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Automatic Recognition of Students' Classroom Behavior Based on Computer Vision

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Abstract: *The performance of students' classroom behavior is an important part of the evaluation of classroom teaching, and the recognition of students' classroom behavior is of great significance to the evaluation of classroom teaching. However, due to the complexity of students' classroom behavior, it is difficult to identify intelligent students' classroom behavior. Therefore, this paper proposes a classroom behavior analysis and evaluation system based on deep learning face recognition technology. The classroom behavior analysis and evaluation system judges whether students pay attention to class from three aspects: Students' side face concentration, students' head up and head down concentration, and eyes opening and closing concentration, so as to provide an objective evaluation basis for students' classroom behavior evaluation in classroom teaching.At present, to solve the problem of performance degradation of convolutional neural network with the deepening of network layers, a deep residual network based on residual structure is proposed. Comparing the accuracy of the depth residual network with that of the depth convolution neural network on this data set, the experimental results show that the former has better network recognition performance.*

Keywords: *Recognition performance; Students' classroom behavior; Quality of teaching; Deep learning*

1. Introduction

Classroom is an important place for students to learn knowledge and receive education. With the continuous development of social technology and the continuous deepening of education reform, the requirements for informatization and intelligent analysis of classroom teaching quality are becoming more and more urgent. For a long time, classroom teaching activities have been the focus of educational research.In classroom teaching activities, as the main body of learning activities, students' behavior state is the direct embodiment of teaching activities. Students' classroom behavior reflects students' learning state and learning efficiency, which is closely related to the quality of classroom teaching.The research level mainly focuses on basic education, secondary vocational education and basic research (social science) [1]. By collecting a large number of pictures of students' classroom behaviors on the spot, we set up a data set of classroom behavior identification, and according to the characteristics of the residual module, we set up a deep residual network suitable for this data set, which provides a new technical method for identifying students' classroom behaviors.

At present, education has entered the era of intelligence, and higher requirements are put forward for the analysis of students' classroom behaviors. Realizing intelligent recognition of students' classroom behaviors has become more and more important [2]. In this context, colleges and universities in some developed countries have established relatively perfect classroom monitoring and analysis systems to conduct in-depth research on classroom teaching activities. As for the research on classroom behavior, the domestic academic circles focus more on the research of teacher behavior and teacher-student interaction behavior, while the research on students' classroom behavior is relatively few.Students' classroom behaviors are complex and changeable, which makes it difficult to identify students' classroom behaviors intelligently [3]. We intend to combine artificial intelligence with education and teaching research, design and develop a classroom behavior analysis and evaluation system based on deep learning face recognition technology, and objectively and quantitatively analyze the classroom behavior of higher vocational students, so as to better serve the field of education [4].

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2. System design

2.1. Overall framework of classroom behavior analysis and evaluation system

Based on the needs of Classroom Nonverbal Behavior Analysis and the interview results of relevant experts, this paper mainly identifies seven typical students' classroom behaviors: listening, looking left and right, raising hands, sleeping, standing, reading and writing. These behaviors not only reflect the basic state of students, but also constitute the basis of complex learning activities.Identifying these typical behaviors can provide data support for subsequent automatic teaching analysis. The training of deep neural network needs a lot of marked training data. Because there is no public data of classroom behavior recognition on the network, this paper constructs a special data set of classroom behavior recognition by collecting data on the spot. Generally speaking, teachers mostly use Flanders interactive analysis system, classroom teaching analysis method, interactive behavior coding system based on information technology, improved Flanders interactive analysis system, etc., and at the same time use classroom teaching video analysis software, Use tools such as observation scales to analyze students' classroom behaviors. But in essence, these methods still belong to the category of manual analysis, which is time-consuming, labor-intensive, and inefficient. The overall framework of the classroom behavior analysis and evaluation system is shown in Figure 1.

