

On the basis of data processing, data security is also the focus of attention. Therefore, the security design of the system uses methods such as anonymous management and identity protection to ensure safe storage and application information security. Therefore, the design of system information security and the management design of permission instructions are carried out. The entire system can be logged in by different people, but different people have different permissions. The details are as follows:

As shown in Table 1, the system that performs the above operations guarantees information security to a certain extent.

Frequency Domain Analysis of Physiological Signals

The frequency domain analysis method is a method of signal processing. The time domain signal is expressed in the form of frequency spectrum through Fourier transform, and the characteristics of a complex signal are studied from the frequency domain. If the pulse time domain signal is f, its Fourier transform is:

$$F(y) = \int_{-\infty}^{\infty} f(t)edt \tag{1}$$

The power spectral density function is:

$$(y) = \frac{2}{t} f(y)` \tag{2}$$

Then in the frequency domain analysis, the discrete Fourier transform is usually used, and the formula is:

$$F(x) = \sum_{n=1}^{n-1} f(n)e \tag{3}$$

Table 1. System safety design operation.

Operating	Content
Role management	Different roles are assigned different authority management, and the operation menu options are different.
Verification of user identity	Different roles have different permissions.
System access control	The first time you log in to register, you get a blank permission, and the permissions of the registered user are assigned. At the same time, there will be a user name and a login password on the login page, and a verification code will be added according to the specific situation.
Access control	Each role has corresponding permissions, and each module distinguishes corresponding restrictions, allowing roles and modules to divide labor.

The discrete power spectral density function is:

$$\sum_{n=1}^{n-1} f(n) = \frac{1}{n} \sum_{n=1}^{n-1} F(x) \tag{4}$$

According to the frequency range of pulse and ECG, the sampling frequency can be between 100-200. In addition, after the signal is sampled, it contains a lot of noise. Although analog filtering and digital filtering have filtered out some of the noise and interference signals, they cannot be completely filtered out. When analyzing the power spectrum, in order to reduce the remaining interference signal in the signal, a rectangular window function can be added to the power spectrum function and defined as:

$$R(X) = 0 \tag{5}$$

$$R(x) = 1 \tag{6}$$

The flow chart of physiological signal power spectrum analysis is shown in Figure 2:

The classic power spectrum analysis method is further divided into the period map method, the bartlett method and the welch method. Because the welch method can improve the performance and resolution of the variance. The following mainly introduces the welch method.

Divide the observation data f at M points into L segments, and the average length of each segment is N, then M=LN. For the x-th segment data to be added to the rectangular window, then:

$$f(n) = f[n + (x-1)NR][n + (x-1)] \tag{7}$$

Among them, R is a rectangular window of length N, and the power spectrum of the x-th section is calculated.

$$P = \frac{1}{nv} \left| \sum_{n=1}^{n-1} f(n) R_2(n) e \right| \tag{8}$$

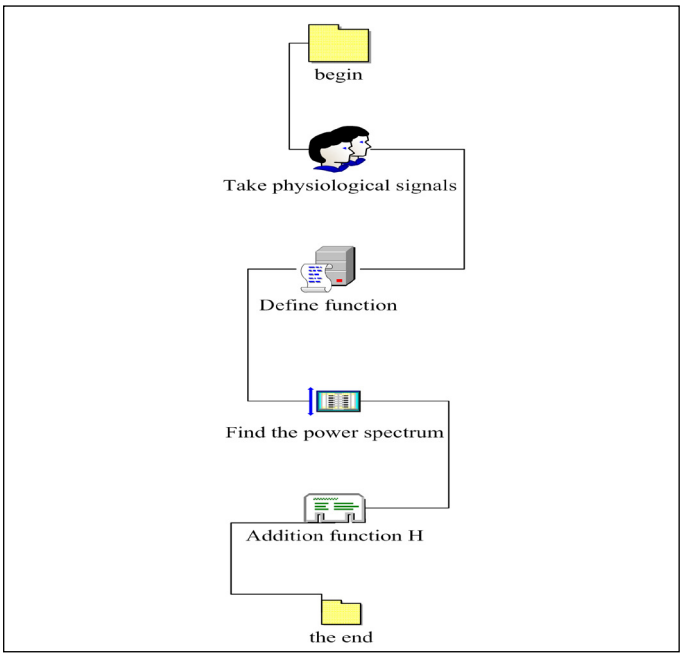

Figure 2. Flow chart of physiological signal power spectrum analysis.

Where V and R2 are:

$$V = \frac{1}{n}\sum_{n=1}^{n-1} R \quad (9)$$

$$R_2 = F(x) \quad (10)$$

Calculate the average of the power spectrum of each piece of data, and get:

$$P\ (w)\ = \frac{1}{nvl}\sum_{i=1}^{l} R \quad (11)$$

$$\sum_{i=1}^{l} R = \sum_{n=1}^{n-1} f(m)e \quad (12)$$

The mean E is estimated as:

$$E\{p(w)\} = P(w)\frac{1}{nv}R_2(w) \quad (13)$$

$$R_2(w) = R_2(n) \quad (14)$$

When n gradually increases, the main lobe of the power spectrum becomes narrower, then:

$$E\{p(w)\} \approx P(w) \quad (15)$$

Therefore, the estimated power spectrum is asymptotically unbiased. Since each segment of data can overlap, the number of data segments will increase, so the performance of variance is improved. In this method, other window functions can be selected. Choosing a suitable window function can reduce the problem of spectrum leakage, increase the peak value of the spectrum, and improve the resolution. Therefore, this article uses this method to do power spectrum analysis of pulse and ECG signals.

