IoT-based Intelligent Management System of Personnel Archives Warehouse

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Abstract. Archives are a valuable information resource. As the archive depository, the internal management level of personnel archives directly affects the integrity and security of archives. In order to ensure the full play of the original value of computer-aided electronic archives. Archives management must fully apply encryption technology to electronic archives management to ensure the security of electronic archives entities and information. Based on the above problems, this paper designs an intelligent management platform for personnel archives warehouse based on the lightweight Internet of Things technology by combining environmental monitoring technology with access control archives can realize retrieval, condition screening, classification, cataloging, data entry, modification and other functions. It is a relatively independent archive system. The goal of this model is to maximize the use of network resources and increase the income of Internet of Things service providers. Practice has proved that the model and algorithm proposed in this paper have achieved good results in resource utilization. The CPU utilization of the virtual gateway is about 30%. The most important thing is that it can extend the life cycle of the archive, which is of great significance to the comprehensive department.

Keywords: Personnel Archives; Intelligent Management; Higher Education Teaching; Internet Of Things Service
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1 INTRODUCTION

Using computer aided system to manage archives is one of the important means to realize the modernization of archives management, and also an important content of the reform of archives work in China. Practice has proved that the application of computer-aided system in archival work is of great significance to improve the efficiency and quality of archival work, and to realize the scientificity, standardization and standardization of archival work. Establish a system platform for computer-aided management of electronic documents. The document management in the electronic document management system should be integrated with the workflow, from the generation, processing and use of the document to the identification, archiving, storage and reuse of the document should be covered in the electronic document management system. And real-time monitoring, real-time collection, real-time identification of records and maintenance of metadata for electronic documents. Deep neural network (DNN) has been successful in image and text classification and retrieval tasks as well as in the field of graphics. Anguish et al. [1] studied the application classification and retrieval. When the technology of the computer-aided system changes, it supports the migration of the files formed under the original software and hardware environment to the new platform. When the system is upgraded, the original files are reprinted. Computer aided system has been widely used in archival work with its high-speed computing ability and strong logic judgment function. Management of machine-readable file directory. Manis et al. [2] solved computer management of machine-readable archive directory includes automatic retrieval, automatic cataloging, automatic statistics and automatic filing. ① Computer automatic retrieval. Computer automatic retrieval refers to taking computer as the main technical means to check out the required file information through the machine-readable file directory according to the needs of utilization and management. The system can retrieve the machine-readable archive directory from the file number, title, responsible person, date, classification number, subject word and other ways. Compared with manual retrieval, automatic retrieval has the main advantages of fast retrieval speed, easy assurance of retrieval rate and retrieval rate, and flexible and diverse retrieval forms to meet the requirements of various users for the use of archives. ② Computer automatic cataloging. Computer automatic cataloging refers to the use of computers to compile various archive retrieval tools. The computer can reorganize and reorganize the machine-readable archive directory, and then compile various archive retrieval tools. The retrieval tool compiled by the computer can be directly printed and output in various forms such as cards or bookmarks. The font and format can be selected by the user. The catalogue compiled by the machine is more standardized and standardized. ③ Computer automatic statistics. The automatic statistics of archives include two aspects: - the statistics of the contents of machine-readable archives; The second is the statistics of the utilization of archives. The automatic statistical progress is fast, the information provided is timely and accurate, and the output reports are flexible and diverse, which can meet various needs. ④ The computer files automatically. Based on the relevant entries of each document in the machine-readable archive directory, the computer integrates the documents with some common points and close links to form a file. And automatically arrange and number the files in the same volume, print out the file directory and the reference table in the volume, and print out the cover of the file in the form of statistics. This work is called computer automatic filing. Automatic filing by computer greatly improves the filing speed, unifies the format of the contents in the file and the cover of the file, and saves a lot of manpower at the same time.

