Convolutional Neural Network Based Network Distance English Teaching Effect Evaluation Method

Jing Wang¹ and Jia Fu²

¹School of Foreign Languages, Henan Polytechnic University, Jiaozuo 454003, China
²Medicine School of Henan University, Zhengzhou 450001, China

Correspondence should be addressed to Jia Fu; fujia@henu.edu.cn

Received 19 March 2022; Revised 5 April 2022; Accepted 11 April 2022; Published 9 May 2022

Copyright © 2022 Jing Wang and Jia Fu. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Aiming at the low accuracy of English teaching quality evaluation, a user perception evaluation modeling method based on convolutional neural network was proposed. Make full use of product usage data to establish quantitative mapping between teaching quality assessment and teaching quality to support product design improvement. On this basis, a convolutional neural network structure suitable for user perception evaluation model is established. Then, the optimal hyperparameters of the model were determined by k-fold cross validation analysis, and the overfitting problem of the model was improved. Finally, an example of user perception modeling for smart phones is taken to verify the effectiveness of the method. It is used for user perception assessment and prediction, which can help English teaching methods timely and accurately assess performance and provide decision support for English teaching improvement. SKYPE is currently the world’s most popular Internet remote video, audio, text, and real-time interactive platform; the real-time audio and video communication is very clear; the remote education will expand to the family, especially to promote the remote universality and universal English education that can play a big role. In this paper, the basic function and performance of the platform are presented, and distance education in English presents a practical approach to the application aspects.

1. Introduction

Nowadays, IT technology in the world has developed to a new era, and people, in their life and work, increasingly rely on the use of the Internet. Compared with the same situation in the past, the emergence of this new mode strongly promotes the universal development of distance education technology [1]. The Internet, with the help of an effective interactive platform, can be very convenient to distance teachers and students in real time to connect as a whole, and each student can, according to the needs of a destination online course selection and lectures, also exchange learning experience and share resources, especially for distance English teaching that is more meaningful. It has played a great role in promoting the improvement of English education methods. At present, with the development of distance education, a variety of online education platforms emerge at the historic moment, but they are still not easy to achieve the real time, convenience, and universality of education [2]. Since the emergence of SKYPE and other systems, to the above requirements, especially the realization of distance English teaching, has identified the technical basis, it is really to achieve the goal of less investment and quick results [3].

There are many factors that affect the quality of school teaching, among which the effectiveness of parents’ educational cooperation with their children is one of the important factors that cannot be ignored [4]. In the traditional assessment, parents often get only a test score, and it is difficult to implement effective cooperation for children’s education. And in the scientific evaluation, parents can not only obtain the results of the children in the evaluation, but also obtain the suggestions with school education according to the evaluation information and better promote their children’s health and comprehensive development [5].
For teachers, teaching quality assessment is not only to know how much knowledge students acquire through learning and how much results they get. More importantly, it is beneficial to the teacher in comprehensive understanding of the students' learning situation, their teaching results, and effectiveness of information, in order to analyze the strengths of their classroom teaching and short, to research the problems in their teaching, adjust teaching behavior, and improve their own teaching strategies, promoting the development of students and promoting their own professional development [6].

There is the modern distance education system on the one hand, in the case of a certain distance interval to rebuild the relationship between teaching and learning, and the other side is to put an education environment in the form of a distance learners' normal life environment, and people have been moving between the two aspects, especially in the premise of individualized learning, a new integration to realize teaching and learning behavior. With the development of computer technology, virtual technology, virtual teaching environment such as virtual classroom, virtual library, virtual laboratory, and virtual campus, the goal is getting closer and closer to us [7]. Virtual campus enables learners' individual learning to have an interactive and personalized environment, complete the interaction and collaboration between teachers and students and between learners, and truly realize the integration of teaching and learning. The virtual laboratory can obtain the same operation experience as the real experiment and can avoid the danger brought by the real experiment or operation [8]. At the same time, the virtual environment is intelligent, rapid, and hyperlinked and has multimedia, among other advantages, enabling learners to personally experience the natural phenomena and the process of things change that cannot be observed in the objective real world, which cannot be achieved by conventional education [9]. The environment provided by modern distance education technology should be closer to the virtual reality. And with the rise of mobile communication technology, the field of modern distance education is affected by it, and it may realize mobile in the future, so that anyone can truly obtain the information and learning resources they need at any place and at any time according to their own will. Therefore, the mobility of modern distance education technology can be regarded as a development direction [10].

