

Research Article

Network Intelligent Education System Based on the Deep Learning Algorithm

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In order to promote the deep integration of education and artificial intelligence and promote the landing of artificial intelligence in the field of education, a method based on deep learning is proposed. Deep learning is a very advanced pattern recognition algorithm, and it can mine potentially valuable knowledge from massive data and provide support for people's scientific decision-making. Experimental data show that the classification accuracy of deep learning algorithm reaches 99.5%. Even in the case of large data volume and large data categories, the accuracy is still up to 96.3%, which is far higher than the support vector machine algorithm, Bayesian theory algorithm, and K-means algorithm, which can mine and learn knowledge for users more accurately. *Conclusion.* The network intelligent education system based on deep learning strengthens the automation, intelligence, and interest of learning, so as to ensure the initiative of users in learning.

1. Introduction

As the core driving force of scientific and technological progress, artificial intelligence has brought profound changes to social development. Education is also actively exploring how to deeply integrate with artificial intelligence, promote educational innovation, and build new education ecology in the era of intelligence [1]. However, the specific empowerment of artificial intelligence in education is not achieved overnight. The education field is still facing problems such as lack of mature application mode, lack of artificial intelligence experts, and lack of technical platform support, and artificial intelligence has not been able to effectively support the construction of education tools and education systems [2]. How to promote the application of artificial intelligence to realize the convenient development of artificial intelligence system will be an important link in the development of artificial intelligence in education.

Automation is a symbol of progress in human civilization and social modernization [3]. With the progress of human society, automation technology is constantly developing under the impetus of social demand. At present, constructing an artificial intelligence system through the

automation method is an important direction of the artificial intelligence field. As a new research method, automatic machine learning, automatic deep learning, and other artificial intelligence methods use the design idea of training artificial intelligence with artificial intelligence, expand the scope of artificial intelligence research and application, and achieve the goal of open and inclusive artificial intelligence [4]. Users only need to give input data and task type, and professional tasks such as algorithm and model construction in system modeling are automatically completed by the machine so as to effectively reduce the threshold of artificial intelligence application and system development and promote the standardization and modular automation of artificial intelligence application. At present, the research of artificial intelligence in education generally presents the status quo of more theoretical discussion and less application. The automatic artificial intelligence method provides ideas for the research and application of artificial intelligence in the education field [5].

By focusing on the selection of AI projects related to application, promotion, and combining with the application in the field of education, the following analysis is obtained, as shown in Figure 1.

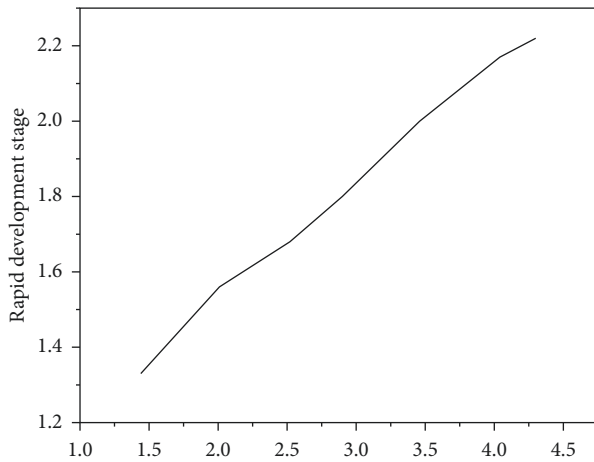


FIGURE 1: Project analysis of artificial intelligence maturity curve.

The application of artificial intelligence landing need support from an expert technical support and infrastructure to support the dimensions such as exploration and technology and services; in 2017, AI was in fast development consulting and system integration services in the technical maturity model that is put forward and aimed from the perspective of professional support for the area of artificial intelligence application demand software implementation and related services [6]. The artificial intelligence development toolkit from the technical support dimension and artificial intelligence cloud service from the infrastructure support dimension, respectively, proposed in 2018 and 2019 give technology maturity curve and rapid development to provide support for the implementation of artificial intelligence applications. The AI development kit includes data platform framework and analysis library software development kit, which can support the rapid development and deployment of AI applications [7].