RESULTS

System Test

1. Experimental design

In order to verify whether the various physiological collection functions of the wearable watch device system are effective, reliable and feasible, the following series of experiments are designed and carried out in this paper. Experimental staff: A total of 10 people with no obvious leg disease, aged 30-40 years, and good health were selected to participate, including 6 men and women each. Experimental equipment: wearable health monitoring watch, the watch has built-in equipment such as heart rate sensor, temperature sensor network, blood oxygen detector, sensor and so on. There is also a health management mobile terminal device, which is used to display the collection effect of physiological signals.

2. Experimental results and analysis

The experimenter wears the set of equipment and completes the actions shown in Table 2 at different times. Due to the difference in the range of normal heart rhythm between exercise and resting state, this article uses exercise heart rate and static heart rate to describe respectively. Exercise heart rate refers to the value of the heart rate maintained by the human body during exercise. This article uses age to determine the highest heart rate standards: men's highest heart rate: 205-age/2, women's highest heart rate: 220-age; for the general population, 60%~85% of the highest heart rate value is a suitable and effective exercise heart rate range; static The normal range of heart rate is 60 to 100 beats per minute. In the experiment, if it is detected that the heart rate is out of the range of exercise in the exercise state, it is considered that the heart rate is abnormal, and an alarm message is sent to warn the user that the user should slow down the exercise; similarly, if the user is detected to exceed the range of the static heart rate in the non-exercise state, the heart rate is considered abnormal. Alarm information.

As shown in Table 2, the heart rate collection is accurate, and the accuracy of the alarm is 90%. Among the acquired signals, the quality of the heart rate signal is better. After analysis, it is found that when the human body moves vigorously (such as fast running), the electrode pads embedded in the watch device on the experimenter's hand are not easy to move, which will not cause the skin electrode impedance to change, and high-quality heart rate signals can still be obtained. When the experimenter wears the device and runs fast for a short period of time and suddenly stands still, due to the different sampling frequency, the system will think that a higher heart rate value is obtained in a static state, and a false alarm will be generated. Therefore, the collector should be adjusted according to the different sampling frequency.

As shown in Figure 3, in the collection of temperature, heart rate and blood oxygen, the dynamic and static results of the collection with or without equipment are not much different, which shows the accuracy and effectiveness of the collection equipment.

3 Functional realization of the health risk assessment module

Health risk assessment is a quantitative assessment of an individual's health status. The results of a complete risk assessment process are obtained through the collection of information and the analysis of the health information management mobile terminal system. The principle of health risk assessment

Table 2. Contents of the experiment.

Serial number	action	duration	Heart rate	Actual number of emergencies	The number of client alarms	Received in the background	Total number of this activity
1	walk	15-20 minutes	66-76	0	0	0	20
2	Run	10 minutes	85-120	0	0	0	10
3	Run	5 minutes	120-160	1	1	0	5
4	Down stairs	5 minutes	65-80	0	0	0	5
5	Run-fall	Run for 4 minutes, stand still for 1 minute	80-95	0	0	0	5
6	Walk-fall	5 minutes walk	70-80	15	13	13	15
7	Run fast-stand still	30 seconds	125-135	0	1	1	10

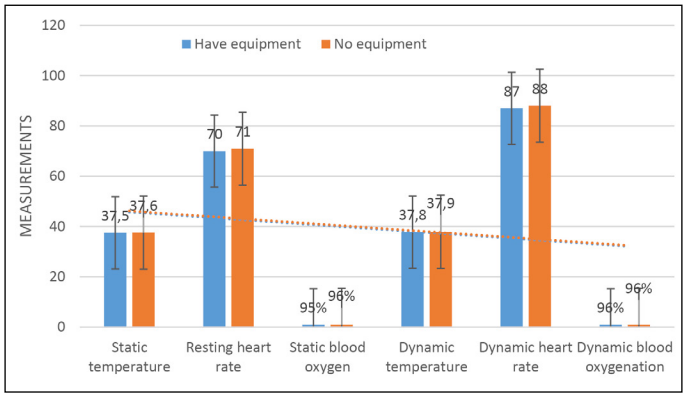

Figure 3. Statistics of detection data with or without equipment.

DISCUSSION AND CONCLUSION

This paper analyzes the health needs of plateau sports tourism to design and research the plateau sports tourism health monitoring and management system. In the health monitoring and management system design, the embedded technology of the Internet of Things and the mobile phone information of cloud services are used. Management technology designed a health monitoring function module and a mobile phone device health information management module and conducted a system test.

The author declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Every author has made an important contribution to this manuscript. XL: written and executed; JZ: data processing.

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