The development and realization of distance education and multimedia technology are closely related. Distance education from the beginning of the correspondence development to today went through a total of three major changes [11]. The first is the changes in the educational environment. It used to be a classroom environment where teachers used to use books, blackboards, and words. After the advent of television, it developed into remote classroom, like TV university, where you can learn from home by TV. For example, under the support of the computer network through the selection of learning, and other different ways, students can learn what they want to complete the learning, and if there is a problem, it can also be timely feedback communication, completely forming a diversified learning method and learning environment. Second, the use of multimedia has been inseparable from our teaching. Before, our teaching only had text and sound; now, it developed into flash animation and video combined with a variety of forms of expression, so that students can be more engaged in learning. The third if interactivity [12].

An important part of modern distance education is the frequent use of interactivity. And it is a multilayered real-time interaction; it is not only the interaction between students and teachers, but also the interaction between man and machine, students and children, and other forms of community. Modern distance and open education is the combination of modern distance education and open education. It is a brand-new educational idea and educational concept. This kind of education is open under the mode of modern distance education. It adopts modern educational technology and implements distance and open education, which is different from the new educational form of campus face-to-face education. It is manifested in the universality, equality, and popularity of the educational object: in the educational form of time and space uncertainty, openness, knowledge in teaching organization and student learning; in the teaching means of learning support services (numerical, multimedia, interactive); innovation of knowledge, quality, and ability in teaching requirements; high quality and efficiency in teaching effect; lifelong in the process of education and learning [13].

With the emergence of new technologies, teaching evaluation methods are no longer single qualitative assessment but gradually developed into a combination of qualitative and quantitative, and the quantitative assessment of various data often requires the establishment of good data models. At present, the mainstream teaching evaluation methods in China and abroad include weighted average method, expert evaluation method, AHP hierarchical analysis method, fuzzy comprehensive evaluation method, neural network modeling method, and Markov chain method. At present, most scholars use fuzzy integrated evaluation method and hierarchical analysis to set the weight of the evaluation index. The studies on the introduction of machine learning technology into the university teaching evaluation system include the use of rough set theory to solve the problem of unreasonable indicator weights, the introduction of decision trees to analyze teaching data, and the use of association rule algorithms to analyze the factors affecting teaching quality. For example, Peng introduced the theory of artificial nerve network into the evaluation of teaching quality in national higher education, developed relevant mathematical models, quantified the indicators together to construct the BP nerve network model, and obtained more reasonable evaluation results. A mathematical model of teaching quality evaluation based on wavelet nerve network was proposed, which can improve the accuracy of teaching quality evaluation indexes. However, in the process of application, the nerve network has its own disadvantages such as being easy to fall into local extremes and strong sample dependence. In summary, some results have been achieved in recent years in the area of evaluation of teaching and learning. However, there are more studies on
the theory of teaching evaluation, but fewer studies on the technology of evaluation methods, and the technology used is relatively unified. Further research is needed on how to effectively use new technologies in data mining and machine learning to address the shortcomings of qualitative and quantitative evaluation in traditional teaching evaluation. To sum up, the following problems in the field of teaching evaluation need to be solved:

(1) There are many qualitative evaluations and relatively few quantitative evaluations, and the existing evaluation system has many qualitative contents but few quantitative contents, which is not easy to operate. It is easy to be influenced by subjective emotions. The evaluation indexes are too general and difficult to distinguish.

(2) The system of evaluation indicators needs to be further improved. There are many factors that affect the quality of teaching and learning, and the degree of influence of each factor varies. At present, the weighting coefficients of the evaluation indicators are mainly determined by expert agreement or teacher experience, which is not scientific and objective enough. There is a lack of modern scientific and technical methods and means to establish the evaluation index system and to assign reasonable weights to the indicators.

(3) The evaluation model is relatively single, and the evaluation method is relatively simple, using the traditional statistical method to determine the weight of the evaluation model. The evaluation algorithm is relatively homogeneous and cannot be dynamically changed or a large amount of data added, resulting in a fixed evaluation model that lacks self-adaptability.

