Research Article

Optimization of Intelligent Display Mode of Museum Cultural Relics Based on Intelligent Wireless Sensor Network

Luolan Shen

School of Fine Arts, Suzhou Vocational University, Suzhou, Jiangsu 215000, China

Correspondence should be addressed to Luolan Shen; shenluolan@jsvc.edu.cn

Received 24 June 2022; Revised 27 July 2022; Accepted 13 August 2022; Published 29 August 2022

Academic Editor: Gengxin Sun

Copyright © 2022 Luolan Shen. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

The traditional way of museum exhibition is physical exhibition, which is essentially restricted by the venue, time, space, and display conditions and is no longer applicable to the display form of modern museum exhibits. Therefore, with the development of a large number of modern technologies such as information technology, wireless sensor technology and image processing technology, the way of museum cultural relics display also tends to be more intelligent and intelligent. Based on this, this paper will set up corresponding gateway nodes, routing nodes, and corresponding terminal nodes for each node of the corresponding museum based on the intelligent wireless sensor network technology; transmit the audio impact information of the corresponding museum exhibits through the terminal nodes; and automatically send the node short address information of the corresponding information to the corresponding analysis end in real time for analysis and processing, and then based on the information characteristics of the corresponding exhibits, combined with virtual fusion and human-computer interaction technology, a set of augmented reality application system for tourist mobile terminal is developed. Abandoning the disadvantages of traditional museum display methods, this paper creatively designs the corresponding museum heritage intelligent display work flow based on intelligent wireless sensor network through C/S architecture and finally realizes the enhancement effect of virtual reality on tourism terminals. In order to verify the superiority of the intelligent display mode of museum cultural relics based on intelligent wireless sensor network proposed in this paper, this paper compares it with the traditional display mode. The experimental results show that this paper has obvious advantages in the display comprehensiveness, visitor satisfaction, and display effectiveness, which further improves the effect of museum cultural relics display.

1. Introduction

The museum is a place to display important cultural relics such as the human history, local conditions, and customs of a country, nation, or region. It has important value significance for improving human cultural quality and promoting the construction of human spiritual civilization. The traditional way of displaying cultural relics in museums is mainly through physical display, accompanied by description and introduction in the form of words, pictures, etc., but lack of vivid and vivid sound, light, and electricity display [1, 2]. The traditional way of displaying cultural relics in museums allows the public to observe the shape, lines, and other corresponding characteristics of cultural relics more concretely and closely. At the same time, by reading the supporting text, pictures, and video impact instructions, the public can also have a more detailed understanding of the function, value, and other historical information of cultural relics [3, 4]. However, due to the limitations of traditional cultural relics display methods, tourists or visitors cannot observe the details of cultural relics in an all-round way. For some experiential and functional cultural relics, tourists can not feel their corresponding functions. At the same time, words, pictures, and other methods cannot more systematically explain the actual value and historical heritage of cultural relics, which is still for tourists [5, 6]. In addition, the traditional way of displaying cultural relics in museums is often limited by the limitations of places and time so that tourists cannot watch the corresponding cultural relics all the time and feel the edification of history [7]. Based on this,
how to better display museum cultural relics and make their cultural relics display more intelligent, and intelligent has become an important issue in the current museum cultural display, and it is also the only way to promote the museum cultural relics display towards informatization.

