DEVELOPMENT OF EVALUATION UTILITIES FOR THE INTERNET-BASED WELLNESS CYCLE ERGOMETER SYSTEM
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Abstract—It is anticipated to offer a safe and optimal exercise environment for the elderly when they want to perform exercise for keeping health. In this paper, we present an Internet-based cycle ergometer health promotion system that aims at supporting appropriate and sustainable personal fitting process for individual elderly persons. Since the elderly shows great individual differences during exercise, continuously supported and appropriate workload control has been implemented according to different exercise levels of each subject by considered historic data. Moreover, it is conceivable to take continuous exercise by using our proposed system at any time and at any possible place. A Sport doctor Analysis Tool (SDAT) has been developed to assist experts for providing improved individual exercise protocols.

Keywords - continuously support, personal fitting, java

I. INTRODUCTION

A convenient, appropriate, and continuously supporting a cycle ergometer system, a wellness bike system, has been developed to aid wellness exercise for the elderly person [1]. The cycle ergometer system adjusts the workload continuously depending on the changes in physical work capacity. Note that the abilities of individuals differ in terms of exercise levels because of their different physical work capacities. The elderly people can’t accurately perceive the cycle ergometer exercise levels or degrees either by subjective observation of themselves or by some indicators, such as a heart rate displayed at the panel. Therefore, it is necessary to provide a customized cycle ergometer exercise process for individual elderly person.

We have studied a single stand alone process of personal fitting for the Internet-based wellness bike system [1]. For ensuring continuous wellness exercise for general users at different places, we mainly adopt Java-based technology to develop our system. We established the communication function by a multitiered Client/Server architecture [2] to meet the demands of large amount of users, high transaction volumes, and easy upgrades. By expanding single workload control process to the Internet, and fulfilling cooperative operations of each working part, a wellness bike system would be available with browsing tools and a history database.

II. METHODOLOGY

The reasons why we construct the wellness bike system on the Internet are briefly demonstrated as follows:

- Continuously supporting wellness exercise regardless of time and place.
- Facilitating convenient communications between general users and experts.
- Solving the problem of meeting demands of a large amount of users to improve the system performance.

All the exercise protocols are downloaded from the central server ahead of exercise and all the measured results are uploaded to the central server after exercise via the Internet. Constructing the history databases, we only record relevant information, a pointer to describe the tag for each target biosignal. Actual biosignals are stored in the central server. Since querying the history database only gets a pointer to each requested biosignal, the response time of accessing the database is shortened, and finally overall performance is improved.

At the client end there are two types of users: the general exercise users and the sport doctors. According to the two different types, the system has defined two kinds of rules for retrieving data and querying, respectively. Data transmission is performed based on the two pre-specified sets of rules residing on the central server. Especially, for sport doctors, the system provides completed analysis abilities. That is, by using the Sport doctor Analysis Tool (SDAT), doctors can perform further analysis and verification. The experimental records, which are transmitted to the doctor end, are analyzed and reformulated by SDAT utilities. Fig. 1 shows an example of the appearance of SDAT. At startup, the SDAT connects to the central server to obtain all the information of valid users. For assisting analysis, the new registered users or new exercise records are highlight showing in the control interface of SDAT (Fig. 1 (a)). Moreover, some specialized explanation graphs (Fig. 1 (b), (c), (d)), which represent a current exercise record, are displayed by clicking each exercise record item.

Web technology is also supported for assisting user registration and examination of past exercise information. On the backend of our proposed web-based query engine, a Java Servlet [3] communicates with the history database to pass data and parameters, and returns comprehensible HTML format pages to display specified answers to the users.

III. RESULTS

To evaluate the systematic procedure more clearly, we accomplished a set of experiments during April and May of 2003. One male and two female senior subjects who had participated in our past experiments assisted us to carry out cycle ergometer exercise on a hypothetical Internet-based environment. Six sets of moderate past workload control experimental results had been imported into the history database beforehand to keep integrity of the system. The exercise protocols of each experiment were decided based on observing previous experimental data. By using the SDAT, it was very expedient to design a renewed vital exercise workload pattern.

An example for a practical procedure exercise is as follows: Before the experiment began, a subject’s previous data was accessed by the SDAT at the sport doctor end. The Doctor redesigned exercise protocols of a subject, and then uploaded the modified information to the central server through the SDAT. Actually, the preparation process was carried out at a different location from the actual exercise field. A subject downloaded the latest
exercise protocols from the central server before exercise, and actual workload control exercise took about 30 minutes. After the exercise finished, experiment results were transferred to the central server and then stored in the history database. At the doctor end, a sport doctor inquired and obtained new exercise information, and made decision for the next exercise by using the SDAT. The experiments were all conducted on an intranet environment, which had 100 Base-T Ethernet connections. The size of exercise protocols downloaded from the central server was about 1 KB, and the measurement results including original signals and estimated indices (heart rate (HR), muscular fatigue index ($\gamma_{ARV-MPF}$), workload (WL), and the rating of perceived exertion (RPE)) were about 8.45 MB. Actually, for the SDAT, only estimated indices, workloads, and RPE information were required and the processed time for downloading those files was about 2 minutes.

IV. DISCUSSION

The experimental procedure indicated that, by using our system, general users could take appropriate exercises and employ newest exercise protocols with no more participation at the exercise end. Moreover, the SDAT, an excellent analysis interface, had been validated to assist doctor in designing appropriate exercise protocols.

For continuous maintenance of customized personal fitted exercise, the Internet technology has been introduced to periodically update exercise protocols. Moreover, our proposed system is easy-to-use even for the elder people and ensures that appropriate exercises can be performed at any time and any possible place. Since the Internet-based wellness bike system is programmed regardless of location, users can take exercises wherever the Internet connection can be established for acquiring required exercise protocols from the central server. Thus, this system is technically feasible and will have extensively applied prospects in the near future. Moreover, the experimental results will be easily browsed using a PDA device either by general users.

For future revisions, some multi-functional websites will be founded for different user intentions. The health promotion system will be designed on the Java 2 Enterprise Edition (J2EE) platform, and the exercise environment will integrate with other health promotion studies to realize a wide ranged comprehensive exercise solution.

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REFERENCES


Fig. 1. Screen image of SDAT. (a) control interface of SDAT; (b) HR-$\gamma_{ARV-MPF}$ scatter graph; (c) time-series of HR and WL; (d) time-series of HR and RPE.