Membrane Technology
ISSN (online): 1873-4049

Construction of Safety Risk Assessment Index System for Mechanical and Electrical Equipment Installation Engineering

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Abstract:

With the continuous expansion of the industrial scale of electromechanical equipment installation, it is necessary to strengthen the ecological management of the construction and installation industry. On the one hand, this can reduce potential safety hazards and safety accidents, on the other hand, it can reduce ecological risk losses. Based on the common risk identification methods and approaches, this paper first describes the relevant concepts and theories of construction risk of electromechanical equipment installation projects. The construction safety risk factors of mechanical and electrical equipment installation project were preliminarily identified through data review and investigation and interview. This paper uses LEC evaluation method to evaluate the preliminarily identified construction safety risks of electromechanical equipment installation projects, and obtains the risk degree and risk level of the construction safety risk factors of electromechanical equipment installation projects. In this paper, the construction safety risk evaluation index system of mechanical and electrical equipment installation project is established and the evaluation basis and standard are clarified. Finally, the paper conducts an empirical study on the feasibility and reliability of the construction safety risk assessment system of electromechanical equipment installation projects through specific engineering examples.

Keywords: Environmental protection engineering, mechanical and electrical equipment installation, ecological risk, risk assessment index system.

AIMS AND BACKGROUND

According to statistics, at present, the investment in intelligent buildings in China accounts for 5% to 8% of the total investment in buildings, some up to 10%[1-3]. Among them, the investment in the intelligent system of residential quarters is slightly lower, while the investment in the intelligent system of public buildings is slightly higher. In the past five years, 2204.22 billion yuan has been invested in real estate development and construction across the country, with a strong growth rate[4]. The broad market potential of China's intelligent buildings provides a great opportunity for the development of intelligent buildings. However, with China's accession to the WTO, the management system is in line with international standards, and the market is open, China's intelligent building industry is also facing severe challenges. Use information technology to improve the service function, management function and security function of buildings[5-6]. Different types of buildings should have different solutions for their intellectualization because of different service objects; Buildings of different grades and in different regions should have different intelligent configurations because of different needs[7]. The market should be subdivided and optimized according to people's needs, and for this purpose, building intelligent systems that can meet different needs should be developed.

OVERALL DESIGN OF ELECTROMECHANICAL EQUIPMENT INTEGRATED CONFIGURATION SYSTEM IN INTELLIGENT BUILDING ENGINEERING DESIGN

The electromechanical equipment integrated configuration system in intelligent building engineering design includes integrated design, product management, material optimization, project quotation, cost management, remote project management and other functions. It includes resource management system, integrated configuration system, project quotation system, remote networked design system and other modules.

In order to successfully develop the integrated spring distribution system for electromechanical equipment in intelligent building engineering design and ensure that the developed system can meet the functional requirements, the system will be designed according to the following principlesS[8-10]: (1) high reliability and safety; (2) It has the characteristics of distributed computing, good development and strong interoperability; (3) The Chinese interface shall be used for easy operation and shall

be oriented to designers or managers of different departments; (4) Control the operation authority of various personnel according to their functional departments or business posts; (5) Pay attention to the accumulation of basic data, timely reflect the market situation, with strong effectiveness and practicability; (6) Comply with national, industrial and international standards to upgrade software products and support new hardware products.

Function and information modeling is an important part of enterprise modeling, as well as an important model established in the process of software design and development. These two models complement each other and constitute the basic model of enterprise business functions and business processing information. The information model describes the information contained in the business objects processed by the enterprise, or the input and output data of activities that perform specific functions, as well as the logical relationship between these data. We use IDEF1X method to establish the information model of the integrated configuration system of intelligent electromechanical equipment in buildings. The main information entities in the business process of this system include equipment information, auxiliary material information and corresponding relationship table.

Traditional intelligent building design and quotation are manually operated by designers (or assisted by simple spreadsheets, such as Microsoft Excel). The design process is complex and has a great impact on the overall quotation in many aspects. It is easy to avoid mistakes when multiple designers work together, which affects the quality of the overall design. Especially in the process of electromechanical equipment configuration design, it is difficult to achieve the overall optimal configuration, which seriously affects the overall design of the project. Therefore, it is necessary to establish a good and scientific integrated configuration workflow. In order to solve the above problems, overcome the drawbacks in the traditional intelligent building engineering design, and improve the design quality and efficiency, we propose a new intelligent building engineering design process.