Conventional museum exhibition methods mainly refer to hanging display, showcase display, placement display, and other exhibition methods. Such traditional exhibition methods do not need special scientific and technological means, and the exhibition methods are more traditional and common. Generally, books, ancient coins, cultural relics, fabrics, arts and crafts, specimens, etc., mostly adopt this layout form. Hanging and display cabinets are often used in the same exhibition space at the same time. Display three-dimensional exhibits by placing display cabinets and platforms on the ground, and hang exhibits on the wall with display boards. This way of exhibition generally requires a large span of exhibition space, which can be determined according to the plane layout and viewing sight distance. Wireless intelligent sensor network technology is a wireless transmission technology with low cost, low rate, low complexity, and low power consumption. At the same time, it also has the characteristics of high security and high network capacity [8, 9]. Based on the characteristics of wireless intelligent network technology, it has been widely used in all walks of life. In these applications, wireless intelligent sensor network technology mainly integrates sensor technology, microprocessor technology, wireless transceiver technology, and other technologies. Through the continuous combination of wireless sensor network technology and management platform, virtual reality technology, human-computer interaction technology, the corresponding wireless sensor protocols, corresponding node power consumption, corresponding data processing and analysis, and corresponding distributed computing are optimized [10, 11]. The combination of wireless intelligent sensor network technology and museum cultural relics display is also a new scenario for the recent development of wireless intelligent sensor network technology. The introduction of wireless intelligent sensor network technology provides data support and guarantee for the application of museum virtual reality technology, thus providing a new way for tourists to visit museums, visit cultural relics, and study the historical heritage behind them; thus, it provides new vitality for the modernization of the museum, realizes the expansion and extension of the museum’s cultural relics display, and breaks its corresponding time and space restrictions [12–14].

Based on the above research status of museum cultural relics display and wireless intelligent sensor network, this paper will set up corresponding gateway nodes, routing nodes, and corresponding terminal nodes for each node of the corresponding museum based on intelligent wireless sensor network technology and transmit the audio impact information of the corresponding museum exhibits through the terminal nodes; the node short address information of the corresponding information is automatic and in real time distributed to the corresponding analysis end for analysis and processing. Then, based on the information characteristics of the corresponding exhibits, combined with virtual fusion and human-computer interaction technology, a set of augmented reality application system for the tourist mobile end is developed. Through the c/s architecture, the corresponding smart display workflow of museum cultural relics based on the intelligent wireless sensor network is designed; finally, the virtual reality enhancement effect on the tourist side is realized. In order to verify the superiority of the intelligent display mode of museum cultural relics based on intelligent wireless sensor network proposed in this paper, this paper compares it with the traditional display mode. The experimental results show that this paper has obvious advantages in the display comprehensiveness, visitor satisfaction, and display effectiveness, which further improves the effect of museum cultural relics display.

Based on the above research and analysis, this paper will arrange the research contents as follows: The second section of the article will analyze the current situation of the museum’s cultural relics display forms, and analyze their corresponding advantages and disadvantages one by one. The third section of the article will systematically analyze and study the application of intelligent wireless sensor network in museum cultural relics display and specifically analyze the virtual reality technology and human-computer interaction technology based on intelligent wireless sensor network and finally give the corresponding design scheme. The fourth section of the article will compare and analyze the schemes proposed in this paper. Finally, this paper will be summarized.

2. Relevant Research and Analysis: Analysis on the Research Status of Museum Cultural Relics Display Scheme

With the rapid iterative development of information technology, visualization technology, big data technology, and other technologies, the traditional way of displaying cultural relics in museums is also undergoing constant changes. Based on this, a large number of research institutions and corresponding researchers have conducted a lot of research and analysis on it [15, 16]. The United States first used information technology to change the display form of museum cultural relics. It digitized the manuscripts, text, video, physical objects, audio, and other contents of various cultural relics, so as to establish a corresponding digital museum and realize digital visualization of the contents in the museum, thus breaking the time and space constraints of museum Cultural Relics Exhibition [17, 18]. Relevant universities in the UK have used digital technology and digital storage technology to digitize the museum. At the same time, based on the corresponding broadband network technology, the server is connected with the servers of major museums in the UK, so as to realize the sharing of cultural relics in museums, thus breaking the isolation between museums [19, 20]. Relevant research institutions in Japan have made great efforts to develop visualization technology; advocated the construction of a global digital museum plan; and conducted construction and processing through the introduction of wireless sensor network technology, virtual reality technology, human-computer interaction technology,
and other information technologies, so as to realize the undifferentiated tour of tourists [21, 22]. Google and other technology-based companies continue to use their own developed street view capture technology to capture the real interior of the museum. At the same time, they use ultra-high-resolution image technology to capture cultural relics and historical and cultural buildings in the museum, so as to provide real-time and fast access for tourists everywhere [23]. However, through comprehensive analysis and research on various new technologies and new situations of the current museum cultural relics display, it can be found that they require tourists to enter the corresponding special channel websites for sightseeing, which is not friendly to different people. At the same time, for some small museums, the cost is high, and the corresponding new exhibition methods do not have certain human-computer interaction. Therefore, the development has the advantages of low cost. The highly interactive exhibition mode of museum cultural relics has important value and significance [24].

