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Research Article

Intelligent Classroom Teaching Assessment System Based on Deep Learning Model Face Recognition Technology

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AI + education technology has had a wide and far-reaching impact on the education industry, which has been applied to classroom teaching in order to achieve real-time monitoring of the classroom and complete closed-loop feedback on teaching. In this paper, AI face recognition based on deep learning is improved and optimized through key points such as image data acquisition, localization, calibration, comparison, and deepening data models, so that the detection can be completed accurately and quickly even under the condition of light and external object interference, maximizing the accuracy and efficiency of face recognition technology under the influence of the objective environment. The traditional manual operation in classroom teaching is automated and intelligent throughout, reducing the workload of teachers and related personnel while further ensuring the scientific organization and management of classroom teaching. While making classroom teaching and learning life safer, more convenient, and more efficient, it also provides a favourable reference for the wide application and development of facial recognition technology.

1. Introduction

In traditional classroom teaching and management, the need for identification and input of students' identities can be seen everywhere, including precourse attendance, pre-examination identification, and registration at the school gates and dormitory access. In the teaching and learning environment, the current use of traditional manual processes is still more than adequate, given the large number of students. This not only creates a huge additional workload for teachers and related staff but also brings certain disruptions to the orderly implementation of normal teaching and administration, such as classroom teaching not being carried out on time, chaotic examinations, and backlogs of queues in and out [1]. For this reason, the introduction of intelligent identification technology is particularly important.

Identity recognition, from the early days of simple words and numbers, to readable ID cards, to later fingerprints, and the current widely used face recognition, has improved a lot in terms of identification speed, correct rate, and wide range of applications, bringing a lot of convenience to our work and life [2]. This paper realizes the artificial intelligence face recognition technology, combines it with the actual teaching and management work, and realizes the overall teaching automation and intelligence through the improvement of machine learning algorithm. At the same time, it reduces the workload of teachers and relevant personnel and ensures the orderly progress of classroom teaching [3].

At present, there are various ways of classroom sign-in in universities, among which are classroom roll-call, card-punching roll-call, and fingerprint recognition sign-in, but there are different problems with these ways. Classroom roll-call is inefficient and there is the phenomenon of substituting for signing in, which takes up a lot of classroom time; attendance machine punched roll-call only recognizes cards but not people, which will have the phenomenon of substituting for punching in; fingerprint recognition attendance, due to dry skin, physiological peeling, broken fingerprints, fake fingerprints, and other reasons, cause many people to fail fingerprint verification and fake fingerprints to form false attendance [4]. Face attendance uses human biometric technology, which not only has the characteristics of unique markings but it is also easy to manage, easy to count, has a certain guarantee of accuracy, real time and operability, and has significant advantages over traditional attendance methods [5]. The face recognition sign-in system designed in this paper, a system for attendance sign-in by means of face recognition, solves the shortcomings of the above attendance methods, achieves efficient and fast classroom sign-in work, reduces the waste of classroom time, and improves students' attendance rate.

Current AI + education technology is mainly used in school management and on the independent teacher or student side, but there is a lack of integration between the teacher side and the student side. The traditional teaching model places too much emphasis on the role of the teacher, who often plays the role of "soloist" in the classroom, making it difficult for students to grasp the knowledge and apply it when they are just listening to [6]. It is also difficult for the teacher to identify where there are problems with students' understanding and to understand where they are going wrong in the class. The time available in the classroom is very limited, but at the same time very valuable, and the teacher is not able to take into account every student in the classroom while teaching the knowledge points, nor are the students in a position to give all their questions to the teacher in class, nor can the teacher be present at all times to help the students [7].

2. Mainstream Recognition Technologies and Comparisons

The widely used identification reading technologies, according to their form of existence and core technology principles, are mainly of the following types.

Magnetic stripe cards were widely used in the early days of bank cards, meal cards, and other scenarios. They were made using a ferrous oxide material that was tightly adhered to a nonmagnetic medium by a resin laminating agent, arranged in magnetic channels, and written and read by a special read/write device, and the magnetic head, using coil currents to write and read data to the magnetic channels. Later on, with the development of the most used noncontact magnetic cards, the core principle is similar. The magnetic stripe is easily worn and susceptible to interference from the surrounding magnetic field, or even demagnetization, resulting in unreadable situations [8].

The IC chip is composed of transistors, capacitors, resistors, and other microelectronic components, which resonate in the microcircuit through electromagnetic waves to form a capacitive memory for storage purposes, with irreversible data writing and safe and stable performance. The datum is written irreversibly and the performance is safe and stable. However, as the number of uses increases, the chip circuitry will wear out and cannot be bent when stored, so its service life is limited [9].

