

# Research on Classroom Teaching Quality Evaluation Method Based on Machine Vision Analysis

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**Abstract:** Concentration is one of the key factors of human intelligent behaviour. Especially in recent years, our attention to learners has received extensive attention. Many evaluation methods are put forward for the evaluation of concentration, including questionnaire, physiological observation and computer vision. In the classroom of primary and secondary schools, students' concentration in class is an important factor that affects students' achievement and teaching effect, so it is a major concern of many parents. Firstly, the analytic hierarchy process is used to construct the evaluation index system, then the multi-population genetic algorithm is used to optimize the design of BP neural network, and finally the BP neural network is used to evaluate the teaching quality. In the traditional classroom environment, students' classroom participation research is mostly obtained through questionnaires designed after class. The lack of real-time learning monitoring and analysis in the classroom is far from meeting the needs of modern education development. Therefore, there is an urgent need for Research on an automatic learning state evaluation method that uses artificial intelligence technology to evaluate students' full and whole process, assist teachers to understand and master students' learning state, adopt targeted teaching methods, and improve students' personalized training level.

**Keywords:** Machine Vision; Classroom; Teaching Quality Evaluation

## 1. Introduction

The "new curriculum reform" has been carried out nationwide since September 2001[1]. The main content of the "new curriculum reform" is to require students to enhance their hands-on operation ability, autonomous learning ability and problem-solving ability in learning ability; In the way of learning, students are required to change from passive to active, and teachers are required to change from teaching to students' independent exploration. China's national conditions determine that the large class teaching method can not be effectively alleviated in the short term, resulting in that teachers can not obtain the real learning state of each student in real time, and can not achieve real targeted teaching and guidance. In the analysis of learning state, concentration is a very important factor and has an important impact on learners' learning effect. Only under the condition of concentration can students have good attention and learning efficiency [2]. If both the superficial consciousness and the subconscious mind can focus on one thing, that is, what we call full involvement, the learning efficiency is the highest at this time. Paying attention to students' concentration is one of the most important topics to study at present, and the premise of improving the concentration is to find a way to measure students' concentration level. To achieve this teaching effect, scientific and complete curriculum system design, continuous improvement of teaching methods, cultivation of excellent teachers and scientific and rigorous comprehensive evaluation of teaching quality and ability are essential aspects.

As a special educational resource, colleges and universities undertake heavy tasks such as discipline construction, scientific research, and development of science and technology industries, training of senior talents, academic exchanges, and serving the country's political, economic, and cultural construction. The high intelligence of the main body, the rapidity of the updating of labour methods, the lag of labour results, and the group nature of the labour process make the teaching profession in colleges and universities difficult, complex, creative, competitive and open[3]. Under the requirements of the "new curriculum reform", teachers need to better develop and utilize curriculum resources, greatly stimulate students' interest in learning, more reasonably arrange and plan each class, and correctly guide students to learn, so as to achieve the purpose of "effective teaching". Students are the main body of the classroom. Students' classroom concentration is an important factor for students to participate in learning and affect effective teaching. Use the video collected by the video monitoring

equipment for intelligent analysis, evaluate the teachers' classroom teaching quality through specific indicators, and intelligently evaluate the classroom teaching quality through the intelligent classroom quality evaluation model. The intelligent classroom quality evaluation can be used as an effective part of teaching evaluation. In this way, an all-round comprehensive teaching evaluation system can be established, which consists of experts' listening and evaluation, students' after-school evaluation and classroom intelligent scoring.

