

## Development of Multimedia Contents for Specialized Skill Education

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Recently, skill education such as music, sport and production activity is focusing on how to transfer a specialized skills to next generation. So far, a specialized skill has been usually transferred by traditional learning environments between high skill veteran specialist and follower, but it has been not so success due to a lack of environments and number of specialist. In this paper, new multimedia content support for playing drum is proposed, which has utilized e-learning with the multimedia like a video record consisting from actual specialist's technique. The explicit knowledge from drum specialist's video, such as position and movement(velocity and acceleration) of drumstick has once extracted and stored as database in the system by using our image recognition techniques. At the follower practice site, video image is acquired from video camera. Then the technique for detecting ,tracking and comparing the trajectory of drumstick with database is performed. The system will point out the missing drum playing to the follower in real-time when he plays not match with database. So, the follower was easily able to learn by review himself for the multimedia until full understanding.

**Keywords** skill transfer ; e-learning; image recognition; multimedia contents

### 1. Introduction

For the last several years, e-learning plays an important role to enhance educative effectiveness, especially for traditional learning environments[1-4]. Recently, e-learning in Japan is focusing for high technical skill transfer to next generation[5]. In the past, a specialized skill such as music, sport and production activity has been usually transferred by traditional learning environments between high skill veteran specialist and follower. However, it has been not so success due to a lack of environments and number of specialist.

In the process of skilled education, the follower is necessary to observe the correct operation(movement, etc.)of veteran specialist carefully. On the other hand, the explicit movement quantity (velocity, etc.) of veteran specialist is needed to be analyzed and extracted then stored as a data by the scientific method, so that the follower can refer as a skilled data for practice.

In this paper, new multimedia content support for playing drum is proposed, which has utilized e-learning with the multimedia like a video record consisting from actual specialist's technique. The explicit knowledge from drum specialist's video, such as position and movement(velocity and acceleration) of drumstick has once extracted and stored as database in the system by using our image recognition techniques.

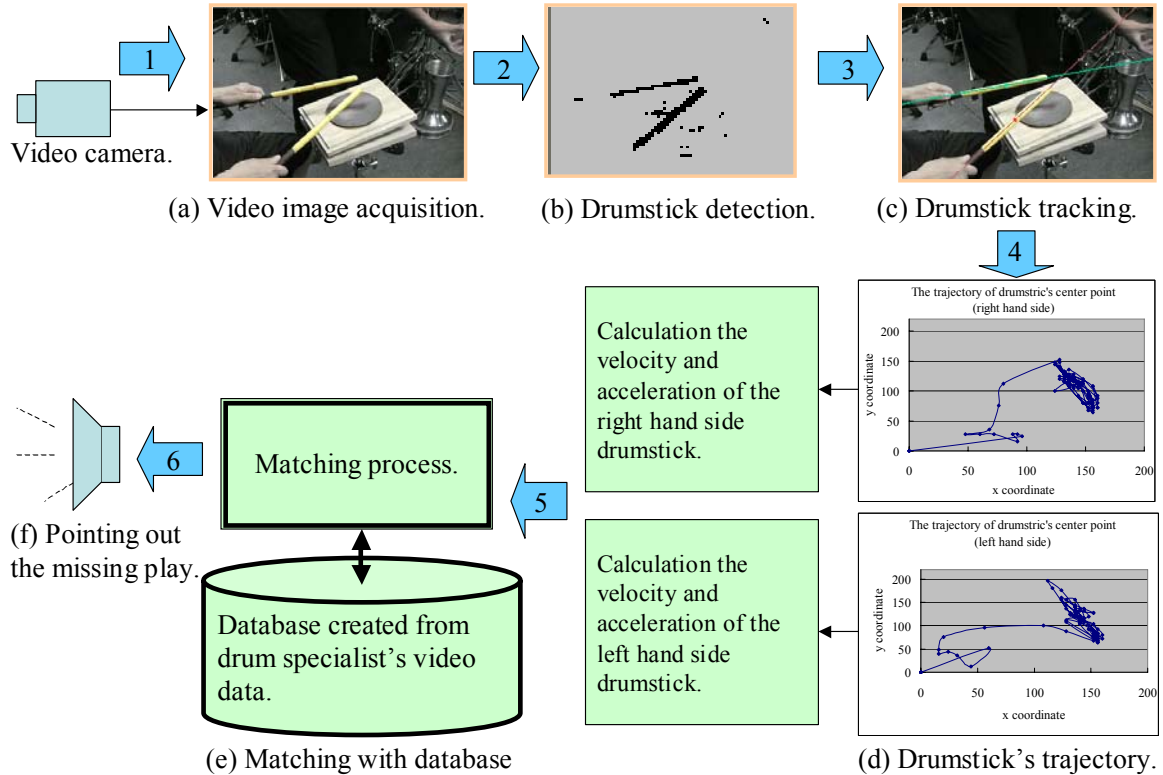
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## 2. System configuration and process algorithm

### 2.1 System configuration

The system's concept of the multimedia content support for playing drum is shown in Fig.1. The system consists of camera for taking video image and personal computer for video image processing. We developed the technique for detecting and tracking the trajectory of drumstick. The algorithms are described as below



**Fig. 1** The concept of multimedia contents support for playing drum.

### 2.2 Drum stick extraction algorithm

We develop drum stick extraction algorithm as a step shown in Fig 2.

