Research Article

Research on the Application of Public Art Design Based on Digital Technology and Multisensor Fusion Technology in Urban Landscape Construction

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During the more than 100 years of modern urban landscape design and construction, in addition to the continuous deductive changes of design thinking, concepts, methods and means, the construction concept and design thinking have also changed for a long time. In different periods, the degree of involvement and the role and the function of the public art involved in the landscape are different, and the applied technology is always changing. This paper emphatically analyzes the role of public art design of digital technology and multisensor fusion technology in the construction of urban landscape in China in recent years, and reveals that after the digital technology and multisensor fusion technology art design are involved in the construction of urban space landscape, they have shifted from the important power of shaping urban space aesthetics to the development of ecological aesthetics. At the same time, in this process, public art and urban design have developed to a new stage, that is, from the physical space to the construction of the spiritual field, which has become the most vivid visual text of today’s urban landscape, so as to further understand the significance and value of art in urban space.

1. Introduction

Public art is also called public art or social art. It exists in public space and serves the public. It embodies the spirit and value of cultural openness, sharing and exchange in public space. Its coverage has broken through the expression category of traditional art concept, its external expression form and internal spiritual meaning have extended to all corners related to the people, and has become a continuously developing and changing art and culture form [1–3].

The origin of the integration of public art into the urban landscape can be traced back to the temple buildings and large squares in the ancient Greek city of Athens. These squares and buildings make the art open and public participation. For example, the relief on the Parthenon temple not only shows the craft techniques at that time, but also reproduces the large-scale parade ceremony at that time. Culturally, it also reflects the ancient Greek people’s respect for the goddess Athena [4–6]. Modern public art can refer to the planning and construction of American cities after the World War II. Artists have moved their artistic creation from the art museum to the public space. The main form of expression is that a large number of sculpture works appear in the city, the urban image and culture are reflected, and the urban environment is also improved [7]. The integration of public art into the urban landscape shows the sublety of art and its humanistic spirit, so that people can feel the depth of culture when they live in a pleasant environment. If the urban modernization is the necessity of the development of human society, the public art space in the city can reflect the urban spirit from the side. In urban space, buildings depict the outline of the city with their blocks,
roads connect the parts and the whole of the city with lines, and public art embellishes the city in the form of dots, letting residents feel the value and feelings with its unique spirit [8–10].

As early as a hundred years ago, monumental public works built by foreigners appeared in some colonial cities such as Shanghai. However, due to the continuous wars in the following period, the economy fell behind, and the city did not develop. After the reform and opening up, the economic level of all parts of the country has been continuously enhanced, the development of related industries has also led to the improvement of people’s living standards, the urbanization process has been accelerated, people’s demand for spiritual level has increased, and China’s cultural and art undertakings have been greatly developed [11, 12]. Different countries have their own unique culture. From the monument in the feudal period to the sculpture mural in modern society, public art has experienced a long evolution and made great progress. From continuing the ancient style and learning from the western modernist civilization to opening up an innovative urban appearance, people have taken firm steps at every step, which also makes people see the rapid changes in urban construction [13].

In the 1960s, the USA issued a law, “percentage law,” which required that all urban construction renovation projects must use 1% of the construction funds for the purchase of art or related supporting facilities, which created good conditions for the development of public art in the USA and gradually integrated public art into the urban landscape. In addition to the USA, some scholars in European countries also put forward the idea of “art in the city” in the 1970s, and European urban construction and urban image have been greatly improved [14, 15]. This is also because after the World War II, after a period of economic recovery, the economies of various countries urgently need to restore and transform the urban appearance, which has simultaneously improved the material conditions and spiritual needs of residents [16, 17].

In the mid-1980s, some artists tried to combine China’s traditional murals [18] and sculptures [19] with the space around the building, so as to solve some problems in urban public space, which became the basis of public art expression. The new technologies and ideas that followed pushed this kind of sculpture and mural works to a more diversified space. While inheriting traditional culture, artists tried to express and carry forward with new ideas. At present, public art has been incorporated into the overall landscape of the city, and has been reflected in more ways, whether natural or humanistic. For example, such settings are common on both sides of the road, building atriums, squares, schools, parks, scenic spots and other places, and even some landscape sketches combine green plants, water bodies, installation materials, and works of art to coordinate public works of art with the environment [20, 21]. In terms of theoretical research, Wang Zhong, a professor of the Central Academy of fine arts, borrowed from Nan Tian Shi Sheng’s Book Introduction to public art that “the times are gradually turning their attention to public art from the perspective of urban planning, urban landscape, architecture, or art”, which also proves that public art has been placed in an important position in the current urban construction.

