Research on Fitness Control System Based on Physiological Parameters Monitoring

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Abstract — In this paper, the author researches on the fitness control system based on physiological parameters monitoring. The direct problem faced by the National Fitness Program is the lack of scientific method, by using the fitness control system based on physiological parameters monitoring and the construction of fitness clubs can help to solve this problem. In the environment of carrying out nationwide fitness campaign, the positive development of sports fitness clubs can be favorable to drive the development of this campaign, and create a good environment for it. Fitness clubs in small and medium-sized cities should take this opportunity to create better fitness conditions, more scientific management system and high-quality sports talents. Consequently, they can serve the fitness consumers better, satisfy their fitness needs and promote the fitness win-win development.

Keywords - fitness control system; physiological parameters monitoring; data flow.

I. INTRODUCTION

It has been well recognized and the common choices for the human beings that it is necessary to implement the human-centered social development strategy in the current modern society. Consequently constructing and consummating sport service system has been seen as an important research topic for building a well-off society in an all-round way and creating a harmonious society. With the combination of the methods of theoretical analysis and positivist analysis, systematic analysis and comparative analysis, documentary analysis, and statistical analysis, based on the theoretical knowledge of several disciplines, Fei’s [1] study conducted a systematic summary and empirical review on the foundational theories and running mechanism of the current national fitness sports service system in China.

The service system of the national fitness can be seen as a kind of integration including all the software and hardware techniques that were adopted in order to ensure the main body of the service system can fulfill the needs of its customers. The service system of the national fitness consists of the basic environment and condition, the main-body provider of the spot fitness service, and the main-body demander of the sport fitness service, which can be characterized as three main features, such as multiple organization patterns, the perfect review system of the national physical fitness, and the effective legal protection system, existing as the public service pattern and marketing service model.

The main-body demanders of the service system of the national fitness are recognized as a complex that includes national, social, and individual need. In the context of the Chinese transitional society transferred from industrialization to marketing, the factor of social class plays a very important role in influencing behaviors, value points, and needs of sports. The satisfaction of the service system for the national fitness is relatively low. Moreover the degree of satisfaction is different in different social groups. The main-body providers can be seen as the amount of varieties of sport fitness service which is offered by the main-body providers, Public sector.

The public product of sport fitness service characterize as multi-facet. Central government provides sustaining system, knowledge system of sport fitness service for all over the country. Local government provides field, facilities and information of sport for the local resident. Nonprofit organization provides instruct, activity and some other sport service. As to each enterprise providing the sport fitness service, the service must be implemented in every procedure. The procedure of providing service can be seen as the outcome of the coincidence of different components, including marketing system, running system, human resource system, fitness service program, transferring systematic design and service delivery system. The running mechanism of the national fitness service system has some special features, such as multiple running main-body, voluntary running mode, multiple running means and comprehensive serving objects. Currently, the aim mechanism of sport fitness service system lacks effective evaluation. The index of evaluation is short of scientific classification, so the number of possess for sport resources become the only evaluation index [2-6]. Combine the athletic sport and mass exercising. Pay more attention to the unbalance of distribution of sport’s resource. It is a key means to heighten the quality of national fitness service system that establish and perfect the laws and performance’s evaluation of national fitness service.

II. THE FRAMEWORK OF FITNESS CONTROL SYSTEM

With the rapid development of network and communication technology, people's living standard has been greatly improved. All of us begin to have a higher demand for living environment than before. Therefore, family information, networked and intelligent has become a necessary trend. And the concept of fitness control is
proposed in this situation, fitness control can be defined as a process or a system, which use advanced computer technology, network communication technology, synthesis wiring technology to combine with each subsystem of the family, by using integrative management, a comfortable, safe and effective life will be supplied to human.

