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# Student Evaluation Model Based on Emotion Recognition through Classroom Monitoring

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**Abstract.** The improvement and perfection of higher education work relies on correct feedback from student evaluation of teaching, however, problems such as strong subjectivity and generalization of the indicator system are common in college student evaluation. Therefore, this article designs a student evaluation model based on emotion recognition through classroom monitoring. First, use classroom surveillance to collect class videos of teachers and students. After that the emotional information of teachers and students in class is captured through emotion recognition technology by calling Baidu AI Open Platform API and gesture recognition technology through improved you only watch once (YOWO) algorithm model, then entering into the database for statistics. Finally, statistical data is used to analyze teaching methods and teaching attitudes such as content mastery and enthusiasm, as well as learning effects such as student initiative and knowledge mastery, and multiple indicators of student evaluation are presented on a web page in the form of bar charts, pie charts, etc through plotting library. As a result, this model improves the objectivity and reliability of the evaluation results and provides data support for the quantification of the indicator system, which makes the evaluation results more intuitive and easy to understand.

**Keywords:** Student Evaluation; Emotion Recognition; Gesture Recognition.

## 1. Introduction

Teaching evaluation is an important link in higher education, which is an important means to improve teaching quality and promote the mutual development between teachers and students. In 2019, “Opinions of the Ministry of Education on Deepening the Reform of Undergraduate Education and Teaching to Comprehensively Improve the Quality of Talent Cultivation” issued by Ministry of Education stated the necessity of quality culture construction, and highlighted the dominant position of student evaluation in the College teaching quality evaluation system [1]. However, at present, most universities adopt online questionnaire forms for student evaluation, causing a series of problems such as abstract and vague evaluation content, strong subjectivity, and overly procedural evaluation process [2]. Therefore, optimizing the methods for student evaluation is of great significance for promoting teaching evaluation reform and improving the quality of higher education. A reference reconstructed student evaluation indicator system and established 6 first-level indicators and 20 second-level indicators including teaching attitudes, teaching content, teaching methods, course assessment, learning effects and open questions [3]. In the classroom, students’ learning emotions and postures provide an important basis for learning effects [4], and those of teachers also directly affect teaching attitudes and teaching methods [5]. So analyzing the facial expressions and postures of both teachers and students can provide objective data for student evaluation, thereby optimizing the teaching process and improving learning efficiency.

At present, class teaching evaluation methods based on artificial intelligence technology are mainly divided into three categories: one is based on emotion recognition technology [6, 7, 8]; one is based on gesture recognition technology [9, 10, 11, 12, 13], among which some references only analyze teaching behaviors [9], some only analyze learning behaviors [10, 11], and some consider both behaviors comprehensively [12, 13]; and the other is based on speech recognition technology [14]. The model designed in this article takes the limitations of these existing assessment methods into account, and combines emotion recognition technology and gesture recognition technology from the

perspectives of teachers and students. Collect videos of teachers and students in class through classroom monitoring, use face detection technology, and combine emotion recognition technology with gesture recognition technology to analyze the teaching and learning status of both teachers and students respectively, and finally use Web page development technology to display the evaluation results of learning effects as well as teaching attitudes and teaching methods. The evaluation results improve the objectivity and fairness of student evaluation.

## 2. Model Architecture

This model is divided into four modules: video processing, face detection, expression recognition, teaching evaluation feedback. The model architecture diagram is shown in Figure 1.

