





Advertising Design Using Convective Neural Network on Click Through and Value Rate

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Abstract. The purpose of this article is to discuss the application of ML (Machine learning) algorithm and CAD (Computer aided design) technology in advertising design, and verify its effectiveness by using simulation research methods. First of all, this article collects and preprocesses a large quantity of advertising design works, and extracts the features related to advertising design through appropriate feature extraction methods. Then, these features are classified and predicted by ML algorithm to understand the inherent laws and trends of advertising design. Moreover, this article combines CAD technology to carry out auxiliary modeling and typesetting of advertising design, so as to provide designers with more accurate and efficient design tools. Through simulation research, the accuracy and efficiency of advertising design combined with different ML models and CAD technology are compared. The results show that the CNN (Convective neural network) proposed in this article performs well in predicting the accuracy and efficiency of consumer behavior and market demand, and its accuracy and efficiency are better than those of GAN and RNN. Moreover, the Click Through Rate (CTR) and Click Value Rate (CVR) of advertisements using CNN network structure proposed in this article are ideal, and their values are better than those of GAN network structure. This advertising design method based on ML algorithm and CAD technology has broad application prospects. For example, end-to-end automatic speech recognition technology has been widely applied in multiple fields such as smart homes, car navigation, smartphones, and tablets.

Keywords: Machine Learning; Convolutional Neural Network; Computer Aided Design; Advertising Design

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1 INTRODUCTION

Advertising design is an important link in advertising activities, which involves how to effectively convey advertising information to the target audience. CAD tool is a computer-aided design software

that can easily draw circuit diagrams and circuit boards through a graphical interface, and can simulate and optimize circuits. Through CAD tools, designers can more efficiently conduct circuit design and data analysis, thereby improving design quality and efficiency. Need to master the application skills of CAD tools in microelectronic circuit design. Microelectronic circuit design requires precise control and consideration of details, so designers need to proficiently master various functions and operating skills of CAD tools. Abugharbieh and Marar [1] discussed the importance and application cases of integrating various in microelectronic circuit design courses. Taking an actual microelectronic circuit design project as an example, illustrate the application effect of integrating multiple computer-aided design tools. This project requires the design of a high-speed cache controller circuit, which requires the use of Cadence for circuit design and simulation, Synopsys for logic synthesis and physical verification, and finally Keysight for testing and verification. Advertising design needs to consider many factors, including advertising objectives, audience groups, communication channels, creative expressions and so on. Customer engagement behavior response refers to the behavioral response of customers after exposure to corporate marketing activities, such as purchasing products, participating in activities, providing feedback, etc. Accurately predicting customer engagement behavior responses can help companies develop more accurate marketing strategies, improve customer satisfaction and loyalty. However, customer engagement behavior responses are influenced by various factors, such as customer demand, market environment, competitive situation, etc., making prediction difficult. Dai and Wang [2] use the random forest model in machine learning algorithms to predict customer participation behavior responses. Comprehensively considers various features of samples for classification or regression prediction. When predicting customer engagement behavior responses, we first need to collect relevant information about the customer, such as personal information, purchase history, social media interactions, etc. Then, a random forest model is used to analyze and learn this information, in order to predict the customer's participation behavior response.

In today's business environment, advertising design plays a vital role. Good advertising design can attract consumers' attention, improve brand awareness and promote product sales. However, the traditional advertising design process often depends on the designer's experience and creativity, and it is difficult to ensure the efficiency and quality of design. With the rapid development of artificial intelligence technology, the field of marketing is facing unprecedented changes. Artificial intelligence technology has brought many opportunities for marketing, but there are also some pitfalls. De Bruyn et al. [3] explored the connection between artificial intelligence and marketing, as well as how to utilize artificial intelligence technology to enhance marketing effectiveness. Artificial intelligence technology requires a large amount of data support, but there is a risk of leaking customer privacy during the collection, storage, and use of data. Once data leakage occurs, it not only damages the reputation of the enterprise, but may also face legal sanctions. The decision-making process of artificial intelligence algorithms is often opaque, leading to consumers' distrust of the results. Using ML algorithm, advertising content can be automatically generated based on user behavior, interests, preferences, and other data, improving the accuracy and click through rate of advertisements. Through CAD technology, advertising design schemes can be quickly transformed into actual products or promotional materials, further improving the efficiency of advertising generation. The ML algorithm can analyze feedback data after advertising placement, including indicators such as click through rate and conversion rate, to help advertisers evaluate advertising effectiveness and adjust advertising strategies in a timely manner. Meanwhile, through CAD technology, advertising design schemes can be optimized to enhance the visual effect and attractiveness of advertisements. Using ML algorithm to analyze user behavior can provide personalized advertising recommendation services for users. By combining CAD technology, more attractive advertising content can be designed based on user interests and needs, improving user acceptance and conversion rates of advertisements. In order to adapt to the development of the times and the needs of teaching, ML algorithm and CAD technology can be introduced into microelectronic circuit design to improve the teaching and practical level of advertising design. In the field of microelectronic circuit design, courses related to ML algorithms and CAD technology are offered to enable students to understand and master the application methods and skills of these technologies in advertising design. Organize

students to collaborate with advertising companies or related enterprises on projects, allowing them to personally experience and apply ML algorithms and CAD technology in the process of advertising design in practice, and improve their practical operational abilities. Complex networks are important tools for describing the relationships between a large number of interacting individuals and are widely used in various fields, such as social networks, biological networks, and the Internet. In complex networks, the importance of participants varies, with some participants having more connections and higher degrees, while others are at the edge of the network. Fan et al. [4] proposed an algorithm based on deep reinforcement learning to identify key participants in complex networks. Firstly, we use Graph Convolutional Neural Network (GCN) to model complex networks to capture their structural information. Then, we use deep reinforcement learning algorithms to optimize GCN to identify key participants. Specifically, we use the Actor Critic algorithm to train GCN and optimize its parameters by maximizing cumulative rewards. During the training process, we use Monte Carlo Tree Search (MCTS) strategy to select key participants in the network.