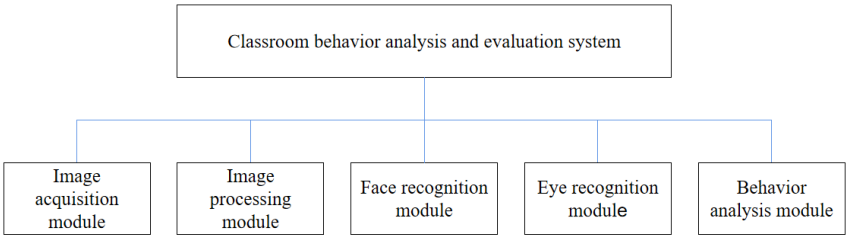

Figure 1: The overall framework of the evaluation system

2.2. System design ideas

Convolutional neural network has strong fitting ability and can effectively extract image features. To build an appropriate convolutional neural network for students' classroom behavior recognition, we should not only consider the complexity and expressiveness of the network model, but also consider that it can adapt to the established students' classroom behavior data set [6]. The residual network is a deep convolutional neural network. For convolutional neural network, deepening the number of network layers can enhance its fitting ability. However, with the deepening of network layers, convolutional neural network will become very difficult to train. When the number of network layers exceeds a certain value, the recognition ability of the network will show a downward trend. In the process of gradient backpropagation, because the number of network layers is too deep, the network parameters close to the output layer will converge very quickly, while the parameters close to the input layer will converge very slowly. In order to avoid the problem of decreased recognition accuracy when the number of network layers is too deep, the residual network introduces a residual unit, that is, by adding a Shortcut structure between the convolutional layers, this structure makes the objective function of the network training become the residual after subtracting the input function.

3. System implementation

3.1. Recognition of students' classroom behavior based on deep learning

Vgg16 network model, a classical deep network model trained on Imagenet, is transferred to student classroom behavior recognition, and a student classroom behavior recognition method based on deep learning is designed [7]. Due to the complexity of students' classroom behavior, the recognition effect is easily affected by some irrelevant factors. Without the support of large-scale students' classroom behavior data set, it is not conducive to the training of deep neural network. The development of pose estimation technology provides the possibility to solve the above problems-pose estimation technology refers to the process of restoring the joint points of the human body from a given

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image or video to obtain the skeleton of the human body. Its main work is in the image or video. The shape of the human body is depicted in the video. This is because the human skeleton information is more suitable to describe the characteristics of behaviors than the original image data [8]. Specifically, it includes: ① data collection; ② Data preprocessing; ③ fine-tune the VGG16 network model; ④ Output the recognition result. Comparing the accuracy of classroom behavior recognition of different deep network models, the recognition rates of the four deep network models VGG16, ResNet18, ResNet50 and AlexNet are all low. The reason may be that this experiment only uses a single frame of static images for classroom behavior recognition, and the behavior of looking around is more suitable for recognition based on the dynamic behavior in the classroom video. Therefore, follow-up work will use relevant classroom video data to more accurately identify students' classroom behaviour [9].

3.2. Database design

It mainly includes student information table, image collection table, image recognition table, judgment process table, concentration status table and concentration statistics table. The experiment compares the performance of the deep residual network with residual unit and the deep convolutional neural network without residual unit in the classroom behavior recognition data set [10]. Among them, the deep neural network without residual unit refers to the neural network composed of the remaining parts after the Shortcut connection in the original residual network is removed. Compared with the deep convolution neural network, the generalization accuracy of the deep residual network is higher. The generalization accuracy of the former is 85.46% and the latter is 90.91%, indicating that the network can achieve better performance after adding the residual structure. The numerical value of the student classroom behavior recognition method based on human skeleton information and deep learning in the student classroom behavior data shows that compared with the original image data, the human skeleton information extracted when using the student classroom behavior recognition method to recognize seven typical classroom behaviors is more efficient in describing the action characteristics of classroom behaviors; Combined with the in-depth learning method, the students' classroom behavior recognition method can effectively eliminate the influence of irrelevant factors such as students' posture, dress and classroom background, highlight the key effective information, and has stronger generalization ability and higher recognition accuracy. Classroom behavior analysis and evaluation system detects students' side face concentration and students' head-up and head-down concentration. However, due to the occlusion of students' faces and the long distance, some students will not be detected and identified. When most students look up, they will be judged as attentive behavior and head-down behavior as inattentive behavior.

4. Conclusions

With the rapid development of information technology, innovative talent training models, while improving the efficiency of classroom teaching in colleges and universities, have practical application value and far-reaching significance. Research on students' classroom concentration behavior and the distribution of classroom concentration, using behavior recognition methods in the field of computer vision to identify students' classroom behaviors, which can provide real-time feedback on students' classroom learning, and serve as teachers to improve teaching methods and optimize classroom teaching and management It is helpful to improve teaching efficiency. Traditional machine learning methods to recognize classroom behavior require complex operations to extract image features, and its classification accuracy is low. Compared with traditional methods, convolutional neural network can automatically extract image features, complete the network training according to the end-to-end training from input to output, make the network have the ability to identify classroom behavior, improve the accuracy and reduce the operation complexity. The recognition method of students' classroom behavior based on human skeleton and deep learning can be used to identify students' typical classroom behavior, timely and effectively reflect students' learning status, and help teachers accurately grasp students' classroom learning, so as to help intelligent classroom teaching. It should be pointed out that the recognition accuracy of students' classroom behavior recognition method depends on the accuracy of attitude estimation results, and the recognized students' classroom behaviors are relatively simple and the types of behaviors are limited. Therefore, follow-up research needs to try different attitude estimation methods, and collect data with larger sample size and more diverse classroom behaviors to improve this method.

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