Design of Intelligent Teaching System Based on Face Recognition Technology

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Abstract. The smart teaching system utilizes facial recognition technology and big data analysis technology to perform intelligent attendance, student situation analysis, smart classrooms, flipped classrooms, and more. This system can automatically recognize the facial features of teachers and students, and provide personalized teaching services based on their features. Through comparative research, it has been found that smart teaching systems are superior to traditional teaching systems in the following aspects: (1) they are more fair and reasonable in terms of interactivity, personalized learning, evaluation, and other aspects. (2) The teaching system has more comprehensive functions, more reasonable and intelligent design, and more efficient efficiency. (3) It is more convenient in classroom interaction, learning situation analysis, project-based teaching, and other aspects.

Keywords: facial recognition; Smart classroom; Smart attendance; Smart Classroom; Big Data Technology

1 Introduction

Smart teaching systems are a combination of artificial intelligence technology and teaching, known as "AI+education". Through analysis and research, it has been found that current smart classrooms mostly focus on classroom interaction and learning situation analysis and processing on teaching resource platforms, lacking real-time analysis of teaching environment, online and offline teaching and learning situation analysis, analysis of students' autonomous learning behavior, and real-time monitoring and analysis of multiple data such as flipped classrooms. In the intelligent teaching system [1], students' classroom behavior data can be analyzed to obtain their classroom learning situation. The visualization of the results can intuitively present students' real-time learning behavior and engagement; By analyzing flipped classroom data, students' ability to learn independently and solve problems can be obtained, and personalized guidance plans can be specified based on each student's data. This article uses big data from teaching and learning to construct an innovative and sustainable smart teaching system, mainly elaborating on the smart teaching system from the following two modules: (1) Smart Classroom (2) Smart Classroom

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2 Smart Classroom

The smart classroom mainly consists of three parts: facial recognition attendance system, learning situation analysis, and interaction system. The attendance system for facial recognition is developed using the OpenCV framework combined with the PyCharm development environment using Python language to complete the algorithm design and simulation. The facial attendance system utilizes a 360° camera installed in the classroom to obtain facial images of the current time period, and compares and analyzes them with images in the facial database to identify students' attendance rate [2]. The attendance system includes: expected attendance, actual attendance, tardiness, and the teacher can enter the number of people who are absent for other reasons. The classroom learning situation analysis system captures and extracts students' learning status, analyzes and compares them, and calculates the learning situation of each class for each student. The data obtained from these two parts can be directly displayed to each teacher using the Matplotlib module. The learning situation analysis system includes 5 and 10 minutes after class, which is captured every 5 minutes to analyze classroom situations such as serious learning, whispering, sleeping, and speaking. This process is fully automatic and does not require the teacher to operate the system, and there is no need to capture break time for activities. The interaction system interacts and collaborates with specific students to complete classroom tasks based on the teacher's teaching situation. Teachers give lectures, conversations, and provide guidance and demonstration of Q&A operations to students in one or several classes. Interactive classroom teaching can be understood as guiding students to engage in learning and discussion around problems through steps such as questioning, summarizing, clarifying, and predicting during the teaching process, sharing learning resources and understanding teaching objectives through communication and exchange. At the same time, teachers participate in discussions to understand students' mastery and guide them to make constructive responses more actively, thereby establishing a student-student interaction, teacher-student interaction, and student-centered classroom atmosphere.

2.1 Face recognition attendance system

Face recognition [3] is mainly divided into data collection, data analysis, data processing, and data visualization modules. Data collection and processing are the establishment of a face database dataset. The face database images consist of the freshman reporting information system and various scene information images of the classroom being taught, including large classrooms, group activities, experimental training classrooms, etc. The extraction and analysis of the dataset are mainly divided into two parts, namely face images and non face images. Face images include a person's face in each sub image, and non face images are similar to face images, Two extraction compositions: firstly, create a human face template as a window, and then use the window movement method to obtain the sub image composition of the face like structure from the scene image of the face library. When the Euclidean distance between the sub image and the template is less than a set threshold, it is considered as a non face, that is, similar to a face. Secondly, using this result to train the neural network, we can identify non facial regions from the results and divide them into images such as faces, which are considered non facial images.

