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Visualization of Utterance Transition in Group Discussion Using Learners' Mobile Devices

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Abstract: This study proposes a method to visualize utterance transition in a face-to-face group discussion using mobile devices. In a group discussion, it is difficult for an instructor to monitor many groups simultaneously, and there have been some preceding studies on finding methods to monitor learners. However, these methods require special equipment. To avoid this, we proposed to utilize the microphones in learners' existing mobile devices to acquire sound data. Our method does not require special equipment to acquire data, as the program to acquire data runs via the learner's web browser. We conducted a preliminary experiment to visualize utterance transition in a group discussion using our programs. The result indicated that we succeeded in visualizing utterance transition. The visualization diagram indicates participants' frequency of communication with each other.

Keywords: Group discussion, Learning analytics, Visualization, Utterance

1. Introduction

Group discussion is a way of introducing active learning to a class. In a group discussion activity for a class, it is difficult for an instructor to effectively monitor many groups simultaneously. To solve this problem, some preceding studies have investigated the use of different devices for monitoring learners. Among examples of using sound information, Zancanaro, Lepri, and Pianesi (2006) classified functional roles in a group by using close-talk microphones and a voice activity detector. Tomiyama, Nihei, Nakano, and Takase (2018) segmented group discussions by using a headset microphone and an inertial motion unit attached to the participants. In our previous work, we visualized utterance transition in a group discussion based on sound source angle using Kinect (Taguchi, Horikoshi, and Tamura, 2018).

In this study, we developed a program for acquiring voice information via the web browser in learners' mobile devices such as smartphones and tablet computers. The information gathered enabled us to identify speakers, utterance transitions, and length of each utterance in a group discussion. We acquired the sound data from learners' mobile devices without having to install any special software or apps on the devices, as the program runs through the learners' web browser. The study aimed to visualize utterance transition in a group discussion by using the program in a preliminary experiment with a group of three learner participants.

2. Method

2.1 Development

To achieve our objective, we developed a set of programs to perform the following functions. Function (i) is acquiring the data. Functions (ii-vi) involve processing the data to enable visualization of the utterance transition (Figure 1).

(i) Obtain the sound volume data from the microphones in mobile devices and send it to a server using Web Audio API with the learner ID (e.g. S1, S2, S3)
(ii) Download the volume data of each learner from the server
(iii) Merge the volume data from all learners mentioned in (ii)
(iv) Judge who was speaking by analyzing which learner data was transmitted at the loudest volume at each time point, and regard volumes lower than a specified level as silence (X)
(v) Detect change of speaker at each time point and create a table including the start and end time of an utterance, and the speaker/silence (X)
(vi) Regard a period longer than two seconds without any utterance as a silence and visualize utterance sequence and transition from the table created in the function (v)