First, We use a colour interface that we have developed to obtain the colour distribution of drum stick as shown in Fig.3. Next, we reduce image size to 1/16 as shown in Fig.4 to save computation cost for real time image processing. Then, binarize the drum stick image region as shown in Fig.5, and adopt Hough transform to get the slope of the stick by detect the maximum peak value in the Hough space as shown in Fig.6. The final results of drum stick extraction are shown in Fig.8.

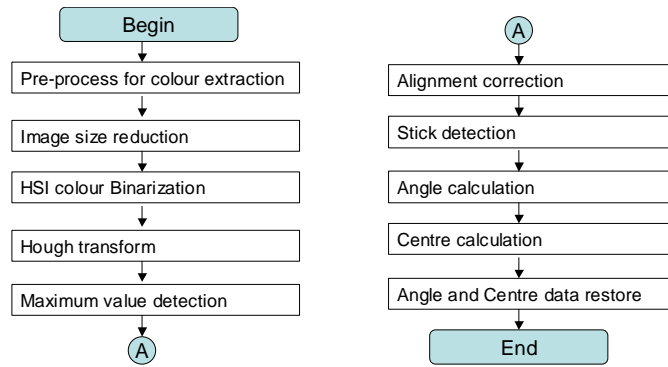


Fig.2 Drum stick extraction flowchart.

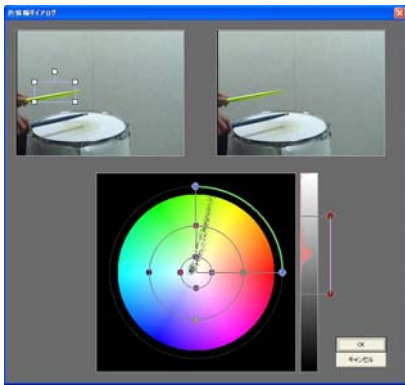


Fig.3 Pre-process for drum stick colour extraction



Fig.4 Image size reduction for reducing computation cost

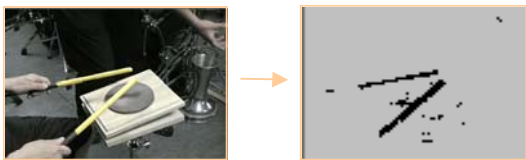


Fig.5 Binarization the drum stick's image region

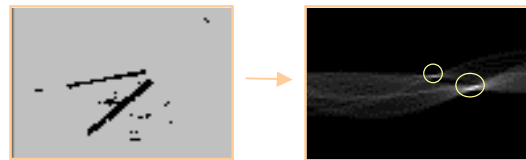


Fig.6 Hough transform and maximum value detection

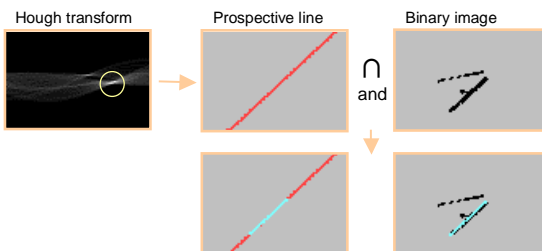


Fig.7 Drum stick detection

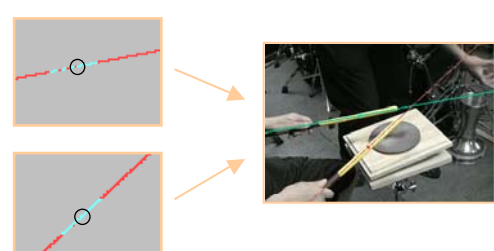
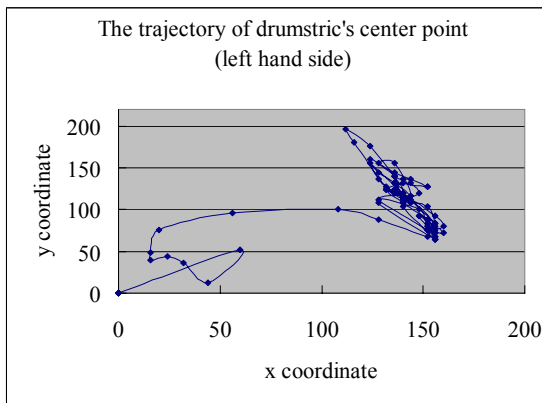


