

Research Article

The Color Planning Method of Shanghai New City Based on Big Data and Artificial Intelligence

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Received 30 December 2021; Accepted 11 March 2022; Published 11 April 2022

Academic Editor: Kalidoss Rajakani

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Due to the rapid development of my country's urbanization construction, today's cities, as a complex and unified combination of humanities, technology, and innovation, most of their core competitiveness highlights the color charm of the city. Urban color reflects the long history and rich urban life of a city. Only by combining the regional and cultural characteristics of the city can it be tailored to fully reflect the charm of the city. In recent years, the livability of cities has gradually attracted the attention of the public. Monotonous colors will not only make the city lose its overall beauty, but also make the residents living in it feel boring. Therefore, in recent years, many cities have carried out research on overall color planning, hoping to improve the overall beauty of the city through efforts and create a color matching scheme that is consistent with the urban culture. Taking Shanghai New City as an example, this paper uses big data technology and modern artificial intelligence technology to analyze the color matching strategies adopted in this area and puts forward suggestions for color optimization in combination with the current construction status and development planning in this area.

1. Introduction

Scientific color matching has a very direct effect on enhancing the beauty of objects. The most beautiful color is not only to interior design, and it has important implications in urban planning as a whole. It can not only directly enhance the external look and feel of the city, but even some colors achieve a deep integration with the urban cultural connotation and become an inseparable part of the urban culture.

Many scholars at home and abroad have carried out research on the application of urban color and achieved good results. For example, a scholar found that color issues are often ignored in the study of urban characteristics. Referring to the basic national conditions of his country and the current situation of urban color, he proposed a color research method and evaluation system with national characteristics, and then adopted a variety of research methods to evaluate urban color. A series of investigations have been carried out, and the social, economic, political, and even the unique cultural characteristics of many cities have been found [1]. A scholar is constantly exploring the process of

urban color planning and discusses color restoration and planning for relevant color restoration points. He believes that building facades and urban landscape elements in different cities have a great impact on people's perception of changes in urban color environment. When carrying out urban color planning, it is necessary to first consider how to use local raw materials to fit the local urban construction process and carry out transformation on the basis of following natural planning. At the same time, it should be noted the material and intangible cultural heritage and human needs [2]. Although the results of urban color planning based on big data and artificial intelligence are still uneven, the study of urban color planning can shape urban characteristics.

Judging from the existing research results, not only the research methods are diversified, but also the case selection is relatively representative. The former, such as the urban color clustering extraction method, the parametric design method, etc., the latter's representative works have carried out case analysis on Dalian, the traditional colors of the Pan Jiangnan area, Zhengzhou and other cities with profound cultural heritage. Through the horizontal comparison,

the innovation value of this paper is very obvious. The first is innovation in research methods. Based on big data and artificial intelligence technology, combined with methods such as questionnaire survey and literature analysis, it has realized the perfect combination of cutting-edge technology and real data. Secondly, it is reflected in the breakthrough of the research object. As one of the most representative cities in my country, Shanghai is a typical representative of the fusion of historical accumulation and contemporary civilization. Especially in emerging development zones such as Shanghai New City, there is a very strong plasticity in color planning. This paper expounds the composition of urban color and the significance of urban color planning. Based on the principles of color planning, the color characteristics of Shanghai buildings are extracted by using big data technology and artificial intelligence technology to understand the preferences of Shanghai residents for the color of buildings in the city and to make preliminary preparations for the color planning of Shanghai New City.

2. Theories Related to Urban Color Planning

2.1. Composition of Urban Colors. Urban color is mainly composed of the following aspects. The first is the color of the building, including the color of the exterior wall, the color of the top, and the color of the surrounding environment. In a city where land is expensive, no building exists in isolation. It must be highly compatible with the surrounding environment in order to show its own design intent. The second is the color of the garden landscape. At this stage, my country's urban construction has been paying more and more attention to garden landscapes, and the value it brings in terms of color adjustment and air purification is generally recognized by residents [3–5]. The third is the color of public service facilities. At present, the level of public services in cities in my country is gradually improving. Service facilities such as newsstands and public toilets have greatly improved the livability of cities. Especially those emerging areas, these service facilities are very complete. However, these small and highly functional service facilities are scattered all over the area. If scientific color planning is not carried out, it will undoubtedly affect the overall perception of the city to a great extent [6]. The fourth is the color of transportation facilities. Transportation facilities are an indispensable part of modern cities, and they are all in a state of regular shape and cannot be changed at will. This requires it to be placed in the overall color planning of the city; otherwise, the latter will be fragmented, and the city's look and feel will be seriously reduced [7].

