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Computer-Aided Design AND APPLICATIONS

Optimization of Intelligent Classroom based on CAD Multi-Valued Color Image Segmentation Algorithm

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Abstract. In order to solve the problem that the efficiency of smart classroom is not high enough, a multi valued color image segmentation algorithm based on CAD is proposed to optimize the smart classroom. This paper explores the notion of smart education as well as a conceptual framework to enable children to receive excellent education and to spark their interest through creative learning. Firstly, CAD software is used to improve software design efficiency and optimize product technology; Secondly, the core technology of the smart classroom is improved by using the national value color image segmentation algorithm, and compared with the smart classroom without the multi value color image segmentation algorithm; Finally, the utilization efficiency of the improved smart classroom is counted. It is proved that the smart classroom based on CAD multi valued color image segmentation algorithm can give greater play to the role of smart classroom, reduce the teaching pressure of teachers by 20% and improve the learning efficiency of students by 20%. The intelligent classroom has a higher degree of informatization and more powerful functions, which is of great help to promote classroom communication and improve communication efficiency. The smart classroom is easier to run and adapt thanks to the optimization of the CAD multi threshold color picture segmentation algorithm, which considerably improves the system's work efficiency and capability. However, the smart classroom also has its own shortcomings, which are mainly reflected in the high investment cost, the complex design of the system and the high maintenance cost in the later stage.

With the optimization of CAD multi valued color image segmentation algorithm, the smart classroom is easier to operate and adjust, which greatly enhances the work efficiency and ability of the system.

Keywords: CAD; Multinational Value; Image Segmentation Algorithm; Smart Classroom; Optimization.
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1 INTRODUCTION

In the information and digital era, multimedia classroom has been gradually popularized in college teaching. The traditional multimedia classroom is composed of central control system, speaker equipment, projection equipment, computer and network equipment, which solves the problems of electronic presentation of teaching information and information operation of students' classroom. Smart classroom is a smart teaching management system based on intelligent interactive teaching, with intelligent equipment as technical support and informatization as its characteristics. The intelligent teaching platform is constructed in a cascade way. The application of this platform in teaching can enable students to experience the fun of information-based teaching.

Traditional learning is based on students memorizing and repeating facts that they are less interested in and recall at a lower rate after evaluation. It does not place enough attention on larger concepts or systems. Under this teaching technique, students have little opportunity to practice group dynamics and teamwork. Smart education has attracted more and more attention in the world, and smart classroom, as one of the smart learning environments, has also received extensive attention. Smart education, which emphasizes learning in the digital age, is gaining traction.

This paper discusses the definition of smart education as well as a conceptual framework. Framework of smart pedagogies and ten important attributes of smart learning environments are offered for producing smart learners who must master knowledge and abilities of 21st century learning. Certain impediments stand in the way, such as a lack of digital literacy and infrastructural support, as well as a lack of experience with digital technologies. As the smart learning environment to realize smart education, smart classroom needs to help the realization of in-depth learning in function. Therefore, how to use CAD multi valued color image segmentation algorithm to optimize the overall functional framework of intelligent classroom and realize deep learning in intelligent learning environment is the main purpose of this research.

When compared to a smart classroom without the multi value color picture segmentation algorithm, the fundamental technology of the smart classroom is improved by employing the national value color image segmentation algorithm. In the process of active engagement and active investigation, one may learn and transmit knowledge, solve issues, and build high-level thinking capacity. The Figure 1 shows the entire system, for the well-functioning of efficient classroom. An intelligent terminal will monitor all the components of classroom. It includes air conditioning, camera, internal light and much more.

2 LITERATURE REVIEW

The oldest imaging technology was created in the 1980's. During many years of research and development, with the continuous development of human science and technology, its basic research and analysis continued at two levels of visual and digital. In s, with the application and development of digital technology, visual imaging technology was largely replaced by digital imaging. Threshold division is one of the basic methods of image division. Its history can be traced back to almost 40 years. A large number of sharing algorithms have now been submitted.

