Research on Art Design Education Based on Genetic Algorithm

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Abstract. In today's society, with the improvement of people's living standards and the acceleration of the pace of life, people's consumption concept is gradually changing. Consumers pay more and more attention to the appreciation of works of art. The beautiful appearance and shape of the art improve the value of the art in people's mind. Now the artistic feeling is mainly based on the long-term experience. In order to realize the innovation of art design, designers must broaden their thinking and try their best to tap creative inspiration. How to tap creative inspiration and bring forth the new has become the key to art design. This paper attempts to use genetic algorithm to study it, and obtain more design schemes through the replacement and iteration of genetic algorithm, so as to broaden the thinking of designers and realize the innovation of art design.

Keywords: Art design · Genetic algorithm

1 Introduction

The research on art design education based on genetic algorithm is a research aimed at improving the performance of the system. The optimization of the system can be completed by using genetic algorithm, which is an evolutionary technology to solve optimization problems. This technology was first used in biology, and then in computer science, engineering, economics and other fields. It has been found that this technique provides better results than other techniques such as linear programming or simulated annealing. Genetic algorithm is also called GA (genetic algorithm), GA (genetic algorithm) or GA (growth algorithm).The so-called art design is to combine the form and beauty of art with the design related to society, culture, economy and our life, so that it has not only aesthetic function, but also use function. In other words, art design first serves people (from space environment to clothing, food, housing, transportation and use). Art design should be the perfect combination of certain material functions and spiritual functions of human society. It is necessary in the development process of modern society [1]. Art design is an independent art discipline, Its research content and service object are different from traditional art categories. At the same time, art design is also a highly comprehensive discipline, which involves many factors such as society, culture, economy, market, science and technology, and its aesthetic standards change with the

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changes of these factors. The value of art design lies in creative activities and practice. Art design is actually the embodiment of the designer's own comprehensive quality (such as expression ability, perception ability and imagination ability). Although each major has different emphasis on design knowledge, the requirements for beauty, rhythm, balance and rhythm of the concept of "big design" are the same. Whether it is plane or three-dimensional design, candidates must first face an understanding of the designed object - an understanding of the background culture, geography, history and humanistic knowledge related to the design object. Natural products. Art comes from life and in turn acts on life.

Swarm intelligence algorithm is constructed from the simulation training of swarm biological movement, foraging attack, reproduction and other processes. Swarm algorithm has been favored by scholars in many fields, such as path optimization, data clustering, search optimization and so on. In art design, swarm intelligence algorithm also shows certain advantages, especially in design [2]. In art design, the character modeling is complex, the roles are diverse, and the design process is complex. Therefore, the efficiency of manual design is generally low, and intelligent algorithm is urgently needed for auxiliary design. Genetic algorithm shows good convergence and high efficiency in data design. The elements of persona are simulated and trained by this algorithm, and finally the persona modeling is obtained, in order to improve the efficiency of art design.

2 Related Work

2.1 Basic Principle of Genetic Algorithm

The main difference between NSGA and simple genetic algorithm is that the algorithm is layered according to the dominant relationship between individuals before the selection operator is executed. Its selection operator, crossover operator and mutation operator are no different from simple genetic algorithm. Before the selection operation is performed, the population is sorted according to the dominant and non dominant relationships between individuals: first, all non dominant individuals in the population are found and given a shared virtual fitness value. Get the first non dominated optimal layer;

Then, ignore this group of stratified individuals, continue to layer other individuals in the population according to the dominant and non dominant relationship, and give them a new virtual fitness value, which should be less than the value of the previous layer. Continue the above operations for the remaining individuals until all individuals in the population are stratified [3].

The algorithm reassigns the virtual fitness value according to fitness sharing: for example, specify that the virtual fitness value of the first layer individual is 1, and the virtual fitness value of the second layer individual should be reduced accordingly, which can be taken as 0 9, and so on. In this way, the virtual fitness value can be normalized. Maintain the advantage of good individual fitness to obtain more replication opportunities, while maintaining the diversity of the population. The flow chart of genetic algorithm is shown in Fig. 1 below.

