Detecting Childcare Activities Using an Off-the-shelf Smartwatch



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relatively high (higher than 0.7).

Result and discussion

• Results of performance evaluation

Machine Learning Model	Accuracy	Precision	Recall	F1-score
Random forest	0.711	0.669	0.711	0.659
Gradient boosting	0.637	0.595	0.637	0.589
Logistic regression	0.605	0.574	0.605	0.564
Multi-class SVM	0.222	0.222	0.222	0.212
K-nearest neighbor method	0.185	0.190	0.185	0.173

The classification performance of random forest model was highest, with values of about 0.7.

The random forest model is expected to be useful in estimating activities during childcare.

• F1-scores of random forest for each childcare activity

Label	F1-score
bathing	0.973
walking_stroller	0.932
sitting_milk	0.796
play	0.785
others	0.698
changing_clothes	0.662
walking_holder	0.572
changing_diaper	0.558
standing_hold	0.385
sitting_hold	0.228

However, "standing_hold" and "sitting_hold" had relatively low values at 0.385 and 0.228, respectively.

It was necessary to examine how the activity labels with low f1-scores were incorrectly estimated using the random forest model.

The values of "bathing", "walking stroller", "sitting milk", "play" were

Estimation accuracy of random forest



It shows how likely each activity label was to be estimated for each activity label. The value for each activity label adds up to 1 in the horizontal direction.

Similar activities were sometimes incorrectly estimated.

- "sitting_hold" \rightarrow "sitting_milk" (0.15)
- "sitting_hold" \rightarrow "standing_hold" (0.52)
- "standing_hold" \rightarrow "sitting_hold" (0.40)

Smartwatch is a device worn on the arm; therefore, it does not capture movements of the body or head. Thus, **performance may be improved using smartphones and wearable devices for evaluation.**

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Conclusion —

This study estimated childcare activities for males in their 20s by collecting motion data from a smartwatch and creating multiple machine learning models. The results showed that **the random forest model exhibited high performances of about 0.7 for f1-score**, so this model may be useful for estimating childcare activities.

However, the classification of similar activities remains a problem, and it is necessary to devise a method of estimation using multiple devices.

This study only considered the childcare activity of males in their 20s in a laboratory environment; therefore, **it is necessary to conduct experiments including other age groups and females and to conduct experiments that consider a real environment**.

Introduction

Since the childcare environment has significantly changed, improving and supporting childcare have become major challenges in current society. Automatically recording and subsequently observing childcare activities can be used for various purposes to support childcare. However, methods to detect childcare activities using off-the-shelf devices have not yet been proposed.

This study develops a method to detect childcare activities that parents perform for their babies using an off-the-shelf wearable device. We define nine childcare activities and develop corresponding detection models based on motion-sensor data from a smartwatch. Our evaluation in a laboratory setting resulted in classification performances of 71% (F1: 0.66).