Fingerprint press recognition uses sensors to capture fingerprint information and convert the data to match the similarity with the fingerprint information preset in the inventory to confirm the screening information [10]. It is more convenient and secure than the traditional contact and noncontact magnetic identification described above and is now being widely used in everyday devices such as mobile phones, door locks, and punch cards. However, it requires a high degree of fingerprint integrity and is inefficient for those with weak fingerprints or abrasive skin.

With the continuous development of artificial intelligence (AI), the development and application of recognition technology have also been further enhanced. While bringing convenience, security issues such as the validity and uniqueness of the real identity of the identified person have repeatedly emerged, as shown in Figure 1.

The key feature points of the five human senses, transformed to matrix point information to calculate and eventually compared with inventory data to screen uniqueness, are also the most cutting-edge identification methods in recognition applications, which are safe, reliable, and fast. However, there are objective conditions that can also affect the speed and accuracy of recognition, such as light and darkness, pupils, and contact lenses [11].

It is not difficult to find that face (facial neural) recognition algorithms based on artificial intelligence (AI) have great advantages in terms of security, speed, and anti-interference, and face swipe payment, face swipe unlock, and face swipe punch cards, and can be said to be ubiquitous and have been widely used.

This research will build on the core algorithm of facial recognition by optimizing the target detection algorithm and deepening the numerical model, so that detection can be done accurately and quickly even in the case of light and external object interference, and also with the help of cloud data management, thus realizing the full intelligence and automation of teaching and classroom teaching life management.

3. System Design Solutions

3.1. Demand Analysis. The purpose of developing a face recognition smart classroom check-in system is to provide a platform for students, teachers, and administrators to check-in to classes, take leave, select classes, and manage various piece of information [12]. Therefore, the most basic functions of the face recognition smart classroom sign-in system are, firstly, the ability to add, modify, and delete information about students, teachers, courses, classes, and grades, and most importantly, face recognition sign-in, and finally, some extended functions such as student leave, student class selection, grade analysis, and import and export of transcripts. Only users with an account can log in to the system and perform related operations. The functional modules of the system are shown in Figure 2, and the data flow of the system is shown in Figure 3.

3.2. System Design. According to the needs and functional requirements, this paper divides the system modules into three main parts: administrator side, student side, and teacher side, and nine functional modules such as students,

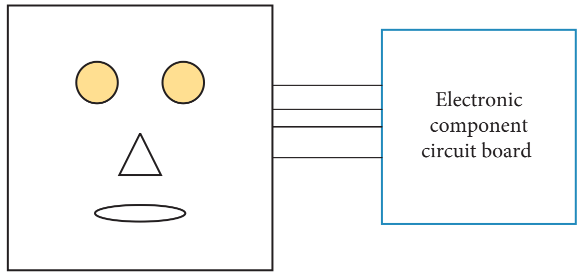

Figure 1: Facial recognition diagram.

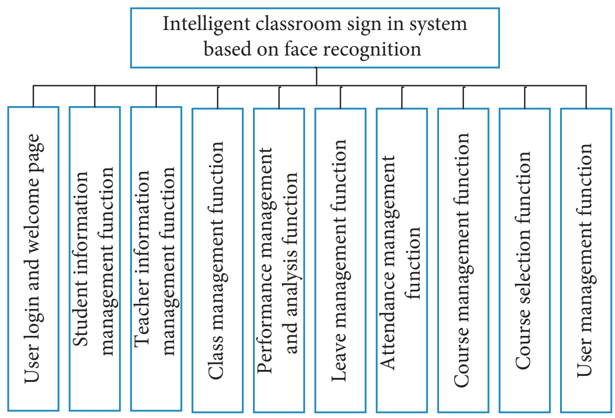

Figure 2: Functional structure of the smart classroom check-in system.

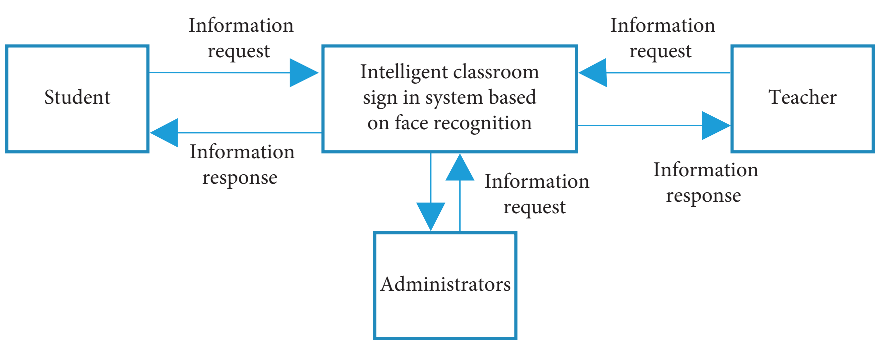

Figure 3: Smart classroom check-in system data flow.

teachers, administrators, classes, courses, attendance, leave, course selection, grade information management, and system management, as shown in Figure 4.