Guo and Li [5] with the aim of providing useful references for research and practice in related fields. Video streaming technology is a technology for real-time transmission of video data, which can achieve streaming transmission and playback of videos on the Internet. Compared to the traditional download and watch mode, video streaming, continuity, and interactivity. In the field of art design and production, video streaming technology provides artists and designers with more flexible and efficient expression techniques. It covers multiple fields such as painting, sculpture, architecture, film and television, and has the characteristics of efficiency, accuracy, and editability. DL algorithm can deal with complex nonlinear data, such as images, voices and texts. It can automatically learn the representation of features and extract deep-seated features from data, thus getting more accurate results. In today's digital age, computer-aided design (CAID) has played an important role in various design fields, including sculpture art. Sculpture art is a form of art in three-dimensional space that creates works with spatial, three-dimensional, and depth by shaping, carving, or constructing materials. Guo and Wang [6] explored the aim of providing some inspiration for sculpture artists and researchers in related fields. Computer assisted modeling design, modification, and optimization. Material mapping is used to make the model appear more realistic by mapping the texture onto the surface of the model. Rendering is the calculation of lighting on a model to simulate real lighting effects; Animation production can achieve dynamic display of models. It provides more powerful tools for these fields and solves many problems that traditional ML algorithm can't solve. This article aims to explore the use of DL algorithm and CAD in ML in advertising design, and verify its effectiveness and superiority through simulation research. In machine learning, data is the foundation for model training. In marketing, data includes information such as consumer behavior, market trends, and competitors. When making marketing decisions, it is necessary to preprocess these data, including steps such as data cleaning, feature extraction, and data transformation. In marketing, the measurement indicators of machine learning include traditional measurement indicators and emerging internet marketing indicators. Traditional measurement indicators such as sales revenue and user satisfaction can evaluate the success of marketing activities. Emerging internet marketing indicators such as social media influence and brand awareness can reflect the brand's influence and recognition on the internet. These indicators can be calculated and analyzed through technologies such as data mining and natural language processing, helping enterprises better understand the market and consumer needs, and optimize marketing strategies [7].

Artificial intelligence technology can be used for image recognition and generation. For example, convolutional neural networks (CNN) can be used to identify features such as style, color, and shape in artistic works, and generate new works with similar features. This technology has been applied in art creation, art evaluation, and art education. Natural Language Processing (NLP) and sentiment analysis techniques can be used to understand textual information in art reviews and works of art. He and Sun [8] use NLP technology to extract keywords and themes from text in order to better understand the meaning of artistic works. Emotional analysis technology can be used to evaluate the emotional tendencies of artistic works or comments, helping people better understand the emotions expressed in artistic works. Through intelligent painting technology, students can simulate the painting process on a computer and learn painting techniques and methods. At the same time,

intelligent painting can also evaluate and improve students' painting works, helping them improve their painting skills. Computer assisted art teaching refers to a new teaching method that utilizes computer technology to assist art teaching activities. It has advantages that traditional teaching methods cannot match, such as large amount of information, strong interactivity, and high flexibility. Through computer-aided art teaching, students' art skills and creative abilities can be improved, and their aesthetic literacy and innovative spirit can be cultivated. ML algorithm make predictions and decisions based on this information. In today's digital age, online advertising has become an important means and marketing activities. However, with the rapid development of digital media, the transaction of online advertising often depends on the design and operational strategies of advertising contracts. Kim et al. [9] explored how to design and optimize online advertising contracts, as well as the important role of operational research in them. The design and operation research of online advertising contracts is a key link in digital marketing. By carefully designing advertising contracts and cooperating with effective operational research, online advertising can achieve the best placement effect, increase brand awareness, and ultimately achieve commercial goals. However, this requires a deep understanding of digital media, advertising regulations, and the market environment, which requires continuous learning and practice. In advertising design, ML algorithm can help designers predict consumers' behaviors and preferences, so as to design advertisements that are more in line with market demand. CAD technology can help designers to realize the design concept more quickly and accurately, and improve the design efficiency. The main purpose of this article is to discuss how to better combine ML algorithm and CAD technology in advertising design. Its innovations are as follows:

⊙ The ML algorithm and CAD are applied to the research of advertising design, and the ML algorithm is used to predict consumer behavior and market demand, and the prediction results are applied to all aspects of advertising design, such as creativity, typesetting, color and font, which is a new application method.

⊙ A new advertising design process is proposed, which combines ML and CAD technology, and guides all aspects of advertising design through consumer behavior and market demand prediction results based on DL. This process is different from the traditional advertising design process, and it pays more attention to data-driven and consumer-oriented.