2. Related Work

2.1. Evaluation Model of English Teaching Quality. We divide students’ achievements into a number of limited grades in a certain order and divide a long period of teaching into a number of hours, each hour as a moment. From the dynamic point of view, the change of students’ learning state from one moment to the next can objectively reflect the teaching effect under the teacher’s leading role, with a stable trend of transfer. This transfer trend depends on the current learning state of the students being taught and has no obvious or direct relationship with the previous state and no after-effect, so the teaching process can be seen as a homogeneous Markov chain. Using the limit distribution of homogeneous Markov chain, the teaching effect can be preliminarily evaluated. For the evaluation of English teaching quality, this paper constructs a specific evaluation index system, the structure of which is shown in Figure 1.

2.2. Research Status of Teaching Quality Evaluation System. Nowadays, more and more attention has been paid to education. All kinds of educational institutions at home and abroad have carried out in-depth research on teaching assessment, and there are many achievements [14].

(I) Teaching quality monitoring and assessment of training institutions are under macro control by governments in all countries. The Government of the Netherlands, for example, used to directly administer teaching assessments for training institutions. Later,
due to some changes in the way of national higher education, the teaching evaluation of training institutions also changed, so the government changed to direct management as the main and indirect control as a supplement. Another example is the British government, which advocated university autonomy before, but after the 1990s, the British government began to directly manage and regulate the monitoring and evaluation of teaching quality of various vocational and technical schools. In addition to the Netherlands and the UK, the governments of other countries also carry out macro-management in the process of the popularization of higher education, mainly through local laws, government allocation of education funds, or the formulation of relevant policies. In this way, through the effective and low use of teaching evaluation means, the government not only respects the schools, but also maximizes the protection of the special needs of higher vocational college autonomy and can ensure the macro control of higher vocational college [15–17]. The composition of school evaluation organizations and the implementation of evaluation activity can undertake regulation by the government, try to monitor it, and further adjust it. This purpose is to ensure the authority and impartiality of school evaluation institutions. At the same time, the government can also be in the results of the measurement from the understanding of higher vocational education teaching quality and teaching efficiency, such as school reputation, to understand the social from all walks of life, demand for the diversification of higher vocational school education to vocational education for more accurate decisions, of course, as the process of evaluation activities as an intermediary structure. It is natural to convey the government’s requirements on the education and research quality of higher vocational colleges, realizing the most effective regulation of higher vocational colleges [18].

(2) The evaluation institution shall have a rigorous organizational system. Such a provision appears in the relevant law of the Higher Education Act of France, which was enacted in July 1989. According to the law, the National Assessment Board is a board with full administrative autonomy, and its reports can be sent directly to the French president, rather than to the education ministry. The evaluation board has its own budget, is supported by the state finance, and consists of a general secretary, 24 full-time staff, and 17 members. The members are strictly qualified, selected from across the country and appointed by the president. In order to make the evaluation more smooth, efficient, and orderly, Dutch University has made strict and clear regulations on the purpose, principles, background, and evaluation institutions of education and teaching evaluation after integrating the opinions of universities, all sectors of society, and the government [19].

(3) The mediation and authority of the assessment institution: as a teaching institution of higher vocational education, its evaluation has its mediating character. For many years, conflicts and contradictions between government, society, and higher vocational colleges have always existed. And the evaluation organization is in alleviating its conflict and contradiction in the formation, and then further developed.

(4) The scoring criteria are as follows: 3 points will be given to those who have completely completed the self-set goals but still have some improvements to make. Two marks will be given to those who have achieved the desired goal in general but need urgent improvement in some important aspects; one point will be given to those who fail to complete the set goals and/or objectives and have serious defects that must be improved. In this way, after synthesizing the opinions of all parties, a more objective and socially recognized evaluation result can be obtained by reevaluation [20].