The detection method based on deep learning is suitable for object detection in complex backgrounds [4]. Firstly, detect and mark the position of the tiger in the image. The method is to use a preset window to scan the window (preprocess the image), and the window scans the entire image in pixel order to detect whether each scanned window is a tiger, as shown in Fig. 1.

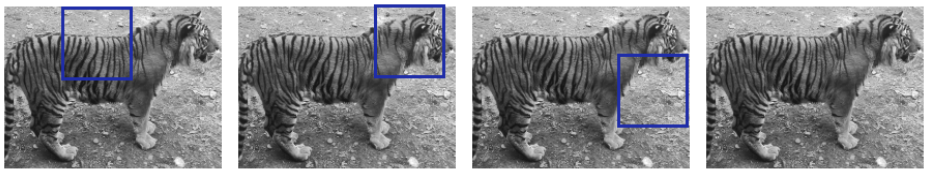

Fig. 1 Tiger

Then, data analysis is conducted, using the adaBoost algorithm based on facial features to learn from simple features (classifiers) and cascade them into complex classifiers [5] to classify faces, as shown in Fig.2. During the training phase, multiple weak classifiers are obtained by changing the sample weights on the same training set. Cascade the trained weak classifiers to form a strong classifier, which can detect more features. Then, strong classifiers are combined to achieve target classification, as shown in Fig.3.

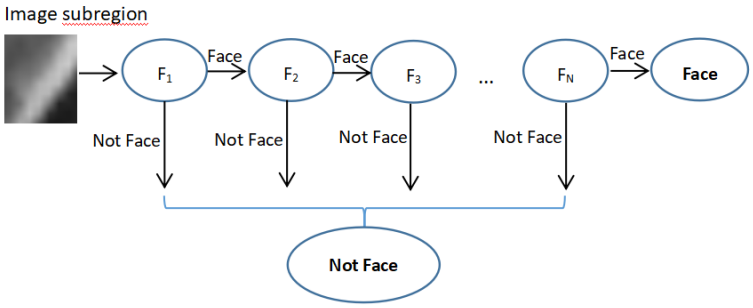

Fig. 2 Face recognition process

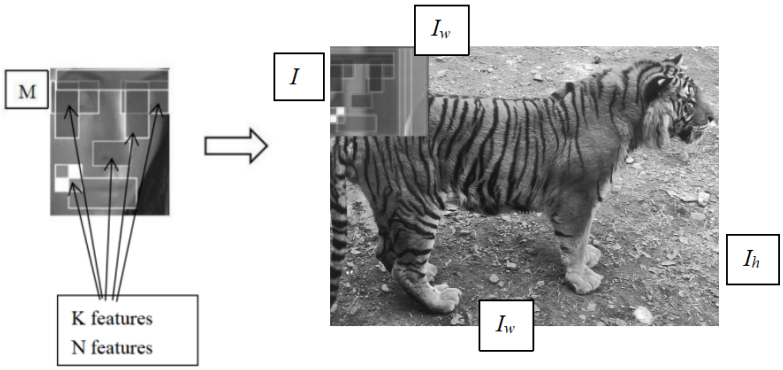

Fig. 3 Feature Cascading

2.2 The analysis of the students

The traditional teaching mode can no longer meet the needs of modern students, and smart education has become a new trend in education and teaching. Smart education utilizes artificial intelligence technology, advanced algorithmic structures, existing teaching materials, big data, and terminals such as robots to make previewing, attending classes, and reviewing more precise and efficient. Through deep machine learning, it provides more intelligent and personalized teaching services for teachers and students, and continuously adjusts and improves according to the actual situation of textbooks and students, improving the overall literacy of teachers and students. Among them, learning situation analysis is one of the important components of smart education[6]. By analyzing and evaluating students' learning situation , it provides teachers with more accurate teaching suggestions and personalized learning services for students. As shown in Fig.4.