Firstly, through collecting and analyzing a large quantity of advertising design data, this article extracts the characteristics related to advertising effect. Then, ML algorithm is used to study and analyze these characteristics, so as to realize accurate prediction of consumer behavior and market demand. Next, combined with CAD technology, these prediction results are applied to all aspects of advertising design, such as creativity, typesetting, color and font. Moreover, in order to better evaluate the performance of ML algorithm and CAD technology in advertising design, a series of experimental simulations are carried out.

2 RELATED WORK

Targeted advertising has become an important marketing strategy in the commercial field. By accurately targeting target users and placing relevant advertisements, enterprises can improve advertising effectiveness and reduce marketing costs. However, to achieve precise targeted advertising placement, the key is to understand the interests and needs of users. Kim et al. [10] explored how to use deep learning technology to identify user interests in targeted advertising. Traditional user interest recognition methods are mainly based on technologies such as keyword matching and text classification. However, these methods often exhibit certain limitations when dealing with complex user interests. The rise of deep learning technology has provided new solutions to this problem. Deep learning models have the ability to automatically extract features and better understand the connotation of user interests. The teaching mode of contemporary art computer-aided design has also become an important way to cultivate innovative talents. Liu and Yang [11] explore the characteristics and core content from an innovative perspective, and analyze its application scenarios and challenges. Cultivating students' innovative thinking patterns,

encouraging them to break away from traditional thinking frameworks and try new design concepts and techniques. This model emphasizes the integration of technology and art, utilizing computer-aided design software to enhance students' design skills and innovation abilities. Through diversified practical teaching methods such as design competitions and practical projects, students are encouraged to apply theoretical knowledge to practice, cultivating their practical and problem-solving abilities.

DRL learns optimal strategies through interaction with the environment, thereby achieving efficient processing of complex tasks. Batch Deep Reinforcement Learning (BDRL) applies DRL to large-scale datasets to achieve more accurate predictions and decisions. In live shopping, BDRL can help merchants dynamically distribute coupons based on consumers' historical behavior and preferences, thereby improving conversion rates and sales. Liu [12] proposed a dynamic coupon positioning method based on BDRL. Firstly, we constructed a deep reinforcement learning model that can learn the optimal coupon issuance strategy based on consumers' historical behavioral data. Then, we collected user behavior data from a live shopping platform as a training set and used Monte Carlo Tree Search (MCTS) algorithm for model training. In the experimental stage, we simulated sales for different product categories and compared the sales effects of the BDRL method with traditional static coupon issuance methods. Advertising optimization based on artificial intelligence mainly involves two aspects: first, optimization of advertising content, and second, optimization of advertising placement channels. In terms of advertising content, artificial intelligence can automatically adjust advertising content by analyzing audience feedback and behavioral data, improving the attractiveness and conversion rate of advertisements. In terms of advertising placement, artificial intelligence can automatically optimize the advertising placement strategy based on the characteristics of different channels and the behavioral characteristics of the audience, improving the exposure and click through rate of the advertisement. Qin and Jiang [13] have promoted the development of advertising business towards digitization and intelligence. Artificial intelligence will also promote the integration of advertising and art. Through intelligent creation and optimization, advertising will better meet the needs and aesthetics of the audience, thereby injecting more innovation and vitality into the advertising industry. Internet marketing and advertising writing skills are of great significance in attracting target audiences. Firstly, it is important to ensure that the advertising content aligns with the user interests and habits of the Instagram platform. For example, using catchphrases and trends to increase the attractiveness of advertisements. Secondly, adopting a storytelling approach to present products or services to evoke emotional resonance among users. Rizomyliotis et al. [14] analyzed the relationship between the advertising design features, brand image, and the purchase intention of the millennial generation of Jia Instagram.

And explored the role of internet marketing and advertising writing techniques in attracting target audiences. In order to better attract millennial users, it is recommended that advertising creators fully utilize the advantages of Instagram's advertising design features. Pay attention to the alignment of brand image with millennial values and interests, and use internet marketing and advertising writing skills to enhance the attractiveness and interactivity of advertising. By continuously optimizing advertising strategies, brands can establish closer connections with the millennial generation and achieve more effective marketing outcomes. In complex product design and manufacturing processes, intelligent assembly modeling is a core link. It not only helps designers better understand and anticipate the behavior of products, but also optimizes the manufacturing process and improves production efficiency. Mo et al. [15] explored how to use computer-aided intelligent assembly modeling to capture and express design intent, as well as its application. Machine learning methods to simulate the assembly process of products. Through this approach, designers can predict and solve potential problems during the product design phase, thereby reducing later modifications and rework. The core of intelligent assembly modeling is to capture and express design intent. Design intent is the designer's expectations and goals for product shape, functionality, and performance.