In an overall analysis of the system, it is the attendance information management module on the student side that is the core and focus. This module has a complex functionality, containing the display of attendance lists, face recognition sign-in, and search and query functions [13]. When students enter the attendance information management interface and click on the Add attendance information button, they will jump to the interface of adding attendance information. The system calls the camera, students click on the photo button, and then click on the confirm button. Then, the system will compare the photo obtained from the photo with the photo in the face library. If the similarity ratio between the two photos is greater than 90%, the recognition will be successful and the system page will jump to the interface of selecting attendance information. Then, the students will select the corresponding course name and click on the confirmation button to add attendance information and complete the face recognition sign-in [14].

4. The Core Technology Principle of Facial Recognition

Facial recognition technology is a technology that uses facial feature information data for identity screening. Through image capture equipment, a graphic containing a person's face is intercepted, identified, and positioned and compared to determine whether it is the same person. Due to its security, stability, reliability, and speed, it is being widely used in various fields such as finance, security surveillance, and mobile devices. The core framework flow [15], from the

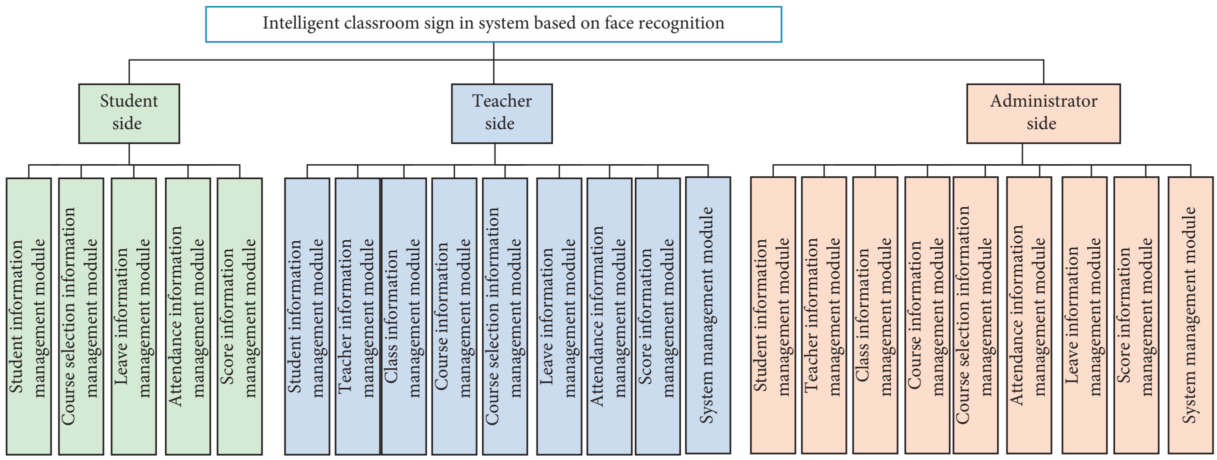

FIGURE 4: Detailed functional module structure of each end of the smart classroom check-in system.

input of the image collection to the output of the comparison results, is shown in Figure 5.

4.1. Facial Testing. Face detection is part of the pre-processing phase of the overall recognition step, i.e., the accurate acquisition of the position and size of the face of the already captured image. Because face images are rich in features, from colour and structure to stencil features, mainstream detection methods, like AdaBoost (adaptive augmented learning) [16] are used to extract this highly characteristic key data information from the image data for fast detection purposes, as shown in Figure 6.

4.2. Facial Positioning. The initial face screening is achieved by fast detection, and the image data with facial features are screened out from the ponderous data and intercepted and cached. The next step is to accurately locate each face data in the cache and obtain key feature point data, so as to prepare for the subsequent value operation and result comparison between each feature vector point [17]. The key feature point data mainly includes both eyes, the tip of the nose, and the corners of the mouth, as shown in Figure 7.

4.3. Facial Data Calibration. Although the key feature data obtained by positioning can accurately obtain the information of the image unit where the face is located, due to some objective reasons, such as the angle of the photo, light, and darkness, the collected key feature data will eventually be incomplete and will directly affect the final comparison result. Therefore, key localised data need to be calibrated or complemented twice to match with the target library data under the same comparison criteria, so as to improve the correct recognition rate [18].