2 RELATED WORK

Relevant units, experts and technicians of archives management at home and abroad are actively exploring and seeking scientific solutions. According to the existing related instruments and products on the market, many personnel archive warehouses have started to configure and use temperature and humidity monitoring instruments, and installed automatic fire alarm or anti-theft monitoring equipment. Han et al. [3] proposed a three-dimensional auxiliary model based on functional language expression. Before the retrieval of the expression function of language semantics, the relevant structure of the model needs to be analyzed and annotated. Through the inspection of different models, the effect of the entity model can be judged repeatedly, so as to save the actual cost. Zhang et al. [4] proposes a new view-based method for 3D CAD model retrieval through deep learning. This paper constructs a multi-view model data set in the industrial field, which collects the entity view and line view of the database model. Campi et al. [5] provides a method to obtain, explain and represent the DfMA rule set to help designers and engineers develop mechanical products. Through the cost prediction of semantic analysis, analyze the manufacturing and cost analysis under the guidance of multi-view, help the product to conduct the set analysis under the rule state, and then carry out the adaptive feature extraction of controllable simulation. Zhou et al. [6] proposed attempt content based on frame semantics and conducted a relevance analysis of language expression for saliency. Generally, the system is equipped with a camera at the entrance guard, through which the user's face image is collected, and the face information is identified and compared. Only the user with the correct identification result can obtain the access right.

Yeo et al [7] Through the analysis of the processing characteristics of different integrated close-knit networks, the language model under the computer aided design of deep learning is summarized. Through the analysis of feature groups of different language models, the system of aided design is constructed. This method uses feature descriptors as the input of neural network to identify machining features. At present, due to its mobility or geographical location, a large number of IoT devices must be powered by batteries. At present, there is no description format specifically designed for lightweight services of the Internet of Things. Generally, computer-assisted security protocols need to protect the confidentiality of communication data, as well as the integrity and authenticity of communication data. Deng et al. [8] constructed a single point cloud framework for different indoor analysis algorithms, and built a content model of the dataset through model database support for the software. It is able to carry out auxiliary design content construction for the model algorithm under the single-point view, and use the software program support under the programming form to carry out interactive environment model analysis. Willis et al. [9] assembled the part model into a whole model, and used the assembly tools provided by CAD software to complete the assembly and adjustment of the model according to the design requirements. Chen et al. [10] In the steps of assembling model, perfecting details, adding annotations and outputting drawings of CAD program, they are all to ensure the accuracy, accuracy and manufacturability of CAD drawings.

3 RESEARCH METHOD

3.1 Overall Architecture Design

The personnel archives warehouse is anti-theft monitoring is designed. In order to monitor all the personnel who enter the warehouse area and the reference room, eliminate the potential safety hazards to the bud, trace the causes after the accident, and design video surveillance. According to the previous requirements, the intelligent management platform of personnel archives warehouse designed in this paper is shown in Figure 1.

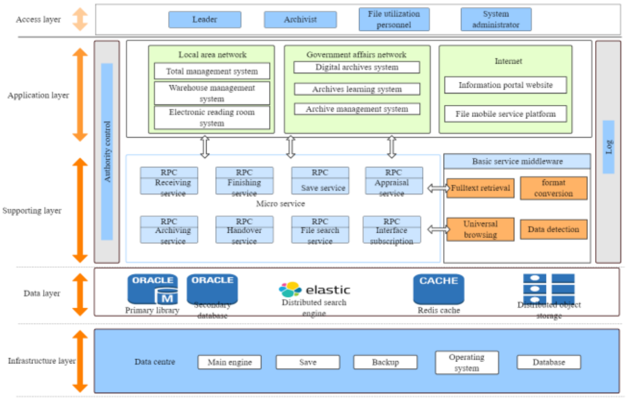

Figure 1: Intelligent management platform of personnel archives warehouse.

Overall, the system mainly includes four modules. This section mainly introduces the design of each module, namely, the design of temperature and humidity module, video monitoring module, report printing module and parameter setting module. For statistics, viewing and analyzing data, basic data for generating graphs and printing reports, the highest or lowest temperature and humidity values in a day can also be stored in the database, so that the comparison and analysis of temperature and humidity data can be realized. The overall workflow of the system is shown in Figure 2.

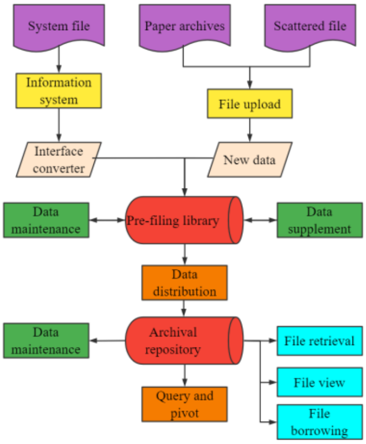

Figure 2: The overall workflow of the system.

