INTERNET BASED SYSTEM FOR ADJUSTING CYCLE ERGOMETER WORKLOAD TO MODERATE EXERCISE

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Abstract - A cycle ergometer is used as several fields including wellness, sport training, and rehabilitation. In order to adjust the cycle ergometer workload, heart rate is generally used. The other factors, however, should be considered to establish moderate exercise. We have combined the information of muscle activity to that of heart rate and proposed a total evaluation pattern using multivariate analysis of several indices estimated from heart rate and myoelectric signals. In this paper, we introduced a fuzzy system to accomplish moderate exercise for an individual person and developed an Internet based system for adjusting the cycle ergometer workload. The fuzzy rules were designed based on the different properties between cardiovascular and muscular activities. We used the Internet technology to achieve on demand support for adjusting the cycle ergometer workload because the workload should be fitted to the individual ability of exercise that probably changes depending on training and physical conditions.

I. INTRODUCTION

The purpose of this study is to establish the appropriate workload control of a cycle ergometer on demand for an individual person. The workload should be adjusted depending on the ability of exercise that probably changes because of different backgrounds including training and physical conditions. We designed fuzzy rules and fuzzy membership functions to adjust the control voltage of the workload. Using the Internet, we can support the suitable workload for an individual person, even if each person live in distributing places. That is, the updated fuzzy membership functions and rules are sent to a workload controller of the cycle ergometer via the Internet in our system.

II. METHODS

During exercise, raw ME signals and heart rate (HR) of each frame were acquired every five cycles and evaluation parameters were estimated in each overlapping interval. This interval was shifted every one frame to calculate the updated workload. We simultaneously examined the respiratory gas exchange and the blood lactate every one minutes to determine the anaerobic threshold and the lactate threshold. We have used the principal component analysis (PCA) to extract the significant information on activity from several types of biosignals. We introduced fuzzy inference to determine the control voltage. As input associants, we used PCA indices and HR.

The HR and surface ME signals are acquired at a notebook PC equipped on the cycle ergometer. Updating system was made via the Internet (**Figure 1**). A part of biosignals can be displayed at the management PC by an Internet browser, using the Java stand-alone application (JSA). By this approach, we can browse and download biosignals and upload the calculated control parameters from remote places.

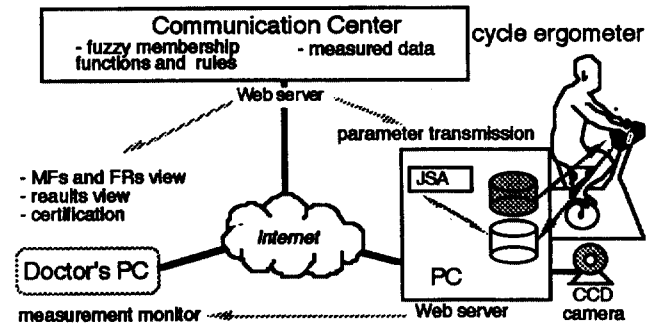

Fig. 1. Internet based remote workload control system.

III. RESULTS and CONCLUSION

Four older subjects participated in our experiments. The typical results showed that the workload increased, then decreased gradually. At the same time, the HR did not show a significant variations. On the other hand, ME parameters indicated muscular fatigue. Compared with the lactate threshold during the exercise at progressively increasing workload, the exercise at controlled workload was able to be maintained at a little bit lower the lactate threshold.

Since the system has flexibility in workload control, this system will be suitable even for older individual persons when they exercise for training or rehabilitation at home.

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REFERENCE

[1] T. Kiryu, K. Takahashi, and K. Ogawa, "Multivariate analysis of muscular fatigue during bicycle ergometer exercise," *IEEE Trans. on BME*, vol. BME44-8, pp. 665-672, 1997.