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Exploring Radio Cognitive Network Applications in the Digital Design of Jinzuo Furniture Cultural Tourism Display Platform Anchored in Intangible Cultural Heritage

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Abstract

The integration of digital design is crucial for showcasing the Jinzuo furniture culture within the tourism sector, particularly in the domains of historical artifacts, archeology, and collectibles, garnering significant academic interest in the antiquities market. Presently, the comprehension of Jinzuo furniture's cultural significance is predominantly theoretical, with a noticeable absence of a comprehensive exhibition platform. Challenges encountered in the portrayal of Jinzuo furniture's regional culture include subpar visual presentations and limited data availability. These issues stem largely from regional cultural disparities and inadequate wireless network support, which hampers the promotion and evolution of the Jinzuo furniture cultural narrative. To address these challenges, this study introduces a digital design strategy that leverages multimedia networks in tandem with cognitive radio technology to craft a dedicated cultural and tourism exposition platform for Jinzuo furniture. The approach involves harnessing cognitive radio technology for data acquisition on Jinzuo furniture, aggregating information across various platforms via multimedia technologies, and categorizing Jinzuo furniture styles based on regional cultural traits. The study delves into the dissemination of digital designs through radio technology to enhance the recognition of Jinzuo furniture's regional cultural identity and the platform's display efficacy. The outcomes of the digital design showcase indicate that cognitive radio and multimedia network technologies can elevate the design quality of the Jinzuo furniture culture and tourism exhibition platform. By employing cognitive radio technology, the platform can fulfill the cultural development objectives of Shanxi.

Keywords: Intangible Cultural Heritage, Multimedia Networks, Jinzuo Furniture, Cultural Tourism Exhibition Platform, Digital Design, Cognitive Radio Technology.

1. Introduction

Cognitive radio technology refers to the basis of multimedia technology and network technology, including text, graphics, sound, images, animation, etc., and includes hypermedia technology that combines these media, so that the content displayed by computer-aided design platforms is more intuitive [1]. However, in the process of cognitive radio technology transmission, the problems of complex data and frequent interference often occur, which affect the design and analysis of the display platform[2]. To this end, this paper integrates cognitive radio technology and cognitive radio technology, analyzes the characteristics of Jin Zuo furniture cultural tourism in different regions according to the assessment criteria of intangible cultural heritage, extracts the key values therein, and better integrates them, and the specific data research path is shown in Figure 1.