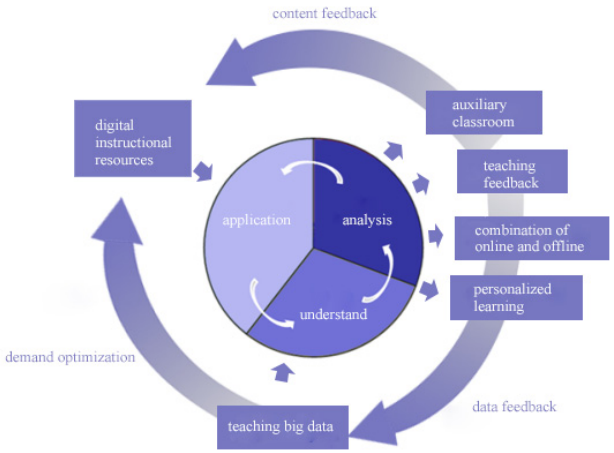

Fig.4 Analysis of Smart Teaching

The student situation analysis module adopts big data analysis technology. The application of big data analysis technology in student situation analysis can change the traditional one-sided analysis based on grades, deeply excavate and analyze invisible information in teaching and learning processes, discover problems in the teaching process, and provide better decision-making and reform strategies for teachers or teaching managers, better meet students' needs and subject guidance. Furthermore, analyzing students' learning situation, the learning situation analysis module mainly includes three stages: pre class, during class, and post class:

Analysis of learning behavior in the pre class stage: Students preview in advance before class and understand their learning habits and effectiveness by analyzing their learning behavior, such as learning time, progress, and methods.

In class teaching and learning outcome analysis: In class learning, group discussions are conducted, and tests are conducted at any time. Teachers can quickly grasp the learning situation of each student and provide targeted guidance. Helps teachers identify problems, adjust and improve teaching details. Understanding students' ability to understand and receive knowledge makes the classroom simpler, smarter, and more effective, which helps to develop

students' independent thinking and learning abilities, and enables them to carry out homework after class.

After class, the main focus is on learning feedback and suggestions: by analyzing and evaluating students' exam scores, homework scores, etc., we can understand their learning outcomes and levels. Based on the analysis of the learning situation, we provide personalized teaching suggestions for teachers and personalized learning services for students.

The data visualization module displays the analysis results of the learning situation in the form of charts, making it easy for teachers and students to view and analyze. Specifically, the data visualization implementation method in academic situation analysis uses the Python library Matplotlib to draw visualization graphics, as shown in Fig.5. Step:

(1) Collect student learning data, such as exam scores, homework scores, participation, etc. The data can be directly obtained from the platform database, including the basic information and data of each student.

(2) Use the Python programming language to read student learning data and store it in a data structure.

(3) Create visual graphics using the Matplotlib library to display the distribution and trends of student learning data.

(4) Analyze visual graphics, such as viewing statistical indicators such as average, median, and standard deviation of student scores, to evaluate students' learning performance.