3. Research and Analysis of Museum Cultural Relics Display Based on Intelligent Wireless Sensor Technology

This section will mainly analyze and study the development of museum heritage display system based on intelligent wireless sensor technology, mainly including intelligent wireless sensor technology, virtual reality technology and human-computer interaction technology. The corresponding Figure 1 shows the basic principle architecture of the museum heritage display system based on intelligent wireless sensor technology [25]. From the figure, we can see the operation process of the corresponding museum heritage display system under the support of intelligent wireless sensor technology, virtual reality technology, human-computer interaction technology, and other information technologies. As can be seen from Figure 1, the wireless sensor network architecture used in this paper is a star topology structure, which is mainly composed of several network terminal devices and network coordinators. The museum information at the corresponding nodes is collected, transmitted, and processed through the terminal devices of this part. The corresponding wireless network transmission protocol adopts ZigBee wireless transmission protocol, which includes physical layer, storage layer, network layer, application layer, and corresponding security service specifications. Through the use of intelligent wireless sensor network technology, the first-hand data of museum scene information and cultural relics information are obtained and sent to the image recognition and detection system and then sent to the three-bit tracking registration system and sent to the virtual and real scene synthesis system. Based on the data...
processed by the virtual and real scene synthesis system, the human-computer interaction operation is carried out, and the output of the synthetic image is finally realized. In the corresponding virtual reality technology, the final 3D tracking registration technology mainly includes the following sub technologies: marker-based detection technology, hardware technology based on hardware sensor, and corresponding hybrid tracking technology; At the corresponding level of human-computer interaction technology, the bare handed interaction technology is mainly used. Through this technology, visitors can abandon the traditional cumbersome external equipment and use gestures for interactive processing and interactive operation. It can also be seen from the figure that the corresponding hardware system design mainly includes the design of data storage system, power management system, and other hardware devices [26]. At the corresponding level of post acquisition virtual image synthesis and recognition algorithm, the recognition algorithm mainly used in this paper is SIFT algorithm. Based on this algorithm, the real-time display and analysis of cultural relics information in the museum can be realized. The whole museum heritage display system mainly follows the principle of “intelligent wireless sensor network key information collection and transmission - virtual reality enhancement technology processing and analysis - human-computer interaction technology operation and processing - final image synthesis and presentation.” Based on the above analysis, the corresponding core algorithm is as follows: Based on the intelligent wireless sensor network technology, set the corresponding gateway node, routing node, and corresponding terminal node for each node of the corresponding museum; transmit the audio impact information of the corresponding museum exhibits through the terminal node; and automatically send the node short address information of the corresponding information to the corresponding analysis end in real time for analysis and processing. Then, according to the information characteristics of the corresponding exhibits, combined with virtual fusion and human-computer interaction technology, a set of augmented reality application system of tourism mobile terminal is developed. Through the C/S architecture, the corresponding museum heritage intelligent display workflow based on intelligent wireless sensor network is designed, and finally the enhancement effect of virtual reality on tourism terminals is realized.

3.1. Research and Analysis of Intelligent Wireless Sensor Network Technology and Virtual Reality Technology for Museum Cultural Relics Display. Based on the characteristics of the museum cultural relics display and the corresponding museum environment, the intelligent wireless sensor network is deployed to obtain the museum scene information and the corresponding details of the displayed cultural relics. The wireless sensor network architecture corresponding to the museum cultural relics display is shown in Figure 2. From the figure, it can be seen that the corresponding wireless sensor network includes the physical layer, MAC layer, network layer, and application layer. At the same time, it can be seen from the corresponding figure that the connection and operation mechanism between different logic layers and function layers and the corresponding functions and modules of different layers are also described in detail in the figure.