For the problem of missing data caused by light, calibration can be achieved by establishing a mediated connection between the two and adjusting the grayscale distribution by assuming that pr is the original image

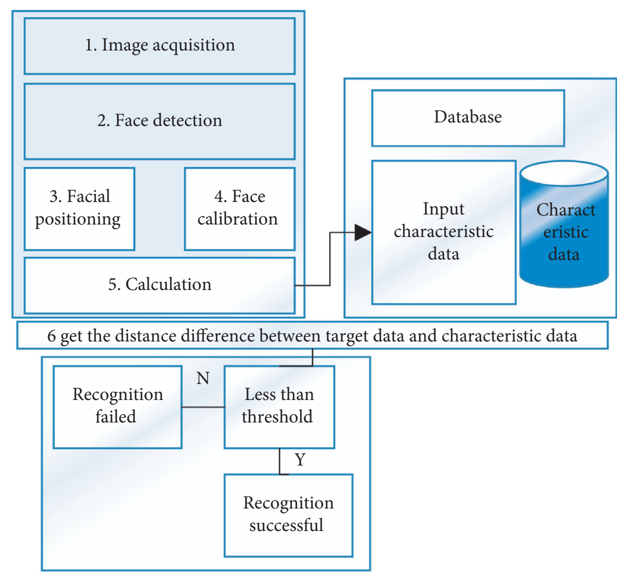

FIGURE 5: Flow chart of the core framework.

grayscale density function and pc is the desired adjusted grayscale density function, as shown in Figures 8 and 9.

The problem of the angle of the portrait obtained by the detection is most common, as the lack of uniformity in the comparison measurement will bring additional overhead to the later comparison calculation, affecting the rate as well as the accuracy to some extent [19]. Therefore, the key feature point data obtained is usually used to perform a matrix transformation operation using the feature point data matrix metric, as in the following equation:

$$\begin{bmatrix} \cos\alpha & -\sin\alpha & a - a*\cos\alpha + b*\sin\alpha \\ \sin\alpha & \cos\alpha & b - a*\sin\alpha - b*\cos\alpha \\ 0 & 0 & 1 \end{bmatrix}. \quad (1)$$

Uniformity of face angle is achieved, as shown in Figure 10.

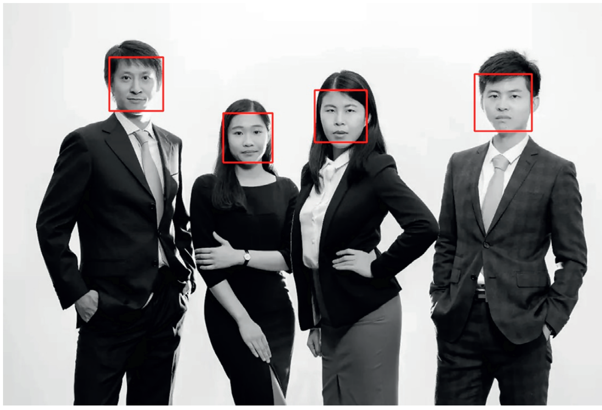

Figure 6: Facial inspection chart.

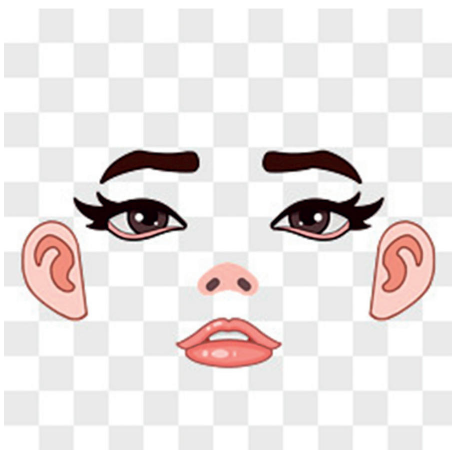

Figure 7: Facial positioning diagram.

4.4. Matrix Calculation of Feature Data and Comparison of Results. After a series of pretype processing such as acquisition, positioning, and calibration of the above image, the key feature data information on the final calibrated image can then be extracted by calculating the key feature points using Euclidean distance as in the below equation:

$$d(\alpha,\beta) = \sqrt{(\alpha_1-\beta_1)^2+(\alpha_2-\beta_2)^2+\ldots+(\alpha_n-\beta_n)^2} = \sqrt{\sum_{i=1}^{n}(\alpha_i-\beta_i)^2}. \quad (2)$$

The Euclidean distance is obtained and compared with the threshold value of the standard library model data. If it is less than the threshold value, the detection is successful, and if it is greater than the threshold value, the detection is not of the same person.