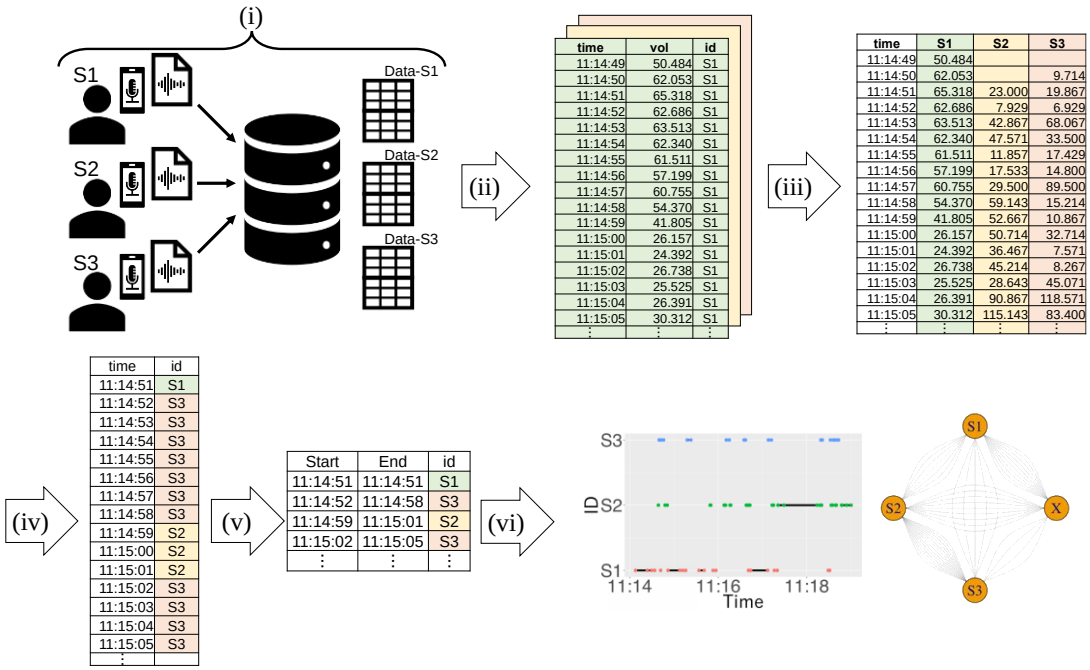

Figure 1. Data acquisition and visualization process

2.2 Preliminary Experiment

The preliminary experiment comprised three participants (a master's course student: abbreviated as M1 in figure 2 and 3, a doctoral course student: D1, and their professor: Pr.). They held a discussion for approximately fifteen minutes. The participants used the same tablet computers that the authors prepared for this experiment to avoid calibration of volume and make the experiment easier.

3. Results and Discussion

We visualized utterance sequence and transition in the first five minutes of the discussion. Figure 2 shows the utterance sequence. The horizontal axis shows the time and the vertical axis shows the participant ID (M1, D1, and Pr.). The results indicated that the utterance transition and sequence could be visualized using our system.

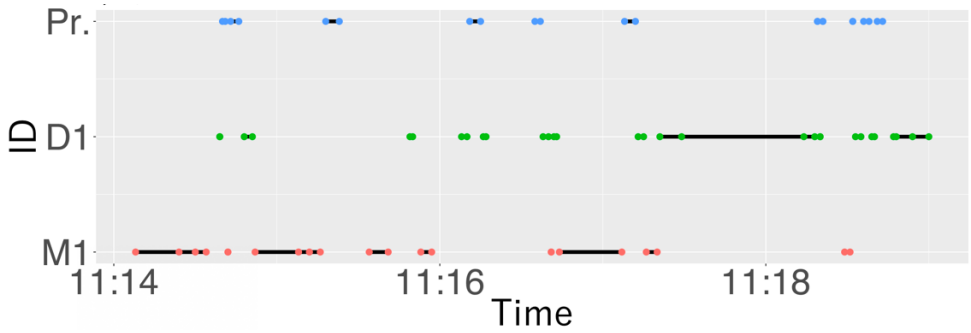

Figure 2. Utterance sequence

Figure 3 shows the utterance transition in the first 5 minutes of the discussion. For example, edges between M1 and D1 indicate that the participant M1 spoke before or after the participant D1. Note that X represents silence. In this figure, there are a relatively large number of edges between D1 and Pr. This indicates that there was a great deal of conversation between participant D1 and Pr. during the first 5 minutes. From the figure, we can identify the frequency of communication between participants.

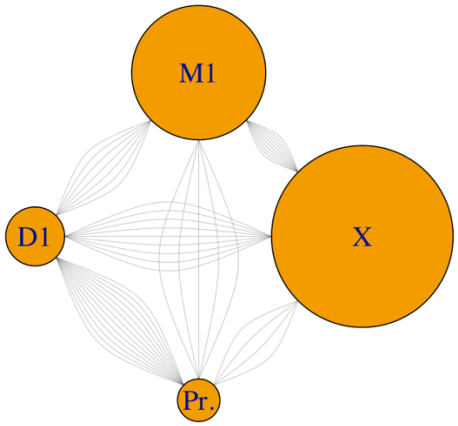

Figure 3. Utterance transition

4. Conclusion and Future Works

The purpose of this study was to visualize utterance transition in a group discussion by using our programs, which does not require special equipment to acquire data in a classroom. The results indicate that it is possible to visualize utterance transition in group discussions using mobile devices. In future work, we will verify the accuracy of the system by using video recorded during the preliminary experiment, improve the utterance detection algorithm, and conduct an experiment using learners' own devices.

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