Machine learning and deep learning algorithm research in artificial intelligence has been relatively mature, has passed the top of the rapid development period of technology, and has started to decline, and this period is also the key period of technology application mode exploration [8]. In the exploration of applications, as an effective method to lower the technological threshold of machine learning and deep learning, AUTOML (automated machine learning), which promotes the application of artificial intelligence, gained rapid development in 2019.

2. Literature Review

In the development of artificial intelligence, there are three main research paradigms and schools: symbolism, connectionism, and behaviorism [9]. The three paradigms have different interpretation and design ideas for the generation of intelligence and also affect the technical means and design mode of artificial intelligence application. At present, the field of educational artificial intelligence mainly uses machine learning and deep learning algorithms to build system applications, which is an intelligence model based on connectionism. The connectivist model is characterized by

“you need to learn higher-dimensional data to get high-level semantic representation”; the result is a black-box model, usually with a high degree of accuracy, but the inner workings of the model cannot be accurately known; it is difficult to estimate the importance of each feature to the predict results of the model and the interaction between different features.

With the support of big data and super computing power, machine learning deep learning has reached or even exceeded human level in computer vision, speech recognition, and natural language processing, and it is one of the important driving forces to achieve the success of artificial intelligence [10]. The design model and process of the education using artificial intelligence system based on connectionism are shown in Figure 2, which can be divided into five main functional modules: education demand, education data, education characteristics, education model, and education application.

The process of making machines intelligent for automatic learning is similar to the process of human thinking and learning. American social psychologist educator Cooper introduced learning circle theory, where he said that the human learning process is composed of four adaptive learning phases with a ring structure, including the specific experience, reflective observation, abstract conceptualization, and active practice, through experience reflection theory, and then used theory to guide the actions and further summed up experience from the action [11]. People achieve spiral progress in learning through experience, reflection, revelation, and action. The automatic artificial intelligence method of acquiring knowledge draw the idea of human learning and obtains knowledge from sublimation and theorization of experience, as shown in Figure 3. Specific experience corresponds to the acquisition of educational data and automatically constructs educational characteristics; reflective observation is the process of intelligent model training, and the abstract concept formed is the model construction, and the experiment and practice are the process of model application [12].

Based on the support of learning theory and automation idea, we design a new educational artificial intelligence application system model as shown in Figure 4. In the model, in the field of education business, it is only necessary to give clear education needs and submit education data to the cloud-based automatic processing module to complete the process of data cleaning feature construction, model construction, evaluation, and optimization. This process is transparent to the user, completed automatically by the system, and the optimized model is provided to the user [13]. In the field of education, we only need to pay attention to education needs and provide education data, and the intermediate process is processed by the automatic process. Among them, automatic feature engineering improves the standard process of traditional manual feature engineering, automatically constructs new candidate features from the data, and selects the best features for model training so that the model can have the best performance. This not only reduces the time spent in feature engineering but also can automatically combine according to data features, which

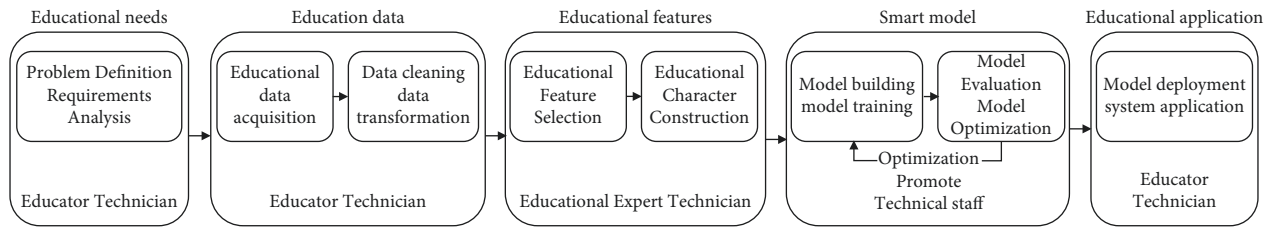


FIGURE 2: The main functional modules of educational artificial intelligence application system.