Fig.8 The results of drum stick extraction

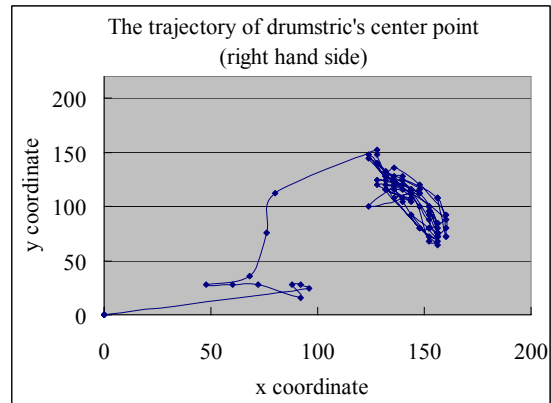
### 3. Experimental results

#### 3.1 Drum stick's trajectory extraction

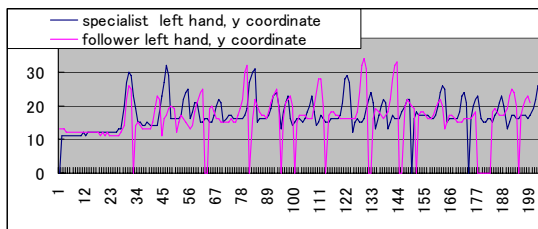
In this paper, we use drum stick in the different colour between the left and right hand side, in order to distinguish left and right stick easier. This underlying assumption can be replaced by another method in the future. We ask both specialist and the follower play drum as the same rhythm. By proposed method, drum stick's trajectory can be extracted in real time, both left and right hand side. The results of drum stick's trajectory extraction are shown in Fig.9 and Fig.10. Figure 11 shows the time sequence trajectory(expresses only y coordinate) of drum stick both veteran specialist and the follower. The system is able to detect the different between both of them.



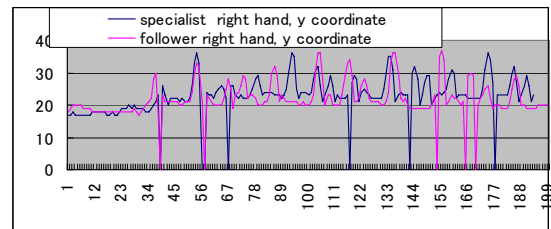
**Fig.9** The trajectory of drum stick(left)



**Fig.10** The trajectory of drum stick(right)



(a) left hand side

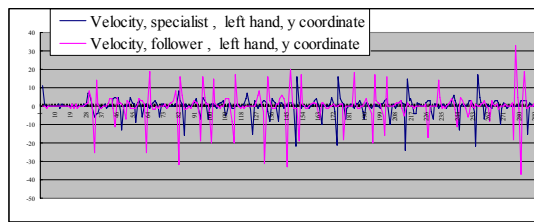


(b) right hand side

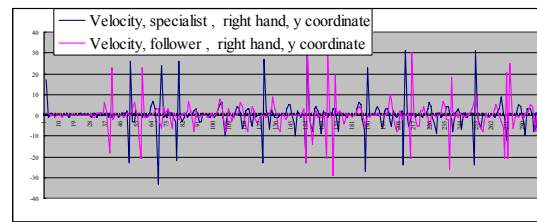
**Fig.11** Time sequence trajectory(y coordinate) of drum stick both veteran specialist and the follower.

#### 3.2 The velocity and accelerator of drum stick

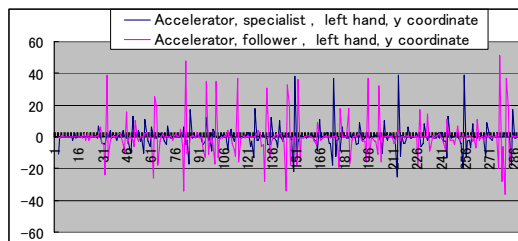
We calculated the velocity and accelerator of drum stick for both specialist and follower. Then compare and find the different between them, in order to point out the missing play. Figure12 (a) and (b) show the comparison of velocity of drum stick between the specialist and the follower. Figure12 (c) and (d) show the comparison of accelerator. It is found that the different between them can make the system able to point out the missing play.



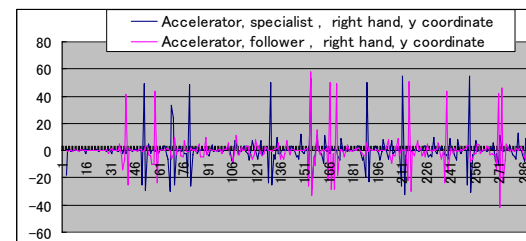
(a) Drum's velocity (left hand side)



(b) Drum's velocity (right hand side)



(c) Drum's accelerator (left hand side)



(d) Drum's accelerator (right hand side)

**Fig.12** Time sequence velocity and accelerator (y coordinate) of drum stick of both veteran specialist and the follower.

#### 4. Conclusions

In this paper, a specialized skills transfer is taken up, and a new multimedia content support for playing drum is proposed. Proposed system has been implemented by using image processing and image recognition techniques. The proposed method, not only delivery the content but also point out the missing drum playing to the follower in real-time when he/she plays not match with database. So, the follower is easily able to learn by review himself for the multimedia until full understanding. The future work would have to develop a sophisticated algorithm to detect the mismatch point for stable result.

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