2.2. The Value of Urban Color Planning. From a scientific point of view, as long as the wavelengths are the same, they can be the same color. However, in specific applications, each color has a lot of branches, whether it is light and shade, purity, etc.; it will have an important impact on the final presentation of the color. As seen in Table 1, the color can generally be divided into 3 categories of chroma, and each category contains 4 small intervals, which provides a variety of choices for urban color planning [8].

TABLE 1: Chroma level.

Low chroma	Middle chroma	High chroma
0-4	4-8	8-12

Scientific urban development is an all-round comprehensive progress. Although pure material construction can bring economic prosperity, it will have a negative impact on the sustainable improvement of urban livability. In the past few decades, my country's urbanization process has continued to advance, and the urban population has shown rapid growth. The large-scale construction of the city makes the original cultural atmosphere almost disappear, and the high-rise buildings everywhere are very monotonous in terms of color performance, which seriously reduces the overall look and feel of the city. This makes us have to undertake the optimization of the original urban color when we carry out urban color planning at this stage, which is a huge waste of labor resources. In contrast, those cities that have always attached importance to color planning in the development stage have better achieved the unity of material progress and urban aesthetics and made color the "spokesperson" of their own cities [9, 10].

2.3. Basic Principles of Urban Color Planning. The first is the principle of livability. The colors presented on the exterior of the city are not as many as possible, nor can they be selected according to the preferences of leaders, but should be based on the combination of the city's own historical heritage and natural landscape, based on improving the life experience of urban residents. The second is the principle of overall unity. The overall unity here does not mean that all functional areas adopt the same color, but to obey the direction of urban color planning [11, 12]. Solemn government offices, elegant living areas, relaxed business areas, etc., should all have distinctive features while respecting the overall color performance of the city. The third is to have local characteristics. The cities in my country basically have a history of development for thousands of years [13, 14]. The choice of colors in the same line of urban architecture also has its own characteristics. In urban color planning, we must not blindly imitate the experience of other regions, but should fully combine our own historical development and humanistic characteristics and choose the color that best reflects the urban charm.

2.4. Urban Color Planning Process. Figure 1 shows the general process of urban color planning at this stage: at first, to carry out research. Through a comprehensive analysis of the city's historical development, cultural customs, and architectural layout, several color options suitable for the city's perception and experience are selected. Second is to evaluate the overall effect of each alternative color through opinion polls and image simulations and through expert argumentation to come to the best solution. Third is the implementation of the color plan and the development of the future direction [15–18].

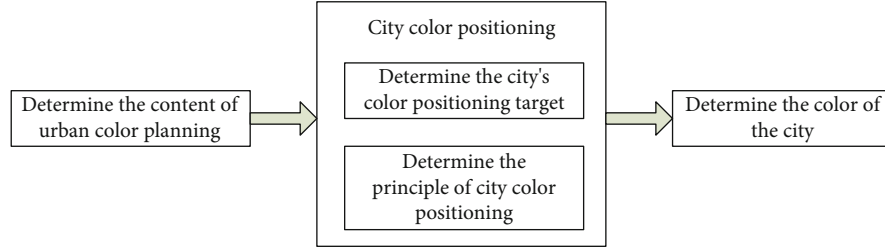


FIGURE 1: Urban color planning process.

2.5. PCA Feature Extraction Algorithm. The PCA method is the most widely used feature extraction method. It transforms the original high-dimensional data into a low-dimensional space for processing and solves many problems caused by the excessively high data:

$$\lambda = \sum_{k=1}^n \mu_k \delta_k \quad (1)$$

The unit vector v should satisfy

$$\|\mu\| = (\mu^T \mu)^{1/2} \quad (2)$$

The ultimate goal of PCA is to obtain the weight vector v :

$$\mu^T F [\delta^T] \mu = F [\lambda^2] - F [(\mu^T \delta)^2] \quad (3)$$

3. Research Content and Research Methods

3.1. Research Content. This paper selects Shanghai New City as the research area and analyzes the city's main color and embellishment color through the hue, saturation, and brightness of the building colors in the area [19–22]. Using big data technology and modern artificial intelligence technology to extract the color characteristics of buildings in Shanghai, analyze the color matching strategies adopted in the area, and put forward suggestions for color optimization in combination with the current construction status and development planning in the area.