5. Acquisition Recognition Algorithm Improvement with Deep Learning Models

After a series of steps such as acquisition, detection, positioning, calibration, and calculation of comparisons, the test results are produced. Finally, test result data are selectively calibrated so that the data standards are consistent with those of the standard library, thus ensuring the validity of the final results. Throughout the process, the picture data is efficiently collected, and in this study, the acquisition, calculation, and model data will be optimized and improved to make the whole process more efficient and accurate [20–22].

5.1. Optimization of Collection Methods. The image acquisition of recognition systems is to some extent fundamentally different from the image acquisition of photography or photography used in life, where images tend to be more high definition and effectual, whereas the images used for recognition only need to ensure the integrity of key information [22]. Therefore, after the image acquisition is generated, a fast computational model can be used to locate faces with problematic angles and quickly evolve other missing or blurred partial feature data in the case of integrity by calculating the local feature data that shows integrity for the purpose of fast calibration.

When actually capturing image data, apart from light, the angle problem is most prominent and varies with the pose of the person being captured, so more often than not the angle of perspective will lead to incomplete images, hence the need for a large number of matrix translation operations later on to achieve recovery. By calculating the relative distances of locally complete feature points, other incompletenesses can be quickly evolved, making the collected data complete and solving the complexity of comparison operations [23].

5.2. Deepening of Model Data. In traditional model databases, the key features of each person to be compared are stored, and the comparison is carried out in real time by sequentially searching and performing Euclidean distance operations on the database and then comparing the results. This approach is extremely inefficient in terms of finding and computing speed and ultimately results in slow recognition and poor concurrency.

For this reason, a machine adaptive learning algorithm can be used to automatically calculate and save the relative relationship values and predetermined Euclidean distances between key data points after they have been entered, and to sort them by the index [24–26]. The initial filtering by relative relationship and Euclidean preset values can reduce more computational redundancy when performing search comparisons [27].

6. Face Recognition System in Classroom Teaching

With the development and progress of classroom teaching and learning and life becoming more and more enriched, the school gate, hostel access control system, supermarket cashier system, canteen checkout system, examination management system, check-in system, and other intelligent terminals have emerged, bringing convenience but also bringing the following problems.