Decompose each part of the corresponding wireless sensor network. The corresponding physical layer mainly includes the physical layer management entity of the museum scene, the wireless channel interface at the museum level, the museum management service interface for the purpose of providing management services, and the physical layer pan information base maintenance model. During the
operation of the physical layer of the museum wireless sensor network, the museum data service access point corresponding to the physical layer provides sufficient data access services for each node of the museum scene, and the corresponding physical layer museum management entity access point provides management service access data. In addition to the above analysis, the physical layer of the museum scene wireless sensor network also has the functions of energy detection of each node, channel quality evaluation, and data transmission and receiving services through the physical layer.

Corresponding to the MAC layer of the museum wireless sensor network, this layer is mainly used to provide the interface between the museum heritage display convergence sublayer and the corresponding physical layer and provide the management service interface corresponding to the MAC management function. At the same time, this layer also needs to maintain the corresponding information base. In the specific workflow of the corresponding museum MAC layer, the management of various scenes and cultural relics data in the museum is realized through the public subservice nodes corresponding to the museum MAC layer and the corresponding management entity service access nodes. In addition, the MAC layer also needs to be responsible for prompting the corresponding node coordinator to generate corresponding beacons, supporting the corresponding pan association, and using relevant technologies to achieve channel access and control.

The corresponding network layer is mainly used to ensure that the MAC layer corresponding to the museum wireless sensor network has the correct and appropriate working capacity, and it also needs to provide the corresponding interface of the application layer. In order to further optimize the connectivity corresponding to the wireless sensor network for museum heritage display, this paper sets up the museum network layer data entity and the museum network layer management entity in this layer. Through these two entities, we can provide data services and corresponding management services for the museum application layer. At the same time, we also provide the NLME module in this layer, which can be used to maintain the museum network layer information base.

The corresponding application layer mainly includes the museum application support sublayer, ZigBee related device objects, and the corresponding museum application layer framework. In the museum application support sublayer, it mainly provides the data service interface between the corresponding application layer and the network layer. At the same time, it also needs to bind the list of museum related data and realize the data transmission analysis between the bound devices.

Based on the above wireless intelligent sensor network architecture of the museum, the description of the museum scene and the corresponding displayed cultural relics can be basically realized, and the virtual reality technology and human-computer interaction technology can be constructed based on the above corresponding data. Based on this, the processing principle of the corresponding virtual reality part is shown in Figure 3. As can be seen from Figure 3, the technical process and corresponding functional composition of the virtual reality technology are used in this paper.
First, the corresponding data collection has been completed in the corresponding museum physical scene and the corresponding cultural relics data collection part through the deployment of the above wireless intelligent sensor network technology. Then, in the tracking and registration technology of the corresponding museums and cultural relics, this paper adopts the collaborative hybrid tracking and registration technology to realize it, which is mainly based on the sensors of each node deployed by the wireless sensor network technology for processing and analysis, and obtains the final attitude estimation and three-dimensional registration through the direct or indirect processing and transmission of sensor data.

After completing the data collection of museum scenes and cultural relics and the mixed tracking and registration processing, it is necessary to process and analyze the combination of virtual and real images. In this part, this paper mainly uses the projection virtual and real combination display technology to realize the link of museum scenes and cultural relics display. In this process, the images processed by the computer are directly projected onto the physical object, thus enhancing the details of the physical object. It restores the real appearance of the museum scenes and corresponding cultural relics and further enhances the immersion feeling of tourists.

At the corresponding human-computer interaction level, the design is mainly based on the concept of “people-oriented.” In this process, the corresponding interactive behaviors of visitors are timely captured and collected into the computer system for digital processing and analysis, and then the processed data results are output and restored for display, so as to obtain an interactive experience. In this part, this paper uses the freehand interaction to realize the final interaction design. Through the freehand interaction, the immersion experience of tourists can be enhanced to the greatest extent, and finally the purpose of tourists’ visit can be completed.