The monitoring system of the upper computer judges whether the analyzed environmental data is in normal state according to the preset environmental threshold parameters. If an environmental parameter is abnormal, the monitoring system of the upper computer will start the alarm mechanism by default, that is, automatically send the opening and closing control instruction of the corresponding environmental equipment to the lower computer system. When the humidity and temperature of the warehouse are abnormal, warehouse managers need to deal with it in time. Therefore, an alarm function is introduced into the system. Once the temperature or humidity is inconsistent, it will take the initiative to give an alarm and notify the managers to deal with it in time. The above work is handled by the perception notification management module.

In the first stage of database design, the E-R diagram is usually used, which can completely represent the tables required by the personnel file warehouse monitoring system. Secondly, it can completely show the relationship among the tables. According to the actual data display requirements, the environment real-time sensing module needs to set a numerical table to store the temperature value, humidity value and smoke value, and the sensing notification management module needs to set an alarm information table, which is shown in detail in Figure 3.

3.2 Key Technology Realization

With the wide application of IoT in various fields, the demand changes of users will emerge in an endless stream. In the current IoT architecture, services are integrated with network functions and hardware devices. Obviously, the same IoT system can't meet the demand of diversified services. Because of its limited resources, the sensing node cannot realize the virtualization operation. In recent years, the emergence of lightweight virtualization technology provides technical support for IoT node virtualization. We assume that physical sensing nodes are treated indiscriminately. That is to say, the physical sensing nodes are all unified hardware platforms, equipped with various sensors required for various sensing services. GWN (Gateway Node) is also a universal platform, which can process all data of the sensing node. Therefore, geographical location constraints must be considered.

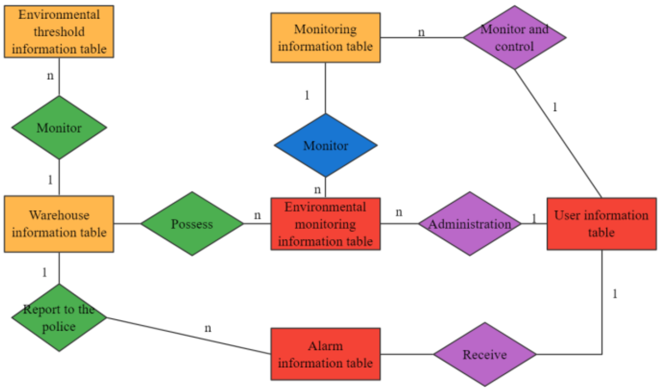

Figure 3: E-R diagram of system.

In this paper, we consider that the s^v requirement of the sensing node is $loc(s^v)$. $loc(s^v)$ is a precise geographical location point, which is a binary group composed of two coordinates (precision, latitude). $\Omega(s^v)$ is defined as the set of physical nodes where the sensing node s^v can be placed.

$$\Omega(s^v) = \{p^s \in P^s | dis(loc(s^v)) \leq d^s_{\max}\} \quad (3.1)$$

Where $d_{\max}$ represent that position requirement of the sensing node s^v and the maximum permissible error distance actually place. Similarly, the geographic location constraints of GWN can be given as follows:

$$\Omega(g^v) = \{g^s \in G^s | dis(loc(g^v)) \leq d^g_{\max}\} \quad (3.2)$$

Figure 4 shows a scheme for WSN user security authentication and real-time data access control, in which GWN is introduced to complete the secure access of legitimate users and the assignment of target sensor nodes.

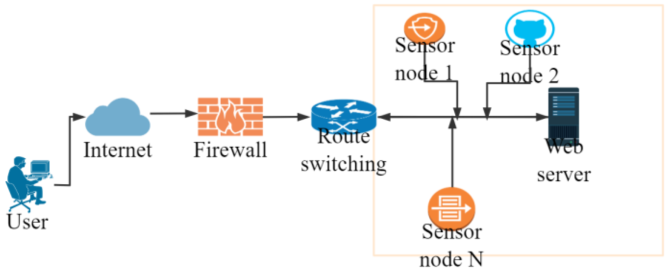

Figure 4: User real-time data access control scheme in WSN.

The user and the target sensor node can complete the subsequent real-time data secure access and transmission process. Through the above scheme, on the one hand, it can ensure that only legitimate users can obtain the perceived data in WSN, and on the other hand, it can ensure that the data obtained by users really comes from the target sensor nodes.