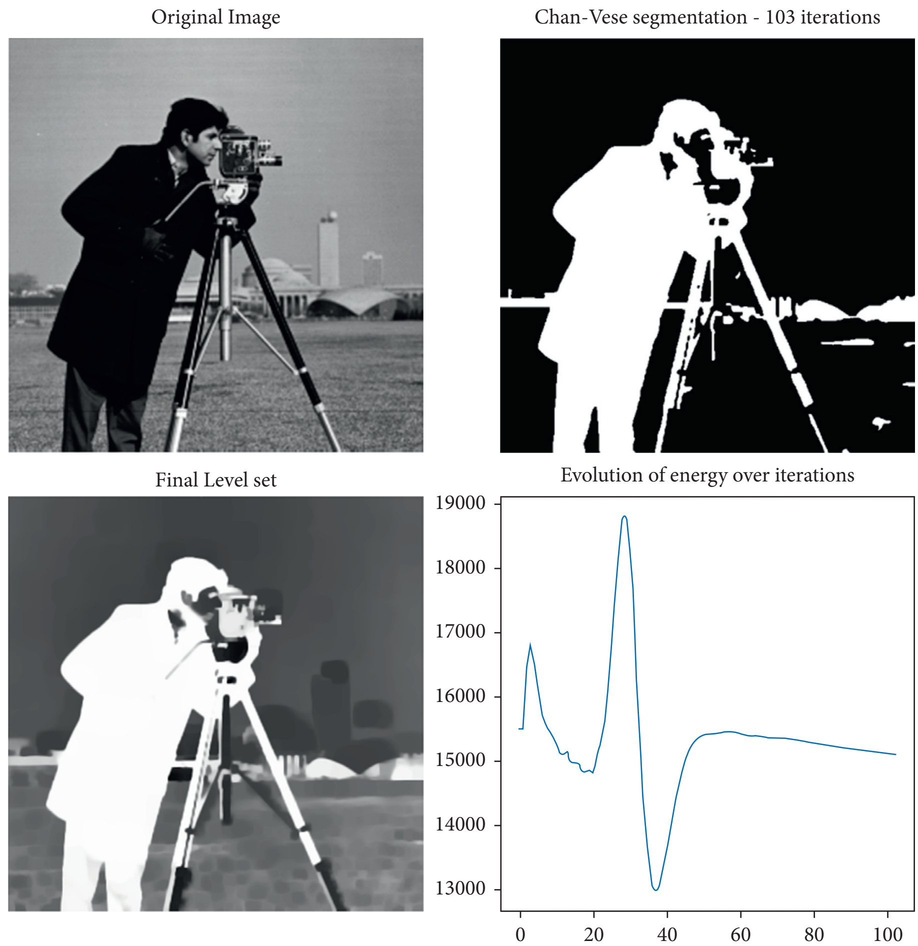

Figure 8: Image and histogram before adjustment.

6.1. Low System Throughput Rate. In the classroom, there are many systems in use at the same time, and the long queues can be seen everywhere. For example, in scenarios such as signing in before class, dining, entering and leaving the dormitory, and shopping in supermarkets, manual cooperation is often required and the system throughput rate is extremely low, causing a lot of inconvenience to the work and life of teachers and students. The effect of different face recognition segments is shown in Figure 11, which shows that as the number of iterations increases, face recognition becomes more effective.

6.2. Inefficient Integrated System Management. Due to the lack of uniformity in the management of the increasing number of systems, most school systems are independent of each other, often requiring the information management department to set up different posts for targeted management according to the system and then finally by a dedicated person to do data collection and collation, which not only consumes manpower but also lacks an intelligent centralised data circulation support system, which brings about a considerable obstacle to the construction and development of intelligent classroom teaching in the future. As shown in Figure 12, the face classification is made clearer by the rub colour effect.

6.3. Safety Hazards. At present, classroom systems are usually identified using the traditional physical card format, which often results in one person having multiple cards, or even multiple people using the same card. Moreover, the physical card is easily damaged and lost, and there are serious problems in terms of security, vulnerability, and the real name system of the user, which brings a lot of hidden dangers to the personal information protection and property security of teachers and students, as well as the security management of classroom teaching [28].

Compared with traditional physical cards, AI face recognition technology has the characteristics of fast reading efficiency, high-security stability, and uniqueness, etc. Using it as a unified identification and screening portal for classroom teaching and life systems will fundamentally solve the efficiency and security problems, and the error of the classroom teaching face recognition system is shown in Figure 13.

AI face recognition technology does not require manual cooperation, just the face of the scanner, and will be completed in milliseconds to verify the reading, making both high-speed and convenient and accurate [29]. With the introduction of AI face recognition technology, teachers and students will no longer have to worry about the management of damaged and lost cards. Especially in the feature of real

FIGURE 9: Adjusted image and histogram.

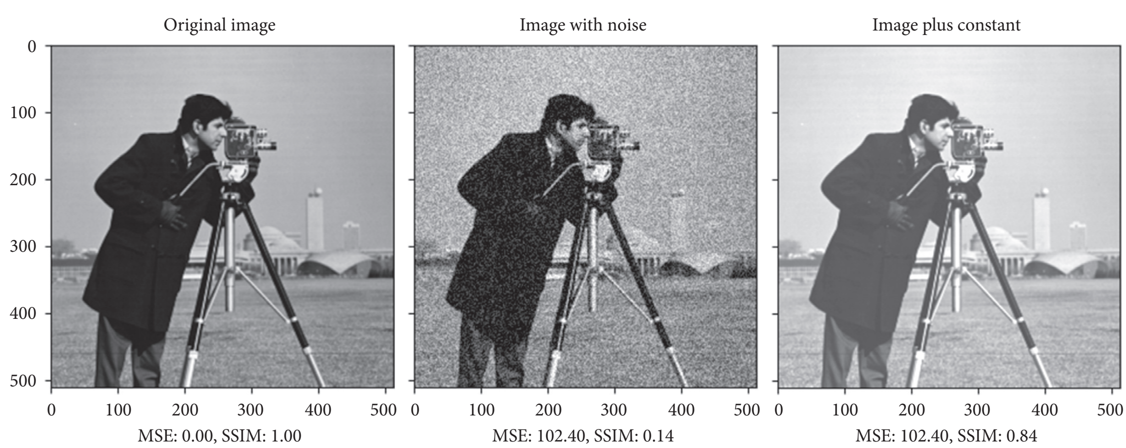

FIGURE 10: Effect of matrix transformation.

name uniqueness, it can be said to play a decisive role in the security management of the classroom teaching access control system, bringing revolutionary help to school security management [30].