At the level of corresponding enhanced image output, this part is mainly to further process the local details of the image processed by the computer, enrich its corresponding local details, and fully ensure that the corresponding image local feature capture has the characteristics of reproducibility, uniqueness, accurate expression, efficiency, and so on, so as to fully solve the image noise, blur, and compression effect problem and discrete effect problem. After the image is output, sift image recognition algorithm is used in the corresponding image recognition part to recognize the output image. Although this method has a long running time, it has many corresponding collected data points. At the same time, its algorithm is relatively simple and the operation and maintenance cost is low.

Based on the above analysis, the main key technologies of the museum heritage display system, namely, wireless sensor network technology, virtual reality technology, and human-computer interaction technology, have been fully described, which mainly serve as the theoretical support for the system level design of the museum heritage display system.

3.2. Design of Museum Heritage Display System Based on Intelligent Wireless Sensor Technology. Based on the above discussion and Analysis on the main key technologies of museum heritage display system, namely, wireless sensor network technology, virtual reality technology, and human-computer interaction technology, this section will mainly give the design scheme of museum heritage display system based on intelligent wireless sensor network technology. The corresponding design scheme framework is shown in Figure 4; it can be seen from the figure that the corresponding main functional parts include the data acquisition and wireless transmission parts of wireless sensor network technology and the image enhancement and interpersonal interaction parts of virtual reality.
In the data acquisition and wireless transmission part of the corresponding wireless sensor network technology, this paper mainly adopts ZigBee technology to realize. The entire data acquisition system is constructed by using wireless sensor network combined with secondary network. At the same time, a monitoring system is added in this part to monitor. The bottom layer of the corresponding wireless sensor network system is mainly designed as the sensor nodes, routing nodes deployed in various scenes of the museum, and the handheld terminal device nodes of tourists visiting the museum site. The corresponding nodes collect data and transmit it to the corresponding network coordinator nodes for processing and analysis, and then the coordinator packages the corresponding data to the terminal PC system; during the operation of the whole system, wireless networking is mainly realized based on ZigBee technology, so as to complete the transmission of various data. The corresponding hardware design of this part mainly includes the hardware circuit design of sensor nodes, routing nodes, and terminal nodes. In the actual design, this paper uses the modular idea to design and process.

In the corresponding virtual reality technology and human-computer interaction technology implementation level, this paper is mainly based on collaborative hybrid tracking registration technology for data feature extraction and analysis. In the corresponding museum scene and the corresponding 3D image rendering of cultural relics, the software of auto-desk Maya is mainly used for production, so as to complete the 3D modeling and analysis of relevant scenes and cultural relics. At the corresponding level of virtual fusion, this paper mainly uses Vuforia-related software to make the identification map and corresponding 3D map of museum scenes and related cultural relics and transfer these data to unity3d for processing, so as to complete the construction of real scenes and objects in Unity3D. At the corresponding level of human-computer interaction, this paper mainly uses freehand interaction to achieve the final interactive design, through the gesture interaction of tourists to view the details of the relevant scenes of the museum and the corresponding cultural relics and enhance the immersion feeling of tourists.

4. Verification and Analysis of Museum Cultural Relics Display System Scheme

In order to verify that the museum heritage display system based on wireless intelligent sensor network technology proposed in this paper has the advantages of interactivity and display compared with the traditional museum heritage display system, a comparative test is conducted in this section. The corresponding experimental scene is a small museum. In this paper, the main indicators of comparative analysis are the satisfaction with the details of cultural relics display, the satisfaction with the informatization of museum display, and the satisfaction with the effect of cultural relics display. The corresponding satisfaction with the display of cultural relics details mainly reflects the comprehensiveness of cultural relics display. The corresponding satisfaction of
museum exhibition informatization mainly reflects the informatization degree of museum exhibition. The corresponding satisfaction of cultural relics display effect is a comprehensive analysis index, which mainly reflects the comprehensive satisfaction of tourists with the museum display.

