Monitoring Students' Classroom Attention on Digital Platform

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Abstract. Most of the learning was shifted from traditional classes held physically to remote and online classes held virtually with the rise of COVID-19. Given the high degree of freedom and efficiency for the participants, online learning is expected to continue to grow post-pandemic. However, there is a noticeable difference between traditional teaching and online teaching. Though students' attention is always the key to keep the quality of learning, it is difficult even for experienced teachers to judge their attention when conducting online teaching. Teachers should always watch the online screen during the session, and also hard to utilize non-visual senses to assess the engagement. Therefore, we propose using a computer vision technique and develop a system that supports the teacher by gauging students' attention level. In this paper, we apply the technique to a Zoom class session and present preliminary results to demonstrate the feasibility of the proposed method.

Keywords: Online Class, Attention Level, Face Detection

1 Introduction

In online teaching, teachers need more efforts to recognize the states of their students that are sitting at home in front of computer. They must always observe numbers of students simultaneously on the screen during the session. With the traditional teaching, teachers could gauge students' attention by students' facial expressions, postures, and utilizing senses we all have. With online teaching, it requires considerable experience understanding the students' attention on limited information based on sound and visual. In addition, most educational institutions have limited online teaching experiences so far.

Although it is difficult for humans to assess students' attitude only over the screen, it is much easier for computers to assess when conducting online teaching. In addition, with the progress in computer vision technology, machines can enhance the teacher's task to conduct students' assessment. Researchers have developed various methods for recognizing facial expressions [1] and behaviors [2, 3] of students in the real classroom scene.

However, the scenes they have dealt with are only from traditional physical classes, but not from online classes. So, we need to develop such procedures that are specific

to online classes. We develop a method to support a teacher by gauging students' attention level. In this paper, we apply it to a Zoom class session and present preliminary results to demonstrate the feasibility of the proposed method.

2 Method

Assuming conducting an online teaching case, we build a system that monitors students' attention utilizing digital information via online meeting platform. Students are sitting in front of their web camera, and a teacher can see their faces on his computer screen. The system monitors students' face, and judges students' attention to be waning if their face often leaves the screen.

The procedure is as follows:

Step 1. Feed the picture from the camera into face detection function.

Step 2. If a face is detected, then show the result on the screen. Then, go back to step 1.

Step 3. If no face is detected, then calculate the ratio of times when a face was detected for a certain period time. If the number is less than a priori given threshold, then notify the warning on the screen. Then, go to step 1.

At step1, we use Viola-Jones method [4] based on Haar-Like features for face detection. We use OpenCV 4.7.0 and a file of haarcascade_frontalface_alt2.xml for training frontal face images [5].

At step 2, letting n be the current frame number of the image, we set

d_n = 1 if a face is detected by the system, and d_n = 0 otherwise.

At step 3, we calculate the following ratio r_n, that is the ratio of times when a face was detected in the last n_0 frames:

$$r_n = \frac{1}{n_0}\sum_{i=0}^{n_0-1} d_{n-i} \ .$$

Then, if

d_n = 1 and $r_n < r_\theta$ (r_θ : a priori given threshold),

the system displays a caution on the screen.

3 Experimental Results

In this section we demonstrate experimentally the performance of the proposed method. We have collected our dataset from our Zoom class sessions. The video sequences are recorded at 25 frame per second and each frame is 1280×720 pixels in size. Figure 1 shows an example of one frame, where 25 images are captured and laid out in 256×144 pixels each.

We set the parameters in this experiment as follows: n_0 =750, i.e. it takes 30 seconds to measure the ratio that a face is showing on the screen; and r_θ =0.6, i.e. if a face is not showing in more than 18 seconds out of 30 seconds, a student's attention is judged as being waning.

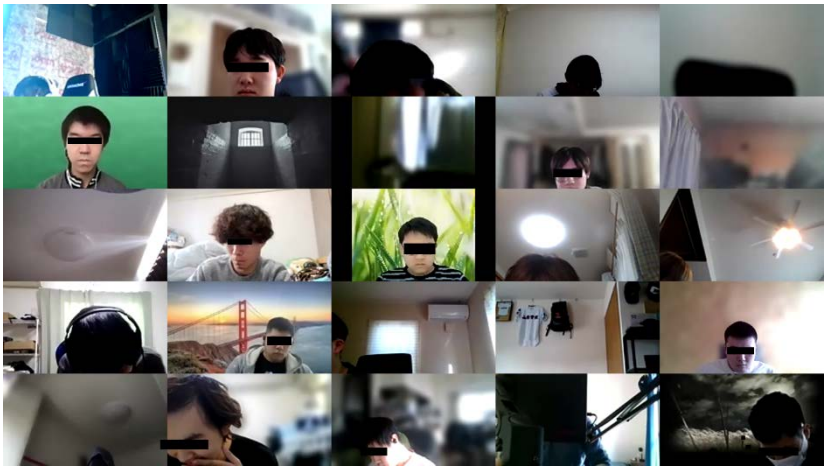

Fig. 1. Example of online class image

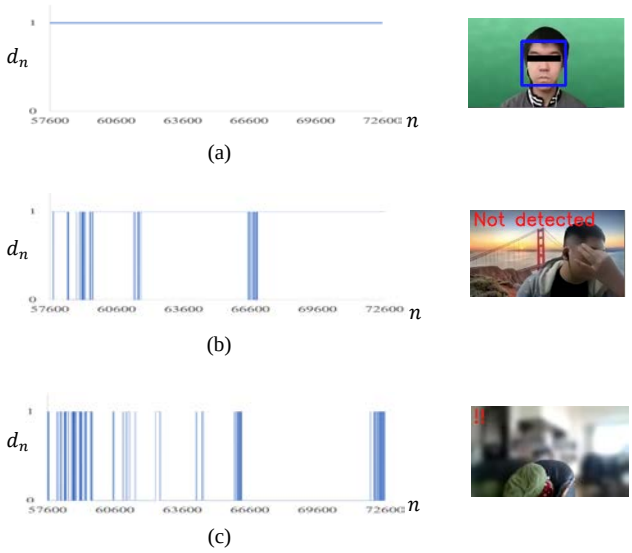

Fig. 2. Changes of students' attention

Figure 2 shows examples of the resulting responses from the face detection function. Three graphs on the left show whether or not a face is showing at frame n. Student of (a) was stable with little motion and his face was detected during that period. Student of (b) occasionally moved his head aside or covered his face, and then his face was not detected. Since student of (c) left his position, the system displayed a warning.

4 Conclusion and discussion

This research applies computer vision technology and builds an environment that supports online classes by realizing the function of recognizing students' attention. In this paper, we applied the proposed technique to a Zoom class session and presented preliminary results to demonstrate the feasibility of the proposed method.

There still remain several problems for the system to measure students' attention accurately. For example, when a student moves their head even for taking notes or solving quizzes, the system could judge their attention level was low. At present, the system cannot tell whether a person is taking a nap or not. To solve such problems, the system needs to recognize meaning of human motions. Those are left for future work.

Our ultimate goal is to enhance education utilizing new opportunities that was created by the accelerating shift to the online teaching, and we are hoping that there will be increasing support in this field.

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