Students are the main body of teaching. Teaching activity is a process of interaction between teachers and students. The object of teaching is the student, and the effect of teaching should be reflected on the student. The purpose of teaching activities is to make the students regarding the thought, knowledge, skills, ability, and personality of continuous development tend to perfect. Studying students’ problems in teaching is the main link of teaching. Students are the main aspect of teaching. Whether the teacher’s teaching enables the students to obtain the learning effect should be the important content of teaching evaluation. Faced with the above problems, (1) Professor Wu Songyuan in 1992 in his research pointed out that students have the best say. (2) In 1996, Peking University conducted a study on curriculum evaluation of students and pointed out that classroom teaching is the main form of teaching in colleges and universities. Teaching is not only a process of transferring knowledge, but also a process of interpersonal communication between teachers and students. Based on this research, we know that college students are the teaching object, the recipient of teaching and the experience of teaching. Teachers’ teaching contents, teaching methods, personality characteristics, and personality charm can produce direct and rapid responses in students. Therefore, students’ response to the teaching effect has a very significant teaching effect evaluation significance. (3) Professor Guo Jianhou did a research in Beijing Foreign Studies University in 1996, a study on the reliability of Student Participation in teaching evaluation. It is pointed out in the study that the teaching of teachers in colleges and universities is satisfyingly beautiful for the benefit of students. It has always been the practice in the past that the evaluation of teaching effectiveness should be done by teachers’ colleagues and those responsible for teaching. They generally used to check teaching in the classroom and collect
the information they need from many aspects and angles, but there are some problems with this method, which neither has flexibility nor can prove anything. Therefore, the conclusion of this study is that it is practical and necessary to know what students really think.

Sliding window technology allows data to be restored to a certain period of time in the past. So, continuous data protection is the protection of continuous data within a certain time range, and this range is the size of the sliding window. The sliding window is the data within the continuous data protection window, the right side of the window is the data not detected by the current sliding window, the data on the left side of the window will be regarded as invalid data, that is, the point in time on the left side of the window is not recoverable, the general user can set the default window to cover the circumference, and the user needs to recover when you can check the recoverable starting time.

### 3. Perceptual Evaluation Modeling Based on Convolutional Neural Network

Convolutional neural network is a representative model of deep learning, originating from computer vision and image classification. It can effectively realize automatic feature extraction and classification, while traditional machine learning algorithms rely on manual feature extraction and selection. Researchers must have expertise in relevant fields to obtain satisfactory results. CNN mainly includes three processing units, namely, convolution layer, pooling layer, and full connection layer. CNN can directly extract deep feature representation of original data according to specific tasks through alternate cascade of convolution layer and pooling layer.

In the convolution layer, the convolution kernel extracts features by traversing different regions of the input data. The weight of the convolution kernel is shared in all regions of the same layer, so only one feature can be extracted by one convolution kernel. In practice, multiple convolution kernels are used to extract different features. The output of the convolution operation forms the characteristic graph through the activation function. The number of feature graphs is equal to the number of convolution kernels. For a given convolution layer, suppose that there are $M$ feature graphs, denoted as $c^m = (m = 1, 2, \ldots, M)$, the number of neurons on each feature graph is $a (a = 1, 2, \ldots, A)$, and the convolution kernel is determined by the weight $w_m$ and bias $b_m$. Then, the calculation formula of characteristic CMA on each neuron is

$$c_a^m = f \left( \sum_{i \in R_a} (w_i^m x_i) + b^m \right),$$

where $R_a$ represents the local receptive field corresponding to neuron $A$, that is, the specific region selected by the convolution kernel on the input data; $x_i$ indicates the specific value of the input data. $F(x)$ is the activation function.

The number of feature maps remains the same, but the resolution decreases. Pooling not only reduces the dimension of features, but also increases the network’s robustness to the problems of distortion, distortion, scaling, and shift of input data. The pooling kernel traverses different regions of the feature map of the convolution layer, selects a value from the window region according to the pooling function to represent the feature of the window, and then combines the features of multiple Windows to obtain the feature map of the pooling layer after dimensionality reduction. Feature diagram after pooling:

$$p^m = f (\beta^m \text{pool}(c^m) + b^m),$$

where $\beta^m$ is the weight coefficient; $\text{Pool}(x)$ is the pooling function.

