

A MEASUREMENT SYSTEM OF HUMAN-BODY CONSTITUTION AND STRENGTH EXERCISE

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This paper introduces a measurement and training system based on sensors, computer software and hardware for body constitution measurement and strength training. The system adopts the sensor technology, computer software and hardware technology, as well as digital display technology to perform automatic data collection and processing in real time in order to enhance the system accuracy and the running efficiency. The measurement errors caused by the staff members, who are over-involved in measurements and by the original equipment, are greatly reduced. According to the measured data, physical educators and instructors can make informed decisions and readjust the items of physical education, by observing the changes in body constitution before and after the exercise. This system is helpful for formulation of a scientific exercise plan and to improve exercise effectiveness.

KEY WORDS: body constitution, physical strength measuring system, sensor

INTRODUCTION: Accurate statistics of measurement for body constitution are important means of assessment, providing indications for establishment of a national standard for body constitution quality. In China, the original body constitution measurement was based on the equipment or device producing inconsistent data, which was further compromised by human error. This kind of method not only results in low accuracy, low efficiency, but also is much more expensive. Consequently, recognizing the backward status of constitution measurement and strength training in China, a set of constitution measurements and physical training system was developed, based on the various sensors and computer software and hardware technology. The systems accord with the Measurement Standard of Adult Body Constitution and Measurement Standard of Beijing 3-6-aged Children Body Constitution set by State Bureau of Physical Culture. These systems can provide the correct evaluation to body constitution for the testers. In addition, they are a convenient method for obtaining statistics on body constitutions for various population groups. In this way the government and the relative departments have access to necessary information about the constitution of the people. Based on accurate data, policies can be introduced to promote programs to improve and strengthen the quality of people's constitution.

THE MEASURING AND TRAINING METHOD: The function of the system. The system of body constitution measurement and the system of strength training have the interfaces, which can process the data collection and data processing in real time for the testers in different work posts. The results can be displayed by digital method. The system has the fault tolerance function, and can repeat tests successfully. Due to the large quantity and different experience levels of the testers there is potential for faults. This system can correct the mistakes appropriately. The system can determine the different testers and different items from large amounts of measured data. It can process the measurements at the same period in a certain order and is able to deal with hundreds of people. It also has a high efficiency and high accuracy rate and is less man-involved.

There is quantification of strength training in real time. At present China has the equipment necessary for muscle strength measurement, but there is a shortage of the equipment for observing the force change and the training results in real time. However, the equipment developed by this research can observe the force change applied by both hands in training process. Measurements can be collected on within the provided time, and the total power done in an exercise within specific time duration. The minimum display value for the force measurement is 1N and for the displacement of a hand is 1mm. The data of every

exercise must be stored for comparison with previous or further data. In such a way, the training database can be established to provide the scientific basis for further training. The system for single item training was used for the athletes in Tsinghua University in 1986, providing good results. It was used in teaching of bio mechanics in Tsinghua University and Beijing Physical Education University, as well as winning the award of Beijing Science and Technology. Figure 1 shows the flow chart of strength measuring system.