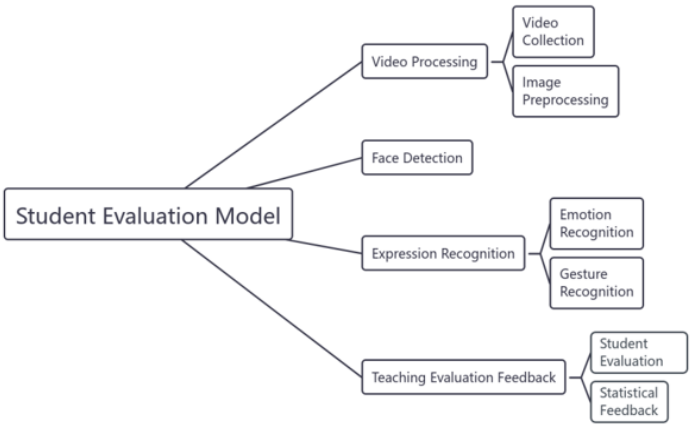


**Figure 1.** Model Architecture Division (Photo credited: Original)

As shown in Figure 1, the video processing module includes two sub-modules: video collection and image preprocessing; The expression recognition module includes emotion and gesture recognition sub-modules for both teachers and students; The teaching evaluation feedback module includes two sub-modules: student evaluation and statistical feedback. Among them, The student evaluation module is used to investigate three first-level indicators of teaching content, course assessment and open questions which cannot be fed back by the expression recognition module, and the statistical feedback module feeds back to the teachers the statistical students' listening status, teachers' teaching status information and the statistical results of the student evaluation module.

## 3. Related Technologies and Designs

Computer vision library of this model selects OpenCV, the database selects MySQL, the back-end language adopts Python development, the Web framework selects Flask, the front-end adopts html5+css3 technology, and the plotting library selects Chart.js. The main processes and technologies used are shown in Figure 2.

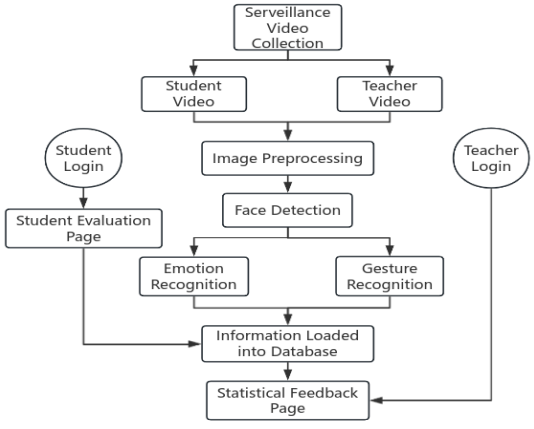


**Figure 2.** Model Flow Chart (Photo credited: Original)

As shown in Figure 2, image preprocessing is performed on student videos and teacher videos respectively. After detecting faces, emotion recognition and gesture recognition are performed, and the corresponding information is inserted into the database. Then use Python to get the data from the database and convert it to JSON format. Finally, use JSON. parse() function to parse the JSON data into JavaScript objects, and use Chart.js to create pie chart and line chart instances on the statistical feedback page. In addition, students need to log in to the student evaluation page at the end of the semester to conduct a questionnaire survey on the remaining first-level indicators such as teaching content, course assessment, and open questions, as well as the corresponding second-level indicators. Relevant data is sent to the server for processing by Python and stored in the database. The statistical results are also displayed on the statistical feedback page.

### 3.1. Video Capture and Image Preprocessing

This model uses universal cameras deployed in the front and rear of the classroom to collect videos of teachers and students in class, named teacher videos and student videos respectively, and then stored as local videos on the hard disk. The video stream is obtained with the help of OpenCV's video manipulation class. First call cv.VideoCapture() function to create a VideoCapture object, and read the video when the parameter is passed in the video file address. After that, loop to call the read() function of the VideoCapture class to read each frame of image.

Image preprocessing is to convert the collected images to grayscale by calling cvtColor() function. It aims to enhance image features that are important for subsequent processing like facial contours and features by reducing the amount of color information.

### 3.2. Face Detection

The surveillance cameras deployed in classrooms are far away from teachers and students, coupled with the uneven distribution of student seats, indoor lighting and other factors [6], face recognition has the problem of low-resolution face recognition (LR-FR). This model uses the LR-FR algorithm based on convolutional neural network (CNN) and common feature space (CFS) with TensorFlow as the framework in reference to improve the face detection resolution [15].Finally, all the data sets containing faces obtained through face detection are used for emotion recognition and gesture recognition.

### 3.3. Emotion Recognition

Baidu AI open platform can provide facial emotion recognition services, which can accurately identify facial emotions from different angles, postures, lighting, etc. The cloud servers and GPU servers it provides provide powerful computing power support for facial emotion recognition services, also supporting OpenCV and multiple development frameworks like TensorFlow. Baidu AI open platform doesn't require sample data set to train a deep learning network [7], which is convenient for developers to use this artificial intelligence service quickly [16].

This model first converts the images of the face data set into Base64 encoding. Then call Baidu AI's face detection API and add the emotion parameter for emotion recognition. Emotions are mainly divided into seven categories: anger, disgust, fear, happiness, sadness, surprise and no emotion. Finally, OpenCV's putText() function is called to mark the emotional information on the images[7].

