Research on Jewelry Design Based on Genetic Algorithm

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Abstract: Based on genetic algorithm, this article discusses the application of jewelry design. In this study, we used a genetic algorithm based approach to achieve automated jewelry design. By optimizing various factors in jewelry design, we can design jewelry that is more unique, beautiful, and in line with human aesthetics. This article will introduce the application of genetic algorithms in jewelry design in detail, and how to optimize various aspects of jewelry design through genetic algorithms.

Keywords: genetic algorithm; Art Design; pearls and jewels; robotization

1. INTRODUCTION

Jewelry design is an art that requires rich imagination and artistic talent. In the design process, designers need to consider many factors, such as the shape, size, material, color, and so on of jewelry. Jewelry design requires a lot of experimentation and research to achieve perfect results [1]. However, due to the complexity of the jewelry design field, designers cannot consider all possible variables, so modern technology is needed to help them achieve automated design.

Genetic algorithm is an algorithm that simulates natural evolutionary processes and can be used to solve optimization problems. Jewelry design can be seen as an optimization issue, as designers seek the best design solution among a variety of possible designs. Therefore, genetic algorithms can be used to optimize jewelry design. In jewelry design based on genetic algorithms, designers need to abstract various elements of jewelry design (such as shape, color, material, etc.) into chromosomes in genetic algorithms. The designer can then define a fitness function to evaluate the quality of each chromosome.

For example, the fitness function can consider factors such as the coordination between various elements in the chromosome [2], and the attractiveness to the target audience. Next, the genetic algorithm will evaluate each chromosome based on a fitness function, and then select some excellent chromosomes as parents, using crossover and mutation operations to generate new offspring chromosomes. The new offspring chromosomes will participate in the next round of evaluation and selection until the optimal jewelry design is found. It should be noted that jewelry design based on genetic algorithms requires designers to have a certain degree of mastery and judgment on various elements of jewelry design. At the same time, designers also need to define a fitness function to ensure that the algorithm can find the optimal design solution that meets the design goals and target audience.

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2. Jewelry design method based on genetic algorithm

Genetic algorithm is a computer algorithm that simulates natural evolutionary processes, mainly used to solve optimization problems. It simulates natural selection, crossover, mutation, and other processes to select better individuals from the population [3], and continuously iterates to obtain the optimal solution. As shown in formula 1, the genetic algorithm is used to calculate the error value:

$$\left|x_i - x_j\right| \geq \frac{l_i + l_j}{2} + D_{ij} \tag{1}$$

The structured attributes contained in several corporate legal affairs related data obtained from major websites, including legal person names, business scope.

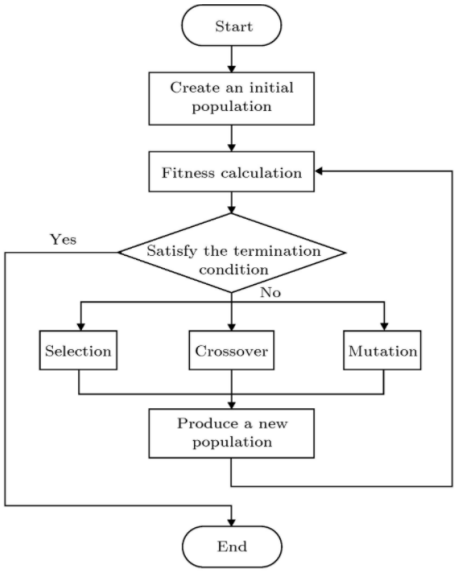

Figure 1. Genetic Algorithm Process

Employment qualifications, credit records, business hours, ownership change records, and other information, are used to construct a basic information table for legal affairs processing, Table-a. Based on the structured attributes in the questions raised by consumers and enterprises [4], including unit price, purchase price, contract signing, fund use records Basic information table such as repayment records Table-b. The corresponding information table is shown in Table 1:

Table 1. Genetic Algorithm Process

Initialization: generate a certain number of random individuals, namely, the initial population
Fitness evaluation: Evaluate each individual and calculate fitness values.
Selection: Based on fitness values, select some individuals as parents to participate in crossover and mutation operations.