Before the industrial revolution of the eighteenth century in western cities, all urban planning and buildings were built according to the original terrain and social environment of each city. The construction characteristics at that time were to adapt to local conditions and use local materials. Architecture, urban planning, urban landscape, and architectural decoration are not only mixed as a whole, but also show their independent characteristics, but do not show the integration of public art [22]. With the development of modern means, monuments, sculptures, and other works of art have appeared in buildings, roads, public squares, and other places in the city, and have developed from early concrete art to abstract cultural embodiment [23].

With China’s industrial upgrading, the functional positioning of some local cities is also changing. In view of the demand of modern society for the embodiment of urban culture in urban public space, public art design has gradually entered people’s vision. With its flexibility and openness, public art design has gradually moved towards the public space of the city. The upgrading and transformation of urban space functions have become a trend. Urban space is facing the upgrading and transformation from residential space to tourism space, art space, cultural space, and cultural space, which requires public art to make a difference. Public art works generate a natural centripetal force between the urban public space and the public and become the spiritual link between the public and the space environment [24].

The development of urban public art should be based on the characteristics of the city itself, fully explore its regional background culture and local aesthetic characteristics, and create representative public art works on the basis of meeting modern needs. At present, large-scale public space transformation is taking place in cities. How to realize the development of urban landscape through public art, so as to drive the comprehensive development of local society, culture, and tourism, has become a problem that all places have to face and think about [25].

2. Basic Design Theory of Urban Landscape Construction

2.1. The Concept of Public Art. Public art originated from the concept of the public sphere. The public sphere is an open public space freely participated and recognized by the public. Such public buildings also reflect the city’s culture, spirit, and value demands. Public art is to carry out artistic creation and environmental design in such a space, such as sculpture, painting, photography, advertising, photography, performance, and gardening, so that public art can be extended to all corners related to the people and become a unique artistic and cultural form.

2.2. The Concept of Urban Landscape. Urban landscape is something that urban residents can see in their daily activities, reflect the city style, and make residents happy physically and mentally. It is not a single individual, but a complex organism formed through the combination of the
main building and the external space environment. Houses and other structures, as places necessary for residents’ survival and life, should have complete functions; as an external component of buildings, landscape needs to use natural beauty and artificial assistance to build an ornamental and comfortable environment. The final goal of urban construction is to make people feel comfortable and pleasant in the city where the landscape and architecture complement each other and combine hardness and softness. In addition to the architecture and spatial environment, the urban landscape also includes streets and street side facilities, and these small manifestations can also enhance the integrity and beauty of a city. The urban landscape is mainly manifested in three aspects: the public environment, public activities, and people in the activities. The public art landscape not only beautifies the public environment, but also provides a recreational site for people in the activities.

2.3. The Concept of Digital Technology. Digitalization is to transform a lot of complex and changeable information into measurable digital data, and then use these digital data to establish an appropriate digital model, convert them into a series of binary codes, and introduce them into the computer, the process of unified processing. In the current computer system, the processing, transmission, and storage of information are represented by the sum of two binary numbers. One bit of the binary number is called a “bit.” Many complex and changeable information objects in the computer, such as numbers and operations, characters, colors, sounds, images, and graphics, together with computer instructions, are transformed into measurable numbers, and data into binary codes are expressed in “bits.” This key technology is called “digitization.”

From a functional point of view, digitalization refers to the process that digital technology in the field of information computer is comprehensively promoted to all fields of human life, including the transformation process that communication technology means in the field of communication and mass communication comprehensively replace the traditional analog system with digital system. Digitalization marks the arrival of a new era. According to Negroponte, director of the Media Laboratory of Massachusetts Institute of technology, digitalization is a way of life. It is used to describe the characteristics of the new era since the mid-1990s, including decentralization, globalization, and the pursuit of harmony and empowerment.