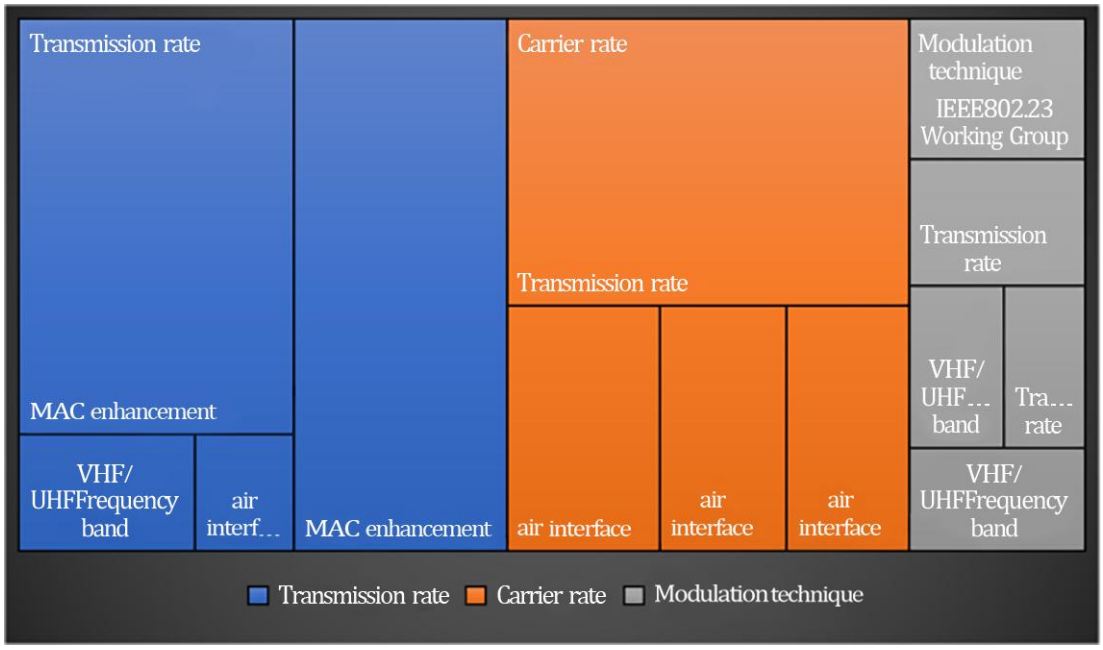

Figure 1. The Research Path of Jinzuo Furniture Cultural Tourism Display (Data Source: Shanxi folk literature, regional survey report)

Cognitive radio technology, known for its adaptability, intelligence, and reconfigurability, incorporates artificial intelligence to dynamically adjust transmission parameters such as power, carrier frequency, and modulation methods. This adaptability allows it to modify its operational state in response to the fluctuating statistics of incoming wireless signals, ensuring robust communication across various locations and times, thereby optimizing the utilization of communication resources [3]. Consequently, this technology lays the groundwork for the digital design of a Jinzuo furniture cultural tourism exhibition platform, with the specifics of the design approach detailed in Table 1.

Table 1. Facility Advantages of Cognitive Radio Systems (in %)

Index	Performance	Error
Capture information	64.14	23.14
Perceive information	52.92	15.68
Spectrum resources	53.01	31.74
Ability to refactor	61.29	19.69

The communication process of cognitive radio technology is shown in Figure 2.

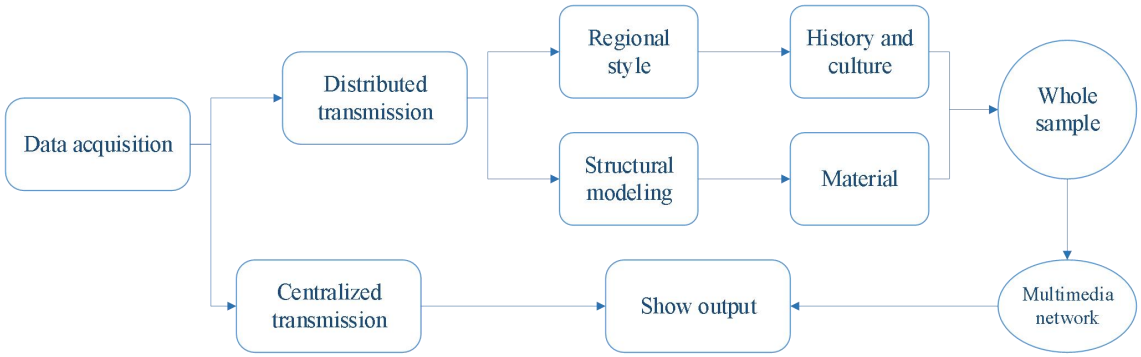

Figure 2. The Transmission Process of Data is Shown under Cognitive Radio

Utilizing cognitive radio technology, the digital design process for cultural furniture display platforms can be streamlined, aligning with the assessment standards for intangible cultural heritage. This approach involves a detailed examination of the data flow and the relationships between entities associated with Jinzuo furniture to ensure the efficacy and completeness of data within cognitive radio communications [4]. Research indicates that cognitive radio's wireless transmission capabilities can enhance the platform's display recognition while reducing the volume and complexity of data transmitted wirelessly, in accordance with intangible cultural heritage evaluation metrics [5]. By applying these metrics and cognitive radio technology to the exhibition of Jinzuo furniture, the platform's display can be rendered more immediate and visually engaging. Nonetheless, the digital design analysis must consider the impact of transmission, selecting spectrum resources judiciously to optimize transmission efficiency. The process for selecting these spectrum resources is outlined in Table 2.

Table 2. Spectrum Resource Selection for Cognitive Radio Systems

Content	Platform	Language
Audio, video	B/C	Java、C#、Html
Massive data, big data, structured data	B/S	Java、C#、Html
Documents, web articles, microblogs	B/C	Java、C#、VB

As can be seen from the description in Table 2, cognitive radio technology can select communication modules and compatible ports according to the amount of transmitted data [6]. Although it can quickly transmit the Jinzuo furniture data in different regions, it cannot realize the identification, classification, mining, and elimination of digital design, which is not conducive to the summary of paper-cutting digital design, as well as the adjustment and reconstruction of relevant parameters. Therefore, it is necessary to use the evaluation criteria of intangible cultural heritage to assist.