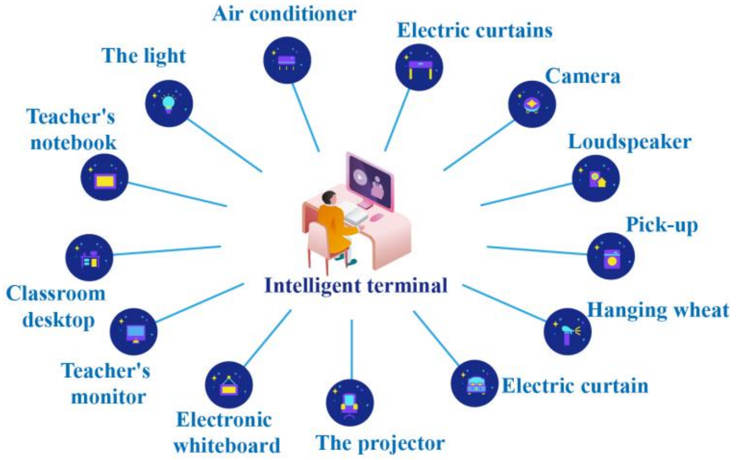

Figure 1: Intelligent classroom based on CAD multi valued color image segmentation algorithm.

Wang Lin and others proposed a hybrid genetic algorithm for multi threshold image automatic segmentation by combining the two significant characteristics of fuzzy mean algorithm and genetic algorithm. This method studies the defects of multi threshold segmentation of mountain climbing method and wavelet transform [1]. Picture segmentation is a key pre-processing step for all computer vision and image comprehension applications. It may be used for biometrics, medical image analysis, crop disease detection and classification, and a variety of other applications. Image segmentation is the process of separating the item (foreground) from the background using picture qualities such as color, intensity, texture, and so on [2, 3]. Although the concept is not new, the use of wavelets for these purposes is a relatively new discovery. The ideas are similar to those of Fourier analysis, which was developed in the early 1800s [4, 5].

The adaptive threshold segmentation method based on wavelet proposed by Qi, Y and others introduces wavelet into image segmentation, obtains the threshold by wavelet analysis, and obtains a better segmentation effect [6]. Wang, s founded the theory of geometry and proposed the measurement concept of fractal dimension to describe the rule degree of natural phenomena [7]. The feature of Miao and Zhu method in image segmentation is that the fractal dimension is intuitively consistent with the roughness of the object surface, while the roughness of different textures in nature is very different, so it can be used as a reasonable feature parameter to distinguish different types of textures [8]. Liu, Y. and others proposed a natural scene image segmentation method based on fractal features, which performs image segmentation by constructing a set of fractal texture features, analyzing the roughness of different parts of the image, the size and direction of texture primitives [9]. Bhandari, A.K. and others believe that the teaching function of smart classroom at home and abroad is mainly analyzed from the perspective of technology, and there is less research on the function of smart classroom, and the substantive impact of these functions on teaching needs to be further studied [10].

Utilizing smart class technology, information may be shown on interactive whiteboards using graphics, maps, graphs, flowcharts, and animated films. Learning becomes more fun and understandable as a result. Smart classroom technology enables students to prepare online presentations and receive feedback from instructors in a fraction of a second required for the proper learning [11, 12]. Teachers do not need to urge students to take rough notes because sharing the presentation is straightforward. This saves both instructors and students time, which may then be spent on more engaging activities [13, 14]. Zhang, C and others believe that deep learning ability is highly consistent with the ability of intelligent talents, and deep learning can be used as the core pillar of intelligent education [15].