(1) Coding mechanism. The process of transforming the solution of the problem into an object that can be operated by genetic algorithm is called coding. Coding is

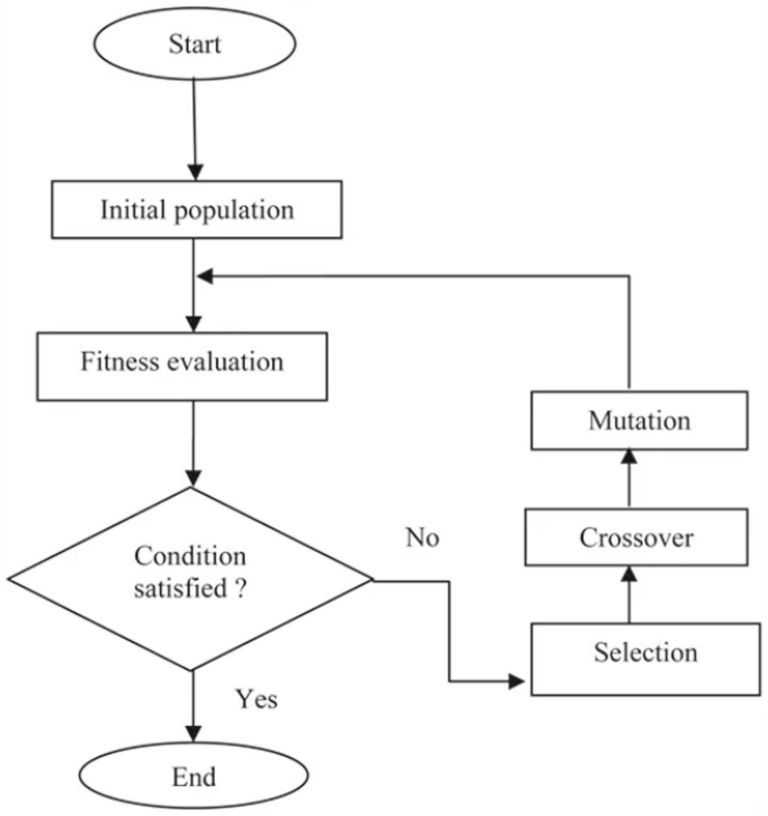

Fig. 1. Flow chart of genetic algorithm

a mapping of solutions to individuals, solution space to chromosome space, and phenotypes to genotypes. Common coding methods are as follows:

1) Binary encoding. Binary is a coding method composed of 1 and 0. It was originally proposed by Holland. This coding method is the most commonly used coding method in genetic algorithm. Binary coding adopts the principle of minimum character to encode. The coding and decoding of this coding method are relatively simple and easy, which is very helpful for the smooth realization of crossover and mutation. At the same time, this method can also be analyzed theoretically by mode theorem. However, when this coding method is used in multi-dimensional and high-precision numerical problems, the effect is not ideal, and it can not reflect the inherent structure of the problem. It has low accuracy, large individual length and occupies more memory. 2) Decimal encoding. This method uses decimal coding to control parameters, which alleviates the problem of "combination explosion" and premature convergence of genetic algorithm. 3) Gray code. Binary coding has some shortcomings in discretization of continuous functions. In order to overcome this deficiency, gray code method is proposed, which is a deformation of binary coding form [2].