2. Related Works

2.1 Identification of Different Entity Relationships in Jinzuo Furniture Data

Because Shanxi ancient furniture is divided into three genres according to different regional cultures, they are Jinbei furniture, Jinzhong furniture, and Jinnan furniture[7]. The identification of entity relationships mainly starts from the content, material, and structure, and displays them through the evaluation standards of intangible cultural heritage, historical and cultural excavation, reducing the characteristic indicators of the region, and adding correlation and impact values in different digital design collections [8]. The combination of digital identification and cognitive radio technology can transmit massive amounts of digital design data and reduce the amount of network transmission [9]. The cognitive radio system can match, reconstruct parameters, and set the transmission amount of Jinzuo furniture and digital design data, and the specific transmission process is as follows.

The characteristic data of Jinzuo furniture: the data of Jinzuo furniture is f_i , the content characteristics is Rf , the structural characteristics is a_i , the digital design calculation function is x_{ij} , and the importance of the characteristics is d_i , The regional data collection of Jinzuo furniture is shown in Equation (1).

$$Rf(d_i \cdot a_i) = \sum_{i=1}^{n} f_i \cdot D(x_{ij}) \tag{1}$$

The process formula for digital design is as follows:

$$sum(D_i) = (\sum x_{ij}) \int p(d_i^{n-1}) \tag{2}$$

From the above formula, the digital identification of Jinzuo furniture can be realized, and the most appropriate spectrum and working parameters can be selected according to the spectrum hole to improve transmission efficiency [10].

Ranking of digital design indicators: weight sorting function is $sum(D_i)$, feature influence degree calculation function is x_{ij} , digital design index integration degree sorting is $T(y_i)$, spectrum resource utilization is p , and digital design index is sorted As shown in Equation (3):

$$T(y_i) = \frac{\sqrt{a^2 + b^2}}{(\sum x_{ij}) \int p(d_i^{n-1})} \tag{3}$$

The transmission of data of Jinzuo furniture by the cognitive radio system: the wireless transmission node is $g(c_i)$, the node transmission function is t , and the cognitive transmission function shown is μ_i .the digital design processing of Jinzuo furniture The process is shown in Equation (4).

$$g(c_i) = \sum_{i=1}^{t} t(x_{ij} - \mu_i) \tag{4}$$

3. Methodology

3.1 Cognitive Radio Transmission Processing of Jinzuo Furniture Cultural Data

Due to the diverse styles and regional cultural variations, Jinzuo furniture cultural data exhibits complex patterns, necessitating the encryption of digital design data on the cultural tourism exhibition platform to secure key content and its contextual relevance [11]. Moreover, in instances where a frequency band is occupied by a licensed spectrum user, cognitive radio can adapt in one of two ways: by switching to an alternative unoccupied frequency band for communication, or by continuing on the same frequency band but altering the transmission frequency or modulation method to prevent interference with the licensed users, thus simplifying data processing. For a more effective digital design analysis, it is crucial to select the most suitable frequency band, with the outcomes of this selection process presented in Table 3.

Table 3. Frequency Band Selection for Jinzuo Furniture Culture Display

Transfer Content / Data Stream	Data Flow Direction	Material	Structure	Content
Forward Flow	9→13→5→10	83.38	81.75	82.44
	4→8→10→12	79.52	84.88	86.87
	12→20→3→8	84.67	85.98	84.62
	5→4→17→6	88.38	83.63	85.03
	9→16→17→16	81.73	80.84	86.27
Reverse Flow	16→12→5→3	86.47	84.02	83.21
	11→14→5→14	84.60	83.88	83.00
	16→11→12→14	88.19	82.13	85.29
	4→7→4→3	83.76	86.38	86.86
	17→12→20→12	86.36	86.30	84.47
Random Streams	19→13→4→11	85.75	82.51	81.92
	19→4→11→12	85.06	81.65	84.74
	17→15→20→18	83.46	88.23	81.86
	10→18→15→7	85.80	83.09	83.31

Table 3's analysis of Jinzuo furniture cultural data reveals that the integrity of data transmission concerning regional culture, exhibition methods, furniture design, and materials is robust. This suggests that the collaborative terminals involved in the operation are functioning effectively.