As we all know, the Internet of Things (IoT) has the capacity to connect a large number of things to the Internet. Deep learning has the potential to make robots think and act like humans in a wireless environment. These technologies affect every element of human life. They are utilized in a variety of industries like as manufacturing, healthcare, transportation smart education through various innovative ways, smart cities, and energy. Zhang, C based on gray image threshold division method is to first determine the gray threshold within the gray range of the image [16]. Han, M. generally, these two types of pixels belong to two types of regions of the image. It can be concluded from this method that determining an optimal threshold is the key to segmentation [17].

Based on the current research, the idea of using CAD multi threshold color image segmentation algorithm combined with smart classroom to improve the use efficiency is proposed [18]. The effective and innovative use of technology in institutions is revolutionizing teaching and learning strategies and approaches through CAD [19, 20]. Smart Classrooms are technology-enhanced lecture halls that promote teaching and learning opportunities by incorporating learning technology such as computers, pre-installed software, useful earphones, audience reaction technology, networking, and audio/visual capabilities, among other things. Smart class is a digital initiative that is rapidly changing the way teachers teach and students learn via the use of technology [21, 22]. Although there are more and more research results in recent years, there is no great breakthrough in the research due to the difficulty of image segmentation itself. There are two main problems. One is that there is no widely used segmentation algorithm. The other is that there is no good general segmentation evaluation standard. The smart classroom based on CAD multi threshold color image segmentation algorithm can give greater play to the role of smart classroom, reduce the teaching pressure of teachers by 20% and improve the learning efficiency of students by 20%. The intelligent classroom has a higher degree of informatization and more powerful functions, which is of great help to promote classroom communication and improve communication efficiency.

3 INTELLIGENT CLASSROOM OPTIMIZATION BASED ON CAD MULTI THRESHOLD COLOR IMAGE SEGMENTATION ALGORITHM

3.1 Characteristics and Construction Mode of Smart Classroom

3.1.1 Characteristics of smart classroom

A smart classroom is a high-tech learning environment that enhances digital teaching and learning. To make lectures simpler, more entertaining, and more participative, digital displays, tabs, blackboards, assistive hearing devices, and other audio/visual components are integrated into the classroom. Integrate computer equipment, multimedia screens, various intelligent terminals, various teaching systems with software and other resources to achieve the objectives of teacher-student interaction, man-machine collection and resource sharing, and realize the upgrading of teaching functions [23].

3.1.2 Construction mode of smart classroom

After years of development, various schools have explored a variety of smart classroom construction modes, as shown in Table 1.

Pattern	*Major Function*	*Construction Investment*	*Construction Difficulty*
Teaching Smart Classroom	Teaching Interaction Course Recording and Broadcasting	Low	Low

Seminar Wisdom Classroom	Wireless Projection Case Analysis Multi-Screen Interaction Panel Sessions Achievement Sharing	High	High
Experimental Smart Classroom	Security Policy Control Experimental Data Sharing Experimental Order Management Discussion And Sharing	High	High
Collaborative Smart Classroom	Cross Regional Learning Cooperation Remote Learning Autonomous Learning Team Sharing	Low	High

Table 1: Construction mode of smart classroom.

3.2 Teaching Design Ideas based on Smart Classroom

Smart classroom provides a brand-new teaching environment, which makes use of its rich interactive functions to provide preconditions for the adjustment and change of classroom teaching mode [24].

3.2.1 Technical requirements for multimedia equipment

The demonstration equipment mainly realizes the demonstration function of teaching resources in various formats, including computers, mobile phones, tablets, etc. The demonstration equipment has a variety of audio and video output interfaces, which can be connected with image acquisition equipment and display equipment by wired and wireless means. The display device supports HDMI (High-Definition Multimedia Interface), VGA (Video graphics array), composite and other general interfaces and 232, 485, infrared and other control interfaces. The image acquisition equipment supports mainstream cameras, codecs and their supporting equipment, supports resolutions of 720p and above, and has PTZ control function. Audio equipment has the functions of audio acquisition, noise reduction, expansion and transmission in the teaching process, and supports wired microphone, wireless microphone, wired wireless audio processor, power amplifier and multimedia audio. The wireless projection device supports WiFi transmission mode, mobile phones and tablet computers.

