Study on Teacher's Behavior Analysis of School Children based on Skeleton Information

Sota Fukushima
Osaka Institute of Technology, Japan
sota-fukushima@mix-lab.net

Sho Ooi
Osaka Institute of Technology, Japan
SHO.OOI@outlook.jp

Haruto Kochi
Osaka Institute of Technology, Japan
Haruto.kochi@mix-lab.net

Takeshi Goto
Oji-kita Compulsory Education School/Kansai University, Japan
tk4goto074@gmail.com

Abstract

Teachers are difficult to reflect on their teaching and try to improve it because they have many other duties. Teachers must reflect on the class to develop their teaching abilities. This study focuses on the teachers' behaviors toward students. First, this study determined the behaviors from the teachers' behaviors toward the students by a questionnaire of 23 people. After that, this study extracted target behaviors from skeleton information by Open Pose algorithm and detected teaching actions by support vector machine and considered effectiveness of our system. As a result, this study obtains teachers-students behavior's interaction information such as "shutting up" and "asking a question," which tended to improve the quality of the system. Next, this study conducted an action detection experiment using questionnaire survey to detect "pointing", the accuracy was 10 percent and a low. This reason Open Pose algorithm cannot detect skeleton information by occlusion problems.

Kerwords: Teacher Behavior Recognition, Support Vector Machine, Skeleton Information, Feedback System

Introduction

Teachers are busy in Japan, and the work system is one of the problems to the survey results of the Ministry of Education, Culture, Sports, Science and Technology (MEXT)[1]. Therefore, beginner teachers are required to have the same quality of work as expert teachers, but they cannot respond flexibly due to a lack of experience [2].

This study proposes a feedback system shown in Figure 1 to solve such problems. The retrospective system analyzes the input lesson video with image processing technology and automatically generates points for feedback. The points for feedback are the content of remarks, behavior, and interaction with students, but this research focuses on interaction with students. Because it is one of the most important elements of class evaluation [3]. Methods for improving various focus skills through reflection throughout the class have been suggested [4, 5].

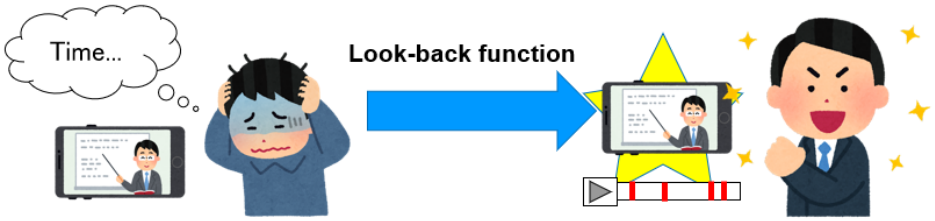

Figure 1 Overview of the feedback system

Research Design and Methods

Figure 2 shows a flow of an approach in this study. First, this study will investigate how the teacher interacts with the students. We surveyed 24 teachers and aspiring teachers using a questionnaire, and Table 1 shows the results.

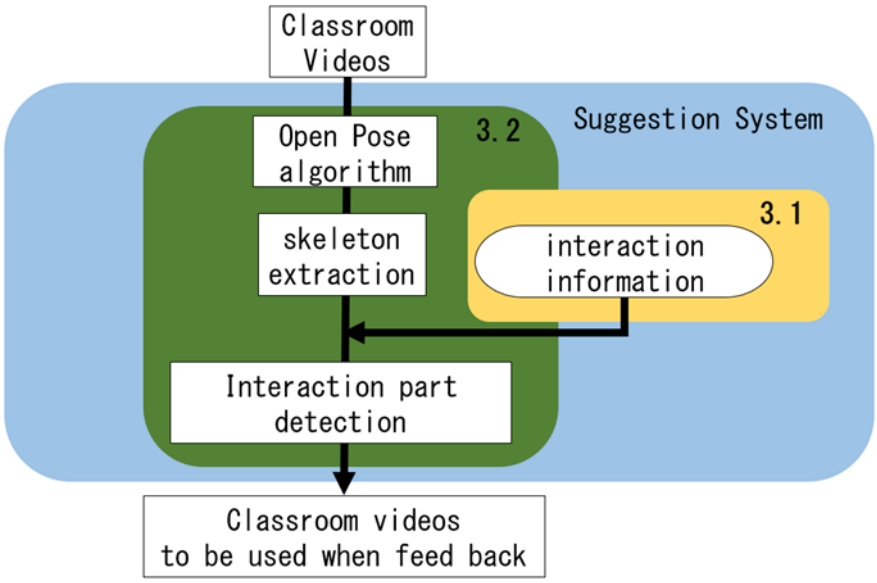

Figure 2 Processing Flow

Table 1 interaction information

Student's status	Leave it alone		greet		clap one's hands in prayer		point at		Others	
Sleeping	3	(0.11)	17	(0.63)	5	(0.19)	*	(*)	2	(0.07)
Talking	0	(0.00)	21	(0.91)	*	(*)	0	(0.00)	2	(0.09)
Standing and walking	2	(0.08)	21	(0.84)	*	(*)	0	(0.00)	2	(0.08)
Poor posture	6	(0.25)	11	(0.46)	5	(0.21)	*	(*)	2	(0.08)
Not looking ahead	5	(0.20)	19	(0.76)	0	(0.00)	0	(0.00)	1	(0.04)
Closing the textbook	6	(0.26)	13	(0.57)	*	(*)	0	(0.00)	4	(0.17)
Standing up and Talking to other students	0	(0.00)	20	(0.80)	*	(*)	2	(0.08)	3	(0.12)
Not writing on the board	5	(0.19)	15	(0.58)	*	(*)	0	(0.00)	6	(0.23)
Looking in different places	8	(0.33)	15	(0.63)	0	(0.00)	0	(0.00)	1	(0.04)