Model AUC for different parameters is shown in Figure 14, and the unique reliability of face identification allows for one-to-one correspondence with all terminal system data for classroom teaching and realisation of true cloud centricity of classroom teaching data, making it possible to correlate data between multiple systems, bringing convenience, and at the same time data support and reference for the construction of intelligent modern classroom teaching. This can lead to communication problems between the two sides of the school-family education equation. Parents may

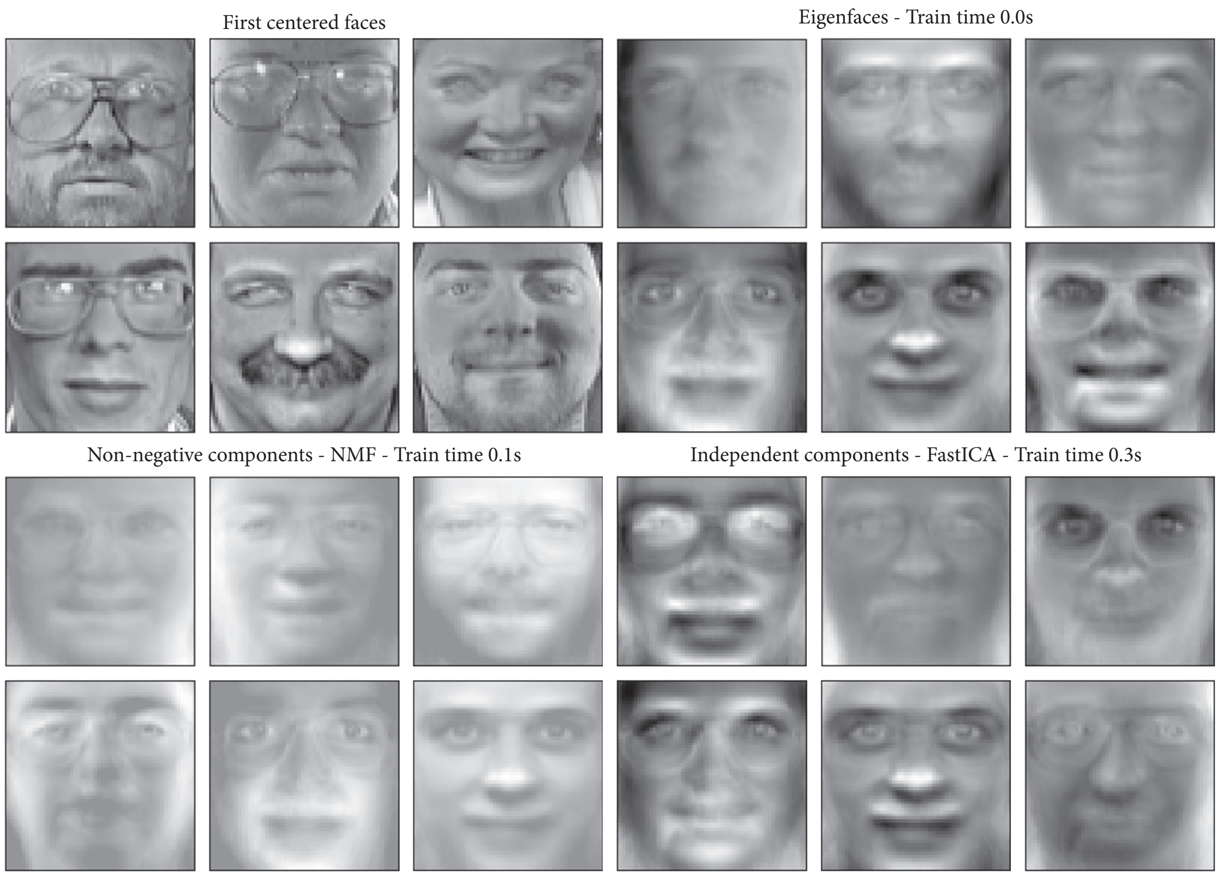

Figure 11: Different face recognition segmentation effects.

