DEVELOPMENT OF MULTIFUNCTIONAL JUDO-DOLL TRAINING SYSTEM FOR ENHANCEMENT OF JUDO PERFORMANCE

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INTRODUCTION

Judo is one of the favorite olympic sports worldwide. Judo skill is divided into two technique groups : *Nage-waza*(throwing techniques) and *Katame-waza*(grappling techniques). Throwing techniques consist of hand technique(*Te-waza*), hip & loin technique(*Koshi-waza*), leg & foot technique(*Ashi-waza),*Sacrifice technique(*Sutemi-waza*) and *Katame-waza* techniques include, *Osaekomi-waza*(pinning tech.), *Shime-waza*(strangling tech.) and *Kansetsu-waza*(joint tech.)*.*

It is very important to train a Judoist(=*Judoka*) with a human partner to develop skills and muscular strength to improve the Judo performance. However it is not easy to find a proper training partner whenever the Judoist wants to practice. Thus, the multifunctional Judo-doll taining system(M-JUDOLLTS) needs to be deveoped to replace the human training partner.

METHODS

1) Structure : The framework of the Judo-doll is made similar to a human body. The height is the mean height of national team Judoists(ave. 173.3cm) and can be adjusted according to the height of trainees. The weight ranges from min. 25kg ~ to max. 100kg.

2) Function : The fuctions of the Judo-doll are to practice the joint movements of a human body, especially hand, hip & loin, and leg & foot techniques in pulling, pushing, and throwing motion.
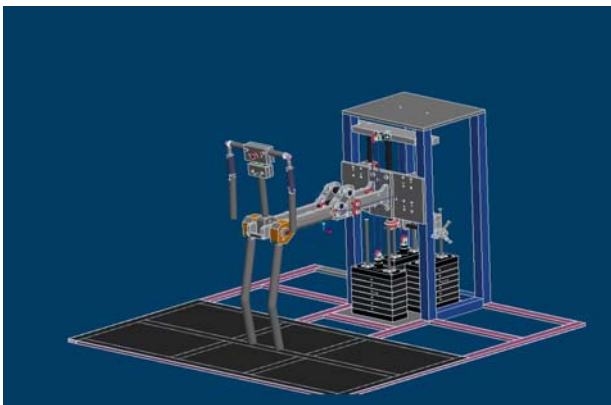

Figure 1. Overview of the M-JUDOLLTS frame. The dummy is to be attached on the body frame.

Figure 1 shows the overview of the M-JUDOLLTS. The M-JUDOLLTS consists of a dummy, a power generating mechanism, and kinematic links which mimics the training partner's motion.

The M-JUDOLLTS can be used to train the Judoist on multiple Judo skills including push-and-pull, shoulder throw, hand/leg & foot and hip & loin techniques.

The force exerted by the trainee is recorded by the computer and can be analyzed to check a Judo's performance improvement.

RESULTS AND DISCUSSION

1) Simulation of a training partner's motion

The M-JUDOLLTS should simulate the real human partner's reactions against Judo skills. The reaction can be characterized by kinematic motion and force profile.

To mimic the kinematics of reaction, the training partner's motions were captured using Vicon[TM] system (7 cameras) and analyzed. The positions of specific points including left and right shoulder, hip, neck were extracted from the captured data at the start and the end of the reactions.

2) Simulation of a force that the trainee feels

Once a Judo skill is applied to a training partner, he/she instinctly resists with a maximum force against the Judo skill at the first stage. However the training partner abruptly looses the resisting force when he/she looses the balance, and finally falls down. Thus, the typical force profile that the trainee feels has a peak at the beginning and decreases. In order to mimic this force profile, electromagnets and dead weights are used. The electromagnets generate the peak force and dead weights generate relatively flat force. The magnitude of magnetic force can be controlled by a microprocessor and the dead weights can be manually adjusted based on the weight of the training partner.

3) Control system

In order to control the system and collect the training data, the 32 bit AT91SAM7S256 microprocessor is used. The microprocessor collects the force data from 3 load cells and controls the magnitude of the magnets and communicates with a computer using Bluetooth[TM] to send and display the force data in realtime. The training history including date, personal information, training time and 3 force profiles are displayed on the computer screen, and saved for analysis in the future.

4) Mechanism

The novel mechanism is developed that can generate the force when the dummy's body and legs are moved from the neutral position. The height of the dummy can also be adjusted.
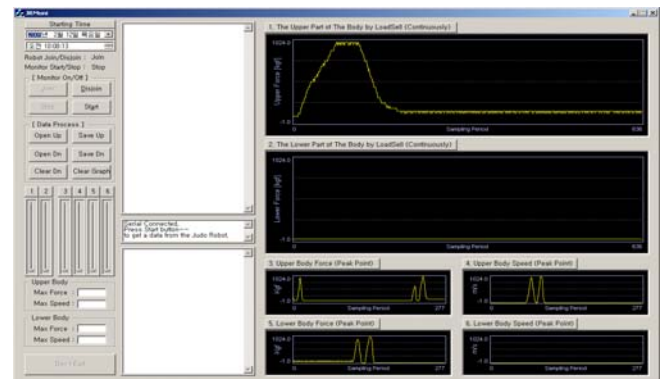

Figure 2. Screen view of computer: force data from load cells are displayed.

CONCLUSIONS

This system developed can be used to train a Judoist without a human training partner. As the system is flexible and easy to use, the trainee can train Judo skills alone.

ACKNOWLEDGEMENTS

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