The results in Table 1 show that speech information is essential for actions such as calling out; however, it is difficult to perform voice recognition in the actual environment, and therefore, this study targets "pointing," which can be detected on an action basis. To detect "pointing" behavior, we use OpenPose algorithm [6], which can acquire skeletal information. The left and right arm angles are obtained from the obtained skeleton, and when the angles exceed

the difference, the pointing behavior is detected. Figure 3 shows a result detected skeleton information using Open Pose Algorithm..

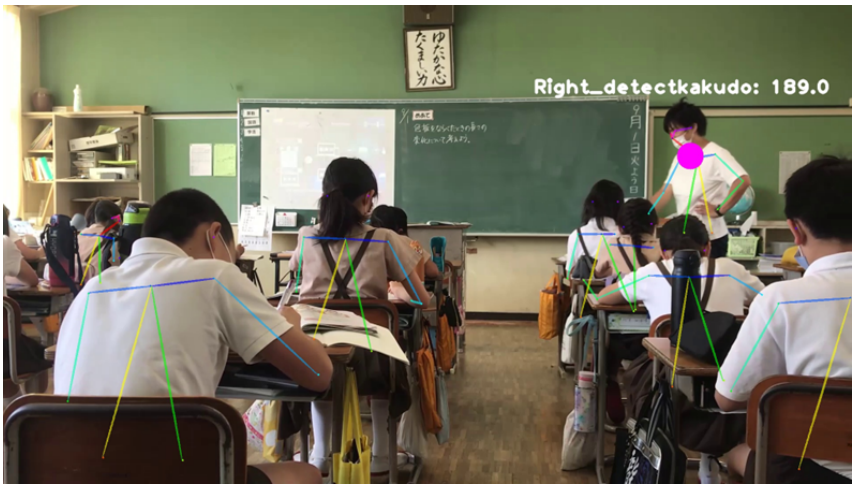

Figure 3 Results of pointing behavior detection by arm angle

On the other hand, action detection was performed by Support Vector Machine (SVM) using the x- and y-coordinates of the neck with the right arm angle $\theta 1$, right arm angle $\theta 2$, left arm angle $\theta 3$ and left arm angle $\theta 4$ as feature values.

Experiments Results and Discussions

The data of a 10-minute lesson in an elementary school were analyzed. In the detection by arm angle, we consider that the accuracy varies depending on how many frames in one second (24 frames) exceed the threshold value, and we compare the results over multiple frames. On the other hand, the data were separated by one second using SVM, and each data was labeled and detected. This experiment was conducted in accordance with the review of the Ethics Committee for Human Subjects at Osaka Institute of Technology (2021-23).

Table 2 shows the results from the thresholding of arm angles.

Table 2 Result from Threshold Processing

Number of frames(flame)	accuracy(%)	accuracy rate(%)	recall(%)	True Negative Rate(%)
5	5.521	70.719	34.615	97.820
10	6.000	80.479	23.076	98.723
15	4.166	88.013	7.692	99.610
20	4.347	91.952	3.846	99.813
25	10.000	94.178	3.846	99.818

Although the percentage of correct answers was high, in the actual class, there were many "non-pointing" behavioral data, which were correctly classified, resulting in a high percentage of correct answers. On the other hand, the accuracy was low, indicating that the "pointing" behavior could not be correctly classified.

Next, this study described the results using SVM. First, we validated the accuracy of teacher behaviors with Open Pose. At this time, the training and validation data ratio was 9:1. The results were that a correct response rate

was 0.53, repeatability was 0.52, a goodness-of-fit rate was 0.64, and an F value was 0.58. We conducted recognition behaviors in the actual classroom and found that a correct response rate was 0.54, repeatability was 0.31, a goodness-of-fit rate was 0.03, and an F value was 0.05. As a result of both experiments, the reasons for the poor fit rate are considered to be the very large number of frames when the skeleton is not recognized in the actual class videos and the problem of occlusion, in which the teacher's pointing is hidden by the pupils.

Summary

This study proposed a system that automatically detects teachers' actions toward students by skeletal recognition, using OpenPose algorithm and SVM, and interaction information, which is an evaluation criterion in questionnaire surveys, in order to solve the problem of camera-taking when feedback at students. The result was a regrettable result with a poor fit rate. In the future, planning is increase the number of data to improve the accuracy of classification and supplement it with voice and wearable sensors. In addition, a reflection system will develop that even busy teachers can use to reflect on their own teaching behavior by automatically analyzing their actions.

Acknowledgment

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