Crossing: Crossing the genes of a parent individual to produce new offspring individuals.
Mutation: The introduction of new genes by performing mutation operations on offspring individuals.
Generation of a new population: The combination of parent and offspring individuals into a new population.
Termination Condition Judgment: Judge whether the termination condition is satisfied. If so, end the algorithm. Otherwise, return to Step 2.

3. Jewelry Design Algorithm Simulation Experiment

3.1 Genetic algorithm solution

According to the research situation, the population size is set to 100, the crossover probability is 0.8, and the mutation probability is 0.05. The genetic iteration ends when it reaches 250 generations. Import the genetic code of the single line layout model into MATLAB software to solve, and obtain the genetic algorithm iteration curve and the genetic algorithm fitness value iteration curve, as shown in Figure 2.

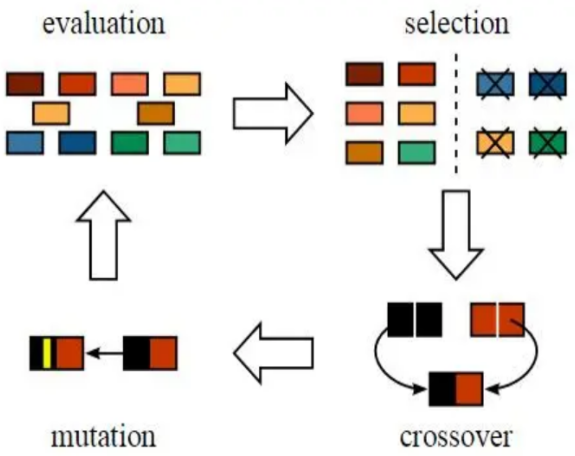

Figure 2. Experimental Iteration Diagram

According to Figure 2, when the genetic algorithm iterates to about 225 generations, the algorithm converges, and the objective function logistics and transportation costs are minimal. By analogy, the genetic code of the two-line layout model is imported into MATLAB software for solution, and the optimal layout of the two-line layout model is finally obtained. The coordinates of each area are shown in Table 2.

3.2 Establish a simulation model

Genetic algorithm is an optimization algorithm based on natural selection and genetic principles, which can be used to optimize complex problems, including establishing simulation models. The following is a basic step to establish a simulation model using genetic algorithms:

Define a problem: First, it is necessary to clarify the purpose of establishing a simulation model and the definition of the problem. For example [6], if a traffic simulation model is to be established, the purpose may be to optimize traffic flow or reduce traffic congestion. Determine variables and constraints: Based on the problem definition, it is necessary to determine which variables need to be optimized and which constraints exist. For example, in a traffic simulation model, variables that need to be optimized may include vehicle speed, number of lanes, signal timing, and other constraints may include vehicle safety and road capacity [7].

Define fitness function: In genetic algorithms, it is necessary to define a fitness function that evaluates the quality of each solution and converts it into a fitness score [8]. The fitness function should be closely related to the problem definition. For example, in a traffic simulation model [9], the fitness function may be the average value of traffic flow or the variance of travel time. Initializing a population: In genetic algorithms, it is necessary to initialize a set of random solutions, called a population. Each solution in the population represents a possible solution [10].

4. Conclusions

Genetic algorithm is an optimization method that simulates natural evolution, while jewelry design is a field that combines art and engineering. In this article, we studied how to apply genetic algorithms to jewelry design to achieve better design results. First, we introduced the basic concepts and processes of genetic algorithms, including the steps of selection, crossover, and mutation. Then, we explored how to apply these steps to jewelry design. Specifically, we consider jewelry design as an optimization problem, using genetic algorithms to search for the optimal solution, that is, the optimal jewelry design scheme.

In the specific implementation, we adopted a jewelry design system based on CAD software, embedding genetic algorithms into it, thereby realizing the automation of jewelry design. We consider jewelry design as a multi-objective optimization problem, taking into account the aesthetics, structural stability, and production costs of the design. We use genetic algorithms to search for the optimal design scheme. Through experimental verification, we found that genetic algorithms can effectively improve the efficiency and quality of jewelry design, while also reducing the workload of designers. We also discussed some possibilities for improvement and expansion, such as the introduction of artificial intelligence and machine learning technologies, to further improve the automation and design efficiency of jewelry design. In summary, this paper studies the application of genetic algorithms in jewelry design, and verifies its effectiveness and feasibility through experiments. In the future, we can further study and improve this method to promote the automation and intelligent development of jewelry design.

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