3.2 Matrix Processing of Digital Design Data

The data in Table 3 is digitized and the matrix values for each planning class are shown in Table 4.

Table 4. Planning Matrix for Digital Design

Test / Number of Bands Matrix	Jindi Culture	How to Show	Type of Furniture	Furniture Material
14	0.57	online, offline	0.68	0.19
7	0.50	online, offline	0.21	0.25
9	0.66	online, offline	0.30	0.34
15	0.45	offline	0.43	0.16
5	0.39	offline	0.33	0.44
7	1.07	offline	0.64	0.19
23	0.41	online, offline	0.50	0.47
28	0.66	online, offline	0.66	0.40
32	0.10	online	0.73	0.75
9	0.51	online	0.53	0.37
25	0.41	online	0.01	0.33
12	0.52	online, offline	0.45	0.27
19	0.37	online, offline	0.68	0.55
17	0.60	online, offline	0.46	0.73

It can be seen from the data in Table 4 that the feature values of the data matrix of the Jin writers cultural tourism platform < 1, indicating that there are feature values in the matrix. After cognitive radio technology processing, the digital design value is less than 2, which meets the transmission requirements of platform data streams. There are great differences in the data in the digital design of the cultural tourism display platform, mainly due to the complexity of the digital

design and the large proportion of transmission volume, so it is necessary to simplify the complexity of the transmitted data.

4. Results and Discussion

4.1 Conditions of Cognitive Radio Systems

Based on the cognitive radio system, this paper analyzes the content, structure and platform based on the cultural characteristics of Jinzuo furniture. Among them, there are 32 receiving terminals and 5 communication modules. The receiving frequency is 12~45Hz, and the display form of Jinzuo furniture cultural tourism is video, voice, text and other formats, and the specific conditions are shown in Table 5 shown.

Table 5. Parameters of Cognitive Radio

Index	Parameter	Quantity
Operating frequency	45Gpisc、23.4Hz	4~7 pcs
Transfer format	Text, pictures, videos	7~13 pcs
Transmission volume	32TG ~ 64TG	3~7 pcs
Single shot file format	0.5G	5~12 pcs
Transport protocol	IEEE802.11	1

The results of the web page construction for cognitive radio communication are shown in Figure 3.

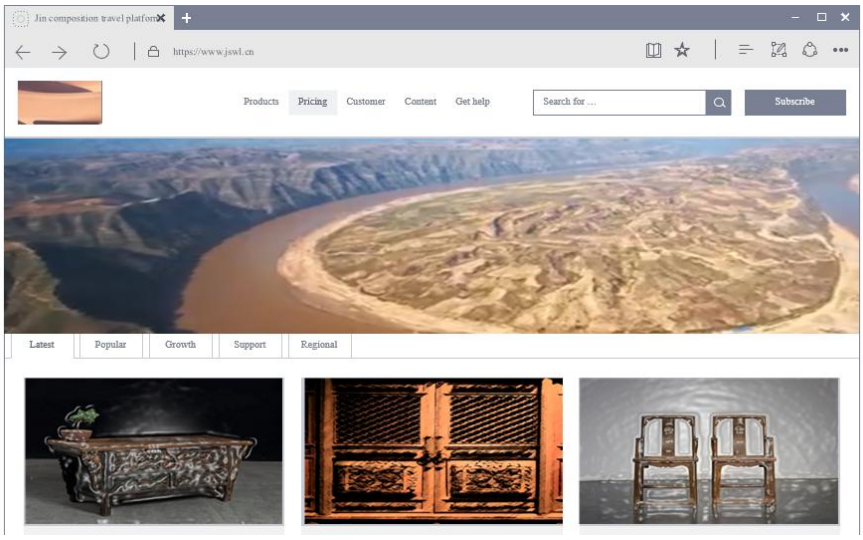

Figure 3. Platform Display of Jinzuo Furniture

Figure 3 illustrates the foundational and actual visualization outcomes for Jinzuo furniture, where the core framework is defined by the digital design parameters of the display platform, encompassing both content and form. The comparative data in Figure 5 suggests that cognitive radio technology enhances the digital design quality of the display platform, effectively conveying the historical and cultural narratives and achieving a more precise amalgamation of digital design data. This implies that the multimedia broadcasting capabilities of cognitive radio technology are optimal. A detailed summary of the data is provided in Table 6.