(2) Fitness function. In evolutionary theory, fitness refers to the ability of an individual to adapt to the environment and the ability of the individual to reproduce. The fitness function of genetic algorithm is also called evaluation or evaluation function. It is an index used to judge the quality of individuals in the population. It is evaluated according to the objective function of the problem. In the process of searching evolution, genetic algorithm generally does not need other external information, and only uses the evaluation function to evaluate the advantages and disadvantages of individuals or solutions, which can be used as the basis of genetic operation in the future. In genetic algorithm, the fitness function should be compared and sorted, and the selection probability should be calculated on this basis, so the value of the fitness function should be positive. It can be seen that in many cases, it is necessary to map the objective function into a fitness function in the form of maximum value and non negative function value.

$$E^N = \frac{1}{2}\sum_{n=1}^{N}\sum_{k=1}^{c}(t_k^n - y_k^n)^2 \tag{1}$$

$$Z_{i,j,n}(K, X) = \sum\nolimits_{C=1}^{C} K_{cn} \bullet X_{i,j,n} \tag{2}$$

Characteristics of genetic algorithm

(1) Genetic algorithm generally searches directly in the solution space, not in the problem space like graph search, and finally finds the solution.
(2) The search of genetic algorithm starts randomly from a point set in the search space, rather than from the initial node or termination node of the search space as graph search, so genetic algorithm is a random search algorithm.
(3) Genetic algorithm is always looking for the optimal solution, unlike graph search, which does not always require the optimal solution, but generally tries to find the solution as soon as possible, so genetic algorithm is an optimization search algorithm [4].
(4) The search process of genetic algorithm is to search from one point set (population) to another point set (population) in space, rather than from one point to another in space as graph search. Therefore, it is actually a parallel search, which is suitable for large-scale parallel computing, and this population to population search has the ability to jump out of the local optimal solution.
(5) Genetic algorithm has strong adaptability. In addition to the fitness function, it hardly needs other prior knowledge.
(6) Genetic algorithm is good at global search. It is not constrained by the restrictive assumption of search space and does not require continuity. It can find the global optimal solution from discrete, multi extreme and noisy high-dimensional problems with great probability.

The step flow of genetic algorithm is shown in Fig. 2.

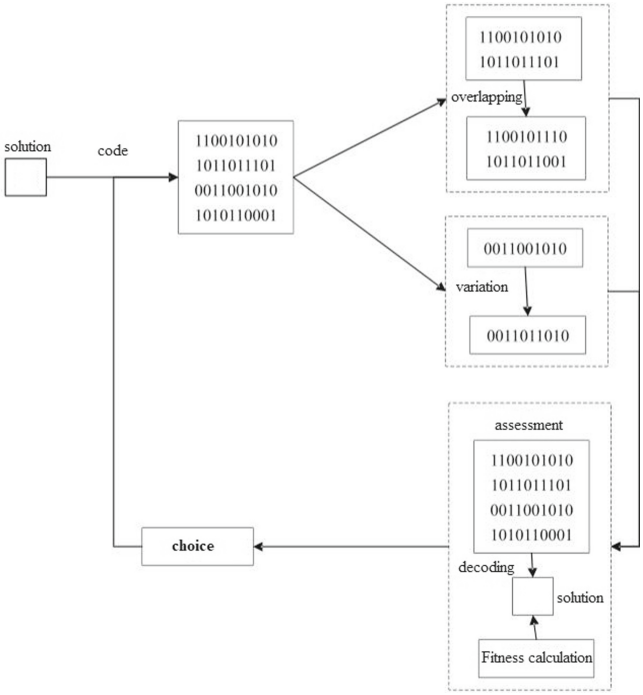

Fig. 2. Genetic algorithm step flow

2.2 Art Design Teaching

Art design is an independent art discipline. Its research content and service object are different from traditional art categories. At the same time, art design is also a highly comprehensive discipline, which involves many factors such as society, culture, economy, market, science and technology, and its aesthetic standards also change with the changes of these factors. The value of art design lies in creative activities and practice. Art design, in fact, is the embodiment of the designer's own comprehensive quality (such as performance ability, perception ability, imagination ability). Although each major has different emphasis on design knowledge, the requirements for beauty, rhythm, balance, rhythm, etc. of the concept of "big design" are the same. Whether it is plane or three-dimensional design, creative thinking ability plays a decisive role. In art design teaching, it is very difficult for students to carry out art design, because most of their homework is completed by copying. In this way, after a period of time, students' creative ability gradually weakens in copying, and they are used to copying others' mode [5]. Therefore, when teachers set questions for students to create, students will say, "how can I design it" "it's too difficult", and they are eager to find information to move things around. Such development will only make students become conformist and lack personality and imagination The students trained can only be "artistic craftsmen".