## 2. Intelligent Classroom Quality Evaluation Model

### 2.1. Multi-Target Face Detection Technology

The research of face detection originated in the 1970s. The main research directions of early face detection were deformable template matching, subspace method and template matching [4]. The first method of face detection is based on template detection. The determination of a person's face template is the primary task of face detection, and then calculate the correlation between the image to be detected and the face template, that is, their matching degree, so as to judge whether there is a face in the image. In the study of students' attention, we can not only simply analyze the relevant information of head pose estimation, but also combine the detailed coordinates of the observer relative to the centre of the blackboard, that is, the origin, in order to obtain an objective and comprehensive attention range, so as to lay a foundation for students' attention analysis. Another simple and easy-to-implement method is to use the gray image of the human face as a template, then transform the image to be detected into a gray image, and finally detect the correlation between the two gray images, and judge whether there is a human face in the image to be detected according to the correlation threshold. In the test, the critical value of the minimum resolution of face images in face detection is  $30 \times 30$ . Images smaller than  $30 \times 30$  can't be used as materials for multi-target detection and recognition because they can't distinguish facial features and facial expression features. If you encounter a frame with too little face resolution, you will skip directly and perform the same operation on the next frame. Fig. 1 is a block diagram of a face recognition system.

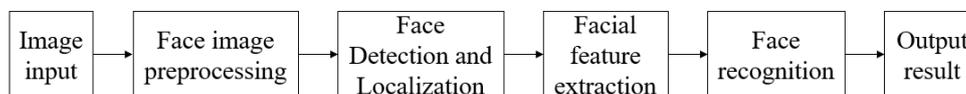


Figure 1: Block diagram of face recognition system

### 2.2. Selection of Evaluation Metrics

Choosing reasonable classroom evaluation indicators is the key to evaluate classroom quality. In the process of evaluation, it mainly focuses on the detection and evaluation of students' and teachers' behaviours. Classroom attendance rate is a very basic but extremely important index to evaluate the quality of classroom teaching [5]. Higher attendance rate is the premise and key factor for whether a class teaching can be effectively carried out. Statistics of the front-row seating rate in the classroom can reflect students' liking for the courses they have learned and teachers' teaching ability to impart knowledge. Interaction mainly refers to a series of activities that people, people and groups or groups interact with each other through various behaviour patterns. When students listen carefully, their attention observation points are mainly distributed on the teaching blackboard and the teacher. In this case, their head is characterized by an upward, forward or following the teacher's head posture. The rotation angles of two degrees of freedom of head horizontal rotation and vertical rotation are used to determine the students' attention distribution area during listening. It directly reflects the students' listening state and plays a positive role in the evaluation and judgment of teaching quality. The evaluation index system of teaching quality in Colleges and universities is divided into three levels. The top layer is the teaching quality evaluation index system; the middle layer consists of four factors: teaching content, teaching method, teaching attitude and teaching effect; the lowest layer is 11 secondary indicators affecting the middle layer. The four factors in the middle layer are subordinate to the top layer and dominate the 11 factors in the lower layer [6]. The general flow of analytic hierarchy process is shown in Figure 2.