Table 6. Overview of Jinnan Folk Paper-cutting

Jinzuo Furniture Cultural Content	Research Directions	The Number of Characteristic Indicators	The Specificity of the Feature
Entity Relationships	Jinbei	3	73.98
	Jinnan	9	69.73
Folklore Characteristics	Jinzhong	8	74.31
	Charm	9	75.82
	Classical	8	81.09
Content Characteristics	tradition	7	76.27
	custom	9	72.59

4.2 Demonstrate the Digital Design Process of the Platform

The digital design strategies for the Jinzuo furniture cultural tourism exhibition platform enable an in-depth examination of the display impact and the detailed execution of Jinzuo furniture culture. The results of extracting these specific features are documented in Table 7.

Table 7. Feature Extraction in the Digital Design Process

Extraction Method	Characteristic Indicators	Degree of Presentation
content presentation	structure	71.85
	color	72.59
	material	81.12
	personality	73.71
	progression	70.68
	visual features	72.02
	cultural identity	70.01
	concept features	79.91
	connotative characteristics	78.43
furniture features	carve	68.58
	size	65.81
	texture	73.65
	characteristics of the times	72.06
	vintage sex	75.97

The feature extraction results in Table 7 show that the degree of display is high, indicating that cognitive radio technology can meet the actual display transmission requirements. The change process of Jinzuo furniture display is shown in Figure 4.

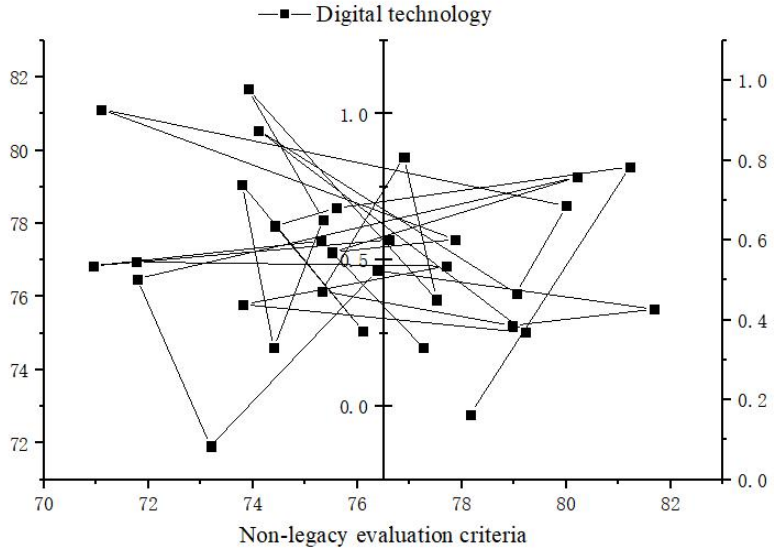

Figure 4. The Digital Design Judgment Process of the Platform

Figure 4 indicates that the methodology introduced in this document effectively captures the essence of Jinzuo furniture, with data characterization achieving over 80% during transmission and showing an upward trend in volume.The reasons for the above problems are mainly based on the integration of intangible cultural heritage evaluation standards, the standardization restrictions on Jinzuo furniture data, cognitive radio technology to improve the data transmission rate, increase the utilization rate of spectrum resources, and realize Jinzuo furniture culture through cognitive radio technology Real-time reproduction.

4.3 Cognitive Radio Technology under Digital Design

Cognitive radio technology can enjoy various audio-visual materials, read pictures, sounds, and electronic magazines and videos, making the display effect of the platform more intuitive and easy to understand. However, it has an impact on color rendering, data transmission, port compatibility, wireless transmission rate, and band usage, so it is necessary to reduce the frequency of change, as shown in Table 8.