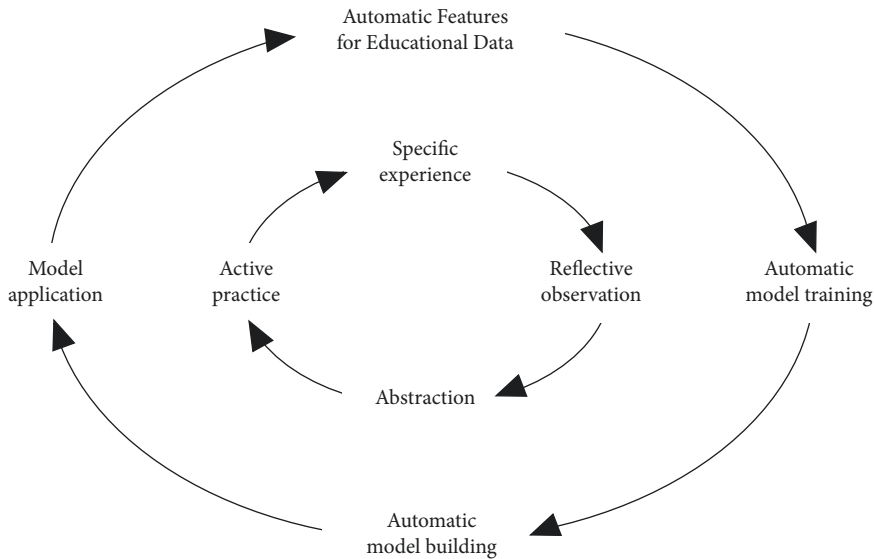


FIGURE 3: Learning circle theory and automated artificial intelligence.

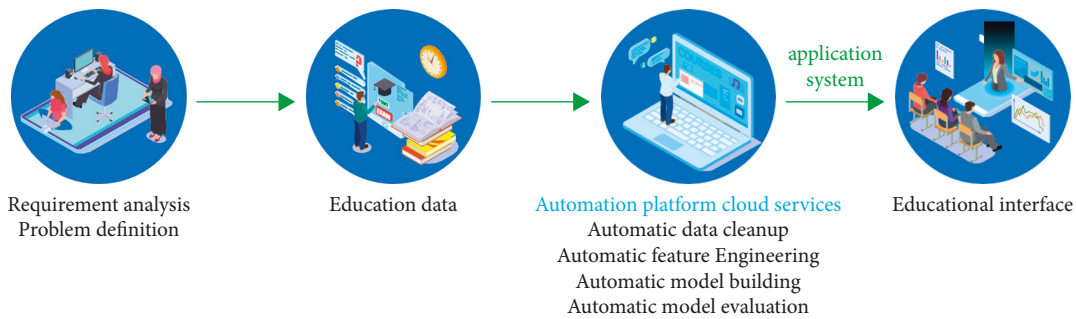


FIGURE 4: Design model of educational artificial intelligence system based on the automatic method.

effectively solves the problem of incomplete artificial combination of features and creates interpretable features, and it is more efficient and reproducible than manual feature engineering. Automatic model construction can select the model suitable for the dataset based on the characteristics of dataset and automatic feature engineering construction, train and adjust multiple models automatically, evaluate the trained model, and output the model with the best effect so as to realize the process of automation in artificial intelligence work.

The entire process of automated AI processing, from data importing to model training, can be done through drag-and-drop interactive interfaces [14]. This ease of use effectively expands the application scenarios and scope of artificial intelligence in education, enables ordinary

educators to use artificial intelligence technology to solve educational problems in reality, and provides an effective way for people who lack professional technical knowledge to quickly build artificial intelligence applications. At the same time, it can effectively shorten the development cycle of intelligent applications and promote the rapid development and iteration of educational artificial intelligence applications [15].