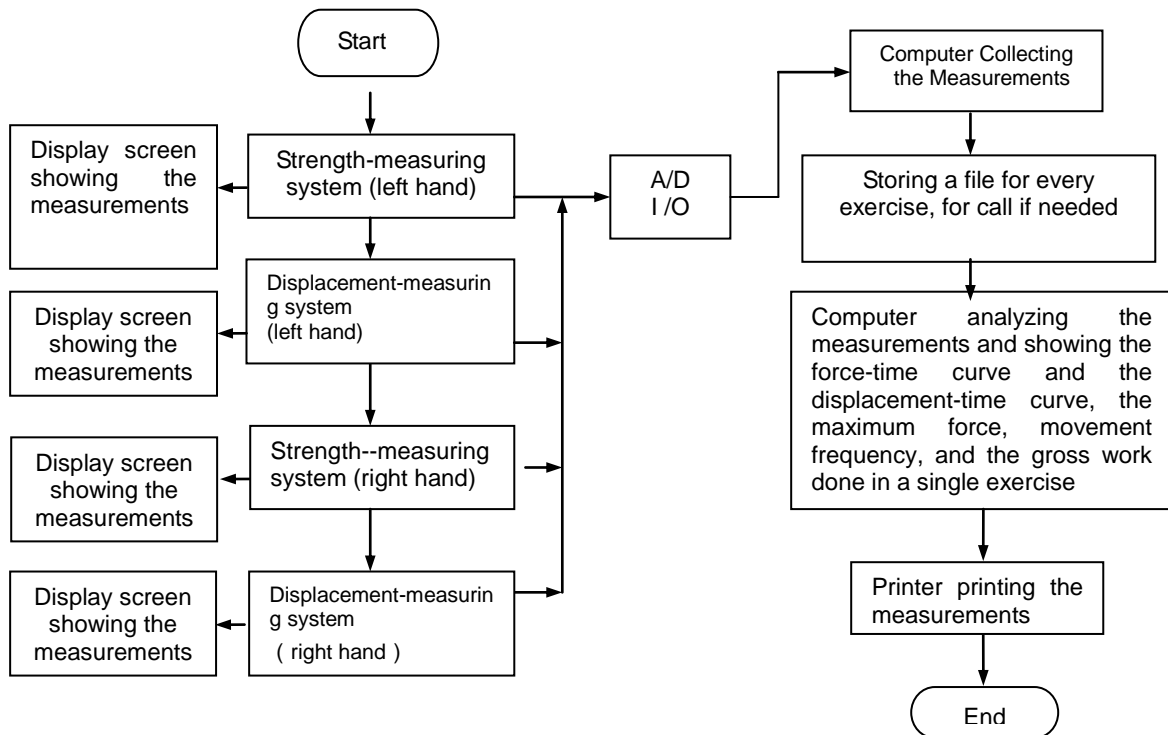


Figure1 - Flow chart of strength exercise measuring system.

Quantification of human-body constitution measurement. The sensor performs the function of sampling in the measuring system. Accordingly, the first important task for the digital display is to choose the suitable sensors. Due to the very large working load the selected sensors have to be reliable and with high accuracy. On the other hand, the measurement of body constitution is possible even with a large group of testers, who have different knowledge levels. In order to make the measuring data accord with the actual situation, and to reduce the amount of artificial error, the digital technology should be used. This digital display system adopts the four-digit number. For height, the body bending, the upward jump, and the body mass center, the minimum display value is 1mm. For the weight is 1N, for the vital capacity is 1ml, for the grip strength is 1N, for closed-eye with one-leg standing is 1s, for the response time is 0.01s. Figure 2 shows the block diagram of body constitution measuring system.

In the process of data collection for body constitution measurement, many work posts are functioning at the same time. These include body height, body mass, body forward-bending, response time, stability of one-leg standing with closed eyes, upward jump, vital capacity, body mass center and grip strength, etc., All of the above parameters measured can accurately determine the basic quality for the individuals. The collected data has to be distinguished from different collection posts and different individuals. This is one of the difficult problems for programming the data collection and it is very important for reasonable arrangement of the whole task of measurement. Figure 3 shows the flow chart of body constitution measuring system.