By understanding design intent, intelligent assembly models can predict and optimize product performance. Machine learning components play a vital role in autonomous vehicle. Through machine learning technology, vehicles can recognize environmental information such as roads, obstacles, and

traffic signals, and make autonomous decision-making and driving control. The main process of machine learning components includes model establishment, data preprocessing, feature extraction, and classification. Train a model that can recognize road information and make autonomous decisions based on a large amount of data. Clean, transform, and normalize the collected raw data to facilitate model training. Extract features related to road information and driving decisions from the preprocessed data. Tuncali et al. [16] used classification algorithms to classify features to achieve functions such as road recognition and obstacle avoidance. Cold start is a crucial stage in increasing the market thickness of online advertising platforms. At this stage, data-driven algorithms and field experiments play an important role in optimizing advertising platforms and increasing market thickness. Ye et al. [17] introduced how data-driven algorithms can optimize advertising platforms and explored the practical application effects of field experiments. The market thickness of online advertising platforms refers to the ratio between advertising revenue and expenditure of advertising platforms within a specific period of time. The higher the market thickness, the stronger the profitability of advertising platforms. In the cold start stage, how to improve market thickness is the core issue that advertising platform operators are concerned about. Data-driven algorithms can help advertising platforms better understand user needs, optimize advertising placement strategies, and thereby increase market thickness. Zhou [18] analyzed its application scenarios and cases, and finally looked forward to future development trends. Firstly, obtain a large amount of user behavior data and product information through data collection. Then, feature extraction technology is used to process the data and extract features related to advertising recommendations. Next, the deep learning model is used to train features and establish a mapping relationship between users and products. Finally, in the application process, precise recommendations for advertisements are made based on real-time user behavior and feedback.

However, most of these studies only focus on a single design element and lack the optimization of the overall advertising design process. Therefore, this article will deeply study how to apply ML algorithm and CAD to the whole advertising design process, and improve the overall efficiency and quality of design.

3 DL ALGORITHM

The classical algorithms in DL field include back propagation, CNN, recurrent neural network and generated countermeasure network. Back propagation algorithm is one of the most basic algorithms in DL. It calculates the error between the output layer and the target value, and then adjusts the weight and bias of neural network by back propagation to minimize the error. CNN is a kind of neural network specially used for processing image data. It extracts features and classifies images through convolution layer, pooling layer and other structures. Generating antagonistic network is a relatively new DL algorithm, which generates more realistic samples through antagonistic competition between two neural networks. DL algorithm can automatically extract features from data and learn complex patterns from data. Through the learning process of DL algorithm, a model that can predict consumer behavior and market demand can be established. In this article, CNN algorithm in DL is used to learn and predict advertising design data. CNN used in this article includes three layers: IL(Input layer), HL(Hidden layer) and OL(Output layer). Among them, IL has n neurons, and the input vector is:

$$X = (x_1, x_2, \dots, x_n)^T \quad (1)$$

$$Y = (y_1, y_2, \dots, y_m)^T \quad (2)$$

$$a_j = (j = 1, 2, \dots, l) \quad (3)$$

The threshold of each neuron in OL is:

$$b_k = (k = 1, 2, \dots, m) \quad (4)$$

The state space expression of CNN is:

$$x^{(k)} = f(\omega_1 u^{(k-1)}) \quad (5)$$

$$y^{(k)} = g(\omega_2 x^{(k)}) \quad (6)$$

Firstly, this article uses CNN algorithm to extract features from advertisement design data, and maps the features in the data to neural network. Then, these features are studied and analyzed by multi-layer neural network, and more and more complex patterns are gradually extracted; Finally, the trained neural network model is used to predict the new advertising design data, and the prediction results are obtained.

4 CONSTRUCTION OF PREDICTION MODEL BASED ON DL

This section is mainly based on DL technology. By collecting and analyzing a large quantity of advertising design data, the characteristics related to advertising effect are extracted. Using these characteristics, the depth algorithm can learn and analyze the consumer's behavior and the trend of market demand, thus constructing a prediction model and providing effective reference for advertising design. First of all, it is needed to make clear the reliability and accuracy of advertising design data sources. These data should include historical advertising design data and consumer behavior data, among which historical advertising design data can be used to understand the effects of different types of advertisements, while consumer behavior data can reflect consumers' purchasing will and preferences. Next, the DL algorithm is used to process these data. The model structure adopted in this article is shown in Figure 1.

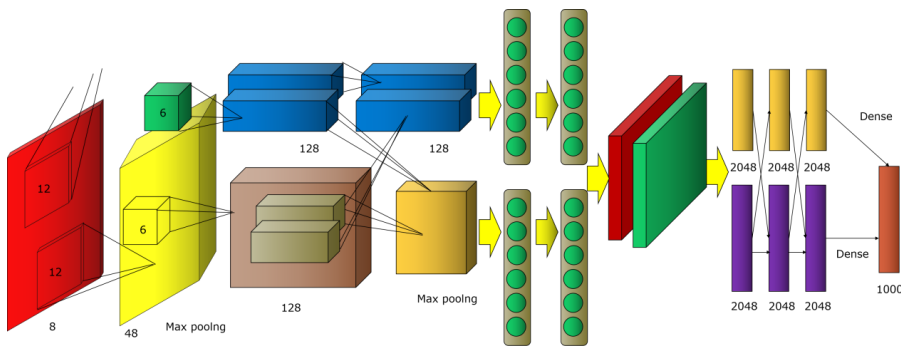


Figure 1: Model structure diagram.