3.2.2 Technical requirements for network facilities

The Internet of Things will make things easier. Smart classrooms are now enhanced by combining computers, software, and technology behind the audience, helper gadgets, and audio-visual amenities. The old lecture and notes-writing teaching-learning technique really hinders modern-day educational success. The network equipment in the classroom is connected to support the transmission and forwarding function of teaching information. The classroom is equipped with access layer switch to support VLAN technology. Equipped with convergence layer switch, which supports 10 Gigabit uplink campus core switches [25]. Independent WiFi wireless network function is provided in the classroom to ensure the signal coverage and signal strength and meet the requirements of wireless internet access for all staff in teaching activities. The network fence management function is equipped to support the virtual unified network access requirements, and the large smart classroom supports the bandwidth management function. The technical requirements of Internet of things gateway equipment shall meet the requirements of access management, protocol conversion, data processing, identification management, security management and other functions, and support 4G / 5G, sensing equipment and cross network data conversion with different protocols and data formats between campus network and other functions [26].

3.3 Multi Threshold Color Image Segmentation Algorithm

3.3.1 Research content of image segmentation

Image segmentation is a method of dividing a digital image into numerous subgroups known as Image segments in order to decrease the image's complexity and facilitate further processing or analysis. In layman's terms, segmentation is the process of labeling pixels. A simple image segmentation approach is picture thresholding segmentation. It is a method of producing a binary or multi-color image by applying a threshold value to the pixel intensity of the original image. The purpose of image segmentation is to divide the image space into some meaningful areas. It is an essential process to realize automatic image recognition and understanding. It is the middle level of computer vision. For example, an aerial photograph can be divided into industrial areas, residential areas, lakes, forests and so on. You can study the breakdown of an image on a pixel background or split it up using some image information in the specified neighborhood. The basis of the breakdown can be based on two basic concepts such as abolition [27]. The research content of image segmentation mainly includes the following points:

(1) Research on segmentation theory and algorithm: In the process of research and development of image segmentation algorithms, there have been hundreds of years of history. With the help of various theories and methods, thousands of types of segmentation algorithms have been proposed, and this research is still in process. Although people have done a lot of research work on image sharing, so far, there is still no general sharing theory and algorithm [28]. Most proposed division algorithms investigate specific problems, and no general division algorithm suitable for all images has been found. Although some people tried to build a model for segmentation and segment by model, it was unsuccessful.

(2) The evaluation methods and standards of image segmentation: Image segmentation evaluation is an important problem in image segmentation. So far, there is still no segmentation evaluation standard acceptable to everyone. The purpose of studying segmentation evaluation is to improve and improve the performance of segmentation algorithm, and also play a guiding role in the research of new technology. In recent years, more and more people have studied image segmentation evaluation and achieved certain results [29].

(3) Research on system segmentation evaluation method: This research is the advanced stage of image segmentation research. At present, there is still a lack of systematic research on this method at home and abroad, but the systematic analysis of evaluation methods can guide the research of segmentation evaluation [30].

3.4 Overview of CAD

3.4.1 Basic concepts of CAD

The full name of CAD is computer aided design, which is a technology that uses computer-aided designers to work. CAD is capable of producing exceedingly exact designs; drawings may be created in 2D or 3D and rotated; and other computer programs can be linked into the design software. You must first determine the scale of a view before you begin drawing using manual drafting. This scale compares the size of an object in real life to the size of a paper model. Time is our most important asset in CAD. It frees up a significant amount of time for the engineer to concentrate on new projects or enhance the present one's design. CAD has certain disadvantages in addition to its benefits. Computers might fail unexpectedly, causing work to be lost. Furthermore, work is vulnerable to viruses and may be easily "hacked." Just like its name, computer plays a central role in CAD technology with its powerful computing and storage functions.