In the initialization stage, V,P generates random numbers N_V, N_P of y bit and sends them to each other. Upon receiving the corresponding random numbers, V,P respectively passes through the pseudo-random number generator f . Calculation:

$$a_0 \| a_1 = f_k(N_V, N_P) \tag{3.3}$$

In which a_0, a_1 is n bit and k is the shared key between V,P.

The selection rule of the response bit $r^{(i)}$ of the prover P in each round is shown in formula (3.4):

$$r^{(i)} = \begin{cases} a_0^{(i)}, c^{(i)} = 0 \\ a_1^{(i)}, c^{(i)} = 1 \end{cases} \tag{3.4}$$

That is, when P receives the i th challenge bit $c^{(i)} = 0$, the corresponding response bit $r^{(i)}$ selects the i th bit in the vector a_0 ; On the contrary, if $c^{(i)} = 1$, the response bit $r^{(i)}$ selects the i th bit in the vector a_1 .

In the fast-switching phase, the response bit generation function f_2 of the single-hop model corresponding to the Reid protocol is shown in formula (3.5):

$$r^{(i)} = \begin{cases} \alpha^{(i)}, c^{(i)} = 0 \\ \beta^{(i)}, c^{(i)} = 1 \end{cases} \tag{3.5}$$

For a cryptosystem, the block length is set to n and the number of iteration rounds is set to r . The difference of Y_i, Y_i^* can be defined as:

$$\Delta Y_i = Y_i \otimes Y_i^{*-1} \tag{3.6}$$

Where $\otimes$ represents a specific group operation in a set of n -bit strings, and Y_i^{*-1} represents the inverse of Y_i in this group. The difference sequence is represented by the following formula:

$$\Delta Y_0, \Delta Y_1, \cdots, \Delta\Delta Y_r \tag{3.7}$$

Where: Y_0, Y_1 is a plaintext pair, Y_i, Y_i^* represents the output of the i round, and at the same time, it also represents the input of the $i+1$ round. If the sub-key of the i th round is represented by K_i and the round function is represented by F , then you can get:

$$Y_i = F(Y_{i-1}, K_i) \tag{3.8}$$

In fact, the addressing of IoT is the same as the Internet, and it has hierarchical iterative addressing rules. Each level of resource addressing system can be implemented in different ways, and the same resource addressing system can be used to complete different levels of addressing functions, but it still belongs to different levels of resource addressing logically.

4 RESULT ANALYSIS

The opportunity of data preparation for computer-aided archive management can promote the process of document integration. The data preparation work of computer-aided archives management is a new work in both the document department and the archives department. Promote the use of excellent and unified archival data standardization software, based on the relationship between documents and the internal information structure of archives. Realize the overall management of document work and archives work, and gradually form a close combination of the data preparation work of the document department, the office archives and the archives. The "trinity" organizational model inherited from the past is a good opportunity to get rid of the problem of "documents cannot be integrated". We should seize the favorable opportunity of data preparation for computer-aided archive management and create a new situation of "document integration". With the help of computer-assisted archive management data preparation, it is widely carried out in all levels of archive departments to promote the process of document integration. At the same time, we explain the significance and importance of the selected indicators, and compare the results with other similar work. The purpose of virtualization is to provide diversified services and improve resource utilization. It is also necessary to directly evaluate the utilization of physical nodes. Figure 5 and Figure 6 show the utilization ratio of algorithm and the utilization ratio of core link and edge link in physical link, respectively.

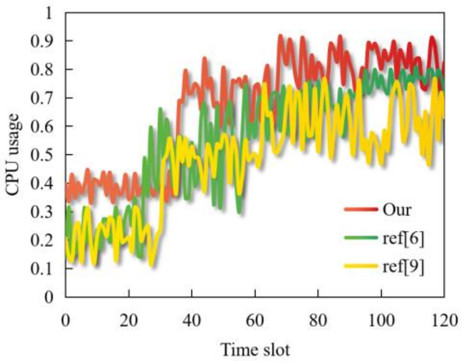

Figure 5: Algorithm utilization ratio.

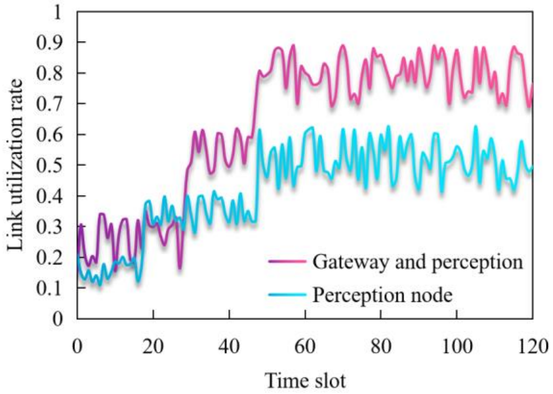

Figure 6: Utilization ratio of core link and edge link in physical link.

