A Design Concept for Smart Fitness System

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Abstract: The purpose of this study was to propose a product planning and design a direction for smart fitness system that will avoid personal blind fitness based on exercise prescription. This concept is proposed by consulting fitness group, professional personal trainers and sports medicine experts. This system consists of a body measurement module, a sports prescription database, a fitness module and a mobile APP. The user obtains physical fitness data via the body measurement module, and the huge exercise prescription database accordingly optimizes a suitable exercise prescription for the user to select according to user's fitness environment. The mobile APP is the carrier that connects the user and the smart fitness system, which can launch scientific fitness instruction videos, record the fitness data at any time, regularly revise the fitness prescription, remind and supervise the user, and can finally achieve the goal of a highly informative and smart fitness exercise.

Keywords: design research; fitness system; scientific fitness; exercise prescription

1. Introduction

With the gradual improvement of economic conditions, people are paying more attention to health. According to Gartner, the size of the global health care industry in 2020 is expected to reach $ 850 billion, which is 15 percent of the total IoT market [1]. A considerable of person are building healthy bodies, so the health care market has grown a lot lately [2]. As an important way for people to improve their health, exercise has become an indispensable part of life. However, problems with fitness have also emerged [1]. So we made a questionnaire on fitness issues and a total of 1,253 fitness enthusiasts participated in the survey. The survey results showed that 35.97% of the respondents did not implement a fitness program, 41.11% of the respondents did not know whether their fitness program was scientific, and only 19.76 of the respondents thought that their fitness program was scientific. 90.12% of the respondents were eager to get a scientific fitness guide, therefore, the lack of convenient and effective fitness guidance is one of the prominent problems in fitness. At present, personal trainers in the gym can provide scientific guidance, but the cost is relatively high. Only 31.62% of the respondents choose to go to the gym and only 8.3% choose personal trainers. Fitness APP also provides fitness guidance, but there are also disadvantages such as single function and not science [3]. How to provide convenient and feasible scientific guidance to fitness groups? We consulted professional personal trainers and sports medicine experts. In addition, we analyzed the questionnaire findings. After a comprehensive consideration, a smart fitness system concept based on exercise prescription was proposed.

Exercise prescription is a kind of fitness method, guiding fitness purpose, plan, and scientific, that is, according to the user's physical strength, cardiovascular and other health conditions, it prescribes the type, intensity, time and frequency of exercise in the form of prescription and the preventive measures in sports[4].The smart fitness system proposed in this paper adopts the concept of exercise prescription, combining the knowledge and experience of fitness instructors and sports medical experts, to establish a powerful exercise prescription database. According to the user's physical condition, the appropriate exercise prescription is pushed to the user through the APP in the form of video to achieve scientific guidance for the user's fitness.

2. Related Research

2.1. Scientific Fitness

Scientific fitness belongs to the category of sports science. It is a multi-faceted, multi-perspective scientific perspective on the phenomenon of fitness exercise so that people can better understand and grasp the essence of fitness exercise as a whole and promote the development of the national fitness program [4]. With the increase of people's health needs, the concept of scientific fitness is gradually recognized and understood.

In this survey, when asked whether you want to determine your fitness plan based on personal health status, 49.41% of the respondents choose "to be very hopeful", 43.87% of the respondents choose "hope". About the question "Do you expect personal fitness plans to be scientifically guided", 41.5% of respondents choose to "expect eagerly", and 48.62% of the respondents choose to "expect". It was revealed that 90% of the respondents expect scientific guidance.

South Korea's Hyun-Suk Lee & Seok-Cheon Park designed a health club fitness system based on NFC technology [2]. The system assigned an NFC tag data to each fitness equipment. The user read the data from the tag and could get exercise according to their status, the relevant knowledge to obtain the correct use of fitness equipment [2].

2.2. Exercise Prescription

The concept of "exercise prescription" was first proposed by the American physiologist Karpovish in 1954 and gradually formed a new discipline. The "exercise prescription" is a rehabilitation physician or physical therapist who, according to the medical examination data (including exercise test and physical strength test), exercises a physical exercise or a physical therapist and specifies the exercise in the form of a prescription according to its health, physical strength, and cardiovascular function status [4].