This paper uses the sliding window technology to divide the time series data into a series of data units. Assume that there are $s$ kind of signal source, the data of length $l$, the fixed window width for $w$, and moving step for $m$, through the sliding window technology using data that can be transformed to $c$ a data unit, and each data unit user perception evaluation real labels by $w$ most times label decided to appear in the raw data, and the corresponding computation formula is as follows:

$$c = \left\lfloor \frac{1 - w_j}{m_s} \right\rfloor + 1$$

$$y_i = \text{mode}\{y_{ij}, y_{i2}, \ldots, y_{ilw}\}.$$  

The specific process of teaching quality evaluation based on principal component analysis is as follows. It is assumed that the original English teaching quality evaluation index set is

$$X = (X_1, X_2, \ldots, X_p)$$

where $P$ is the number of teaching evaluation indicators. It is necessary to conduct standardized processing of collected data, and the standardized processing formula is

$$x_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j}$$

Among them,

$$\bar{x}_j = \frac{1}{n} \sum_{i=1}^{n} x_{ij}$$

$$s_j = \frac{1}{n-1} \sum_{i=1}^{n} (x_{ij} - \bar{x}_j)^2.$$  

After standardization of teaching quality evaluation indicators, the correlation coefficient matrix of evaluation indicators is calculated as follows:

$$R = (r_{ij})_{p \times p},$$

where $r_{ij}$ represents the correlation coefficient between the $i$-th teaching quality evaluation sample and the $j$-th indicator, and the calculation method is
Construct the characteristic equation $\lambda u = Ru$, and calculate the eigenvalue and eigenvector of the characteristic equation:

$$\lambda = \left(\lambda_1, \lambda_2, \ldots, \lambda_p\right)$$

$$u = \left(u_1, u_2, \ldots, u_p\right).$$

Calculate the contribution of main components of English teaching quality evaluation index to cumulative variance:

$$\xi = \sum_{i=1}^{p} \alpha_i.$$

### 4. Experimental Results and Analysis

The experiment designed in this paper requires basic setting of experimental data to ensure experimental comparison under one variable. The set data is shown in Table 1.

| Number of test | English teaching duration/min | English teaching content          |
|----------------|--------------------------------|-----------------------------------|
| 1              | 15                             | English grammar                   |
| 2              | 30                             | English vocabulary explanation    |
| 3              | 35                             | The sentence pattern analysis     |
| 4              | 40                             | Oral practice                     |
| 5              | 45                             | Writing practice                  |
| 6              | 45                             | English dialogue                  |

#### Table 1: Setting test data.

| The evaluation period | Our method | Reference [4] | Reference [5] |
|-----------------------|------------|---------------|---------------|
|                       | Assessment accuracy | Utilization % | Assessment accuracy | Utilization % | Assessment accuracy | Utilization % |
| 1                     | 98.21      | 98.02         | 87.43         | 89.12         | 83.23         | 86.33         |
| 2                     | 97.09      | 97.67         | 86.55         | 87.34         | 82.12         | 87.3          |
| 3                     | 96.33      | 99.03         | 88.76         | 89.31         | 86.09         | 79.31         |
| 4                     | 98.54      | 96.34         | 89.43         | 87.67         | 88.23         | 78.92         |

#### Table 2: Performance test comparison.

$$r_{ij} = \frac{1}{n-1} \sum_{k=1}^{n} x_{ik} x_{kj}.$$ (8)

Construct the characteristic equation $\lambda u = Ru$, and calculate the eigenvalue and eigenvector of the characteristic equation:

$$\lambda = \left(\lambda_1, \lambda_2, \ldots, \lambda_p\right)$$

$$u = \left(u_1, u_2, \ldots, u_p\right).$$ (9)

The analysis of Figure 2 shows that the evaluation method in this paper is obviously close to the theoretical value in the process of comparison with the theoretical value, so it can be said that the design method in this paper has the comprehensive evaluation. Comparison of experimental results 2 is shown in Figure 3.

After systematically observing and analyzing the teaching factors that affect students’ learning, this paper extracts the indicators of teaching quality, such as learning objectives, exam difficulty, teacher exchange evaluation rate, and class language and obtains the factors that affect English teaching quality and the English learning situation of 620 students. Taking the individual with an improvement rate of 50% as the standard of progress and the significant improvement rate of the individual student as the objective evaluation index, the factors affecting the progress of achievement were analyzed by CHAID algorithm, and the experimental results are shown in Table 3.

Out of a sample of 620 students, 121, or 19.5% of the sample, showed significant improvement over the previous test. The most important factor that can be derived is "learning purpose." By comparing the size of each node in the decision tree, the influence of relevant factors on the apparent progress rate of individual achievement can be
obtained, and the influencing factors can be supported by policy. Comparison results of evaluation performance are shown in Table 4.

The results of the consistency experiments reflect the accuracy of the model for image quality prediction. The results are as follows, as shown in Figure 4, and our method performs the best on different kinds of datasets, especially on the JP2K.