2.4. Multisensor Fusion Technology. Multisensor data fusion technology is a multilevel, multifaceted, and interdisciplinary comprehensive information processing technology. The theories involved include digital signal processing, probability statistics, pattern recognition, artificial intelligence, and fuzzy theory. This process uses computer technology to detect, combine, correlate, and combine multisensor information in different time and space to achieve accurate state estimation and identity estimation, as well as complete and timely situation assessment and threat assessment. Due to the redundancy, complementarity, timeliness, and low cost of multisensor information, the multisensor data fusion system has high confidence and strong robustness [26]. The basic principle of multisensor data fusion technology is the same as the process of human brain’s comprehensive information processing. It is necessary to fully control and use the multisource data and optimize the combination of multidimensional, multilevel redundant, or complementary information of various sensors. Through the separation and observation of each sensor, the data are combined in multiple levels and aspects to obtain the interpretation or description consistent with the measured object [27–29]. Redundant data among multiple sensors enhances the reliability of the system, while complementary data extends the performance of a single sensor, as shown in Figure 1.

3. Application of Public Art Design in Urban Landscape Construction

3.1. The Function of Public Art Design in Urban Landscape Construction. As a modern cultural phenomenon, public art design can meet people’s aesthetic needs, create a good humanistic atmosphere, enhance the interaction between public art and people, promote the innovative development of the city, and show various functions.

3.1.1. Express the Cultural Connotation of the City. As the representative of urban culture and art, public art can express the connotation of urban culture to a great extent. First, the application of public art in urban space has endowed the city with a new cultural connotation, which is conducive to reshaping the city image, reflecting the regional culture with local characteristics, and enhancing the attractiveness of the city. Second, in urban public works of art, it carries the way of thinking and feelings of urban people, can enhance people’s sense of identity and pride in the city, and promote the innovation of urban culture. Thirdly, from the perspective of urban historical development, urban public works of art are the witness and epitome of urban development, highlight the connotation and temperament of the city, have a unique historical and cultural charm, and awaken people’s urban memory. For example, the group carvings of the “eight monsters in Guanzhong” in Xi’an, in terms of material selection, process performance and theme connotation, all highlight the urban characteristic culture with local characteristics, including food, clothing, housing, and transportation.

3.1.2. Enhance the Artistic Taste of the City. As an important means and way of urban space expression, public art products can create an artistic urban environment. With the rapid development of urbanization, the number of buildings has increased dramatically, occupying a large amount of urban space. Through the embellishment of public art, we can make the city more artistic, add a “soft” power in the “hard” reinforced concrete forest, complete the filling of the sustainable use of urban space, and show the different face of the city. For example, the graffiti street of Sichuan Academy of Fine Arts has reformed the buildings on both sides, making full use of the space of the street. It starts from
With the improvement of urbanization, the original functions of the city cannot meet people’s aesthetic needs. The application of public art in urban space can beautify the environment and reshape the city image. For example, decorative public art products can break through the shackles of the traditional single environment, enrich the interest of the urban environment, give people the enjoyment of beauty, and meet people’s spiritual needs. High-quality public artworks can provide people with a space to release pressure; delight people’s spiritual life; enrich the functions of city squares, streets, and parks; and improve the quality of life. Taking the East Square of Shijiazhuang Railway Station as an example, in terms of public art design, combined with urban cultural and historical resources, the square space is fully optimized, modern experience technology is integrated, and some auxiliary facilities are added, which not only gives play to its original functions, but also creates a good urban environment, provides people with places for leisure and entertainment, becomes a landmark building, and improves the utilization rate of urban space.

### 3.2. Construction Principles of Public Art Design in Urban Landscape

In order to meet the basic requirements of the current rapid development of urbanization, the application of public art design in urban public space needs to adhere to the principles of aesthetics, interactivity, timeliness, and common development; reshape the city image; and build a more beautiful urban environment.