The computer can quickly compare and select the best scheme among a large number of different schemes, store various design information and extract it quickly, easily convert the sketch into working drawing, quickly convert the graph into program and edit [31].

CAD technology is a common tool in manufacturing industry. It can transform design products into models, and has innovative applications in all walks of life. Decoration buildings, buildings and industrial parts manufacturing can be designed and transformed into two-dimensional drawings with the help of CAD. As a research subject, CAD technology has several characteristics, which have created its cutting-edge position: close knowledge network, high IQ requirements, rapid transformation of economic interests and high requirements for comprehensive ability.

3.4.2 Advantages of CAD

CAD technology can improve the working mode of mechanical design, replace manual operation with mechanical operation, reduce the working pressure of designers and improve work efficiency. Once, manual hand drawing was based on the spatial imagination of the human brain, which was difficult. It needed to consider the repeated verification and modification of the structure, the operation was cumbersome, and it was easy to become irreparable due to small mistakes. In this process, a lot of time and human resources will be wasted. CAD software can generate mechanical design drawings as long as data is input. While ensuring the accuracy of data, CAD can modify and retain relevant data, and emphasize the display of important designs for easy viewing and modification. CAD software can save historical data samples, allowing designers to mobilize and reuse. Only some parts that need to be redesigned and manufactured can improve the design efficiency by more than three times [32]. According to the survey, the time required for mechanical design today is only 60% of that in the past.

4 RESEARCH AND APPLICATION

4.1 Multi Threshold color image segmentation algorithm

4.1.1 Basic principle of threshold image segmentation

The basic principle of threshold image segmentation can be expressed by formula (1):

$$g(x,y)=\begin{cases} Z_E \\ Z_B \end{cases} f(x,y)=\begin{cases} -x \\ x \end{cases} \tag{1}$$

Where, $f(x,y)$ represents the original image, and the selection of $g(x,y)$ threshold is the key of threshold segmentation technology. If it is too high, too many target points will be mistakenly classified as the background, causing damage to the target area; If the threshold is too low, the opposite happens. It can be seen that the threshold segmentation algorithm mainly has two steps:

(1) Firstly, a reasonable segmentation threshold is determined;

(2) Secondly, according to the comparison between the determined threshold and the pixel value, the pixel line of the image is divided.

When using threshold method to segment gray-scale image, generally there are certain assumptions about the image, based on a certain image model [33]. If an image meets these criteria, its gray bar graph can be considered as a combination of single highlight bar graphs that match the target and background, respectively as shown in Figure 2.

4.1.2 Definition of threshold segmentation method

Threshold based segmentation method is a widely used image segmentation technology. The essence of the so-called threshold segmentation method is to obtain the threshold for segmentation by using the gray histogram information of the image. It is especially suitable for images in which the target and background occupy different gray levels. The biggest characteristic of threshold segmentation method is simple calculation and high operation efficiency.

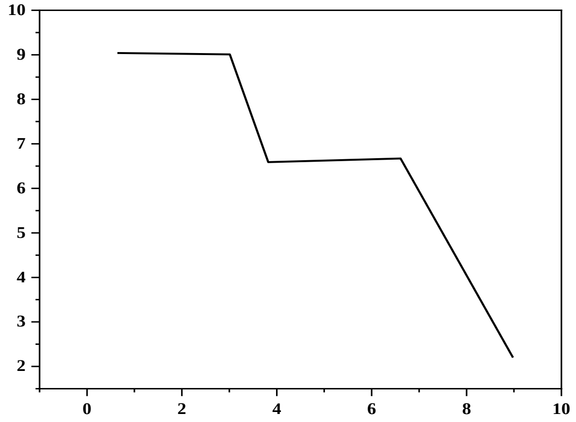

Figure 2: Gray histogram.