In the teaching of art design, teachers play a major role, not only in imparting knowledge, but also in leading thinking. Therefore, teachers' own quality has become

an important factor for the success of teachers' teaching. Now in school, the most direct place for students to accept knowledge is the classroom. Classroom teaching should not be instilled unilaterally by teachers [6]. As teachers, they should not only observe the reflection of each student, but also give feedback in time. In fact, this process is the process of testing the quality of teachers. Teachers should change the concept of teachers monopolizing the teaching platform, enhance the interest of teaching, create a lively classroom atmosphere, create a democratic and open teaching situation, and regard the teaching process as a process of sharing experience between teachers and students. Innovative thinking, flexible use of various logical thinking methods, can be found and achieve fruitful results. There are many ways to cultivate students' creative thinking, but all kinds of ways are inseparable from teachers, because teachers are the organizers and implementers of training activities. To cultivate students' creative thinking, teachers' own thinking must first be creative, so teachers should continue to study, work hard to "change their minds", manage "thinking advance", respect students, weaken the sense of authority, and establish a new relationship between teachers and students. As long as we pay attention to cultivating students' creative thinking ability in all aspects of teaching and at all times, students' creative ability will be improved.

3 Art Design Based on Genetic Algorithm

Art design itself is a kind of super logical visual language, and intuitive thinking is a very important way of thinking in artistic conception. All designers who have had creative experience in design have had such experience. Although they have carried out comprehensive and rational analysis and long-term and arduous thinking on the design theme, the idea of satisfaction has not appeared yet, As the saying goes, "there is no way out of doubt". At this time, a wonderful idea was born through the induction of some accidental factors, which is the typical application of intuitive thinking in design. Intuition means "a way of understanding or knowing that occurs directly and instantaneously without conscious thinking and judgment" [7].

This paper studies art design. The solution of art design is a combination of different types and types. Based on the practical problems of this paper, this paper adopts binary coding. There are many coding methods in genetic algorithm, and binary coding is a commonly used coding method. In this coding method, 0 and 1 are the symbols of the individual, and the whole individual is the symbol string of 0 and 1 composed of several 0 and several 1. The symbol precision of the problem to be solved by genetic algorithm determines the length of binary coding string. Suppose there is a parameter whose value range is [UMIN, Umax]. If the parameter is represented by a binary string with length L, it can generate 2L codes. Figure 3 below shows the art design parameterized binary code.Then the binary encoding accuracy is:

$$u_{max}(t) = u_{min}(t) + L(t)(\dot{e}_{k+1}(t) + e_{k+1}(t)) \tag{3}$$

The advantages of this coding method are as follows:

(1) For genetic algorithm, the important genetic operations are crossover and mutation, which are easy to realize by binary coding;

