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Short Paper

An Immediate Feedback Video Production System for a Table Tennis Class

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1. Introduction

Visualization of the calculated trajectories of target objects and materials enables us to understand the various behaviors and phenomenon (Hosotani 2006). Trajectory visualization technology is utilized not only for Physics, Medical Sciences, Engineering but also for Sports Sciences (Ota and Ninomiya, 2007). Skill acquisition is a process through which a person gains experience and learns to perform movements that are refined into skills. Feedback can be an important part of the mechanics of skill acquisition, and videos are often used in conjunction with sports skill instruction for physical education (Rothstein, 1976, Starek, 1999). Currently, video technology is widely employed in sports training due to the development of digital video technologies (Asai, 2004). For example, Hämäläinen examined a gesture- and voice-controlled video system for sports training (Hämäläinen,2004). However, self-video feedback is not effective for use with a large class of students.

It is also important for sports beginners to use markers in a video image as instructional navigators so that students can focus on important elements. Since video provides a large amount of information, appropriate guidance or navigation is necessary in providing feedback videos. Nosu *et al.* described a system that provided a model performance video as well self-videos for a table tennis class. However, their system did not provide students self-video feedback immediately after class practice (Nosu, 2006). Ideally, self-video feedback should be provided immediately, before a student loses the athletic sensation obtained from the exercise. Therefore, the development of an efficient feedback self-video production and editing system is necessary for a large class (*i.e.*, containing more than 10 students).

This paper describes a novel self-video system that provides immediate feedback for a table tennis training classes with a large number of students. This system resolves the following problems; (A) video feedback for a large number of students in a class; (B) immediate video feedback before a student loses sensation obtained from the exercise; and (C) markers in a video image so that students can focus on important areas.

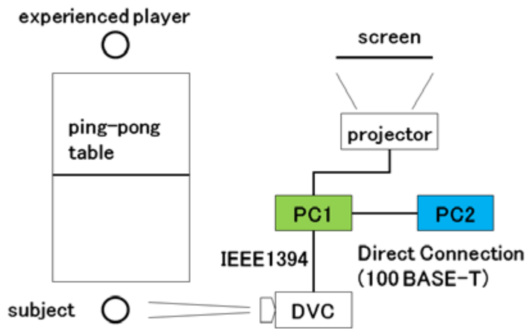

Fig. 1 System configuration

2. System Configuration

Figure 1 shows the configuration of the proposed video system. The time required for video recording depends on the athletic skills of the students, class control, and other factors of training management. Therefore, fully automatic video shooting and image processing is not a realistic solution. This system involved two personal computers (PCs): PC1 for video shooting and projecting and PC2 for image processing of the markers. The operation of PC1 is almost completely manual, while that of PC2 is semi-automatic. Image processing software (PTV; Digimo Co. Ltd., Japan) was used for semi-automatic production of a student's hand trajectory center of gravity (CG) by automatic tracing of a marked point. Microsoft Windows-based control and operation software, "Rocket Mouse" (provided by Mojosoft Co. Ltd., Japan) achieves automatic

Fig. 2 Time sequential images of video

operation of several software applications in Microsoft Windows by combining software applications.

Image processing time was reduced by the following two factors: (1) tasks are shared by two PCs, and (2) semi-automatic image processing tasks are separate from PC1 and performed in PC2.

AVI-MV format conversion is performed between PC1 and PC2. An MV format video consists of time sequential bit-map still images. The image tracking software Image Tracker PTV (Digimo Co. Ltd.) creates trajectory data of the wrist at PC2. It scans the area near the marker position of the previous frame to identify a new marker position in the present frame by calculating pattern matching and degree of similarity between the previous and present frames. Therefore, once the initial marker position is set manually, the software traces the marker automatically. The MV format frame size was 640 x 480 pixels, tracer size was set as 30 pixels, and tailing radius in the screen size was set as 50 pixels.

Figure 2 shows an example of a video with a wrist trajectory, which is denoted by a red curve. To facilitate the motion of the wrist, the student wore a colored wristband as a marker, and a white curtain was added as the background.

3. Results and Discussion

This new system was introduced to a class of beginning table tennis students at a university to evaluate system performance. The class contained 30 students. The students in the class were divided into two groups. Individual self-videos of the students in the two groups were produced and projected in the gymnasium. The students in one group received feedback during the 3rd and 5th classes, and the rest of the students had feedback during the 2nd and 4th classes. The instructor explained key points of each student's table tennis performance individually by showing each student's self-video as well as the model video of a skilled player. Table 1 shows the production time of the feedback videos. Average production time was about 2.4 minutes per student.

Table 1. Video Production time

class	#2	#3	#4	#5
the shot subjects	14	16	14	14
over all processing time	33 min	24 min	40 min	45 min
average processing time / subject	2 3 min	1 5 min	2 9 min	3 2 min.
average processing time / subject				2 4 min

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