Table 8. Frequency Selection for Digital Design

Frequency	Content	Color	Compatible Data	Key Content	Transfer Point	Key
Centralized	Jindi	65.08	65.10	64.91	64.87	84.96
	folk custom	65.05	64.81	65.35	54.90	85.12
Distributed	Jindi	64.80	65.02	64.92	74.74	84.99
	folk custom	65.04	65.14	65.19	54.98	85.02

The flow of digital design in Table 8 is shown in Figure 5.

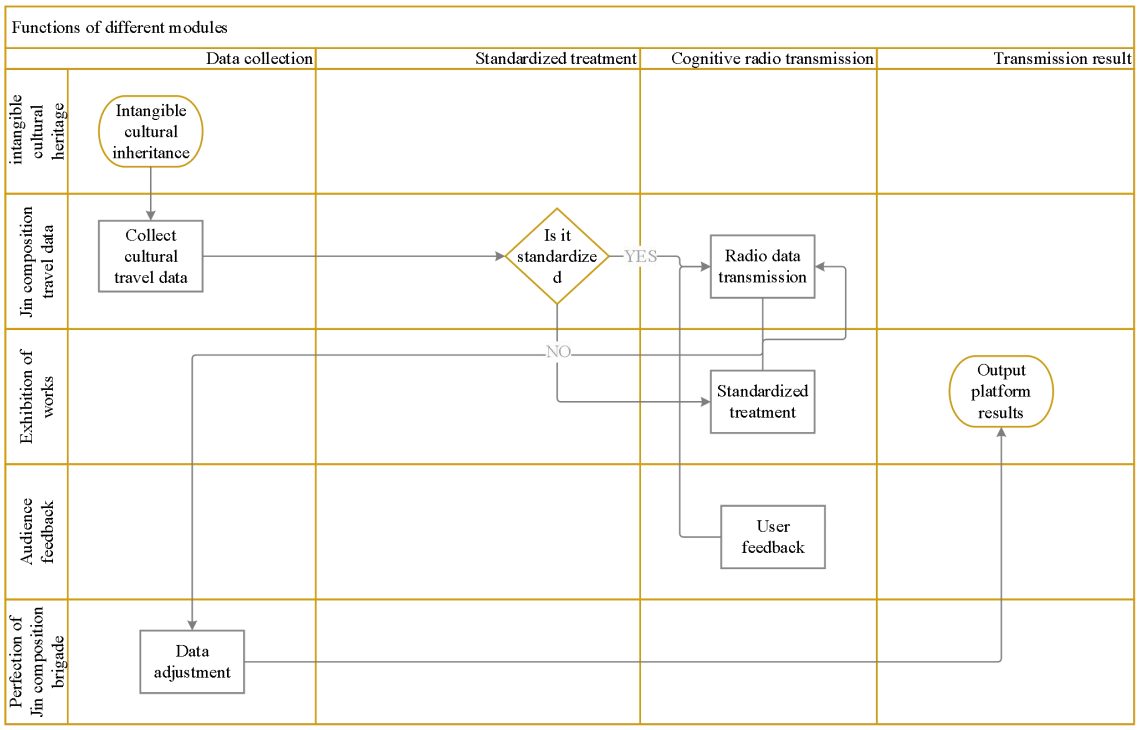

Figure 5. Process Design of Jin-made Furniture Cultural Tourism Display Platform

The data flow for different methods varies, as shown in Figure 6.