It can be seen from Figures 4 and 5 that the model has a high consistency with human subjective perception, and the effect of the model has surpassed many classical and traditional quality evaluation methods. However, there is still a gap in the effect of the model compared with the previous two chapters. This chapter considers that there are two main reasons for this gap:

1. The loss function of the model consists of three parts, belonging to multitask learning, which increases the difficulty of network optimization. Three parts of loss function due to set the coefficient of different will have different effect on overall loss function, and the optimization of one of the tasks will affect the prediction effect of the other two tasks, so the study of three tasks at the same time increases the difficulty of network training, makes it hard for the model of this chapter for each task learning, and gives very good effect. The model in the first two chapters focuses on the task of learning image quality prediction, which greatly reduces the difficulty of network learning.

2. The structural design of this model is not to improve the accuracy of predicting mass fractions of the
model, but to enhance the interpretability of the model. On the one hand, the model does not adopt multiscale network structure, nor does it introduce attention mechanism to improve the learning process of the network. This network structure will not achieve very good quality prediction effect.

### Table 3: CHAID original data table.

| Level indicators                  | The secondary indicators | Sample size | The proportion (%) |
|-----------------------------------|--------------------------|-------------|--------------------|
| Gender                            | Male                     | 350         | 56.45              |
|                                   | Female                   | 270         | 43.55              |
| Learning goals                    | Interest in              | 131         | 21.13              |
|                                   | To study abroad          | 127         | 20.48              |
|                                   | To pass the exam         | 362         | 58.39              |
| Teaching mode                     | Flip the classroom       | 351         | 56.61              |
|                                   | The traditional teaching | 269         | 43.39              |
| Communication between teachers and students | No communication        | 97          | 15.65              |
|                                   | Communication in general | 387         | 62.42              |
|                                   | Communicate frequently   | 136         | 21.94              |
| Whether to teach in English       | All England teaching     | 184         | 29.68              |
|                                   | Half the teaching         | 436         | 70.32              |
| Students’ evaluation of their teacher | Optimal                 | 286         | 46.13              |
|                                   | Good                     | 305         | 49.19              |
|                                   | Poor                     | 29          | 4.68               |
| The difficulty of the exam        | Difficult                | 129         | 20.81              |
|                                   | General                  | 453         | 73.06              |
|                                   | Simple                   | 38          | 6.13               |
| The teacher type                  | A foreign teacher        | 134         | 21.61              |
|                                   | Domestic teacher         | 486         | 78.39              |

### Table 4: Comparison results of evaluation performance.

| Evaluation method | Evaluation accuracy (%) | Mean evaluation time (s) |
|-------------------|-------------------------|--------------------------|
| GA-BPNN           | 75.2                    | 2.59                     |
| SVM               | 83.64                   | 8.9                      |
| Our method        | 91.25                   | 2.13                     |

![Figure 4: Comparison of SRCC values of different algorithms on CSIQ.](image-url)
5. Conclusion

This paper introduces product usage data to establish teaching evaluation model. A teaching effect evaluation modeling method based on convolutional neural network is proposed to realize automatic extraction of data features and accurate modeling of user perception. Through the network teaching quality evaluation means, it not only improves the efficiency of evaluation, but also improves the transparency and reliability of evaluation. In the past, it can only evaluate the teaching quality after the end of the semester, but also check the daily teaching work. Statistical analysis of relevant data is also possible, and on this basis, the school related department puts forward the teaching suggestion, thus reflecting the evaluation work teaching service function. On the basis of some exploration and research on the English distance education system, this paper tests the English distance education system. English distance education system today is becoming increasingly perfect, and in the global distance education project under the background of positive development, English distance education system prototype will also be mature and perfect and become a reliable practical system and teaching methods, and English education and other subjects of distance education will play a huge role in promoting. However, its disadvantage is that it does not have a good support for synchronous voice communication between teachers and students, which should be improved in the future.

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.