The role of exercise prescription in fitness has been verified by many scholars to varying degrees. Applying systematic and multi-dimensional concept of physical education and introducing systematic exercise prescription into school physical education is conducive to the realization of students' health and the improvement of their quality of life [4]. Mazzeo, RS and Tanaka, H recommended that health care professionals implement education programs and design interventions to guide older people to participate in regular exercise therapy and improve the health of the elderly. Researchers in such fields as Chong-jin and BAE have proposed in their study an exercise prescription model for people over the age of 65 and over 112 years of age. Ardic and Fusun discussed the principle of exercise prescription and the specifications of FITT (frequency, intensity, time and type). Li Ganlin designed an exercise prescription management system based on cloud storage technology, selected Microsoft Sky Drive as a cloud storage medium, designed and developed a PC client using Microsoft .net technology, completed a personalized exercise prescription system, and used mobile terminals to display prescriptions [4].

2.3. Smart Fitness

With the rapid development of communication technology and the mobile internet era, design platforms or systems that can achieve fitness networking, intelligence, and digitization has gradually become scholars' research fields. The research and design of smart wearable devices, sports fitness monitoring systems, Internet of Things-based interactive health promotion platform ITIHP [5], gym's networked digital fitness system, smart fitness equipment have laid the foundation for the further development of smart fitness [6].

The ITIHP platform established a communication link between the fitness equipment and the smart device through Bluetooth technology, and uploaded the fitness data to the cloud database. The cloud management system and the health expert system can analyze the historical exercise data to develop a personalized exercise program for the user [5].

A use of mobile device for exercise monitoring and based on this personalized exercise prescription was studied by Kang and Seungae. Individual users use mobile devices to send their own body's important information), then all information will be collected in the u-Fitness center. Then the sports expert provides customized prescriptions to the u-Fitness Center's database based on the collected information and feed data.

The U-Fitness Center System will provide the best personalized exercise prescription by automatically connecting content providers.

3. Struture of Smart Fitness System

The smart fitness system mainly solves the problem of providing fitness guidance for users. The results of this survey showed that the fitness training methods which were easily accepted by fitness groups are shown in Figure 1. It can be seen that the easy-to-accept fitness instruction of the fitness crowd comes from the mobile phone APP, fitness coach, sports medicine expert, gym fitness software and others. Due to the relatively high price of personal trainers, only 8.3% of them choose personal trainers. Sports medical experts mostly serve professional sports players and rehabilitation training. Gym fitness software also has site use limitations. In the survey on fitness requirements, 66.4% of the surveyed people were in need of scientific guidance, and 62.45% of respondents needed to supervise and promote fitness. In view of this, the smart fitness system proposed in our research includes four parts: body detection module, fitness prescription module, fitness module and mobile application. The user obtains fitness guidance through the mobile phone APP, and the guidance is based on fitness coaches and sports medicine experts. Figure 2 shows the overview of the smart fitness system.
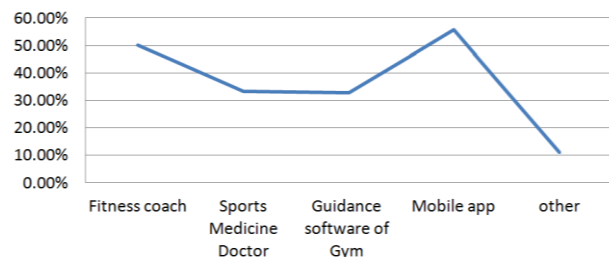

Figure 1. The easy-to-accept fitness instruction.

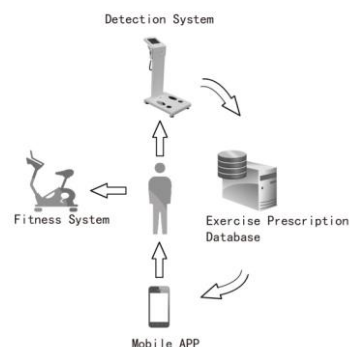The operating procedure of the smart fitness system is shown in Figure 2.

Figure 2. Overview of smart fitness system.

First, the user obtains the body condition data through the body detection module, and the body detection module sends the body condition data to the fitness prescription module which has a large exercise prescription database that is responsible for setting up a fitness plan for the user and transferring this plan to a personal application. Each exercise prescription in the

fitness program has a scientifically-directed video that provides the user with correct exercise instructions and records fitness data.
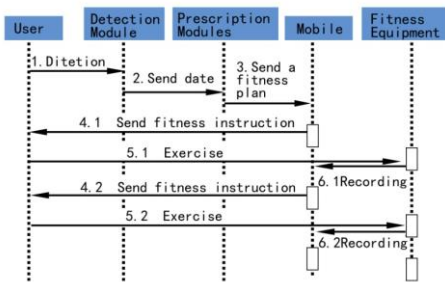

Figure 3. System operation procedure.