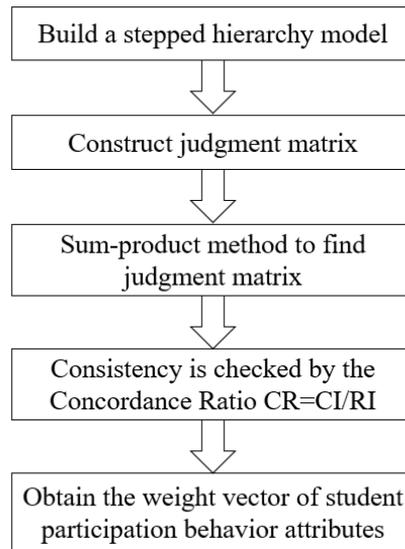


Figure 2: Flow chart of analytic hierarchy process

### 2.3. Design of Evaluation Model

The full score of the evaluation system is 100, and the number of students in the class is basically in the range of 20-50. The following four indexes are discussed separately. Contemporary college students pay more attention to the evaluation results of knowledge while ignoring its understanding and application [7]. They lack initiative, enthusiasm and enthusiasm in learning. At the same time, domestic scholars have also begun to study the learning state. Attendance rate is 100% when all students are here. At this time, it is the best standard, and set 25 points. The front row seating rate is the best when the front row is full, and the seating rate is 100%, which is set at 25 points. The score of teacher interaction rate is 15 points, which is evaluated according to the measurement data of teachers' teaching, writing on the blackboard, asking questions and walking around. Class concentration introduces two sub indicators: head up rate and abnormal behaviour, and the total score is 35 points. After establishing the hierarchical structure model, we can clearly see that the factors between indicators affect each other and have different importance [8]. Through repeated comparison, different values are used to explain different degrees of importance, so as to obtain the corresponding weight proportion coefficient. The importance evaluation is based on the five grades of "extremely important", "very important", "important", "a little important" and "unimportant", which evaluates the attendance rate, front row seating rate, teacher interaction rate and classroom concentration respectively, and gives weight again according to the evaluation results. As shown in Figure 3, the whole process of judging students' class concentration is introduced in detail.

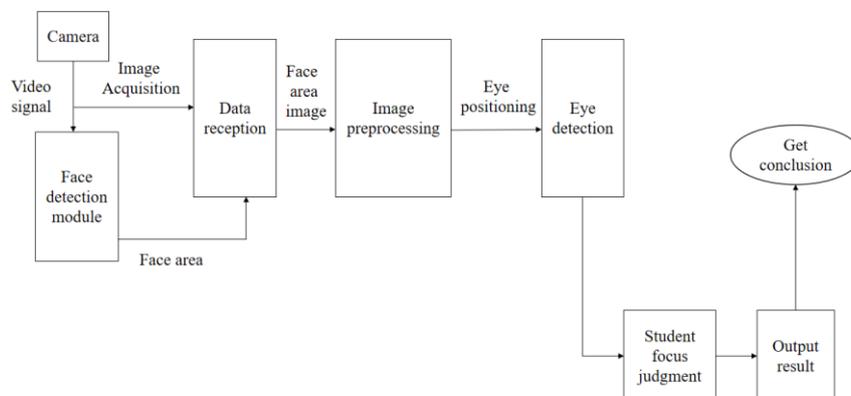


Figure 3: Flowchart for realizing focus judgment

### 3. Algorithm Realization of Judging Students' Concentration in Class Based on Machine Vision

We can approximately regard the human eye as an ellipse and the eyeball as a circular object in the ellipse. Among them, the eye is the core of observing external things, so how much the eye sees determines how much the human eye observes. In other words, the opening degree of the eye is closely related to the observed eye area. The more focused people are, the larger the eye area is. Among the most biological features studied at present, facial expression feature is considered to be the least invasive technology in visual monitoring environment. However, in terms of facial feature statistics, there are relatively few studies on the changes of facial expression. Detecting changes in students' facial expressions is crucial to the study of class concentration in this paper. The most intuitive emotional expressions of students in the classroom are the related changes of eye muscles, facial muscles and mouth muscles. Any slight changes in these expressions can reflect students' inner emotions and emotions. Human eye recognition is a further upgrade of the face detection technology [9]. On the basis of the successful recognition of the face area, the correlation detection of the facial features of the face is carried out, and finally the position of the human eye is accurately located, so as to realize the human eye detection and detection. Identify.

After the whole search space is divided into  $ns$  subclasses by grid based equal density clustering, the densities among the subclasses are different. It can be approximately considered that the number of grids  $V_i (i = 1, 2, \dots, n_s)$  occupied by subclass I is the volume of this class, and the number of grids occupied by each sampling point in this class is:

$$v_i = V_i / |S_i|, i = 1, 2, \dots, ns \quad (1)$$

Let the fitness probability density of the whole sampling set be  $f(x)$  and the fitness probability density of each subclass of  $ns$  be  $f_i(x), (i = 1, 2, \dots, n_s)$  respectively, then  $f(x)$  is actually the

weighted average of  $f_i(x)$  and the weight  $w_i = v_i / \sum_{i=1}^{ns} v_i$  of each item, and then:

$$f(x) = \sum_{i=1}^{ns} w_i f_i(x) \quad (2)$$

Calculate the normalized factor:

$$Z = 2 \sum_j \sqrt{w_{+1}^j w_{-1}^j} \quad (3)$$

Calculate the product of the weighted sums of positive and negative samples on each subspace, and then add the sum.