As an online learning platform, the intelligent education system has stored massive data resources through years of accumulation and operation. Therefore, introducing a deep learning technique, making full use of these runtime resources, improving the intelligent degree of Internet + education, realizing the diversity, and individualism of education have a great influence and meaning.

3. Method

3.1. Analysis and Design of the Intelligent Education System.

The traditional online education system only provides functions such as live courses, on-demand courses, and browsing. Users need to search for learning courses according to their own needs, so it cannot improve learning efficiency. On the basis of Internet+ education and other information systems, the intelligent education system introduces advanced deep learning technology and fully combines the current Internet+ education application mode. At the same time, cloud computing database 5G communication and other technologies are used to build an intelligent education system so that it can automatically collect, store, and push teaching resources from the network. In addition, it can intelligently push teaching resources according to teachers' application behaviors, including teaching content and teaching methods, as shown in Figure 5 [16].

3.1.1. Live Streaming. The intelligent education system can provide users with an online live streaming function, which can invite some famous scholars and teachers to carry out regular live streaming courses [17]. The live streaming function adopts advanced multimedia streaming technology to realize breakpoint continuation and offline download. Users only need to log in to the intelligent education system and choose their desired courses from the system for learning. In order to ensure that users can concentrate on learning, the intelligent education system also introduces the examination function. During each video playing, the knowledge of the previous section will be reviewed and summarized. Only after the exam is successful can you continue to study, which can ensure the effectiveness of online live learning.

3.1.2. Online VOD Function. The intelligent education system can collect videos of lectures and lectures of professional knowledge from scholars and upload them to the intelligent education system server so that students can demand these courses. At present, the intelligent education system can effectively find popular videos online through deep learning algorithm. Learning video resources required by users are recorded into the server so that users can learn and use them. VOD is one of the most critical functions of the system. Users can use advanced deep learning algorithms to search and find the courses they want to learn, so as to able to use VOD. The system also introduces breakpoint continuation technology to record every rhythm of user learning to ensure the continuity and integrity of user learning.

3.1.3. Basic Information Management Functions. The intelligent education system has a basic information management function, which can record users' basic information and input users' learning interests and courses according to their preferences, so as to provide applications for deep learning algorithms more quickly and realize the customization of personalized learning programs.

3.1.4. Personalized Learning Program Design. The intelligent education system according to the actual needs of users can develop some personalized learning programs. For example, a user is a computer professional student who is more interested in the course for computer composition principle and computer network, so when the user input their information, the intelligent education system can use deep learning algorithms and enable mining and analysis of user's learning records in order to develop learning solutions for clients. This program is customized for users. The learning program includes examination content of course knowledge and professional knowledge, as well as the cutting-edge development of the professional knowledge, so that users can master more advanced knowledge and the content needed by the current society, which can better improve the learning effect [18].

3.1.5. Teaching Resource Database. Teaching resource database can be saved and processed according to the data collected by a search engine [19]. At present, the intelligent education system can collect data information from the network according to the user's learning hotspot and can save the information in the intelligent education database, so as to improve the access efficiency of the intelligent education system. Intelligent education database can use the priority rotation algorithm to place popular data in the fast location and put the less frequently visited data in the slow location, so as to improve the resource utilization rate of database.

3.2. Application of the Deep Learning Algorithm in the Intelligent Education System

3.2.1. Deep Learning Application Process Modeling. The concept of deep learning was proposed in 2006 to discover distributed feature representation of data by combining low-level features to form more abstract high-level representation attribute categories or features [20]. Deep learning adds a feedback learning mechanism and has multiple network layers, including the convolutional layer, pooling layer, and full connection layer, which can effectively increase the training and learning depth of convolutional neural network so as to improve the accuracy of training and flexibly adjust the output parameters of convolutional neural network. In the application of deep learning, more advanced methods or technologies are gradually introduced, such as the measurement of simulated annealing factor gradient descent information, which not only improves the accuracy of deep learning but also expands the application field of deep learning. For example, smart grid medical image processing, abnormal event detection, and wireless signal prediction improves the accuracy of data mining pattern recognition or machine learning. Deep learning consists of six layers: input layer, convolutional Layer C1, pooling layer S1, convolutional Layer C2, pooling layer S2, and fully connected layer. By using convolutional mathematics and neural network learning process, the training accuracy of neural network model increased, and the accuracy of neural network identification information improved. The functions and