#### 3.2.1. Aesthetic Principle

The development of public art plays a very important role in people’s aesthetic tendency. In the application of public art design in urban public space, it is necessary to adhere to the principle of aesthetics, optimize the internal layout, enrich the urban spatial structure, and give people an overall coordinated aesthetic feeling. In terms of material and color selection, decorative means of expression should be adopted to enhance the artistic effect of the design. In terms of design ideas, it should be consistent with the characteristics of urban public space, meet the requirements of urban historical and cultural development, and the product appearance should be beautiful, conform to the aesthetic concept of modern people, and highlight the distinctive artistic style. Therefore, public art should pay attention to the application of aesthetic principles in the design of urban public space, create a beautiful urban space, and establish a good urban image.

#### 3.2.2. Principle of Interactivity

In the application of public art design in urban public space, designers should adhere to the principle of interactivity, deeply integrate with people’s daily behavior and spiritual needs; and obtain a unique experience. Therefore, designers should adhere to the principle of interactivity, enhance the interaction between art and the public, and give full play to the role of public art in communication and publicity.

#### 3.2.3. Principle of Common Development

At present, public art and design has had a very important impact on urban development. Designers need to choose a variety of design methods according to the actual situation of the city, so as to meet people’s pursuit and aesthetic appreciation of art from the material and spiritual levels. Public art works represent the image of the city. Through concrete and narrative ways, they truly integrate people, environment, art, and space; express abstract urban culture; make the public space of the urban environment full of artistic flavor; let art land; accurately transmit information to people; fully tap the intrinsic value of public art; create a common urban

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**Figure 1:** Schematic diagram of multisensor data fusion.

**Figure 2:** Overall structure diagram of urban landscape system of public art design based on digital technology and multisensor fusion technology.
4. Overall System Design.

The overall structure of the urban landscape system of public art design based on digital technology and multisensor fusion technology is shown in Figure 2. The terminal sensor collects the basic urban index data of urban buildings, roads, air, humanities, and environmental lights and transmits them to the cloud platform through wireless communication. Users can monitor remotely through the intelligent device APP. The various terminal sensors detect the urban environment parameters and transmit them to the ZigBee coordination node and then to the intelligent gateway, which is transmitted by the router to the cloud server. Users can remotely monitor the urban landscape environment by logging in to the intelligent device cloud APP. When the urban landscape environmental parameters do not conform to the basic design value or exceed the basic index range, the buzzer will give an alarm prompt, and the user will send control instructions through the intelligent device cloud APP, send them to the intelligent gateway through the cloud server, and then send them to the ZigBee coordination node that is to say, the control command is sent to the relay control module of the terminal node to remotely automate the design of urban buildings, air purification equipment, vehicle restriction equipment and other basic equipment, so as to realize the functions of reducing urban buildings, purifying urban air and improving urban environment. The intelligent gateway communicates with ZigBee nodes (including coordinator nodes and terminal nodes) through serial ports and communicates with routers in the form of WiFi.

4.2. Intelligent Gateway Design. Intelligent gateway is the core component of the urban landscape system of public art design based on digital technology and multisensor fusion technology. It is mainly responsible for information fusion of data collected by each sensor at the terminal, making early warning judgments, and realizing information interaction with the user [30]. It is mainly composed of STM32 and WiFi module ESP8266.

STM32 adopts STM32F103ZET6 model, which is an embedded MCU. The core of the chip is 32-bit Cortex-M3, the maximum operating frequency is 72 MHz, the program memory capacity is 256 kb, the program memory type is flash, and the RAM capacity is 48 K. Each general input/output interface (GPIO) pin can be configured by software as a peripheral function port for output (push-pull or open drain), input (with or without pull-up or pull-down), or multiplexing. Most GPIO pins can be shared with analog or digital multiplexing peripherals. It is powered by a single DC power supply. The power supply voltage range is 2.0~3.6 V, and the general power supply voltage is 3.3 V.

ESP8266 is a low-cost wireless device with large operating temperature range and stable performance. It can adapt to various operating environments. It is designed for mobile devices, wearable electronic products, and Internet of Things applications. It has low-power consumption and is highly integrated. It supports real-time operating system (RTOS) and WiFi protocol stack. ESP8266 and ZigBee nodes adopt serial port communication. The communication principle is shown in Figure 3.