4. The Function Modules of the Smart Fitness System

4.1. Body Detection Module

The body detection module is responsible for physical detection, data screening, and output data. Currently, fitness guidance comes from sports medicine experts and fitness instructors. Traditional exercise prescription is based on the individual's cardiopulmonary function, muscle strength, joint mobility, body metabolism, physical condition and psychological measurement data. Sports medicine specialists use medical equipment to measure these data and combine their own technical experience to formulate exercise prescriptions. In general, fitness instructors use body composition analyzers and function analyzers to obtain detailed data on body composition, bone location structure and muscle function status. Meanwhile they combine their own technical experience to develop fitness plans. Sports medical experts use medical equipment to measure the required data to formulate a fitness program. In order to make fitness instructions more scientific, it is necessary to combine the two methods. Comprehensively measured data are compared with normal physical status databases and screened. Unqualified abnormal data is sent to the fitness prescription module as a basis for formulating a fitness prescription.
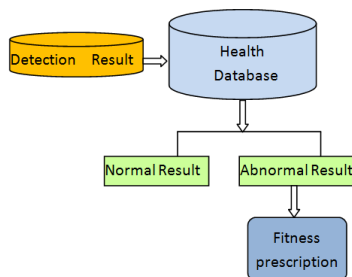

Figure 4. Body detection module.

4.2. Fitness Prescription Module

As shown in Figure 5, the fitness prescription module includes three parts: data management of fitness people, fitness prescription database and prescription generation. The fitness prescription module can provide fitness guidance according to the data provided by the body detection system, combined with the experience of a sports medical expert and a fitness instructor. By

retrieving the fitness prescription database, the personalized fitness prescription required by the user is rapidly synthesized, and the fitness prescription is transmitted to the mobile terminal APP. The establishment of a fitness prescription database belongs to the basic information library of the fitness prescription module, and it is the information base of smart fitness. At present, the establishment of a fitness prescription material library is not mature and is the key to the development of the smart fitness system.
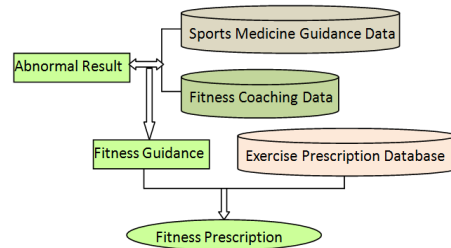

Figure 5. Structure of a fitness prescription system.

The key to establishing a fitness prescription database is the classification and prescription treatment of fitness projects.

The finer the classification of fitness project (n), the more conducive to the formulation of fitness prescriptions. There are several ways to classify fitness project (a, b, c, d, e, f...). For example, according to the basic body movement quality of the human body, fitness projects can be divided into strength, endurance, flexibility, speed, and sensitivity in five aspects. According to the body's exercise site, fitness projects can be divided into head, neck, shoulder, chest, waist, chin and other parts. According to the fitness effect, they can be divided into the goals of reducing fat, increasing muscles, etc. According to the use of the fitness equipment, they can be divided into fitness equipment and non-instrument fitness. From another point of view, fitness projects are divided into aerobic fitness and anaerobic fitness. Figure 6 vividly illustrates that a fitness project has many characteristics, that is, one fitness project belongs to different categories.
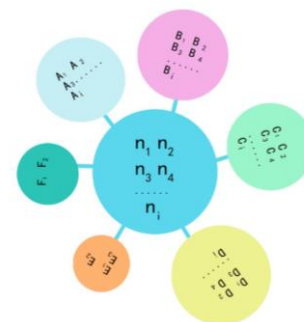

Figure 6. Sorting of fitness projects.

Figure 7 shows the "prescription processing" of the fitness project, which refers to the standardized organization of the project in the form of an exercise prescription, that is, the name, classification, exercise frequency, exercise intensity, motion demonstration,

precautions, and functions of the materia [7]. The more detailed the fitness project is, the more favorable it is for the synthesis of synthetic prescriptions, and it also helps to encode the contents of the material library into the computer. The more detailed the fitness project is, the more conducive to the synthesis of fitness prescriptions, and the basis for encoding the contents of fitness projects into the computer.
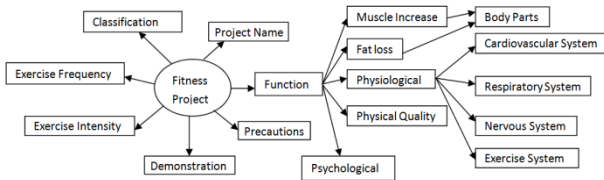

Figure 7. Prescription processing of fitness projects.

