Development of Air-squat Supporting System using Microsoft Kinect

Youji Ochi
Faculty of Science and Engineering, Kinki University, Japan
ochi@kindai.ac.jp

Abstract: Sports training is intended to promote health and improve skills of the sport. We think that the Study of the education system application of motion capture equipment such as Kinect become popular in the future. In this paper, we propose a new approach for air-squat, which is a type of training, behavior training to provide support using squat Kinect there. Finally, this paper reports on the development and operation verification of training support systems.

Keywords: Air-squat Supporting, Kinect, Skill Learning

Introduction

Sport training is intended to promote health and improve skills of the sport. Most people don't know the correct way of training. Their own way of training cannot be gotten the effect as expected and leads to an injury. There are some researches of sports supporting systems using virtual environments [1]. It is very important for educational system research to recognize behavior of learners or teacher [2][3]. In addition, research has also been movement analysis using motion capture equipment. We think that the education system using motion capture equipment such as Kinect becomes popular in the future [4]. However, Kinect has some constraints on the specification. Therefore, we propose a new approach for air-squat, which provide the training environment using Kinect. In this paper, we report the development and evaluation for the verification as training support systems.

1. Requirement for air-squat supporting

In this study, we define the following requirements for the air-squat supporting system.

(1) Support to check the position of the hip and knee

It is difficult for the user to check the position of her/his hip and knee. Because when s/he checks them by her/himself, s/he often slouches forward. It means the wrong movement. Therefore the environment where the user can check the position of the knee and hip is necessary.

(2) Support of checking the motion speed

Squat requires hold for at least one second after bending down. Therefore the user must look at a watch continuously to check the time. It is difficult for the user to check it during the squat exercise. Therefore, it is necessary environment where the user can check the time of squatting.

2. Our approach

2.1 Introduction of Kinect and the constraints on the specification

We think that it is appropriate for the introduction of motion capture equipment to support body movements. In this study, we focused on the Kinect. Kinect can output the coordinates of 20 joints as user's skeleton information. It is better to show a picture of the user from the side angle. However, Kinect outputs the human body model from front view only. Therefore Kinect cannot output the skeleton of the user correctly from the side view. Moreover, Kinect cannot output the correct skeleton information without full-body photograph. Therefore, the shooting location is important.

2.2 Attitude estimation and visualization of the using depth information

We focus on the depth information of skeleton from Kinect. The depth information is a Z coordinate of skeleton. The infrared sensor of Kinect calculates it. By using this depth information, it is possible to determine the Z coordinates direction of the knee. Then, I propose the projection way based on the depth information. The way is that the vertical axis is Y and the horizontal axis is Z. I think that information supports to estimate the angle from the side and check her/his skeletal position of the toe, hip and knee.

3. Prototype system

We have developed a system air-squat training system using the Kinect for SDK beta2 for the implementation of this system. The following describes in detail. The user interface is following four areas (Figure 1). "Body position view area" shows Z-Y axis skeleton information, the number of squat, and squat keeping time. "Mode show area" displays the current operating mode by the arrow shapes and text for user. "Video view area" displays a video image of Kinect for the user in order to understand the shooting range. "Skelton view area" displays an image of the user's skeleton form.