At present, wire is widely used in most system designs of fitness control, but it is not suitable for the widespread because it’s difficult for installing in old buildings and the cost is too high. Thus, applying wireless communication technology to fitness control will be the development direction and tide in future. It not only provides flexible and convenient network structure for family intelligence, but also saves the manpower and material resources. And it is more suitable for features of network communication. At the same time, the great progress of microelectronics and diversified demand in each application area has promoted integrate circuit (IC) to develop toward to the system integration direction of high-speed, high-integration density and low power consumption. SOC (System on Chip), which integrates embedded CPU, DSP, memory and other control functions in a single chip, is in the rapid development. SOPC (System on a Programmable Chip) based on FPGA (Field Programmable Gate Array) integrates components, which are necessary in system design, like CPU, memory, I/O interface and so on, in a FPGA. And it has many advantages such as flexible, scalable, expandable, and portable, in-system programming and so forth.

Focusing on the features of Fitness control, wireless communication technology is adopted to design a wireless fitness control system based on SOPC. In this paper, the monitoring technology is introduced simply first. Later, the cluster tree topology applied to Fitness control system is proposed, and detailed research on organization structure of network is given. Finally, the function of network communication technology to fitness control will be the development direction and tide in future. It not only provides flexible and convenient network structure for family intelligence, but also saves the manpower and material resources. And it is more suitable for features of network communication. At the same time, the great progress of microelectronics and diversified demand in each application area has promoted integrate circuit (IC) to develop toward to the system integration direction of high-speed, high-integration density and low power consumption. SOC (System on Chip), which integrates embedded CPU, DSP, memory and other control functions in a single chip, is in the rapid development. SOPC (System on a Programmable Chip) based on FPGA (Field Programmable Gate Array) integrates components, which are necessary in system design, like CPU, memory, I/O interface and so on, in a FPGA. And it has many advantages such as flexible, scalable, expandable, and portable, in-system programming and so forth.

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![Figure 1. The system structure](image)

### III. THE ALGORITHM

A fitness data wireless acquisition system is developed for fitness club, and based on wireless sensor network technology with proper algorithm. The system consists of wireless acquisition nodes, which can be worn on the wrist of each gym membership, cluster node, computer, etc. The wireless terminal which can be carried with people can collect the temperature and pulse data in real-time. All the nodes and the cluster together form a wireless sensor network, cluster nodes communicate with the computer through the serial port. The real-time parameters can be passed to the host computer program by cluster node. Through this system it can realize the real-time data acquisition and evaluate the effect of exercise of every gym membership. This design is especially suitable for wireless data collection; analysis and evaluation of physical activity and fitness are the long-term fitness monitoring.

The basic formula generates labels for each file block.

\[\text{for }(j = 0, j \leq n-1;j++);\]

\[\{W_f = r 
\]* (j+1);T_i\]

\[= [h(W_f)*m_j] \mod N;\]

\[\text{Output}(T_0, T_1, \ldots T_m);\]

And local fractional integral of \( f(x) \) defined by Eq. 4.

\[J_{\alpha}^L f(t) = \frac{1}{\Gamma(1+\alpha)} \int_{-\infty}^{t} f(t')(dt')^\alpha \quad (4)\]

Its local fractional Hilbert transform, denoted by \( f_{\alpha}H(x) \) is defined by

\[H_{\alpha} \{f(t)\} = f_{\alpha}H(x) \quad (5)\]

Where \( X \) is real and the integral is treated as a Cauchy principal value, that is,

\[\frac{1}{\Gamma(1+\alpha)} \int_{-\infty}^{t} f(t')(dt')^\alpha = \lim_{\varepsilon \to 0} \frac{1}{\Gamma(1+\alpha)} \int_{-\infty}^{\varepsilon} f(t')(dt')^\alpha + \lim_{\varepsilon \to \infty} \frac{1}{\Gamma(1+\alpha)} \int_{\varepsilon}^{t} f(t')(dt')^\alpha\]

To obtain the inverse local fractional Hilbert transform, write again Eq. (6) as

\[f_{\alpha}H(x) = \frac{1}{\Gamma(1+\alpha)} \int_{-\infty}^{\infty} f(t)(t-x)^\alpha(dt')^\alpha \]

\[= \frac{1}{\Gamma(1+\alpha)} \int_{-\infty}^{\infty} f(t)g(x-t)(dt')^\alpha\]