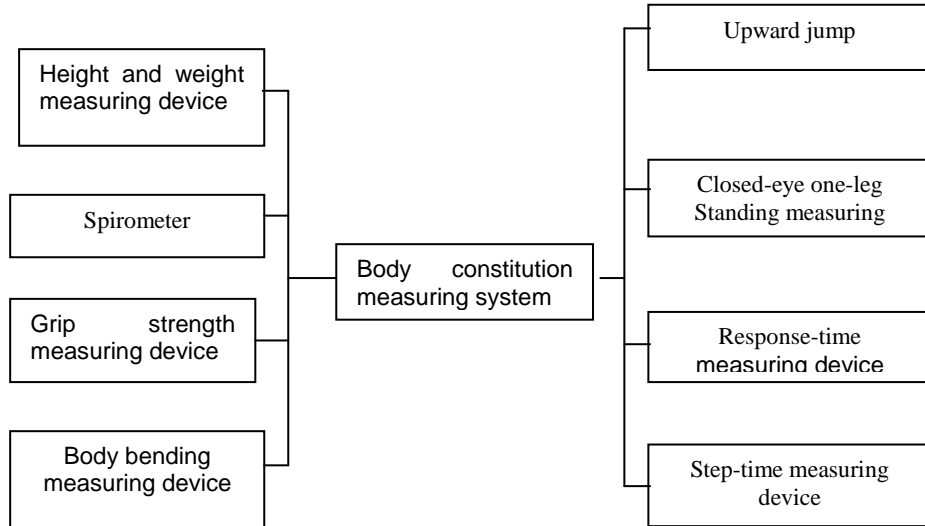


Figure 2 - Block diagram of body constitution system.

The body constitution for the children in the Kindergarten of Chinese People's University was measured by means of the body constitution system. Two teachers are in charge of every class. The measuring task for 320 students was completed within 3 hours employing only 3 staff members for assistance. Each measurement of every item for every student took only 10 seconds. The result has already proven that due to the application of digital technology, the system has a high accuracy and high efficiency rate, producing data at low cost for such detailed measurement.

At the point of data processing, the data of the personal body constitution measurement should be chosen accurately from the data base, and given the scores based on the 《Chinese Body Constitution Measuring Standard》. The remaining measurement data are entered into the computer, for instance, the back and forth running, etc, and the final evaluation is provided for every tester.

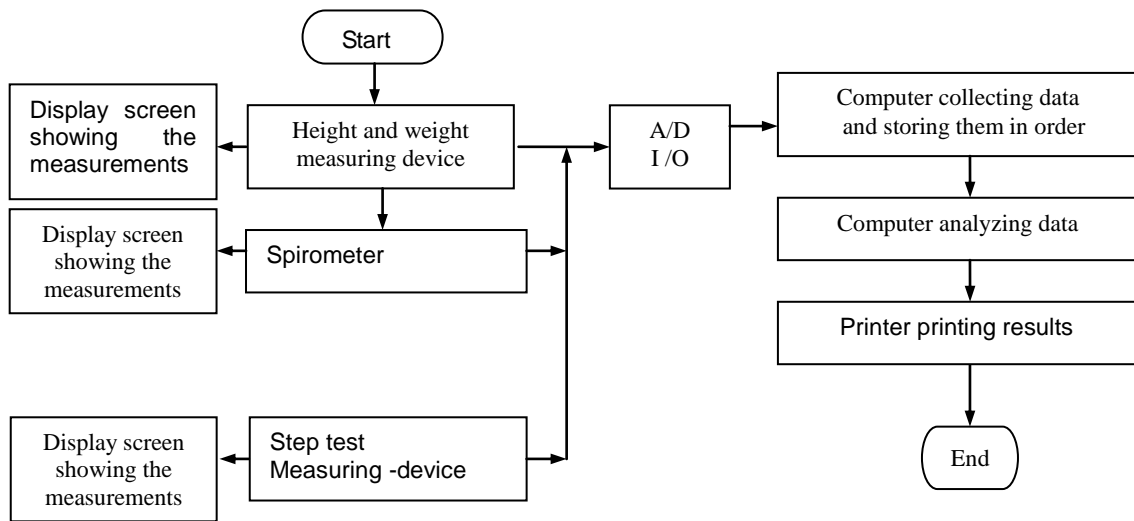


Figure 3 - Flow chart of body constitution measuring system.

CONCLUSIONS: From the above research and application, the following conclusions are made:

1. With the popularization of the computer technology, the outdated equipment should be replaced by a system controlled by computer.
2. With the development of higher socio-economic levels and the improvement of living condition, the importance of standards for human-body constitution of the nation will continue to be stressed. This will provide an opportunity for further development of advanced equipment for constitution measurement and strength training nationwide.
3. With the application of the quantification method in body constitution measurement the deficiencies in strength training will be greatly reduced and the efficiency of training will be enhanced.

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