The results show that our algorithm is 10% to 18% higher than the other two solutions. On average, each physical sensing node carries more virtual sensing nodes, which further leads to higher CPU utilization. We notice that the CPU of the virtual gateway has a utilization rate of about 30%. Because GWN is not connected to each sensing node, some sensing nodes must access the gateway through other sensing nodes, which makes the link of the sensing nodes connected to the gateway have higher traffic and utilization rate.

Software testing is a process of operating a program on a specific premise to find all kinds of errors in the program, measure the quality of the software, and evaluate the software in a series. Automated testing is to use some automated tools and execute test scripts instead of manual testing. According to the software development instructions, the system developer should adopt appropriate testing methods in each stage of software design, and try to test out software errors as much as possible, and then locate errors and debug errors, thus achieving the goal of perfecting and optimizing the software.

For this reason, 50 concurrent users are taken as the final test target to see if the performance can reach the standard. The adopted strategy is that the initial users are 10, and the number of users is increased by 10 until 60. In this process, various results are recorded, as shown in Figure 7.

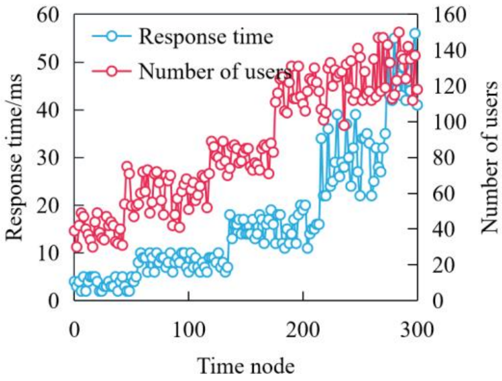

Figure 7: Analysis chart of transaction response and maximum number of concurrent users.

No matter the limited information processing ability and system resources of sensor nodes in WSN, or the explosive business volume faced by GWN in large-scale WSN, the designed WSN security protocol is required to have high security and high operating efficiency. Table 1 and Table 2 respectively compare this protocol with other similar lightweight security protocols in terms of computation, traffic and running time in authentication and key agreement stages.

Execution object	*This paper protocol*	*ref*	*ref*
User	7.3	8.6	7.6
Gateway	10.2	15.2	9.7
Sensor	5.1	19.7	6.2

Table 1: Comparison of security features between this protocol and other similar protocols.

Contrast parameter	*This paper protocol*	*ref*	*ref*
Energy consumption (Ws)	6.63	2.37	7.88
Execution time (ms)	24.57	9.88	30.01
Total traffic (bits)	1782	701	2247

Table 2: Comparison of execution time and traffic volume.

In this paper, the above algorithm is used to verify the reduction experiments of 20 groups of different demand numbers. Each group travels 50 times to calculate the arithmetic mean, and then this arithmetic mean is taken as the final time result of this experiment. The running time results of the final 8 demand reductions are shown in Table 3 below:

Number of demands	*Run time(ms)*
100	1469.79
500	1527.1053
900	1548.8899
1300	1528.4869
1700	1476.6973
2100	1588.6706
2500	1966.6426
2900	2454.5467

Table 3: Experimental result.

It can be seen that when there are few demand ports in the set, the average time required for reduction is not much different. When the quantity reaches a certain value, the required time changes significantly. The experimental data starts from 1700, and the required time changes significantly. Therefore, it can be concluded that the demand reduction algorithm in this paper is suitable for processing large-scale service demand sets. As shown in Figure 8.

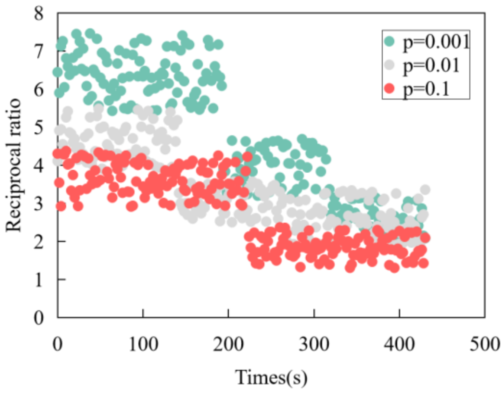

Figure 8: Reciprocal ratio under random failure.