3.2. Research Methods. Based on big data and artificial intelligence technology, combined with methods such as questionnaire survey and literature analysis, it has realized the perfect combination of cutting-edge technology and real data. The study firstly surveyed Shanghai Xincheng residents' satisfaction with colors in this area through questionnaires and scored the satisfaction of each color. The questionnaires are in the form of online questionnaires and field questionnaires. The online questionnaires are distributed to public institutions and public servants in the Shanghai New City area. A total of 271 people participated in the responses, and 258 valid responses were obtained, with an effective rate of 95.2%. The field questionnaires were selected and distributed in the activity squares of several living quarters in the Shanghai New City area. A total of 300 copies were distributed, 285 copies were recovered, and the recov-

ery rate was 95%. Among them, there are 272 valid answer sheets, and the effective rate is about 90.67%. In this way, the main opinions and development demands of the public on the color layout of Shanghai New City have been grasped. At the same time, this paper collects the growth rate of building types in Shanghai every five years and uses big data and artificial intelligence technology to analyze and extract the color characteristics of various types of buildings in Shanghai. Saturation and Brightness to Analyze Shading in Shanghai New City Color Planning.

4. Current Situation Analysis and Development Suggestions of Shanghai New City Color Planning Based on Big Data and Artificial Intelligence

4.1. Current Situation Analysis of Shanghai New City Color Planning Based on Big Data and Artificial Intelligence

(1) Proportion of Buildings in Shanghai New City

As shown in Figure 2, the proportions of various building types in Shanghai are increasing over time, and office buildings and transportation buildings account for the largest proportion, which also reflects the increase in construction demand brought about by economic development and population growth. The growth trend of educational buildings is very stable, and the growth trends of cultural and entertainment buildings, communication buildings, and garden buildings are similar.

(2) Analysis and Extraction of Color Features of Shanghai Buildings Based on Big Data and Artificial Intelligence

Using big data and artificial intelligence technology to extract the color features of Shanghai's buildings, the city colors of Shanghai are divided into three categories, namely, natural environment colors (including landscape colors and plant colors), historical and humanistic colors (including the colors of historical records, humanities and historical sites, and theatrical culture), and artificial environment colors (including architectural colors, furniture colors, and road colors), in the combination of artificial intelligence and computer algorithm technology; the three types of Shanghai color are analyzed and extracted. For Shanghai's natural and historical environmental colors, artificial qualitative

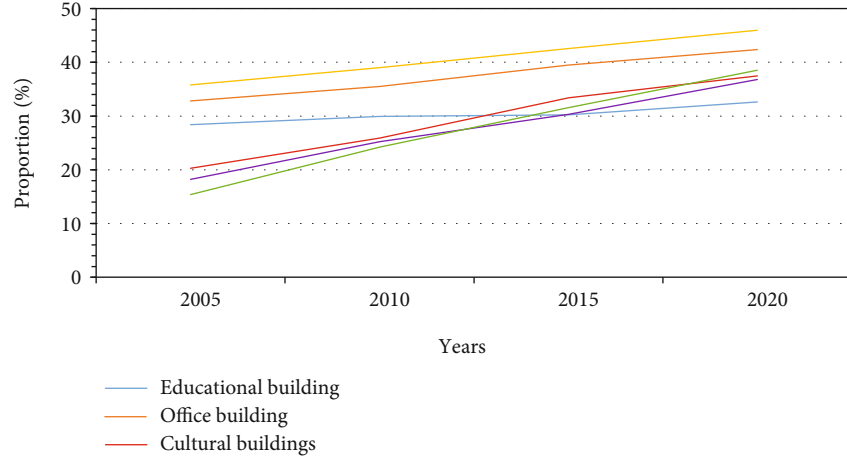


FIGURE 2: Building types and proportions.

TABLE 2: Satisfaction scores of various colors.

Color	Score
White	235.92
Blue	244.31
Brick red	254.77
Blue-gray	211.39
Brown	205.91
Yellow	227.72
Green	266.18

extraction methods are used, and artificial environmental colors are computer qualitative extraction methods.