Select the weak classifier  $h(x)$  that minimizes  $Z$  as the weak classifier selected in this round of iteration:

$$Z_t = \min Z \quad (4)$$

$$h_t = \arg \min Z \quad (5)$$

Students' classroom concentration refers to an internal and external behavioral feature that students focus their attention on classroom learning tasks. Students' external behaviors are inherently complex and uncertain, and even the same behaviors may represent different intents of concentration, which brings great difficulties to the judgment and quantitative research of classroom concentration. In probability, the more data, the greater the probability of occurrence, and then most students in the class look up to indicate that the probability of looking up is high, and vice versa. Classroom can adopt pan-tilt control mode, and use mini intelligent high-speed ball camera to meet the requirements of multiple optical zoom, electronic zoom and automatic aperture. According to the classification of the body posture characteristics of middle school students in the classroom, the six characteristic movements are raising hands, lying down, supporting cheeks, lowering head, playing, writing and sitting. The obtained two-dimensional coordinate information of joint points is taken as the original data, and the spatial coordinates of each joint point are independent of each other. These joint point coordinate data are used

to construct the global features of human body in a single frame picture, and then classified according to the collected body actions. In the research, we set the behavior intention of most people as focus intention. If most people look up, they look up as focus [10].

According to the disadvantages of students' concentration in class, this paper puts forward a new algorithm to judge students' concentration, which can detect students' concentration in class more comprehensively, accurately and timely. It changed the traditional way of teachers visually identifying students' concentration in class, saved the teaching time of teachers, and timely fed back the concentration of students to parents. Head pose estimation based on geometric features of face usually needs high image resolution. This algorithm uses many feature points of facial expressions to form a feature model, and calculates the difference between one pose and another pose to speculate the head pose. According to the analysis results of AHP, a scoring table of college teaching quality is formulated. Teaching experts, relevant teachers, teachers attending lectures and students in class are asked to rate the teachers in class, and then the evaluation samples with more consistent scores are selected as cases. Three algorithms are used to judge the concentration of students in class, namely, the algorithm for judging the concentration of students' side faces, the algorithm for judging the concentration of students' low (up) head, and the algorithm for judging the concentration of students by the degree of eye opening and closing. These three algorithms can more accurately determine the concentration of students in class in real time. At the same time, the system plays an important role in improving the quality of teachers' class and parents' real-time understanding of their children's concentration in class.

#### 4. Conclusion

If students lack concentration, they may not be able to do what they want to do. The reason why it has such an impact on learning efficiency is usually due to two factors. First, when students concentrate on one thing, they can make their superficial consciousness work at full power. Second, it can make students' subconscious mind enter a state of focusing on one thing. While thinking about this matter, if their thoughts are interrupted by other things, that is to say, the surface consciousness does not think about this matter for a certain period of time, but the subconscious level still maintains this thinking inertia. In this paper, aiming at the problem that traditional classroom quality evaluation is subjective and lacks long-term universal significance, an intelligent classroom quality evaluation system model is designed by extracting and analyzing diversified information of students' learning status and behaviours in the classroom. Compared with the traditional single evaluation method, the evaluation accuracy is higher. The classroom is situational and changeable. Excellent teachers can well regulate the classroom rhythm, mobilize students' enthusiasm in class and attract students' attention and interest. At the same time, through the analysis of students' classroom concentration, teachers can feed back to students' parents, which can be combined with students' parents' family education, find and find some students' problems, and then give targeted counselling. To sum up, cultivating students' concentration is an important direction worthy of attention and research.

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