In the experiment, all the final fault topologies are connected, which ensures that the data can be transmitted to the sink node.

5 CONCLUSION

The opportunity of data preparation for computer-aided archive management will promote the process of document integration. The data preparation work of computer-aided archives management is a new work in both the document department and the archives department. Realize the overall management of document work and archives work, and gradually form a close combination of the data preparation work of the document department, the office archives and the archives. We should seize the favorable opportunity of data preparation for computer-aided archive management and create a new situation of "document integration". With the help of computer-assisted archive management data preparation, it is widely carried out in all levels of archive departments to promote the process of document integration. This paper studies and implements an intelligent management platform of personnel archives warehouse based on lightweight Internet of Things technology. Through system testing and analysis, it is proved that the system is practical and universal, and has important theoretical significance and practical value for the research of remote monitoring of personnel archives warehouse environment. Several heuristic algorithms are proposed to find the suboptimal solution in polynomial time. Practice has proved that the model and algorithm proposed in this paper have achieved good results in resource utilization. On average, each physical sensing node carries more virtual sensing nodes, which further leads to higher CPU utilization. We note that the CPU utilization of the virtual gateway is about 30%.

6 ACKNOWLEDGEMENTS

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REFERENCES

[1] Angrish, A.; Bharadwaj, A.; Starly, B.: MVCNN++: computer-aided design model shape classification and retrieval using multi-view convolutional neural networks, Journal of Computing and Information Science in Engineering, 21(1), 2021, 011001. https://doi.org/10.1115/1.4047486

[2] Maninis, K.-K.; Popov, S.; Nießner, M.; Ferrari, V.: Vid2cad: Cad model alignment using multi-view constraints from videos, IEEE Transactions on Pattern Analysis and Machine Intelligence, 45(1), 2022, 1320-1327. https://doi.org/10.1109/TPAMI.2022.3146082

[3] Han, Z.; Mo, R.; Yang, H.; Hao, L.: Structure-function correlations analysis and functional semantic annotation of mechanical CAD assembly model, Assembly Automation, 39(4), 2019, https://doi.org/10.1108/AA-09-2017-109

[4] Zhang, C.; Zhou, G.; Yang, H.; Xiao, Z.; Yang, X.: View-based 3-d cad model retrieval with deep residual networks, IEEE Transactions on Industrial Informatics, 16(4), 2019, 2335-2345. https://doi.org/10.1109/TII.2019.2943195

[5] Campi, F.; Favi, C.; Germani, M.; Mandolini, M.: CAD-integrated design for manufacturing and assembly in mechanical design, International Journal of computer integrated manufacturing, 35(3), 2022, 282-325. https://doi.org/10.1080/0951192X.2021.1992659

[6] Zhou, H.-Y.; Liu, A.-A.; Nie, W.-Z.; Nie, J.: Multi-view saliency guided deep neural network for 3-D object retrieval and classification, IEEE Transactions on Multimedia, 22(6), 2019, 1496-1506. https://doi.org/10.1109/TMM.2019.2943740

[7] Yeo, C.; Kim, B.-C.; Cheon, S.; Lee, J.; Mun, D.: Machining feature recognition based on deep neural networks to support tight integration with 3D CAD systems, Scientific reports, 11(1), 2021, 22147. https://doi.org/10.1038/s41598-021-01313-3

[8] Deng, Y.; Han, S.-Y.; Li, J.; Rong, J.; Fan, W.; Sun, T.: The design of tourism product CAD three-dimensional modeling system using VR technology, Plos one, 15(12), 2020, e0244205. https://doi.org/10.1371/journal.pone.0244205

[9] Willis, K.-D.-D.; Pu, Y.; Luo, J.; Chu, H.; Du, T.; Lambourne, J.-G.; Matusik, W.: Fusion 360 gallery: A dataset and environment for programmatic cad construction from human design sequences, ACM Transactions on Graphics (TOG), 40(4), 2021, 1-24. https://doi.org/10.1145/3450626.3459818

[10] Chen, J.; Kira, Z.; Cho, Y.-K.: Deep learning approach to point cloud scene understanding for automated scan to 3D reconstruction, Journal of Computing in Civil Engineering, 33(4), 2019, 04019027. https://doi.org/10.1061/(ASCE)CP.1943-5487.0000842