In the color satisfaction scores of Shanghai citizens for the city, Table 2 is obtained. From the data results, it can be found that Shanghai citizens have a relatively uniform position to the city's color beauty. For example, in the most impressive building color survey, the green satisfaction score is the highest, indicating that Shanghai's greening is recognized by the citizens and the urban greening construction work well. Then, there are blue, brick red, and white. Blue and brick red are mostly used in high-rise residential buildings, and their colorfulness often leaves a deep impression on people, while white is used more in residential and public buildings. In the survey of main hue trends adopted in Shanghai's urban planning, people tend to be full of vibrant hue, which is also in line with the fast-paced life in Shanghai, and people need more vibrant colors to fill their lives.

(3) Shanghai Building Color Planning

It can be seen from Figure 3 that from the analysis of hue, blue, brick red, and green account for more than 60%, indicating that Shanghai's hue is mainly these three colors, and the color ratio of the other four colors is 50% below; the saturation of most of the seven colors is concentrated between 10% and 30%, and only the saturation of brick red and green exceeds 30%. Therefore, the colors of buildings in Shanghai are mainly low saturation main, medium, and

low saturation as a supplement; the brightness of the seven colors is mainly concentrated in the 40%-60%, indicating that Shanghai's architectural colors are mainly medium brightness.

4.2. Suggestions for the Color Planning and Development of Shanghai New City

(1) Introduce Regional Color Control Standards as Soon as Possible

As an emerging area that has developed rapidly in recent years, Shanghai New City is in a stage of increasing year by year in terms of population density, number of enterprises, and number of buildings. If the regional color control standards are not introduced as soon as possible, urban color will soon be out of control. It is recommended to develop color control standards from the following steps. The first is to summarize and refine the various color data of the natural ecology and artificial buildings in the Shanghai New City area. Based on the future development goals of Shanghai New City, taking into account the regional functions, historical culture and building characteristics, the production of "Shanghai New City Area Color Planning Control Spectrum" and strictly implement it.

(2) Aiming to Improve Livability

Livability is an important criterion for evaluating urban development, and all work in urban construction must take the improvement of livability as the ultimate goal. Although the Shanghai New City area has not developed for a long time, it has clearly defined its own regional characteristics at the beginning of its establishment. That is to say, the development of high and new technology is the main force, and the cultural industry and leisure industry are the driving force of economic development. Try to control the scale design of each functional area and strictly limit the number and layout of high-rise buildings and super high-rise buildings so that the overall appearance of the area reflects a more reasonable sense of hierarchy.

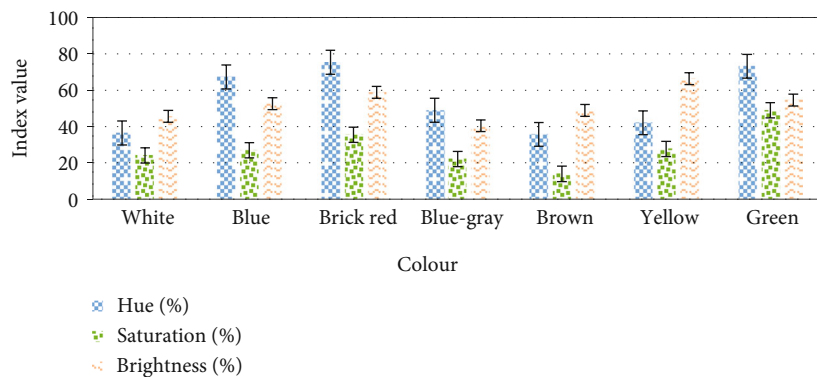


FIGURE 3: Hue, saturation, and brightness comparison chart.

5. Conclusion

Urban color is not an independent existence; it must be consistent with the city's natural humanities, historical heritage, and development goals, so as to better show its own charm. To carry out color planning, it is not to require the uniformity of urban colors, but to achieve the integration of the overall color of the city and the individual colors of functional areas. Therefore, to carry out the overall color planning of the city, it is necessary to start from the control of the specific constituent areas, strictly implement the predetermined standards, and realize the unity of the overall planning and individual development. From the analysis of this article, it can be seen that the main colors of Shanghai are blue, brick red, and green, which are mainly for urban buildings and garden vegetation, while the embellishment colors are white, yellow, and tan. Therefore, the color planning of Shanghai should embody people-oriented, show the city image and style of Shanghai, create a harmonious urban visual environment, and be able to integrate well with the surrounding environment.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

It is declared by the authors that this article is free of conflict of interest.

Acknowledgments

This study was supported by the Shanghai Planning Project of Philosophy and Social Science (Study on color planning system of new City area in Shanghai, 2021EWY004).

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