It has been widely used in applications that pay attention to operation efficiency. The common methods for determining the best global threshold generally include the following experimental methods, histogram method and minimum error method. This method assumes that the gray distribution of background and foreground is normal distribution [34]. When the illumination is uneven, there is sudden noise, or the background gray changes greatly, there will be no suitable single threshold for the whole image segmentation, because a single threshold cannot take into account the actual situation of each pixel of the image. At this time, the image can be divided into blocks according to coordinates, and a threshold can be selected for each block for segmentation. This coordinate related threshold is called dynamic threshold method, also known as adaptive threshold method. This kind of method has large time and space complexity, but strong anti-noise ability. It has a good effect on the image which is not easy to be segmented by using global threshold [35].

4.1.3 Algorithm description

The algorithm is shown in Figure 3. In the Figure, assuming that the brightness of the target is higher than the background brightness, the mean value of the target is greater than the overall gray mean value of the image. The overall gray mean value of the gray histogram can be set as the initial value to segment the image. Then, calculate μ_1, μ_2, σ_1, σ_2. if they meet formula (1), take the threshold as the best threshold and separate the target and background more accurately. Otherwise, the part of the gray histogram lower than the threshold is regarded as the gray histogram of the target area, in which the threshold is calculated and the image is segmented again until the best threshold is met as shown in Figure 3.

4.2 Optimal Design of Smart Classroom

4.2.1 Platform design of smart classroom

The starting point and ultimate goal of smart classroom construction is to provide intelligent, networked and personalized teaching services for students and teachers. On the one hand, wisdom education integrates teachers' courseware database, learning situation analysis and test information, on the other hand, it integrates students' pre class and post class feedback, classroom homework, personal sharing services and other information to form a teaching knowledge base.

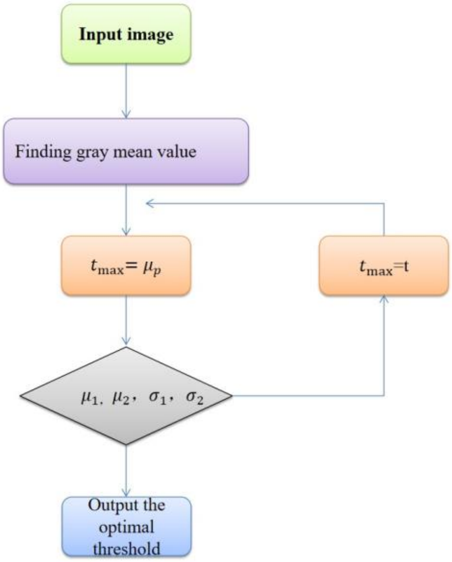

Figure 3: Prediction results of head loss of filter layers at different depths.

The two sides of teaching conduct close communication and interaction through various intelligent devices and platforms, promote the continuous optimization of teaching methods and teaching contents, constantly improve the teaching knowledge base, and improve students' learning enthusiasm and knowledge mastery level. The smart classroom service system is shown in Figure 4 [36].

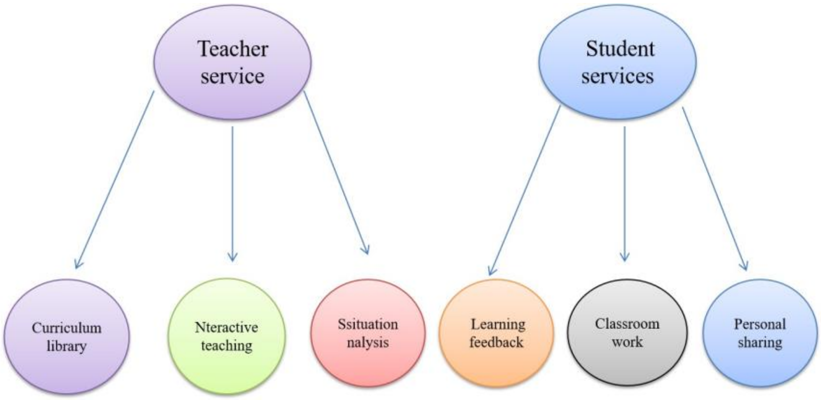

Figure 4: Prediction results of head loss of filter layers at different depths.