The advantage of CNN is that it can automatically adjust the network weight and optimize the model parameters through learning. CNN optimizes the model parameters by minimizing the energy function between input and output. In CNN, a smaller batch size can accelerate the training, but it may lead to the convergence of the model to the local optimal solution; Larger batch size can improve the stability of model convergence, but it may waste computing resources. Choosing an appropriate batch size can balance memory usage and training speed. The batch size chosen in this article is 150. In this article, we choose the Dropout regularization method. Dropout is a very effective regularization method, which reduces the risk of over-fitting by randomly eliminating (or "inactivating") some neurons when training neural networks. Specifically, during the training process, Dropout will traverse each layer of the network and randomly eliminate (or "inactivate") each neuron with a certain probability (usually 0.5). Eliminating the neuron means that the neuron will no longer participate in the subsequent training process, including the calculation of its output and the back propagation of the gradient. In this way, the network structure used by each training sample is slightly different, which is equivalent to training multiple networks at the same time. In the test, another method is adopted-for each input sample, a combination of all possible sub-networks is used to calculate its prediction result, and then the average value is taken as the final prediction result. Because Dropout is not used in the test phase, all neurons in the network will be activated at this

time, so more accurate prediction results can be obtained. In order to facilitate the design of neural network, the Holt-Winter model is adjusted as follows:

$$\text{Sales level : } L_t = \alpha \frac{Y_t}{S_{t-s}} + (1-\alpha)(L_{t-1} + b_{t-1}) \quad (7)$$

$$\text{Sales trend : } b_t = \beta(L_t + L_{t-1}) + (1-\beta)b_{t-1} \quad (8)$$

$$\text{Seasonal influence factor : } S_t = \gamma \frac{Y_t}{L_t} + (1-\gamma)S_{t-s} \quad (9)$$

$$\text{Sales forecast : } F_{t+m} = (L_t + b_t)S_{t-s+m} \quad (10)$$

Where α , β and γ are smoothing coefficients, and their values range from [0,1]. Subscript t is time series; Subscript s is the length of seasonal interval; Subscript m is the prediction interval length; L is the sales level; Y is the actual sales volume; b is the sales trend; S is a seasonal influencing factor; F is a sales forecast. The input of the network is the actual sales volume and the output is the sales forecast.

For numerical features, use -1 instead of outliers, especially for features with negative values, use -10000 instead of outliers; For category features, such as user's age and grade, one-hot coding is adopted, and a 1028-dimensional feature matrix is obtained after coding. The higher the feature dimension, the longer the model training and prediction time, and the larger the memory occupation, so it is needed to reduce the dimension. In this article, the feature selection method based on gradient descent tree is considered. CNN must learn according to certain learning criteria before it can work, and this learning process is also the optimization process of the model. In order to establish

CNN, the iterations in equations (7) and (8) are expanded in the form of L_0 and b_0 :

$$\text{Sales level : } L_t = \sum_{i=1}^t v_{it} \frac{Y_i}{S_i} + v_{L0t} L_0 + v_{b0t} b_0 \quad (11)$$

$$\text{Sales trend : } b_t = \sum_{i=1}^t \omega_{it} \frac{Y_i}{S_i} + \omega_{L0t} L_0 + \omega_{b0t} b_0 \quad (12)$$

Among them, L_0 , b_0 and S_i^0 are initialization data, which can be obtained by using the data of the last seasonal interval; v and ω are weights of neural network. In fact, the training process of CNN is to find a set of best parameters that can approximate the real correlation on the data set. It is needed to make clear the expected error and actual error in the learning process.

$$E = \frac{1}{2} \sum_{i \in I} \sum_{i \in M} (o_{im} - p o_{im})^2 \quad (13)$$

In ML, data imbalance is a common problem, especially when there are large and small classes of data. Small classes of data usually have fewer samples, while large classes of data have more samples. This may lead to over-fitting of the model to large-scale data, thus ignoring the important information of small-scale data in forecasting. In order to solve this problem, this article controls the weight of different types of data by adding regular terms to the loss function. Specifically, this article adds a regularization term to the standard loss function to control the weight of different types of data. This regularization term can be regarded as a penalty term, which is used to punish those models that over-fit small classes of data. In this way, the weights of different types of data can be controlled, which makes the model pay more attention to small types of data in the training process, thus avoiding over-fitting of large types of data. In addition, in order to improve the accuracy of the

prediction model, this article continuously collects more data and conducts training to achieve higher prediction accuracy.

5 ADVERTISING DESIGN BASED ON CAD TECHNOLOGY

The construction of prediction model based on DL is an important technical means in advertising design, which can improve the pertinence and efficiency of advertising design and help to improve the CTR and CVR of advertising. In this section, we will discuss how to combine CAD technology with the prediction results of consumer behavior and market demand based on DL in the previous section, so as to apply it to all aspects of advertising design, including creativity, typesetting, colors and fonts. CAD technology, especially software such as Adobe Illustrator and Photoshop, has been widely used in advertising design. These tools can help designers realize creativity, conduct design experiments quickly, and present the final design with high precision and efficiency. Various tools and functions in CAD software, such as adjustable drawing tools, color filling, transparency and gradient, and various preset graphic styles, provide designers with great creative space.