First of all, at the level of comprehensive indicators of the corresponding museum display, it mainly inspect the comprehensive degree of the display details of different scenes in the museum. Based on the two museum cultural relics display schemes, a questionnaire survey was conducted among 20 visitors after their actual experience, and the percentage was quantified and evaluated by investigating their overall feelings. The comparison curve of the comprehensive indicators of the two corresponding schemes is shown in Figure 5. From the figure, it can be seen that the scheme proposed in this paper has obvious advantages in the overall display, and its satisfaction with the details of museum cultural relics is about 30% higher than that of the traditional display system. From this analysis, the presentation of more details of museum exhibits benefits from the use of modern information technology. This paper uses wireless sensor network technology and other related modern information technology. The addition of such technology can make the museum display more attractive.

In the corresponding tourist satisfaction experiment, it mainly aims at the overall satisfaction of tourists with the museum’s cultural relics display under the two display schemes. The corresponding specific indicators include the museum’s informatization degree, the museum’s interaction degree, the museum’s humanization degree, and other relevant specific indicators. The corresponding comparison curve is shown in Figure 6. From the figure, it can be seen that the museum heritage display system proposed in this paper has obvious advantages in overall satisfaction compared with the traditional heritage display system. From the comprehensive indicators, the scheme proposed in this paper has about 40% satisfaction advantage in the corresponding museum informatization degree; by analyzing the specific reasons, we can see that this is due to the use of a large number of modern information technologies (wireless sensor network technology, virtual reality technology, interpersonal interaction technology, etc.) in the museum. The use of modern information technology can make the museum have more advantages in the presentation form of exhibits, and the corresponding display details are more specific. At the same time, it also helps tourists better understand the cultural story behind the exhibits.

At the corresponding level of effectiveness of museum cultural relics display, it mainly inspects the effect of museum cultural relics under the existing display scheme

---

**Figure 6**: Comparison curve of tourist satisfaction indicators of museum heritage display system based on wireless sensor network technology (compared with traditional).
system. The main indicators include the details of cultural relics, the story telling of cultural relics, and the experience of cultural relics technology or functional parts. Based on this, the comparison curve between the display scheme proposed in this paper and the traditional scheme at the level of cultural relics display effect is shown in Figure 7. From the figure, it can be seen that the cultural relics display scheme proposed in this paper has obvious advantages over the traditional scheme at the level of cultural relics detail reflection indicators and cultural relics accident recurrence indicators. In terms of tourists’ satisfaction with the details of cultural relics, the corresponding tourist satisfaction is about 30% higher than the traditional satisfaction, which is also due to the use of modern information technology, which makes the details of cultural relics more vivid and specific.

Based on the results of the above experiments on the comprehensiveness of the museum’s cultural relics display system, the satisfaction of tourists, and the effect of cultural relics display, the museum’s cultural relics display scheme based on wireless sensor network technology proposed in this paper has obvious advantages over the traditional cultural relics display, which plays an important role in the museum to display the cultural heritage and historical stories of the region. At the same time, it is also helpful for tourists to better appreciate the details of historical relics and feel the edification of history. In addition, the museum cultural relics display scheme based on wireless sensor network technology proposed in this paper breaks the time and space constraints of the museum by using wireless sensor technology, virtual reality technology, and human-computer interaction technology; completes the information construction of the museum cultural display; and endows the museum with new characteristics of the times.