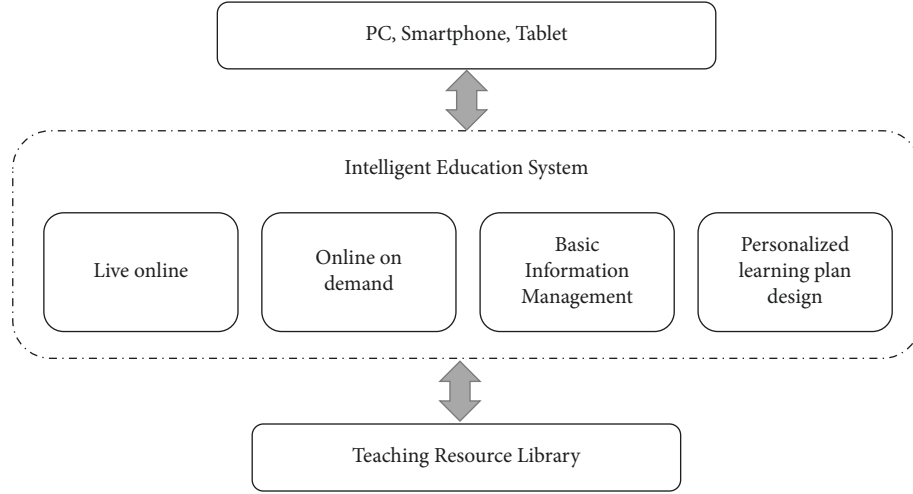


FIGURE 5: The overall function design of the intelligent education system.

functions of each layer of deep learning in the personalized learning customization process of the intelligent education system are described as follows.

(1) Input Layer

The text vectorization method is selected as the input layer processing method of convolutional neural network, and the massive input information is mapped to n-dimensional vector space through word embedding, and all input information is combined. Set the data format of the input learning materials as $(user_i, c_{i0} \oplus c_{i1} \oplus \dots \oplus c_{in}, 1/n(\sum_{j=1}^n o_{ij}))$, and \oplus represents learning information connected by convolution symbols, and thus, user information could be gained as $(user_i, g_i, \bar{o}_i)$. g_i represents all information about the learning material, \bar{o}_i represents all the information of the learner, the text vectorization technology is used to combine all information and represent it by vector vec_i :

$$vec_i = \text{Doc2VecC}(g_i). \quad (1)$$

The function Doc2VecC is returned to the n-dimensional vector through formula (1), and all the user information is expressed as the simple average value of text embedding, so that the obtained vector reflects the semantic content of the whole information during training and learning, and the user sample information is transformed into formula (2) through text quantization technology:

$$A = (user_i, vec_i, \bar{o}_i). \quad (2)$$

(2) Convolutional Layer

The input information vectorized by text is convolved in the representation matrix. The form of information convolution is different from that of image convolution, and the information can be convolved through one-dimensional space. $c^j \in R^1$ is used to represent the feature after text convolution, and the convolution formula is

$$c_i^j = f(W_c^j * g_{(:i:(i+W_s-1))} + l_c^j). \quad (3)$$

In formula (3), $*$ represents convolution operation, $c_1^j \in R$ represents bias vector, and f is ReLU activation function of the convolution layer, which can effectively avoid gradient disappearance.

Eigenvector is $c \in R^{i-WS+1}$, and the convolution formula (4) using the convolution kernel W_c^j is as follows:

$$c^j = [c_1^j, c_2^j, \dots, c_i^j, \dots, c_{i-WS+1}^j]. \quad (4)$$

Through the above process, the multigroup convolution kernel is used to obtain the convolution features of relevant information of university talents.