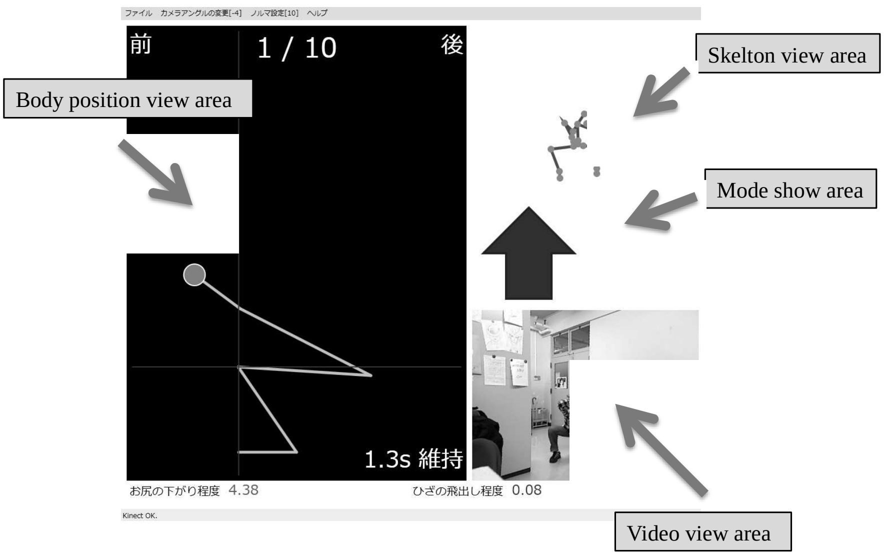

Figure 1 User Interface

4. Evaluation

We have prepared two trial environments (T1 and T2). T1 had the system navigation (Showing Main Window and Speech message) and T 2 had not it. We made 11 examinees (A-K) squat 10 times in the both environments. Then, we investigated the number of squat recognized by the system. We have described the definition of the air-squat to the examinees before this trial. Figure 2 shows the result. The “Failure” in the figure means the examinee did not bend down over one second in the keep mode. In T2, the system judged that most examinees did not bend down to the base position of their knees. Therefore, the system could not be recognized as their squat motion. The number of squat is less than 10 times about most examinees. In T1, the system was able to recognize all the squat of all users. The examinees were trying to bend down to the base position by watching the screen. The number of most users less than 10 times. I think the reason that the air-squat is difficult for the examinees.

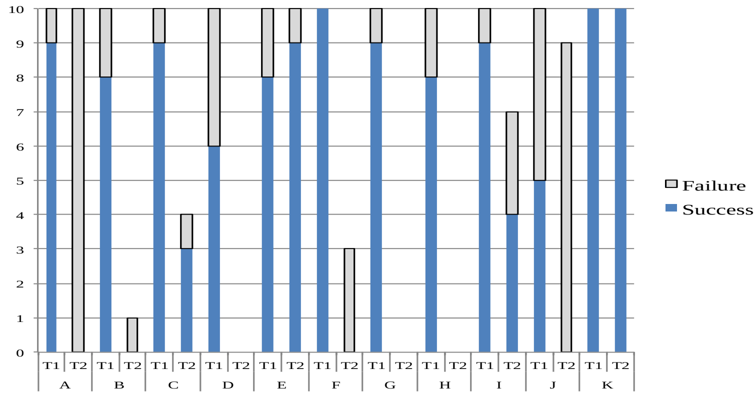

Figure 2 The Number of Squat

5. Conclusion

In this paper, we reported on the development and operation verification of training support systems. The users tend to drop the hip was seen more deeply by using this system. However, there were some different between the system’s posture and the user’s one in the examinees. My future work is the improving the system’s validity

Acknowledgements

This work was supported by Grant-in-Aid for Scientific Research(C) 23501122 from the Ministry of Education, Culture, Sports, Science & Technology in Japan

References

[1] Helen C. Miles, Serban R. Pop, Simon J. Watt, Gavin P. Lawrence, Nigel W. John (2012). A review of virtual environments for training in ball sports, Computers & Graphics 36, 714–726.

[2] Shimada Atsushi, Suganuma Akira, Taniguchi Rin-ichiro (2004). Automatic Camera Control System for a Distant Lecture Based on Estimation of Teacher’s Behavior, Proc. of the Seventh IASTED International Conference on Computers and Advanced Technology in Education, 106-111.

[3] Yong Rui, Anoop Gupta, Jonathan Grudin and Liwei He (2004) Automating lecture capture and broadcast: technology and videography, MULTIMEDIA SYSTEMS,Volume 10, Number 1, 3-15.

[4] Hui-mei Justina Hsu, The Potential of Kinect in Education (2011). International Journal of Information and Education Technology, Vol. 1, No. 5, 365-370.