5. Conclusion

This paper mainly analyzes the disadvantages of the traditional way of cultural relics display in museums and the transformation of the way and form of cultural relics display under the current information background. Through the specific analysis of the problems existing in the current museum cultural relics display and the reasons behind it, this paper proposes a museum cultural relics display scheme based on the intelligent wireless sensor network technology. Firstly, based on the intelligent wireless sensor network technology, targeted gateway nodes, routing nodes, and corresponding terminal nodes are set for each node of the corresponding museum; then, the audio influence information of the corresponding museum exhibits is transmitted through the terminal node, and the node short address information of the corresponding information is automatically sent to the corresponding analysis end for analysis and processing in real time. Then, based on the corresponding exhibit information characteristics, and combined with virtual fusion and human-computer interaction technology, a set of augmented reality application system of the tourist mobile end is developed, through the c/s architecture; the corresponding smart display workflow of museum cultural relics based on intelligent wireless sensor network is designed. Finally, the end-to-end virtual reality enhancement effect of museum scenes and related cultural relics is realized, and the immersion feeling of tourists is further improved. In order to verify the superiority of the intelligent display mode of museum cultural relics based on intelligent wireless sensor network proposed in this paper, this paper makes a comparative experimental analysis with the traditional display mode of museum cultural relics. The experimental results show that this paper has obvious advantages in the aspects of display comprehensiveness, visitor satisfaction, and display effectiveness. Therefore, the display scheme proposed in this paper further improves the effect of museum cultural relics display. In the follow-up research, the article will focus on the human-computer interaction performance optimization plan in the museum heritage display system to improve the interactivity of the display mode, so as to further enhance the participation and experience of tourists.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.
Conflicts of Interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments
This work was supported by Design for Digital Communication of Intangible Cultural Heritage Based on Jiangsu section of the Grand Canal (SVU2021YY09), and Research on Digital Communication Design of Intangible Cultural Heritage Based on Suzhou section of the Grand Canal (SZDYKC-220805).