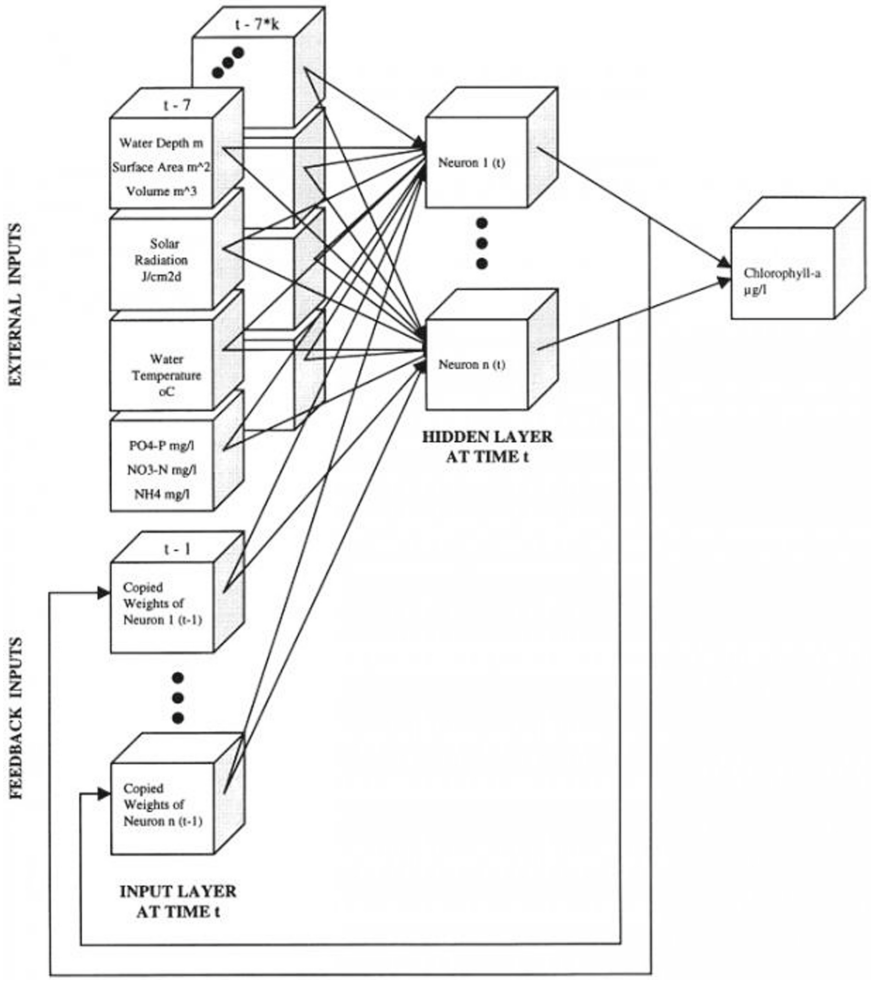

Fig. 3. Art design parametric binary coding

(2) Encoding and decoding are relatively simple and easy to operate;
(3) Binary coding conforms to the coding principle of the minimum character set in the coding principle;
(4) The binary coding method is more convenient to analyze by using the pattern theorem.

Genetic algorithm basically does not use external information in evolutionary search, only based on fitness function. The value of individual fitness function in genetic algorithm is the basis of population search. Whether the fitness function is properly selected is very important for the whole algorithm to find the optimal solution at a faster speed. The selection of fitness function is generally transformed from the objective function of the problem objective [8].

The fitness function design shall mainly meet the following conditions:

(1) Reasonable and consistent. The fitness function value is required to reflect the advantages and disadvantages of the corresponding solution;
(2) Adapt to as many problems as possible. For a class of specific problems, the fitness function should be universal without much change;
(3) The amount of calculation shall be as small as possible. Because genetic algorithm needs to search for many generations and has a large time cost, the fitness function should be as simple as possible, reduce the amount of calculation and improve the efficiency of genetic algorithm [9]. Figure 4 below shows the art design coding process.