Using DL algorithm to predict consumer behavior and market demand. These prediction results can provide valuable guidance for advertising design. The following are several specific application examples: ① Creativity: Through DL algorithm, consumers' reactions to different types of advertising creativity can be predicted. Suppose the DL model in this article predicts that consumers are more interested in advertisements with a sense of humor. In order to make advertisements more humorous, designers can use some funny elements, such as using funny characters, funny scenes, or word games that can arouse readers' association. Moreover, designers can also use CAD technology to present these ideas, such as using drawing tools to draw unique characters or scenes, or using text tools to make text typesetting with special effects. ② Typesetting: Assuming that DL model shows that simple and clear typography style is more popular with consumers. Designers can use layout and typesetting tools in CAD software to present text information in a clear and easy-to-understand way. For example, you can use formats such as title, subtitle and body to distinguish different text information, or use grids and reference lines to ensure the layout balance and consistency of advertisements. ③ Color: Through DL, it can be predicted that some color combinations are more attractive to consumers. If DL model predicts that blue and orange are better together, designers can use the color tools in CAD software to integrate these two colors into advertising design. For example, you can use blue in the background and orange in text or graphic elements, or vice versa. Moreover, we need to lay stress on the saturation and brightness of colors to ensure that they have enough contrast and attraction in advertisements. ④ Font: If the DL model shows that a certain font is more attractive to consumers, designers can select this font in CAD software and apply it to various elements of advertisements. For example, you can use this font to make a title or brand name, and use another font to present the text or additional information. In addition, you can also adjust the font size, line spacing and kerning to make the text part of the advertisement more attractive.

6 PREDICTIVE MODEL SIMULATION

In this section, the performance of advertising design based on ML algorithm and CAD technology will be evaluated through a series of experimental simulations. The experimental computer is configured with Intel Core i7-8700K processor, 16GB memory and 512GB solid state drive. The computer has good performance and can meet the needs of processor, memory and storage space in the experiment. The experiment uses Python programming language and TensorFlowDL framework. TensorFlow is a widely used DL framework, which can support various hardware devices, including CPU and GPU. When installing TensorFlow, this article ensures that the correct version is installed and related environment variables are configured. In the experiment, Python and related libraries are used to scale and normalize ImageNet and CIFAR-10 data sets. Use TensorFlow framework to implement CNN, RNN and GAN algorithms, and debug the code to ensure its correctness.

The purpose of experimental simulation is to objectively measure the application effect of ML algorithm and CAD in advertising design, and to test the improvement degree of these technologies on advertising performance. First of all, in order to build an experimental database, this article collected a series of historical advertising data, including information on creativity, typesetting, color, font and other aspects, as well as the corresponding consumer behavior and market demand forecast results. Then, using these data, the ML model and CAD design tools are constructed respectively, and many experimental simulations are carried out. During the experiment, by changing different network parameters and conditions, the key indicators such as CTR and CVR of advertisements in each experiment were recorded to evaluate the performance of ML algorithm and CAD technology under different conditions. The CTR and CVR of advertisements with different batch numbers are shown in Figure 2, Figure 3 and Figure 4.

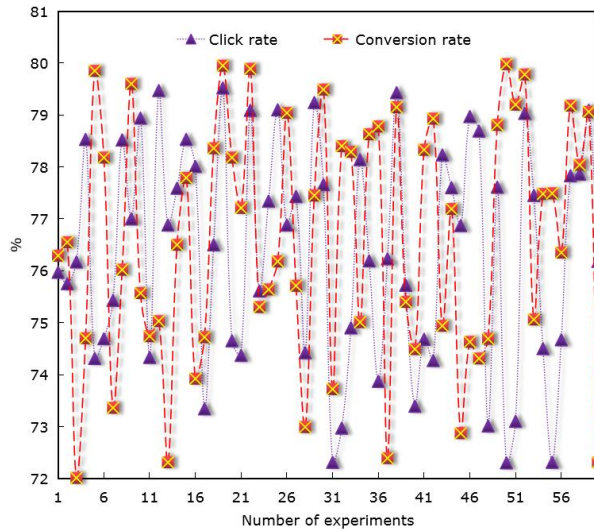


Figure 2: Indicators when the batch number is 100.

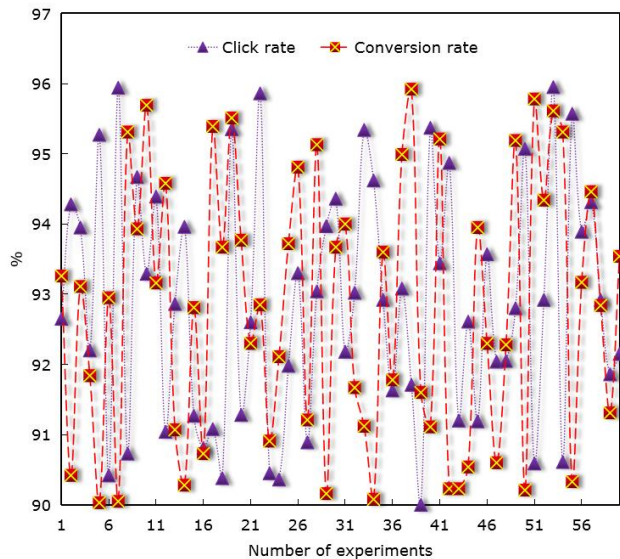


Figure 3: Indicators when the batch number is 150.

