Estimating Degree of Concentration through Activity Recognition: Use in a Classroom with SNS

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Abstract
This study develops an automatic method to estimate the degree of concentration on a task mainly focusing ones in a classroom. To know the degree is useful to understand a situation of a student and to improve the qualities of a classroom. Concentration depends on hidden internal states of a human so that it is difficult to measure the degree from observable external his/her behaviors. In this study, we first assume concentration degrees can be characterized by a set of activity patterns that is defined over each task. Thus we first identify activities, each of which completes in a short time interval, using data obtained from the standard accelerometer in a smartphone, and next the degree is calculated based on patterns of them. From another point of view, a historical record of calculated degrees is a part of important information for the lifelog of a person. We then periodically compose a tweet of him/her, and post it over Twitter. We show how we can use the lifelog in effective classroom education. By investigating tweets in a classroom, this system scores points for students, and it further arises competition spirits of students with a use of gamification. This poster presentation shows an outline of the system, primary implementation, and some experimental results.

Keywords: activity recognition, education system, data mining, lifelog, SNS, Twitter,

1 Introduction
Intelligent information systems are effective in classroom education, and in fact many lecture support systems are already developed and can be used in a classroom. In particular, several studies show the applicability of the SNS including Twitter approaches, whose main advantages are possibilities of connections among students and comments on mutual posts. We also attach importance to a smartphone as an effective ubiquitous educational tool, where most of university students now wear it almost all the time. We especially use a smartphone as a device for recognizing activities of a student. Our approach in this study combines these two recent technologies, recognizing a student activities based on sensing data with a smartphone and posting the activities over SNS as a part of his/her lifelog. In previous studies using SNS, a student has to post short messages by oneself. This cost cannot ignorable in general and be a tougher task for continuing over a long term. On the hand, our approach is based on an automatized posting so that the cost decreases to almost ignorable level.

Figure 1. Using Smartphone

2 Activity Recognition using Smartphone

Figure 1 shows a smartphone worn in a breast pocket of a student. We assume the student keep wearing it in the same pocket during a classroom, and the smartphone continuously collects sensing data of the accelerometer, the sensing frequency is about 100Hz a second. The similar approach is already used in [2].
Activity recognition is carried out by using the collected data and predefined activity template pattern data. This task recognizes an activity every 2 seconds, where the basic activities listed below are completed in this short interval. The activities recognized here are i) sitting lazy; ii) shaking body; iii) looking back; iv) unstably moving; v) keeping quiet.

The method used in the activity recognition is based on the idea of time-series data datamining [1] with clusterings and decision trees.

After extracting feature patterns, which are characteristic sub-sequences of data, and then build a decision tree to classify a given time-series data into the activities above. Feature patterns depend on persons so that each student has own feature patterns and own decision tree. In other words, we need a learning task collecting sensing data and completing datamining for each student.

2.1 Calculating Concentration Degree

The key point of this system is a calculation of a concentration degree based on recognized activities. Concentration is a matter of unobservable brain activities. We then need to calculate its degree from body activities but there is no general method to do this. We develop a mechanism that is restrictedly applicable in the case of having a lecture sitting at a desk in a classroom. The basic idea here is based on observations that a student moves less and quiet when he/she deeply concentrate in a lecture. The activities listed above are recognized every 2 seconds, concentration degree is calculated every 10 seconds by considering a sequence having 5 activities. Experimental results including the precision of this method will be shown in the poster session.

3. Using SNS and Lifelog

Making a personal lifelog is a social activity to record various aspects of his/her life from viewpoints of events, situations, statuses, relationships, etc. The recorded lifelog is used to look back his/her life and can be used to discover unrealized aspects of the life, to reflect own activities, to decide actions based on precedents and to improve everything to reach better life. Moreover having a lifelog, which is open to a community, means to be a part of community and to extend strong connections among members. Members each other can comments on a record, a tweet in the case of Twitter, this naturally stimulate mutual competition in a classroom.

3.1 Automatic Tweeting

A good lifelog requires frequent records, posting many articles or tweets however costs time and patience. In particular it is difficult to post a tweet in a classroom with keeping enough concentration to a lecture. To solve this problem, we adopt an automatic posting. Calculating concentration degree is translated into a short message tweet and is posted over Twitter as we show in Figure 3.

![Figure 3. Example of Tweets](image)

3.2 Competing over Lifelogs

Lifelogs are shared over a classroom community. We then introduce an idea gamification [3] to increase self and mutual competitions to increase situations in classrooms. Awards or points obtained in the gamification increase motivations of students. The design and experimental results will be also shown in the poster session.

4. Conclusions

We propose an intelligent classroom information system that activates useful interactions and increases mutual understanding. The key idea is an automatic posting of concentration degree as a tweet, which is calculating based on sensing data with a smartphone. By investigating tweets in a classroom, this system scores points for students, and it further arises competition spirits of students with a use of gamification. Several experimental results with future problems will be shown in the poster session.

References