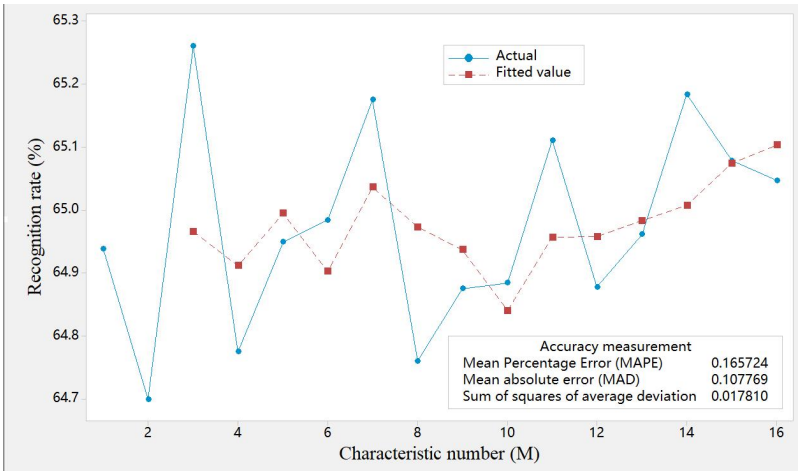

Figure 6. Changes in the Frequency of Jinzuo Furniture Data

It can be seen from Figure 6 that under different frequencies, the cultural characteristics and digital design of Jinzuo furniture do not change greatly, indicating that the centralized and distributed change frequency has little impact on the display content, which further proves that the cognitive radio technology of digital design can realize the effective display of Jinzuo furniture culture. The reason is that cognitive radio technology can reduce the error rate of transmission through data simplification, shorten the display time of Jinzuo furniture data, increase the amount of single data transmission, and fully meet the display needs of digital design.

4.4 Transmission Results of Cognitive Radio Endpoints

The transmission result is the basis for Jinzuo furniture display, and the link points should be sampled and identified by multiple endpoints, the actual display results should be recorded, and the specific results are shown in Figure 7.

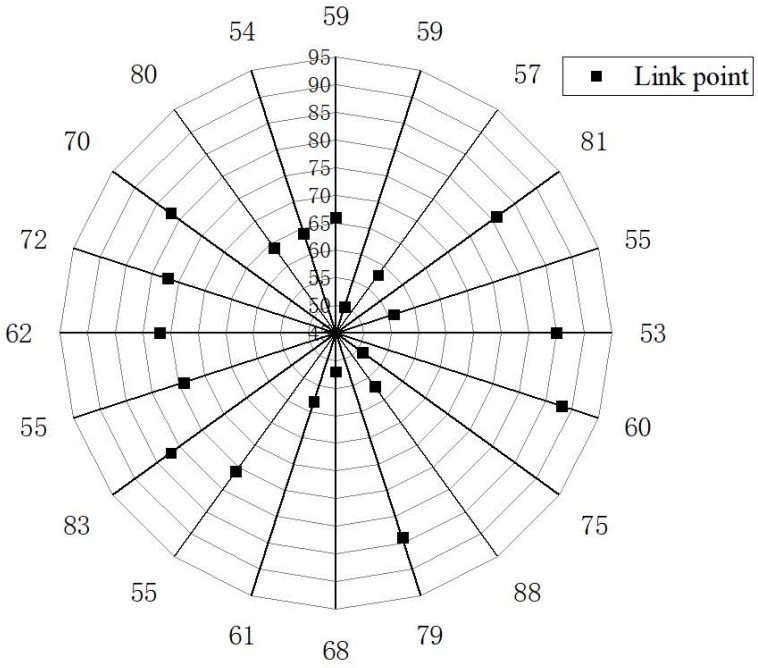

Figure 7. Transmission Results of Jinzuo Furniture Display

Figure 7 demonstrates that the connection points are distributed sporadically, with the resulting transmitted data aggregating from the peripheries towards the center. This pattern suggests a significant variance between the relay points and the feature quantities, confirming that the connection points suffice for the actual transmission needs. The data exhibits dispersed distribution during transmission due to the frequency alterations and characteristic attributes representing two distinct data sets moving in separate directions, with each iterating within its trajectory, thus facilitating improved iterative computations. These observations confirm that cognitive radio technology can effectively showcase Jinzuo furniture content and enhance the transmission capabilities of cognitive radio. By analyzing the data presented in Figure 7, the subsequent computational outcomes have been deduced, as detailed in Table 9.

Table 9. Transfer Results of Cultural and Tourism Resources of Jinzuo Furniture

Cultural Tourism Resources	Parameter	Utilization Rate of Cultural Tourism Resources	Transfer Effect	Digital Metrics
Local cultural tourism resources	furniture	78.34	77.27	9
	cultural tourism	76.19	75.30	7
	digit	75.93	70.95	13
Furniture cultural tourism resources	furniture	74.03	76.61	16
	cultural tourism	72.94	71.77	6
	digit	70.93	77.70	10

The results of furniture cultural tourism resources and local cultural tourism resources were identified, and it was found that the evaluation results of utilization rate, transmission effect and digital indicators were good in the entire display content, and the difference between the virtual display of Jinzuo furniture and the actual presentation results was small, and the change range of the result data was small, which further indicated that cognitive radio technology could realize the real-time transmission of Jinzuo furniture data.