4.3. Sensor Selection

4.3.1. DHT11 Temperature and Humidity Sensor. Temperature and humidity are the biggest factors that affect the sense of the city. The quality of the sense of the city will greatly affect the appearance and development of the city. High temperature and humidity will lead to poor livability of the city.
city, resulting in the lack of retention of talents and restricting the development of the city. Generally, the urban sensible temperature is stable at 20–30°C, and the humidity is maintained within 30% RH, which is suitable for the long-term residence of the population.

DHT11 temperature and humidity sensor have the advantages of strong anti-interference ability, high quality, fast response, strong anti-interference ability, high-cost performance, small volume, and low-power consumption. It has good application value in the temperature and humidity monitoring of urban landscape. It consists of a resistive humidity sensor and an NTC thermistor, which is applicable to humidity readings of 20%–80% (accuracy ±5%) and temperature readings of 0–50°C (accuracy ±2°C). It has 4 pins, of which Pin1 is the power pin and the power supply voltage is 3 ~ 5.5v; Pin2 is a serial data terminal with single bus communication; PIN3 is generally suspended; and Pin4 is the grounding terminal. Figure 4 shows the typical application circuit of DHT11 sensor. Generally, when the length of the connecting line between DHT11 and MCU is less than 20.0 m, 5 K pull-up resistor is used. When the length is greater than 20.0 m, appropriate pull-up resistance shall be used according to the actual situation, so as to improve the measurement accuracy. MCU sends signals to DHT11 sensor, and DHT11 collects temperature and humidity data (one complete data transmission is 40 bit) and inputs it to MCU data port [31].

### 4.3.2. Carbon Dioxide Sensor

In urban air quality monitoring, the monitoring of carbon dioxide content is one of the necessary items. Carbon dioxide is mainly produced by automobile exhaust, human, animal, and plant respiration, and its concentration can directly affect people’s daily life. When the concentration of carbon dioxide is too high, it...
can generally be judged that there is a large amount of auto-
mobile exhaust or industrial gas in the city, which directly
affect the rise of urban temperature and urban pollution
index, and has a great impact on urban landscape design.
It can be seen that the concentration of carbon dioxide
should be strictly controlled in urban landscape design.
The urban landscape system of public art design based on
digital technology and multisensor technology constructed
in this paper adopts RS-Co2 sensor. It uses a new infrared
verification technology to measure the concentration of car-
bon dioxide. It has high accuracy, small drift, long service
life, wide measurement range, and built-in temperature
compensation and is less affected by temperature. Generally,
its power supply voltage is DC voltage 10~30 V, the mea-
surement range is 0~5000 PPM, and the accuracy is 40
PPM ± 3%f.s. The variation diagram of carbon dioxide con-
centration in Shanghai in the first quarter of 2022 monitored
by this method is shown in the ordinate of Figure 5.

4.3.3. Oxygen Sensor. During gas monitoring, in addition to
carbon dioxide directly reflecting the urban landscape, the
content of oxygen can also reflect the urban landscape. Oxy-
gen is generally produced by plant photosynthesis, and the
general oxygen capacity can also indirectly reflect the urban
greening rate. Therefore, it is necessary to monitor the urban
oxygen capacity. The urban landscape system of public art
design based on digital technology and multisensor technol-
ogy constructed in this paper adopts LOX-O2 fluorescent
oxygen sensor. It is a digital sensor with UART output. It
does not need signal conditioning circuit; has low power
consumption, long service life, stability, and environmental
protection; does not contain lead or other toxic materials;
and will not be subject to cross-interference of other gases.
Generally, its power supply voltage is DC voltage of
4.5~5.5 V. The oxygen measurement range is 0~25% and
0~300 mbar. The variation diagram of urban oxygen con-
centration monitored by this method is shown in the
abscissa of Figure 5.

4.3.4. Relay Control Module. The system uses the relay con-
trol module to remotely and automatically control the city
exhaust fan, heating equipment, humidifying equipment,
and other field equipment, that is, to realize the on and o
of the relay switch by controlling the pulse signal input to
the relay module, or to realize the control manually. The
power supply voltage of the relay control module is 220 V.
The schematic diagram is shown in Figure 6. It has three
external pins, of which the input pin receives the pulse
signal.