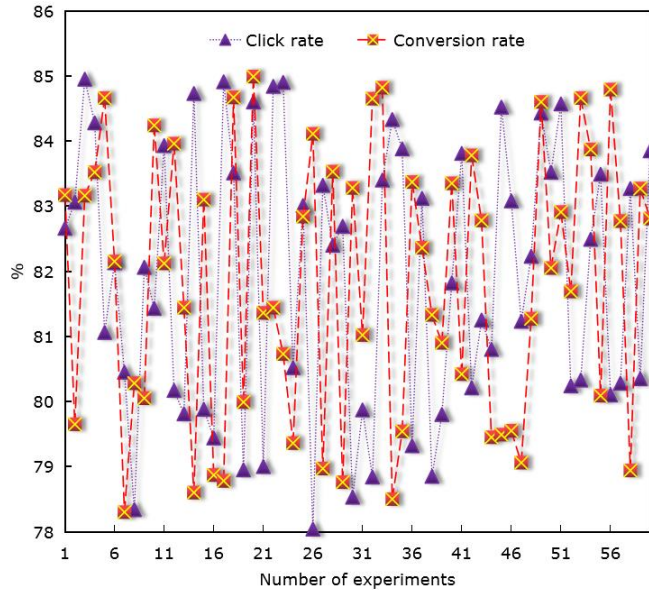


Figure 4: Indicators when the batch number is 200.

From Figures 2, 3, and 4, it can be seen that the CTR and CVR of advertisements change with the increase of batch numbers. In the figure, when the batch number is 150, the CTR and CVR of advertisements reach the highest value. This shows that when the batch number is 150, the CTR and CVR of advertisements reach the best, and the advertising effect is the best. Therefore, the batch size chosen in this article is 150. This also shows the effectiveness of ML algorithm and CAD technology in advertising design, and the combination of them can achieve higher advertising effect. The CTR and CVR of advertisements when using GAN network structure are shown in Figure 5.

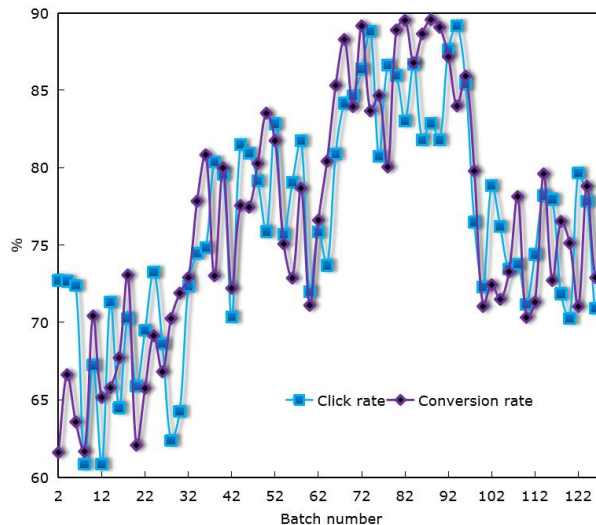


Figure 5: Indicators of adopting GAN network structure.

As can be seen from Figure 5, the CTR and CVR of advertisements in the structure of GAN network showed an upward trend at the initial stage of the increase of batch number, but with the further

increase of batch number, the CTR and CVR began to decline. This trend may be due to the high model complexity of GAN network structure and relatively weak processing ability for large-scale data sets, which leads to poor performance in front of a large quantity of data. In addition, the learning process of GAN network structure is complex, and it is easy to fall into local optimum, which leads to unstable model effect. When CNN network structure is adopted, the CTR and CVR of advertisements are shown in Figure 6.

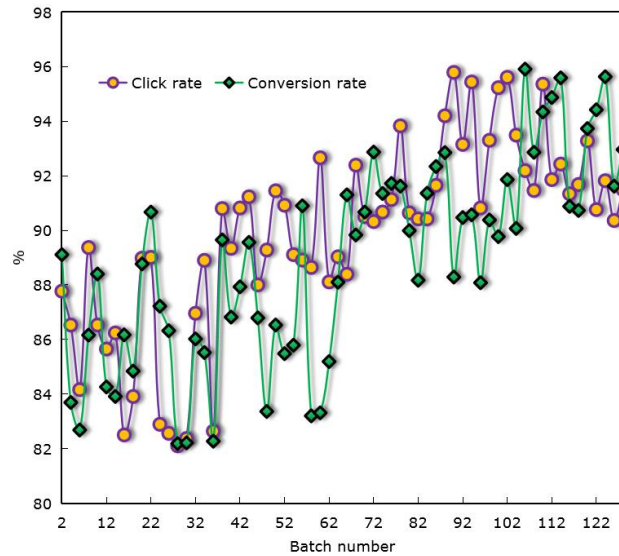


Figure 6: Indicators of adopting CNN network structure.

The overall performance of the CTR and CVR of advertisements using the CNN network structure proposed in this article is better. CNN network structure has advantages in processing image data, which can effectively capture the key features of images, so as to better understand the visual elements in advertising design. In addition, the model complexity of CNN network structure is relatively low, and it has strong processing ability for large-scale data, so it can still maintain good performance under a large quantity of processing. On the whole, the CTR and CVR of advertisements using CNN network structure proposed in this article are ideal, and their values are better than those of GAN network structure.

The experiment is carried out again, and the accuracy of different ML algorithms in predicting consumer behavior and market demand is shown in Figure 7. The efficiency of different ML algorithms in predicting consumer behavior and market demand is shown in Figure 8.

CNN is a ML algorithm which is especially suitable for processing image data. In advertising design, the prediction of consumer behavior and market demand often requires understanding and processing a large quantity of image data. By using CNN, we can better learn and understand the key features of images, such as the color, typesetting, font and creativity of advertisements, which have an important influence on predicting consumers' reactions and behaviors. As can be seen from Figure 7, CNN is excellent in predicting the accuracy of consumer behavior and market demand, which may be because it can better process and understand advertising image data.