References
[1] B. F. Gumaida and J. Luo, “Novel localization algorithm for wireless sensor network based on intelligent water drops,” Wireless Networks, vol. 25, no. 2, pp. 597–609, 2019.
[2] P. Nancy, K. S. Muthuraj, S. Ganapathy, S. V. N. S. Kumar, M. Selvi, and K. Arputharaj, “Intrusion detection using dynamic feature selection and fuzzy temporal decision tree classification for wireless sensor networks,” IET Communications, vol. 14, no. 5, pp. 888–895, 2020.
[3] X. Liu, J. Li, B. Shi, G. Ding, F. Dong, and Z. Zhang, “Intelligent detection technology for leakage bag of baghouse based on distributed optical fiber sensor,” Optical Fiber Technology, vol. 52, article 101947, 2019.
[4] M. Sajwan, D. Gosain, and A. K. Sharma, “CAMP: cluster aided multi-path routing protocol for wireless sensor networks,” Wireless Networks, vol. 25, no. 5, pp. 2603–2620, 2019.
[5] E. C. Strinati, G. C. Alexandropoulos, H. Wymeersch et al., “Reconfigurable, intelligent, and sustainable wireless environments for 6G smart connectivity,” IEEE Communications Magazine, vol. 59, no. 10, pp. 99–105, 2021.
[6] J. Y. Lu, K. F. Hu, X. C. Yang, C. J. Hu, and T. S. Wang, “A cluster-tree-based energy-efficient routing protocol for wireless sensor networks with a mobile sink,” The Journal of Supercomputing, vol. 77, no. 6, pp. 6078–6104, 2021.
[7] G. Villarreal-Zapata, T. E. Salais-Fierro, and J. A. Saucedo-Martínez, “Intelligent system for selection of order picking technologies,” Wireless Networks, vol. 26, no. 8, pp. 5809–5816, 2020.
[8] B. Dhanalakshmi, L. Sairamesh, and K. Selvakumar, “Intelligent energy-aware and secured QoS routing protocol with dynamic mobility estimation for wireless sensor networks,” Wireless Networks, vol. 27, no. 2, pp. 1503–1514, 2021.
[9] S. Kumar, Y. Palanchamy, M. Selvi, S. Ganapathy, A. Kannan, and S. P. Perumal, “Energy efficient secured K means based unequal fuzzy clustering algorithm for efficient reprogramming in wireless sensor networks,” Wireless Networks, vol. 27, no. 6, pp. 3873–3894, 2021.
[10] Z. Zhang and Y. Zhang, “Application of wireless sensor network in dynamic linkage video surveillance system based on Kalman filtering algorithm,” Journal of Supercomputing, vol. 75, no. 9, pp. 6055–6069, 2019.
[11] J. Calvert and R. Abadia, “Impact of immersing university and high school students in educational linear narratives using virtual reality technology,” Computers & Education, vol. 159, article 104005, 2020.
[12] L. D. Clark, A. B. Bhagat, and S. L. Riggs, "Extending Fitts' law in three-dimensional virtual environments with current low-cost virtual reality technology," International Journal of Human-Computer Studies, vol. 139, no. 4, article 102413, 2020.
[13] A. Klici, A. Brown, I. Aras et al., “Using virtual technology for fear of medical procedures: a systematic review of the effectiveness of virtual reality-based interventions,” Annals of Behavioral Medicine, vol. 55, no. 11, pp. 1062–1079, 2021.
[14] M. Alex, B. C. Wünsche, and D. Lottridge, “Virtual reality art-making for stroke rehabilitation: field study and technology probe[]],” International Journal of Human-Computer Studies, vol. 145, no. 12, article 102481, 2020.
[15] N. Iqbal, S. H. Akbar, and K. V. Cleemput, “Identification of industrial heritage and a theoretical framework for an industrial heritage inventory system in Pakistan,” Sustainability, vol. 14, no. 10, p. 5797, 2022.
[16] W. Wei, J. Wu, and C. Zhu, “Special issue on situation awareness in intelligent human-computer interaction for time critical decision making,” IEEE Intelligent Systems, vol. 35, no. 1, pp. 3–5, 2020.
[17] T. Zhu and F. Zhang, “Design of marine two-way voice communication system based on human-computer interaction,” Journal of Coastal Research, vol. 95, p. 1389, 2020.
[18] Y. Aydin, O. Tokatlı, V. Patoglu, and C. Basdogan, “A computational multicriteria optimization approach to controller design for physical human-robot interaction,” IEEE Transactions on Robotics, vol. 36, no. 6, pp. 1791–1804, 2020.
[19] M. Shin, S. W. Song, S. J. Kim, and F. Biocca, “The effects of 3D sound in a 360-degree live concert video on social presence, parasocial interaction, enjoyment, and intent of financial supportive action,” International Journal of Human-Computer Studies, vol. 126, no. 5, pp. 81–93, 2019.
[20] H. Zhe, H. Yang, and Z. Sun, “Binding thermodynamics and interaction patterns of human purine nucleoside phosphorylase-inhibitor complexes from extensive free energy calculations,” Journal of Computer-Aided Molecular Design, vol. 35, no. 5, pp. 643–656, 2021.
[21] B. D. Batista, M. N. Dourado, E. F. Figueredo et al., “The auxin-producing bacillus thuringiensis RZ2MS9 promotes the growth and modiﬁcation of the root architecture of tomato (Solanum lycopersicum cv. Micro-Tom),” Archives of Microbiology, vol. 203, no. 7, pp. 3869–3882, 2021.
[22] K. A. Oetjen, D. E. Bender, M. B. Ruzinova, D. A. C. Fisher, S. T. Oh, and D. C. Link, “Imaging mass cytometry reveals the spatial architecture of myelodysplastic syndromes and secondary acute myeloid leukemias,” Blood, vol. 136, Supplement 1, pp. 44–45, 2020.
[23] Y. Lei, D. Peng, P. Zhang, Q. Ke, and H. Li, “Hierarchical paired channel fusion network for street scene change detection,” IEEE Transactions on Image Processing, vol. 30, no. 4, pp. 55–67, 2021.
[24] R. Wang, X. Wen, X. Wang, Y. Fu, and Y. Zhang, “Low carbon optimal operation of integrated energy system based on carbon capture technology, LCA carbon emissions and ladder-type carbon trading,” Applied Energy, vol. 311, no. 4, pp. 118664–118669, 2022.

[25] T. Jiang, X. Gan, Z. Liang, and G. Luo, “AIDM: artificial intelligent for digital museum autonomous system with mixed reality and software-driven data collection and analysis,” Automated Software Engineering, vol. 29, no. 1, pp. 1–22, 2022.

[26] X. Shen, G. Shi, Y. Zhang, and S. Weng, “Wireless volatile organic compound detection for restricted internet of things environments based on cataluminescence sensors,” Chemosensors, vol. 10, no. 5, p. 179, 2022.