4.2.2 Teaching management module

Connect with the school's educational administration system and student system, and closely combine with relevant systems through the information portal to make the timetable, teaching tasks, student information and course selection clear at a glance. The teaching requirements, documents and courseware can be sent to relevant students in time, and relevant students can also communicate with teachers about the problems in the process of lectures and exercises. It can realize course creation, course revision and release, test topic release, review and courseware (video, audio, text materials) release, etc. Blackboard writing, temporary forms, various knowledge points and discussion points in the teaching process can be electronic and stored [37].

4.2.3 Examination management module

The system provides a variety of test question types and basic templates. Teachers can quickly establish the test paper framework through simple modification of the basic template, and then display the questions to be investigated in various forms according to professional characteristics. At the same time, teachers can simply standardize the accumulated questions according to the import template provided by the system, and then import them into the examination management module in batch. At the same time, it can schedule, automatically notify and remind the small tests of each teaching class. At the same time, the completed tests can be reviewed online.

4.2.4 Teaching effectiveness statistics and evaluation module

Record the learning process, evaluate the students' feedback and test results, analyze the teaching effect, and evaluate the students' mastery of knowledge. Students can view learning tasks, learning courseware, classroom test scores and correct answers. At the same time, the module provides teaching statistical reports, which can count the teaching results of a course from the dimensions of time, class and major, and assist in teaching improvement.

4.2.5 Knowledge management module

Collect all kinds of teaching knowledge, classify and integrate them, push relevant knowledge to the student terminal through various channels, and label and manage the catalogue, labels and keywords of knowledge.

4.3 Theoretical Analysis of Deep Learning

4.3.1 Definition and characteristics of deep learning

With the deepening of in-depth learning research at home and abroad, there are four understanding methods of in-depth learning theory: learning style theory, learning process theory, learning result theory and learning goal theory. This study believes that deep learning is a compound learning concept. Deep learning is a kind of active and critical high-level cognitive processing method, which can understand and transfer knowledge, solve problems and develop high-level thinking ability in the process of active participation and active exploration. The "depth" of these four levels not only corresponds to the four understanding methods of deep learning theory, but also the characteristic expression of deep learning. The four depths of deep learning are shown in Table 2:

Level	*Mode of expression*
Deep learning style	Critical thinking, high-level cognitive processing
Deep learning process	Active participation, active exploration and high learning investment
Deep learning results	Knowledge understanding and transfer, problem solving
Deep learning objectives	Achievement of multidimensional goals

Table 2: Four depths of deep learning.

4.3.2 Teaching conditions of deep learning

Clarifying the teaching conditions of deep learning and designing the functional framework of smart classroom on this basis is a necessary condition to ensure that deep learning takes place in smart classroom. According to the literature at home and abroad, this paper summarizes the teaching research of deep learning and summarizes the teaching conditions of deep learning.

5 CONCLUSIONS

To sum up, the intelligent classroom has a higher degree of informatization and more powerful functions, which is of great help to promote classroom communication and improve communication efficiency. At the same time, due to the realization of the electronization of teaching process data, it is also of great help for accumulating teaching database, summarizing teaching experience, timely statistical analysis of teaching results and so on. However, the smart classroom also has its own shortcomings, which are mainly reflected in the high investment cost, the complex design of the system and the high maintenance cost in the later stage. With the optimization of CAD multi threshold color image segmentation algorithm, the smart classroom is easier to operate and adjust, which greatly enhances the work efficiency and ability of the system. The future of the smart classroom is multifaceted. Virtual and augmented realities are not far-off futuristic technologies. Today's technology is developed enough to be employed as learning aids in classrooms. AR content enables students to participate in hands-on learning in the classroom. AR content brings lessons to life in a multimodal way that is significantly more pleasant and engaging.

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