The equation of motion is as follows:

\[\partial_t(C_{\partial_t} \partial_t \varphi + e_n \partial_t \varphi) - \rho u_j = 0 \quad (7a)\]

Under the line theory, that is:

\[\partial_t(C_{\partial_t} \partial_t u_j - \eta_{\partial_t} \partial_t \varphi) = 0 \quad (8)\]

Linear equation can be expressed into the following simplified forms:
In this system, fast type (NIOS III f) was used because (NIOS III), standard type (NIOS IIIs), economy type (NIOS II). Processor modes are provided by NIOS II, they are fast type, medium type, and standard type. NIOS II Soft-core processor: Three kinds of optional processor modes are provided by NIOS II, they are fast type (NIOS III), standard type (NIOS III s), economy type (NIOS III e). In this system, fast type (NIOS III f) was used because it contra posed best performance optimization, maximize the instructions-per-cycle execution efficiency and maximize fMAX performance of the processor core. It employed a 6-stage pipeline to achieve maximum DMIPS/IMHz, performed dynamic branch prediction, provided hardware multiply, divide, and shift options to improve arithmetic performance, and only need 1400Les~1800LEs when accomplished in FPGA.

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SPI core: A communication interface used to operate CC2420 register. Besides SPI interface, CC2420 also contained CSn, SI, SO and SCLK pins, and could communicate with NIOS II Soft-core processor via allocated CC2420 PIO IO module.

LCD and LED cores: Because the coordinator has the function of Graphic Operations, a LCD touch screen was adopted here. The subscriber could do the operation directly via it. LCD. LED module was a stator display lamp and operation of Graphic Operations, a LCD touch screen was adopted here. The subscriber could do the operation directly via it. LCD. LED module was a stator display lamp and operation of Graphic Operations, a LCD touch screen was adopted here. The subscriber could do the operation directly via it. LCD. LED module was a stator display lamp and operation of Graphic Operations, a LCD touch screen was adopted here. The subscriber could do the operation directly via it.
SDRAM Controller and FLASH Controller: External memory interface. They were connected with system via Athlon tri-state bus.

On chip RAM memory: The FPGA chip of Cycone 2 series provided on chip memory resource max to 1,152,000 bits, the cache was provided and system performance was improved via setting on chip RAM.

Epcs Controller module was used to control hardware configuration files and program download from serial configuration device to FPGA when the system was power up. Timer module was used to provide system timer interruption. Power module adopted Lithium battery and supplied power to system. Crystal Oscillator module supplied system clock to system.

C language was adopted in software; it was compiled in the environment of NIOS II IDE and downloaded into FPGA to debug. NIOSII IDE was a software development tool of NIOSII Soft-core processor; it supplied an integrated design development environment to software development, including a GUI (Graphical User Interface) that contained managements of projects, source code development and functions based on the JTAG debug. The system architecture is shown in the figure 2.

Figure 3. The system structure

V. CONCLUSIONS

In this paper, the author researches on the fitness control system based on physiological parameters monitoring. The direct problem faced by the National Fitness Program is the lack of scientific method, by using the fitness control system based on physiological parameters monitoring and the construction of fitness clubs can help to solve this problem. Harmonization system lacks effective linkage, long effect measure, systemization and periodicity. Prompting system doesn’t form countryside system, i.e., national system increasingly consummate, but local system lag. Controlling system lacks industry criterion and quality controlling. Sport administration government lacks effective supervising. Adapting system lacks self-survive ability. The source of invest is so single that lack of effective combine of market and government. The main body of management should be multi-source.

In the environment of carrying out nationwide fitness campaign, the positive development of sports fitness clubs can be favorable to drive the development of this campaign, and create a good environment for it. Fitness clubs in small and medium-sized cities should take this opportunity to create better fitness conditions, more scientific management system and high-quality sports talents. Consequently, they can serve the fitness consumers better, satisfy their fitness needs and promote the fitnessy win-win development.

REFERENCES