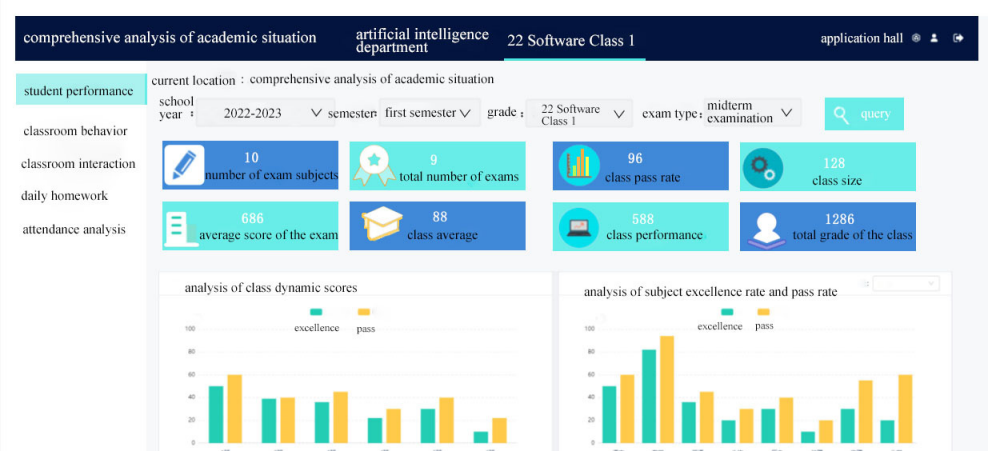

Fig.5 Feature Cascading

2.3 Interactive classroom teaching

Interactive classroom teaching utilizes smart screens to communicate and explore problems between teachers, students, and students during the class process. Ordinary questioning and answering questions are expressed through oral questioning by teachers or students, which is a form of language. Interactive classrooms can convert speech into text and display it on a large screen, which is more conducive to answering and organizing questions; Teachers can also

push learning resources, real-time classroom assessments, and other teaching activities through smart screens, as shown in Fig.6; Adopting a "flipped" classroom with technical support, guiding students to use the platform for independent inquiry learning, and stimulating students to think deeply about problems; Group discussions can be conducted on different screens, while sharing learning experiences, peer evaluations, etc. [7].

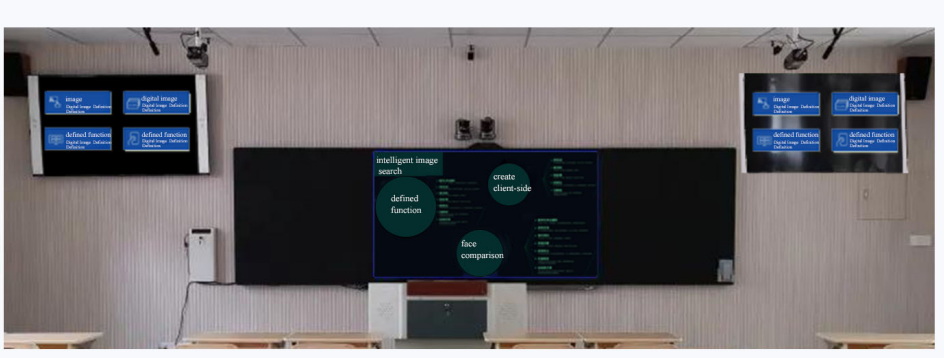

Fig. 6 Feature Cascading

3 Smart teaching

3.1 Smart management platform

The Smart Classroom Hardware Management System is a subsystem developed based on Python language, mainly used to manage hardware devices in the classroom, including computers, projectors, audio systems, and so on. This system can achieve equipment monitoring, control, maintenance, and troubleshooting functions, providing convenience for classroom management and teaching.

The smart classroom management platform can adapt to various types of terminal interfaces and cross platform requirements of system software. The platform supports PC and mobile applications, meeting the needs of users for work in different environments and occasions, breaking through the limitations of space and time to achieve comprehensive control of teaching equipment in different types of teaching spaces. It integrates projectors, screens, amplifiers, speakers, lighting, curtains Air conditioning and other equipment are remotely controlled through the cloud, achieving scene based control and visual management; Realize intelligent operation and maintenance of equipment and facilities, and conduct intelligent analysis of equipment status monitoring, fault warning, fault diagnosis, asset usage, etc. [8]. Fully control the equipment in the teaching space, save the preparation time for teachers and technicians before class, and reduce the impact of environmental factors on classroom effectiveness. The hardware control of the smart classroom adopts one click operation, which is operated by the system administrator or teacher on the system end, as shown in Fig.7.