4.3. Fitness Module

The fitness module is the carrier for the user to perform scientific fitness and is the basic condition for achieving fitness. The results of this survey showed that people selected the following sports, namely, 75.1% of ball games, 31.62% of gymnasiums, 30.06% of indoor venues such as yoga, and 24.11% of outdoor fitness equipment. Therefore, the fitness module in the smart fitness system includes fitness instruction videos such as fitness equipment, outdoor equipment, and sports activities, and the fitness staff selects fitness activities according to actual conditions.

4.4. Mobile APP

It was concluded that smart phone-based training was beneficial for improving body composition, physical fitness, and QoL [7]. The quality of smart phone fitness application services is directly proportional to the structural relevance of the effect of post- use satisfaction, trust, immersion, and willingness to continue to use. The results of this research showed that 39.92% of the fitness population are using a fitness APP, and 55.73% of the fitness groups are willing to choose APP to guide their fitness. Mobile APP can effectively establish the interconnection system of "user-app-fitness system" [3]. In order to make the APP design more reasonable, we investigated the advantages and disadvantages of the existing fitness APP. The results are shown in Figure 8 and Figure 9, respectively. Another issue worth noting is that 62.45% of users need to "supervise" fitness. Therefore, we have positioned the design of the mobile APP as: functional simplicity, simple operation, strong scientific guidance, strong applicability, social function.

The mobile APP can receive a variety of fitness prescriptions. The user can select an appropriate fitness application according to the fitness conditions. The selected fitness prescription is pushed in a video manner, which can communicate with the bodybuilder and has the function of reminder, supervision, and sharing fitness pleasure.
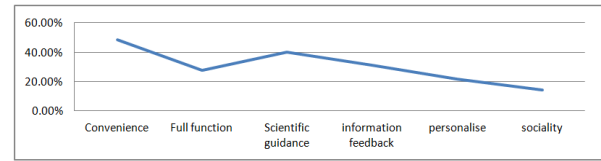

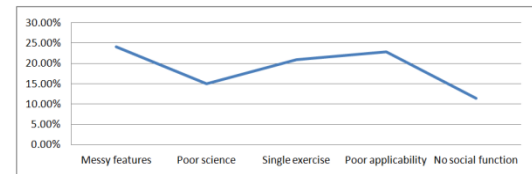**Figure 8.** The advantages of existing fitness APP.

Figure 9. The shortages of existing fitness APP.

5. Discussion and Conclusions

The importance of scientific fitness instruction in the current fitness exercise has been recognized by the fitness group. The related physical fitness techniques, fitness prescription techniques, fitness software and other technologies are all undergoing theoretical research, for example, gym management software and fitness APP have been used by some fitness groups. The research on BIA bio-resistance measurement technology, real-time exercise intensity assessment model, cycle-optimal exercise volume prediction model, individual-based fitness assessment system model, and exercise prescription system database are scattered. The digitization and intelligence of scientific fitness is still in the early stages of research. However, these technical studies provide technical guidance for the design of the smart fitness systems and also increase its feasibility. The smart fitness system proposed in this paper starts from the study of the needs of fitness users, basing on the digital and intelligent fitness technology research results, elaborates the structure and use flow of the smart fitness system, and builds a complete smart fitness system. The study advocates combining the experiences of sports medicine and fitness instruction to formulate selective fitness prescriptions. The visualization of fitness prescriptions also greatly improves the science of fitness guidance and provides a way of thinking for implementing intelligent fitness. In this article, fitness prescriptions are only visually guided by video, and they do not incorporate technologies such as cameras, smart wear, and data analysis. For difficult, error-prone fitness prescriptions, you can also use sensors such as muscle instruments to further the user's actions. Through testing and vision correction, the user's scientific fitness ability is further enhanced. However, these will increase the development cost and use cost of the fitness system and will also reduce the usage rate. Several decades later, with the maturity of related technologies, smart fitness systems will become more scientific and the penetration rate will increase.

Acknowledgment

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