4.4. System Software Design. The software design of this sys-
tem mainly includes the design of intelligent gateway. The
intelligent gateway is composed of STM32 and ESP8266.
As the core component of the system, it connects the ZigBee
wireless LAN and the Internet, and is responsible for the
interaction of two types of data, that is, the data collected
by the terminal node sensor uploaded by the ZigBee coordi-
nator and the control instructions sent by the user through
the intelligent device app. At the same time, as the control
center, it performs basic analysis, processing, and temporary
storage of data and instructions. The intelligent gateway of
the system is developed on the KeilM DK5 platform. The
program flow chart is shown in Figure 7. After the intelligent gateway is powered on and initialized, it enters the monitoring network state and waits for the terminal data to be uploaded. The intelligent gateway will judge the received data. If it is ZigBee data, it will judge it as terminal sensor data, and upload it to the ECS. If it is TCP/IP data, it is judged as a control instruction and sent to the ZigBee coordinator. If the data is neither ZigBee data nor TCP/IP data, it is judged as illegal message data, which is lost and enters the monitoring network state again [32].

5. Multisensor Data Fusion

The construction of urban landscape monitoring system based on the public art design concept of digital technology and multisensor fusion technology mainly depends on two points: One is the extraction and calculation of big data by digital technology, and the other is multisensor fusion. During the construction of this system, multipoint measurement of urban environmental parameters is generally used. A temperature and humidity sensor is embedded every 5 km to detect the temperature and humidity of cities at different depths and locations. At the same time, carbon dioxide sensors and oxygen sensors are distributed at different locations to monitor the gas parameters in the urban environment in real time. In order to improve the accuracy of urban environmental monitoring and effectively improve the comprehensiveness and real-time of data, the system adopts local fusion of monitoring data from similar sensors and then uses D-S evidence theory algorithm for global fusion of monitoring data from different sensors [33], so as to reduce the error of collected data.

The data fusion structure of the system is shown in Figure 8. Firstly, local data fusion is carried out for the data collected by similar sensors; that is, multiple experiments are carried out to calculate the mean value of different time periods through arithmetic mean, and any value is compared with the mean value of the corresponding time period. If it is greater than the mean value of the corresponding time period, the value is regarded as an abnormal value and replaced by the mean value. If it is less than the average value of the corresponding time period, the value will be regarded as a normal value and will not be processed, so as to correct the abnormal data of similar sensors. Then, the D-S evidence theory algorithm is used to perform global fusion analysis on the data collected by heterogeneous sensors; that is, the temperature and humidity, carbon dioxide concentration, and oxygen concentration levels in the urban environment are assigned as probability functions, and the D-S evidence theory is used to make the final urban environment assessment. First, the temperature and humidity and carbon dioxide concentration levels are fused, and the normalization constants K and MAS functions are calculated. The results are fused with the oxygen concentration levels. Then, the environmental grade of the whole city is obtained, which increases the credibility of the judgment result of the system on the urban environmental grade and ensures the accuracy of the judgment result [34].

6. Conclusion

Public art design plays an important role in the construction of public space. It can not only show the cultural charm of the city and promote the development of culture and art, but also greatly improve the cultural atmosphere and improve people’s artistic aesthetic level and cultivation. Under the dual requirements of the current urban cultural landscape and people’s real life, designers cannot do without public art design to make a public space that conforms to the public aesthetic. After considering the local culture and innovative technology, this paper, starting from the actual needs of the development of modern cities, combined with the Internet of Things technology, communication technology, cloud computing technology, and multisensor fusion theory, designed an urban landscape monitoring system based on the public art design concept of digital technology and multisensor fusion technology. Through the analysis of digital technology, the digital model of modern city is established. Combined with the concept of public art design, multisensor fusion technology is introduced to monitor the urban environment, which provides real-time, accurate, and reliable data for urban environmental monitoring; improves the intelligent level of urban environmental information; and ensures people’s quality of life. At the same
time, the experimental monitoring of this paper proves that the system constructed by this paper is stable and reliable, and the relevant achievements have a certain promotion and application prospect in the field of intelligent city construction.

**Data Availability**

The dataset used in this paper are available from the corresponding author upon request.

**Conflicts of Interest**

The authors declared that they have no conflicts of interest regarding this work.

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