(3) Pooling Layer

The pooling layer is used to reduce the dimension of the features acquired by the convolutional layer, and the relatively important features in the convolutional neural network are retained by dimensionality reduction to avoid the over-fitting situation of the convolutional neural network. Use $K_t = \{k_1, k_2, \dots, k_{z-s+1}\}$ and q_t to represent the feature map obtained by the t th convolution layer and the result of pooling. K_t is selected as the maximum value in the pooling layer, and the pooling layer processing formula of convolutional neural network is as follows:

$$\begin{aligned} Q_t &= \max(K_t) \\ &= \max\{k_1, k_2, \dots, k_{z-s+1}\}. \end{aligned} \quad (5)$$

(4) Fully Connected Layer

The input results of the pooling layer are input into the full connection layer. Let the number of neurons in the full connection layer of the convolutional neural network be m , then ReLU function is selected as the activation function of the full connection layer, and the obtained fixed vector v_i is the hidden feature

TABLE 1: Experimental results of data mining for intelligent education system based on deep learning.

Dataset	K-means algorithm (%)	Support vector machine algorithm (%)	Bayesian theory algorithm (%)	Deep learning algorithm (%)
Dataset 1	69.5	82.6	80.1	99.5
Dataset 2	62.3	78.4	76.3	98.8
Dataset 3	60.1	74.2	70.4	97.9
Dataset 4	54.7	68.2	66.5	96.3

of the talent information in universities. The calculation formula (6) of the full connection layer is as follows:

$$v_i = \text{Relu}(w_t Q_t + l_t). \quad (6)$$

$v_i \in R^m$, Q_t and w_t are the pooling layer output of convolutional neural network and the weight of full connection layer, respectively, and l_t represents the bias coefficient.

3.3. System Testing. In order to verify the effectiveness of the deep learning algorithm, the system was compared with the k-means algorithm and support vector machine algorithm. The experimental process is described as follows: this paper collects teaching resources of 20 courses such as computer network communication principle and mechanical design, including 5000 in total. Learning resources include both learning content and advanced teaching or learning methods, each of which belongs to a separate classification, such as computer network teaching resources. 5000 datasets are divided into five datasets, each of which contains 1000 pieces of data. Dataset 1 contains 5 categories and 1000 pieces of data, and dataset 2 contains 10 categories and 2000 pieces of data. Dataset 3 includes 15 categories and 4000 pieces of data, and dataset 4 includes 20 categories and 5000 pieces of data. These data are classified by the deep learning algorithm k-means algorithm and support vector machine algorithm, and conclusions are analyzed and discussed.

4. Results and Discussion

For each method, 100 tests were conducted, and the average value of these 100 tests was taken as the comparative data. The detailed experimental data processing results are shown in Table 1.

Experimental results show that the classification accuracy of deep learning algorithm reaches 99.5. Even in the case of large data volume and large data categories, the accuracy is still up to 96.3%, which is far higher than the support vector machine algorithm, Bayesian theory algorithm, and k-means algorithm, which can mine and learn knowledge for users more accurately. In addition, at the same time, the running time of the algorithm is relatively short, can be completed in a short time, and the work efficiency is far more than the manual processing time and other algorithms. After the deep learning algorithm is introduced into the intelligent education system, it can not only recommend a learning scheme for users but also analyze users' learning interests according to their learning behaviors so as to recommend learning courses for them.

The intelligent education system strengthens the automation, intelligence, and interest of learning so as to ensure the initiative of users in learning.

5. Conclusion

This paper proposes to introduce deep learning technology to improve the online education system and develop an intelligent education system, which can automatically collect learning records, recommend learning resources according to people's hobbies or interests, and develop personalized learning programs. The intelligent education system can also be deployed and applied in teaching and training institutions of large enterprises, scientific research colleges and universities, changing the traditional online education mode, so as to attract more users to learn, and has a wide range of industrial value.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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