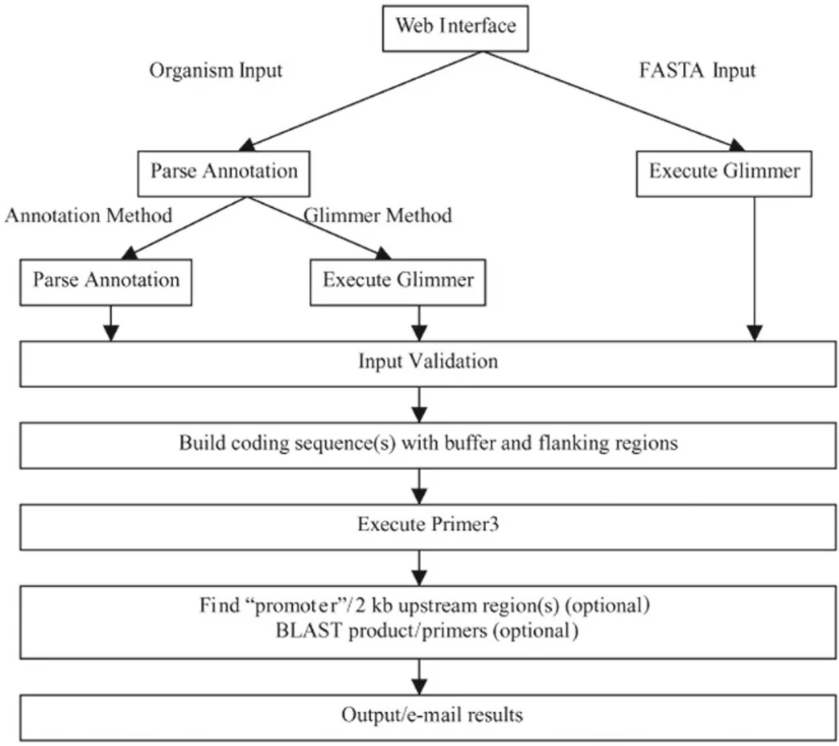

Fig. 4. Art design coding process

K-means algorithm is a method of clustering with the help of the center of data. Therefore, when the distribution of some data is very special, such as some data is large, it will affect the center position of the data, thus affecting the results of the whole clustering. In order to overcome the shortcomings of K-means algorithm, we can consider using medoid as a clustering center to replace the average center of the previous k-means algorithm. The data can be classified according to the principle of minimizing the sum of

the distances between each data object and medoid. This is the basic idea of k-medoids algorithm [10].

Because the value of an abnormal data may be very large, which will affect the estimation of data distribution (the calculation of clustering mean in k-means algorithm), K-means mean algorithm is very sensitive to abnormal data. Therefore, it is envisaged to use medoid as a reference point to replace the mean value of each cluster in the k-means algorithm (as the cluster center). Thus, the division method can continue to be applied according to the principle of minimizing the sum of the distances (differences) between each object and each reference point. This constitutes the k-medoids algorithm.

The basic idea of k-medoids method is to randomly select a data to represent a certain class, so that K clustering centers can be found from n clustering data (which needs to be repeated). According to the distance from these clustering centers, other objects are classified into their corresponding categories (according to the principle of minimum distance). If you change a clustering center, you can get a better clustering result, It is proved that the new cluster center is better, and the original cluster center can be replaced. The quality of clustering will be evaluated by a cost function, which can express the distance between each data and the cluster center.

In artistic creation, intuition is the direct understanding and Revelation of the inside story or essence of things by omitting the reasoning process. Inspiration and intuition are the same word inspi ratio in English. The ancient Greeks believed that "inspiration is a sudden understanding of the fundamental nature of something". Psychology believes that although inspiration is sudden and unexpected, it is positive after the excitement of the advantage of brain concentration. That is to say, although its occurrence is accidental, it must be an instant manifestation of the barrier between long-term ideation and sexuality. Cheng needs to transform design concepts into design images, which is the key point of creative thinking. From design concepts to Jun's fear, we must first help intuition and inspired thinking activities to achieve. The designer should first explore and establish the forms and models of W countless possibilities, and the bridge from here to there. Then repeated logical inference and test are carried out [11]. Finally, T2 image appeared Excellent designers strive to design the "bird's nest", the National Swimming Center "Water Cube", the British Pavilion of the Shanghai WorldExpo "seed Temple", and so on. These five are not from concept to image It is derived from the design process of intuition and inspiration, and the spirit of allowing full officials to be creative.