References

[1] M. Bordagaray, L. dell’Olio, and A. Ibeas, “Modelling user perception of bus transit quality considering user and service heterogeneity[J],” Transportmetrica A:Transport Science, vol. 10, no. 8, pp. 705–721, 2014.
[2] M. C. Chen, K. C. Chang, and C. L. Hsu, “Applying a Kansei engineering-based logistics service design approach to developing international express services [J],” International Journal of Physical Distribution & Logistics Management, vol. 45, no. 6, pp. 618–646, 2015.
[3] A. Krizhevsky, I. Sutskever, and G. E. Hinton, “Imagenet classification with deep convolutional neural networks [J],” Advances in Neural Information Processing Systems, vol. 25, no. 2, pp. 1097–1105, 2012.
[4] R. Hecht-Nielsen, "Theory of the backpropagation neural network[C]//international joint conference on neural networks," IEEE, vol. 1, pp. 593–605, 2002.
[5] S. R. Young, D. C. Rose and T. P. Karnowski, Optimizing deep learning hyper-parameters through an evolutionary algorithm,” ACM, in Proceedings of the workshop on machine learning in high-performance computing environments, pp. 1–5, Austin, Texas, November, 2015.
[6] Z. Deng, L. Cao, and Y. Jiang, "Minimax probability TSK fuzzy system classifier:A more transparent and highly interpretable classification model [J]," IEEE transactions on fuzzy systems, vol. 23, no. 4, pp. 813–826, 2015.
[7] M. Zarinbal, M. H. F. Zarandi, and I. B. Türksen, “Relative entropy fuzzy c - means clustering,” Information sciences, vol. 260, no. 1, p. 74-97, 2014.
[8] W. Xue, X. Mou, and L. Zhang, “Blind image quality assessment using joint statistics of gradient magnitude and Laplacian features [J],” IEEE Transactions on Image Processing, vol. 23, no. 11, pp. 4850–4862, 2014.
[9] Q. Zhang, R. Cao, and F. Shi, “Interpreting CNN Knowledge via an Explanatory graph,” in Proceedings of the National Conference of the American Association for Artificial Intelligence, pp. 2124–2132, New Orleans, LA, USA, July, 2018.
[10] D. Pan, P. Shi, and M. Hou, “Blind Predicting Similar Quality Map for Image Quality assessment,” in Proceedings of the...
[11] Q. Zhang, Y. Nian Wu, and S. C. Zhu, “Interpretable convolutional neural networks,” in Proceedings of the Conference on Computer Vision and Pattern Recognition, pp. 8827–8836, San Juan, PR, USA, June, 2018.

[12] M. D. Zeiler and R. Fergus, “Visualizing and understanding convolutional networks,” Proceedings of the European Conference on Computer vision, pp. 818–833, Munich, Germany, September, 2014.

[13] A. Mahendran and A. Vedaldi, “Understanding deep image representations by inverting them,” in Proceedings of the Conference on Computer Vision and Pattern Recognition, pp. 5188–5196, Chapel Hill, NC, UK, October, 2015.

[14] K. Simonyan, A. Vedaldi, and A. Zisserman, “Deep inside convolutional networks: visualising image classification models and saliency maps,” Proceedings of the International Conference on Learning Representations, pp. 120–127, Vancouver, BC, Canada, April, 2014.

[15] J. Kim, H. Zeng, and D. Ghadiyaram, “Deep convolutional neural models for picture-quality prediction: challenges and solutions to data-driven image quality assessment [J],” IEEE Signal Processing Magazine, vol. 34, no. 6, pp. 130–141, 2017.

[16] Y. Lecun and L. Bottou, “Gradient-based learning applied to document recognition [J],” Proceedings of the IEEE, vol. 86, no. 11, pp. 2278–2324, 1998.

[17] L. Kang, P. Ye, and Y. Li, “Convolutional neural networks for No-reference image quality assessment,” in Proceedings of the 2014 IEEE Conference on Computer Vision and Pattern Recognition, June, 2014.

[18] S. Bosse, D. Maniry, and K. R. Muller, “Deep neural networks for No-reference and full-reference image quality assessment [J],” IEEE Transactions on Image Processing, vol. 27, p. 1, 2017.

[19] K. Ma, W. Liu, and K. Zhang, “End-to-End blind image quality assessment using deep neural networks[J],” IEEE Transactions on Image Processing, vol. 27, no. 3, pp. 1202–1213, 2017.

[20] J. Kim and S. Lee, “Fully deep blind image quality predictor,” IEEE Journal of Selected topics in signal processing, vol. 11, no. 1, pp. 206–220, 2017.