Classification of Children’s Group Activity from Acceleration Data by Wavelet Transformation

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Abstract: We are developing the system that analyzes friendship relation from the acceleration data that represents children’s activities. This system observes the children’s group activities and identifies their groups. In this paper, we propose a method that analyzes children’s group activity from acceleration data that represents children’s activity. Our method consists of the automatic segmentation step and classification step. The automatic segmentation step detects the specific time when the group activity changes and divides time series into group activities. The classification step distinguishes the group activity of the divided acceleration data. We conducted an experiment in the kindergarten to evaluate the method and shows that the method has high accuracy.

Keywords: group activity, classification, wavelet transformation

Introduction

Children learn to fit into society through living in a group and their social ability is greatly influenced by their friendship relations. Therefore, preschool teachers need to understand the friendship relations to determine appropriate childcare activity. For this reason, we have been developing the system that analyzes children’s friendship relations from the acceleration data that represents their activities [1] [2] [3] [4]. In order to extract the appropriate friendship relations, we need to observe children’s group activity and identify the interval of the specific group activity called “Free Playing”. Furthermore, we need to extract the acceleration data of a specific group activity.

In this paper, we propose a method that analyzes children’s group activity from acceleration data that represent the activity of children, and validate the evidence. Our method consists of two steps; automatic segmentation step and classification step. The automatic segmentation step detects the specific time when the group activity changed from the acceleration data, and divides time series into each group activity. The classification step distinguishes the kinds of group activity of the divided acceleration data.

In the following, section 1 describes the details of the proposed method and section 2 describes the evaluation of the proposed method.

1. Proposed Method

This section describes the proposed method that analyzes children’s group activity from acceleration data that represents children’s activity. This method consists of two steps, the automatic segmentation step and the classification step.
The automatic segmentation step detects the specific time when the group activity changed, from the acceleration data and divides time series into each group activity. Figure 1 shows the diagram of the automatic segmentation process. This process consists of three processes. The first process converts the acceleration data into frequency spectrum by wavelet transformation. The second process calculates the difference of their activities at all time from frequency spectrum. We adopt the Euclidean distance for calculating degree of non-similarity. The last process detects the time when group activity changed from the average of the degree of non-similarity.

The classification step classifies the divided acceleration data into group activities. The group activities of the kindergarten are classified into six categories: "Setting Child-care," "Free Playing," "Lunch Preparation," "Lunch," "Relay," and "Other." This process classifies the divided acceleration data into each group activity from five features: "average of degree of non-similarity," "variance of the degree of non-similarity," "degree of non-similarity of the divided acceleration data," "length of interval," and "time when group activity is done."

2. Experimental Evaluation

We conducted an experiment to evaluate the proposed method. In an experiment, we get 24 children’s acceleration data that represents their activities. The length of observation time was about 4 hours.

From these data, we evaluate the proposed method and compared it to the observation record by hand. Figure 2 shows the results of the proposed method. The top left graph in Figure 2 is the correct time when group activity changed from the observation record by hand and the bottom left is the result of the automatic segmentation method. The solid line is the correct calculated time when group activity changed and the dotted line is the false calculated time that the proposed method detected. The top right graph in Figure 2 is the correct classification from the observation record and the bottom right is the result of proposed classification method. The colored time interval is the time series that the proposed method classified mistake.
The automatic segmentation method is evaluated by the hitting rate and inclusion rate of correct segmentation. The result of the hitting rate was 71% and that of inclusion rate was 100%. The classification method is evaluated by the hitting rate of correct classification. The result of the hitting rate was 81%.

3. Conclusion

In this paper, we propose a method that analyzes children’s group activity from acceleration data that represent the activity of children, and validate the evidence. Our method consists of two steps; automatic segmentation step and classification step. The automatic segmentation method detects the time when the group activity changed from the acceleration data and divides time series into each group activity. The classification method classifies the group activity of the divided acceleration data into predefined six categories. We conducted an experiment at a kindergarten to evaluate the method and shows that the automatic segmentation step has a hitting rate of 73% and an inclusion rate of 100%, and the classification step has a hitting rate of 81%. This accuracy is sufficient for analyzing children’s group activity.

References