### 3.4. Gesture Recognition

For the identification of students' class behaviors, this model uses an improved YOWO algorithm model proposed in reference to classify students' class behaviors into listening, reading, writing and no studying [12]. As for that of teachers' teaching behaviors, this model uses the 3D-convolutional neural network (3D-CNN) teacher behavior recognition model framework proposed in the reference to classify teachers' teaching behaviors into looking down at courseware, writing on the blackboard, interacting with students, and patrolling [13]. Generally speaking, the greater the proportion of

students' non-learning behavior is, the lower the students' enthusiasm is and then the learning effect is worse; The proportion of teachers looking down at courseware is much higher than the behavior of writing on the blackboard and interacting with students, indicating that teachers fail to use teaching tools appropriately and their teaching methods are poor.

### 3.5. Web Design

#### 3.5.1. Login Page

Login personnel enter their ID number and password, and choose student or teacher type to log in. If the logged-in person is a student, it will jump to the student evaluation page. Otherwise, it will jump to the statistical feedback page.

#### 3.5.2. Student Evaluation of Teaching Page

This teaching evaluation model is mainly to make the evaluation of the three first-level indicators of teaching attitudes, teaching methods and learning effects more objective. It cannot completely deny the validity of student evaluation in the form of online questionnaire.

#### 3.5.3. Statistical Feedback Page

This page is divided into three sections: student evaluation results, student class status, and teacher teaching status. Among them, the student class status section is divided into two sub-sections: student facial expressions and student posture expressions. And the teacher teaching status section is divided into two sub-sections: teacher facial expressions and teacher posture expressions. Teachers can log in to this page at any time to view the statistical results of each lesson presented in pie chart format, or that of the data trends so far presented in line chart format.

## 4. Discussion

In the existing intelligent teaching evaluation, Wang et al. designed a classroom teaching monitoring system, recognizing students' emotional information in class, which uses the image recursive cutting and OpenCV to increase the recall rate [6]; Song designed a system for monitoring students' learning emotions based on OpenCV and Baidu AI face recognition interface [7]. The results are presented in the form of charts to facilitate teachers' intuitive understanding; Sun et al. established the corresponding relationship between expression features and learning status [8]; Zheng used gesture recognition technology to score the collected teacher posture information by the fuzzy comprehensive evaluation method, but the teaching behaviors studied were limited to the traditional form of teaching in front of the blackboard [9]; Zhou et al. proposed a students' class behaviors recognition method based on deep learning to reflect learning status [10]; Xu et al. Proposed an improved YOWO algorithm to identify learning behaviors [11]; Guo et al. used 3D-CNN for teacher behavior recognition and used improved YOLO-v5 for student behavior recognition [12]; Zhang et al. used attention mechanism and intra-class differential representation earning module to improve the accuracy of class behavior identification between teachers and students [13]; Liang et al. construct a classification model for teacher speech emotion recognition in class based on RNN algorithm [14]. Teachers and students are the two essential subjects of class teaching activities, and the inspection of teachers and students is equally important for the evaluation of teaching attitudes, teaching methods and learning effects in the student evaluation index system, therefore, this article builds a two-dimensional student evaluation model between teachers and students. According to The Rule of Mehrahbian, body language information accounts for up to 55% of emotional expressions, in addition, facial expressions and postures are two significant components of body language. So, the model designed in this article used both emotion recognition technology and gesture recognition technology.

## 5. Conclusion

In this article, emotion recognition and gesture recognition are used as core technologies to improve student evaluation methods. By statistically analyzing the facial expressions and postures of teachers and students on class videos captured by surveillance cameras, the evaluation of the three first-level indicators of teaching attitudes, teaching methods and learning effects is more objective, also enhancing teachers' timeliness in improving teaching methods and adjusting teaching progress. However, this model also has certain limitations: it doesn't solve the problem of examining the teaching interaction indicator which have a high proportion of questions and communications between teachers and students. In addition, different courses and class formats result in differences in the proportions of teachers' and students' emotions and postures, but this model does not differentiate between them. Therefore, this model needs to improve in the near future. And then on the premise of ensuring privacy and security, class behavior videos of teachers and students need to be extensively collected and organized to train the relevant algorithm models used in this model to improve detection accuracy.

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