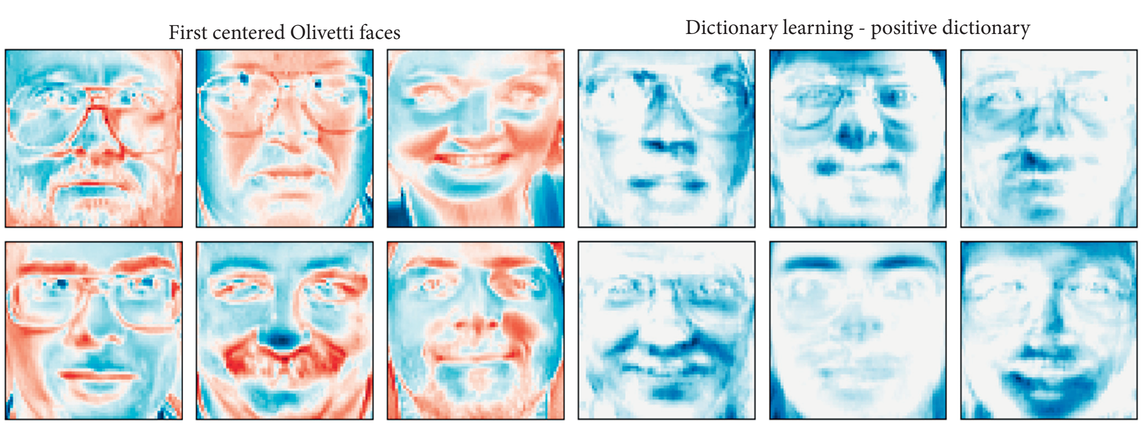

Figure 12: Face classification.

even lose face in front of their children, making them reluctant to take advice from their parents. In contrast, teachers can share our method's statistics on how seriously students are taking lessons with their parents, enabling them to keep track of their students' learning and be able to educate students in tandem with the school. There is generally no problem with the two sides of education colliding [27].

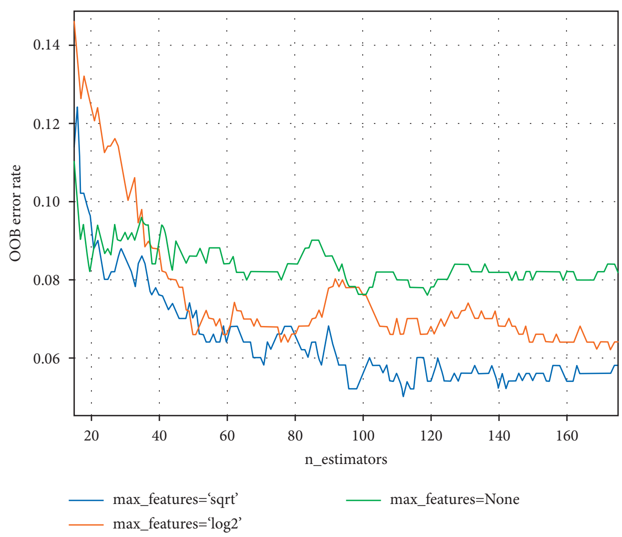

FIGURE 13: Classroom teaching of face recognition system error.

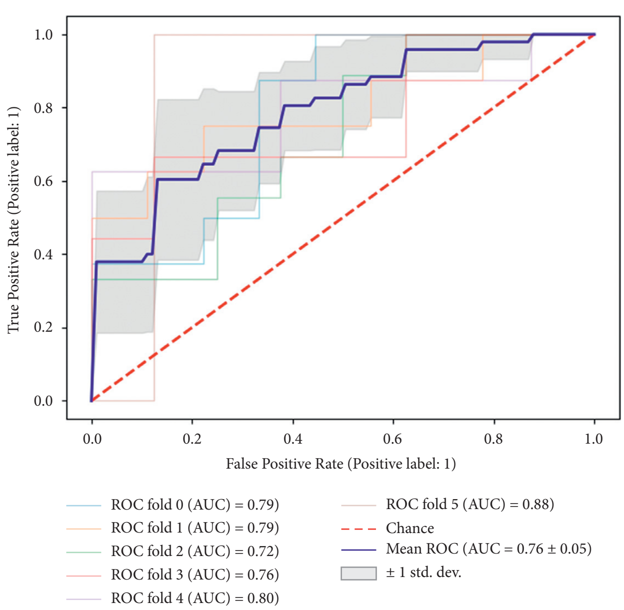

FIGURE 14: Model AUC for different parameters.

7. Conclusions

Based on the feature recognition technology of AI face recognition, this paper improves and optimizes the key points of image data acquisition, positioning, calibration, comparison, and deepening of the data model, so that the detection can be completed accurately and quickly even under the presence of light and external object interference, maximizing the accuracy and efficiency of face recognition technology under the influence of the objective environment. It provides a favourable reference for the wide application and development of face recognition technology, which lays the foundation for intelligent classroom teaching assessment.

Data Availability

The data underlying the results presented in the study are included within the article.

Conflicts of Interest

The authors declare that there are no potential conflicts of interest in the paper.

Authors' Contributions

Xiaona Zhang and Ts. Dr. Jasni Bin Dolah made equal contributions to the manuscript.

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