4.5 Accuracy of Digital Design

The varied nature of Jinzuo furniture, the nuanced depiction of its cultural elements, and the amalgamation of distinct Jindi styles necessitate precise digital design to ensure accurate representation and assessment of Jinzuo furniture. The outcomes of this necessity are depicted in Figure 8.

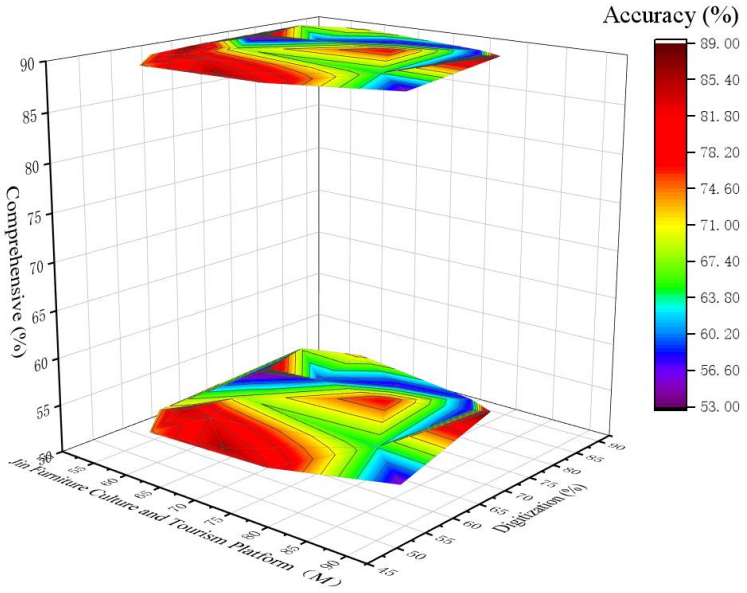

Figure 8. The Accuracy of Digital Design of Jinzuo's Furniture

Figure 8 reveals that the transmission precision of the cognitive radio system surpasses that of manual methods. The transmitted furniture data for each piece of Jinzuo furniture closely aligns with its actual representation, signifying that the cognitive radio system's transmission can accurately execute feature extraction. This provides robust support for the exhibition of Jinzuo furniture culture, with the detailed results presented in Table 10.

Table 10. Identification Accuracy of Jinzuo Furniture Display Indicators

Extract Location	Cognitive Radio Technology Demonstration		Cultural Tourism Exhibition Platform	
	Jindi Style	Furniture	Jindi Style	Furniture
8	88.64	86.20	84.58	82.76
5	85.89	85.37	83.28	81.95
1	86.28	81.41	84.36	82.28
3	85.53	82.71	81.28	82.55
5	84.49	82.40	83.40	81.13
4	86.81	82.90	81.58	85.76
3	88.92	85.78	79.94	83.51
9	84.53	85.12	82.76	81.35
7	81.59	83.21	84.49	88.85

The construction process depicted in Table 10 indicates that the digital design of the display platform is highly recognizable, with the transmission rate of cognitive wireless communication exceeding 83%. This efficiency is primarily attributed to the guidelines set by intangible cultural heritage criteria, which streamline the complexity of data in cognitive wireless communication. This evidence further substantiates the capability of cognitive radio transmission to fulfill the practical demands of digitalization. Additionally, the process of selecting cultural tourism exhibits encountered minimal interference, suggesting that the digital presentation of the Jinzuo furniture cultural tourism display platform is optimal.

5. Conclusion

Aiming at the digital design of Jinzuo furniture culture and tourism display platform, this paper proposes a digital design method based on a cognitive radio system. This method uses a cognitive radio system and display platform system to display Jinzuo furniture cultural tourism more vividly, vividly and intuitively, so as to realize the inheritance of Jinzuo furniture cultural tourism knowledge and meet people's spiritual and material needs and economic requirements. At the same time, we should promote people's protection and inheritance of intangible cultural heritage and enhance their recognition of the value of intangible cultural heritage.

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