Another advantage of CNN is its efficient computing performance. The convolution layer of CNN can effectively reduce the computational complexity of the model and make the model more efficient when dealing with large-scale image data. In addition, CNN's parallel processing ability enables it to use GPU to accelerate the calculation in the training and prediction stages, which further improves its efficiency in processing large-scale data.

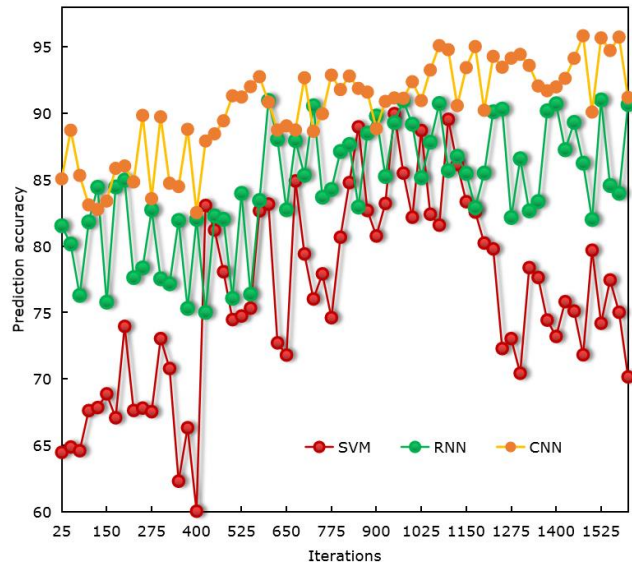


Figure 7: Accuracy of predicting consumer behavior and market demand.

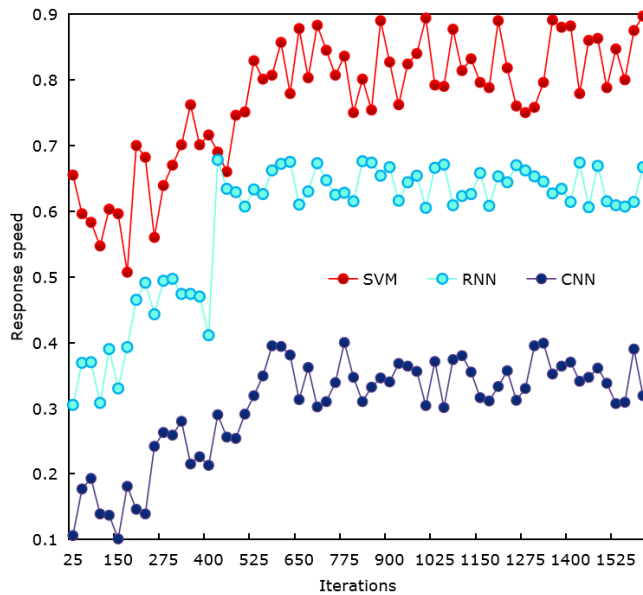


Figure 8: Efficiency of predicting consumer behavior and market demand.

As can be seen from Figure 8, CNN also performs well in prediction efficiency, which is inseparable from its efficient computing performance. Based on the above analysis, we can draw a conclusion: CNN performs well in predicting the accuracy and efficiency of consumer behavior and market demand, and its accuracy and efficiency are better than GAN and RNN. This is because CNN can better process and understand advertising image data, and has efficient computing performance. These advantages make CNN an ideal tool to predict consumer behavior and market demand in the field of advertising design.

According to the simulation results in this section, CAD technology has advantages in advertising creativity, typesetting, expressive force and adjustability of colors and fonts. Designers can use CAD tools to quickly achieve various creative effects, and can adjust and optimize according to the predicted results, thus improving the efficiency and diversity of advertising design. Combining ML algorithm with CAD technology can significantly improve the CTR and CVR of advertisements. By applying ML prediction results to all aspects of advertising design, designers can better grasp consumer demand and market trends and create more attractive and influential advertising works.

7 CONCLUSIONS

This article studies the advertising design method based on ML algorithm and CAD. Through data collection, preprocessing and feature extraction of a large quantity of advertising design works, the research uses appropriate ML algorithm to classify and predict, and Moreover, combined with CAD technology to carry out auxiliary modeling and typesetting of advertising design, which improves the accuracy and efficiency of advertising design. According to the experimental simulation results, ML algorithm is excellent in predicting the accuracy and efficiency of consumer behavior and market demand. Through the CNN model in DL, we can quickly and effectively predict the impact of different advertising ideas, typesetting, colors and fonts on consumers, which provides strong data support for advertising design. Moreover, the CTR and CVR of advertisements using CNN network structure proposed in this article are ideal, and their values are better than those of GAN network structure. Compared with the traditional advertising design method, and improve the CTR and CVR of advertisements. In addition, this study also found that different ML algorithms have different application effects in advertising design, among which DL algorithm is particularly outstanding in predicting the accuracy of consumer behavior and market demand. This research is not only of great significance advertising design, but also provides new ideas and methods for the innovative growth of advertising industry.

This article studies the application of ML algorithm and CAD in advertising design, and verifies its effectiveness and superiority. However, there are still some limitations in this study, such as the universality and accuracy of data sources and the applicability of algorithm selection, which need further discussion. Therefore, future research can deeply explore the application characteristics and effects of different ML algorithms in advertising design on the basis of more extensive and complex data, and try to combine other advanced technologies to achieve comprehensive optimization and innovation in the advertising design process.

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