The algorithm flow of this paper is as follows:

(1) Coding: binary coding.
(2) Generation of initial population;
(3) Determination of fitness function. The fitness function is designed according to the artistic characteristics;
(4) Implementation of selection operator: using tournament method to select operator;
(5) Implementation of crossover operator: single point crossover is adopted for the first 1/3 individuals with fitness function value, and three-point crossover is adopted for the last 2/3 individuals;
(6) Implementation of mutation operator: set individual mutation probability threshold a and gene mutation threshold β Two parameters, according to which the selected individuals are mutated.

4 Creative Thinking in Art Design Emphasizes Intuition and Inspiration

Art design itself is a kind of super logical visual language, and intuitive thinking is a very important way of thinking in artistic conception [12]. All designers who have had creative experience in design have had such experience. Although they have carried out comprehensive and rational analysis and long-term and arduous thinking on the design theme, the idea of satisfaction has not appeared for a long time, which is the so-called "no way out". At this time, induced by some accidental factors, a wonderful idea was born, which is the typical application of intuitive thinking in design. Intuition means "a way of understanding or knowing that occurs directly and instantaneously without conscious thinking and judgment". In artistic creation, intuition is the direct understanding and Revelation of the inside story or essence of things by omitting the reasoning process. Inspiration and intuition are the same word inspi ratio in English[13]. The ancient Greeks believed that, "Inspiration is a sudden understanding of the fundamental nature of something". Psychology believes that although inspiration is sudden and unexpected, it is certain after the advantage of brain concentration. That is to say, although its occurrence is accidental, it must be the result of long-term thinking. Therefore, inspiration and intuition are, to some extent, a breakthrough in the barrier between rationality and sensibility, and an instant manifestation of the high integration of the two.

Art design is a subject that uses image thinking. The creative process needs to transform design concepts into design images, which is the key point of creative thinking. The transformation from design concepts to design images needs to be realized with the help of intuitive and inspirational thinking activities. Designers should first explore and establish the design concept, which is the starting point of creativity. Then build countless possible forms and models in the mind with intuition, and constantly try to build a bridge between subjective concepts and objective images. Then repeated logical inference and test are carried out [14]. Finally, with the outbreak of inspiration and intuitive judgment, the idea is connected, creative artistic images appear, and excellent design schemes are born. This creative design process represents the creative process in almost all design fields. We are familiar with the "bird's nest" of the National Stadium of the Olympic Games, the "Water Cube" of the National Swimming Center, the "seed Temple" of the British Pavilion of the Shanghai WorldExpo, and so on. All these design works with profound ideological connotation, dreamlike beauty and wonderful creativity came from this design process from conception to image, with the help of intuition and inspiration, full of adventure and creativity.

5 Conclusion

The research on art design education based on genetic algorithm is the research on the relationship between art design and genetic algorithm. The main purpose of this study is to find out the most effective method of using genetic algorithm to design art. The purpose of this article is to better understand how these two areas work together to create more effective products, which is beneficial to both students and designers. In this research, we are using genetic algorithm to design art education courses. The main goal

is to find a course that can be used in art schools. In other words, our goal is to find out what kind of art education courses are most effective for students and teachers. We want to know which type of course is more efficient than others. The study was conducted by the University of California, Davis, through its neural computing center (CNC). CNC aims to develop neural networks that can solve problems related to computer vision, speech recognition, natural language processing (NLP) and machining.

Art design has always been one of the art design themes widely concerned by people, and has also added color to people's life. Because of its variety, or elegant, or gorgeous, or fresh, it has been widely selected by people in life and career to beautify the environment and improve the quality of the environment. Based on the research of genetic algorithm, this paper uses heritage algorithm to study art design, which can open up ideas for designers and improve the efficiency and quality of art design.

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