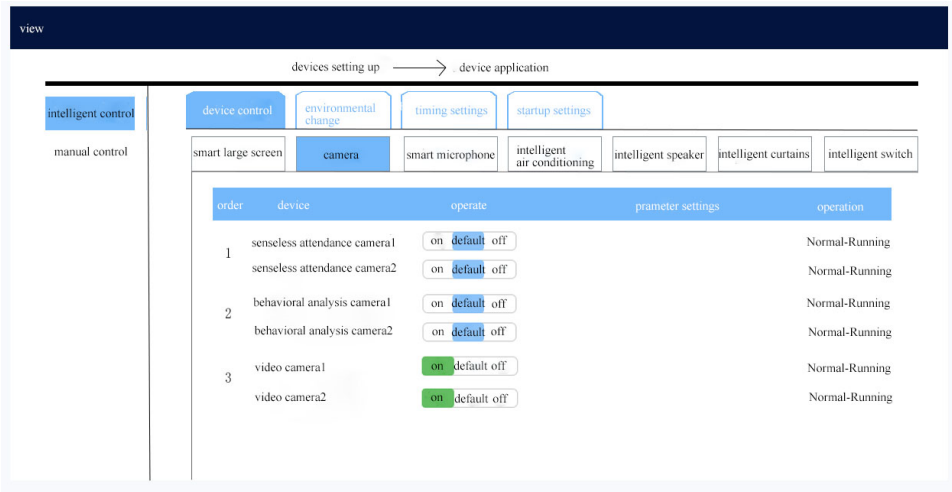

Fig.7 Smart Classroom Equipment Control

3.2 Smart Classroom Functions

The teaching of smart classrooms has achieved functions such as multi-screen interaction, energy efficiency management, intelligent roll calling, and automatic data collection, providing a positive and effective teaching experimental environment for exploring digital teaching modes and methods, as well as researching the construction and use of digital teaching resources. Using a course recording system to synchronously record classroom scenes and teacher-student interaction processes, generating digital teaching resources that include classroom scenes, is conducive to students' after-school review, teaching demonstration communication, and inter school education resource sharing. The functions of the smart classroom are as follows:

(1)Classroom equipment control: Through the main control panel on the teacher's computer, the teaching equipment in the classroom (such as smart screens, cameras, speakers, IP broadcasts, smart switches, smart curtains, intelligent temperature and humidity regulators, etc.) can be uniformly controlled. Teachers can choose to switch the equipment on and off with one button or control it separately through the control screen, thereby reducing the complexity of equipment operation.

(2)Teaching process recording: The teaching process is networked and stored through high-definition cameras installed in the classroom. The smart terminal can automatically record according to the teaching schedule or record with one click through the central control panel on the podium.

(3)Environmental monitoring and management: Real time monitoring and data recording of the classroom environment can be achieved through monitoring equipment installed inside the classroom (such as temperature and humidity, light intensity, intelligent curtains, etc.). Improvement of the classroom environment can be achieved through the backend control system, and intelligent adjustment and control can be carried out based on pre-set strategies.

For example, lighting can be adjusted according to weather, time, and other eye protection modes.

(4)Teaching interaction management: The system's teaching video courseware is published through the cloud, and students can learn independently through the network. They can comment on and interact with the teacher's courseware, and generate learning portraits. Teachers can achieve teaching interaction and project orientation through online interaction.

(5)Remote centralized control management: The system management platform adopts a B/S architecture, which can achieve separate control of equipment in each classroom through remote login, and can also achieve centralized control of this teaching building.

4 Conclusions

The intelligent teaching system based on facial recognition has completed the intelligent management of classroom equipment and adjusted the brightness of lighting to protect students' eyes; Air conditioning adjusts temperature and humidity according to room temperature, and purifies air; Adjust the opening or closing of curtains according to the intensity of sunlight; The sound microphone can record indoor sound according to needs. Implement intelligent facial recognition, intelligent attendance, learning situation analysis, and teaching interaction functions for the classroom teaching system. Thus, it can enhance students' interest and initiative in learning, and gradually accumulate a large amount of teaching resources for the school. The application of smart teaching will inject new vitality into classroom teaching and promote teaching reform.

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