RESEARCH ON KEY TECHNOLOGIES OF ELECTROMECHANICAL EQUIPMENT INTEGRATED CONFIGURATION SYSTEM IN INTELLIGENT BUILDING DESIGN

Client/Server (C/S for short) mode refers to the collaboration of complex relationships between two logical systems and application logic components. In the client/server architecture, the server is mainly used to undertake the sharing management, communication management, file management of the database system and provide services to the client; The client is mainly used to manage user interfaces, execute client applications, collect data, and send application requests to the server. In this architecture, an application database system is divided into the application program of the foreground client and the server part of the background. The application program of the client and the management program of the server are connected through the network, and the actual access operation of the database is separated from the data requirements of the client for the database. It is executed by the client application program of the database server and workstation respectively, which can improve the operation performance of the whole system and enhance the scalability and maintainability of the system. The server usually adopts high-end microcomputer, workstation or minicomputer, which performs background tasks; The client is usually a microcomputer, which performs foreground tasks. The client and server cooperate with each other, each performs its own responsibility, each takes its own advantages, and together constitute the application system platform.

With the increasing scale of enterprises and the increasing complexity of software, the traditional two-layer C/S structure has the following limitations: (1) The two-layer C/S structure is a single server and takes the LAN as the center, so it is difficult to expand to the large enterprise wide area network or the Internet; (2) The combination and integration of software and hardware are limited; (3) The load of clients is too heavy to manage a large number of clients, which affects the system performance; (4) Difficulty in code reuse ⑤ Poor data security. Because the client program can directly access the database server, and other programs on the client computer can also access the database server through other methods, the security of the database is threatened.

Because of the shortage of two-layer C/S, three-layer C/S structure came into being. The three-tier C/S structure divides the application functions into three parts: the presentation layer, the function layer and the data layer, as shown in Figure 1.

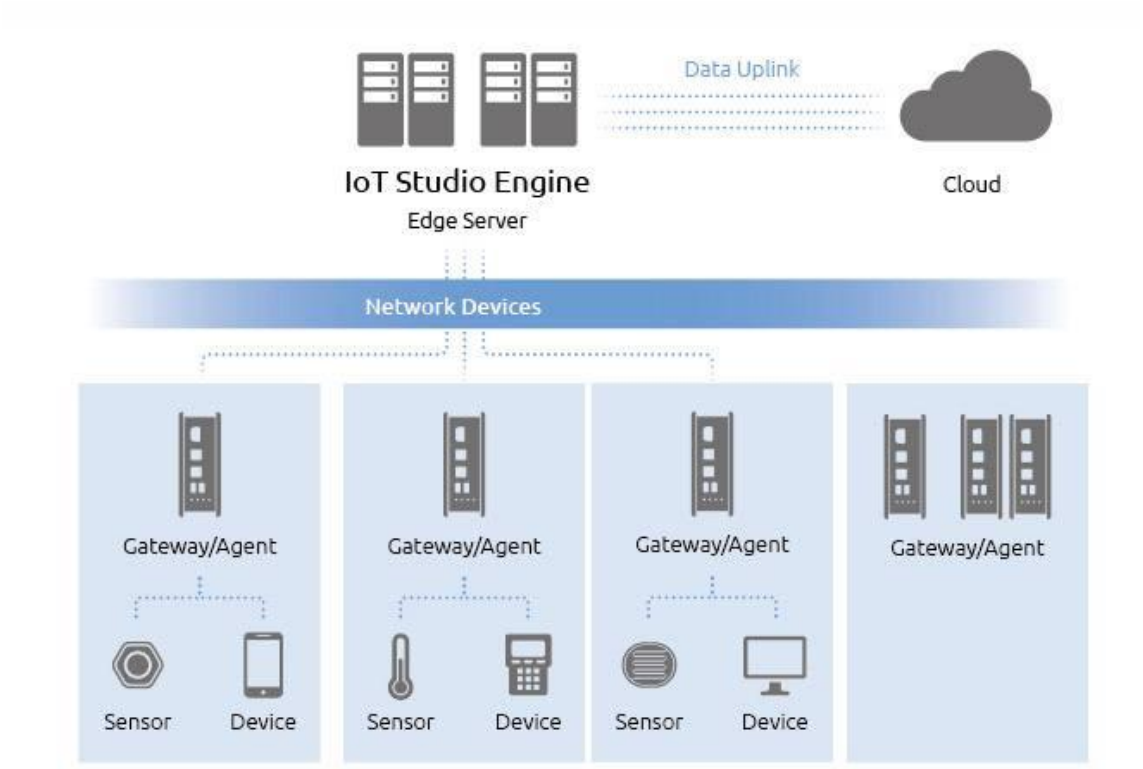

Fig. 1. C/S architecture execution process

When developing the electromechanical equipment integrated configuration system in intelligent building engineering design, the problem that developers need to solve is how to extract the knowledge and experience of these intelligent building engineering designers, organize the information wealth in their minds, and keep it in the form of programs. And how to change and clearly express the corresponding programs when these knowledge or experience are further developed. This requires that the relevant transaction code in the developed system be easy to understand and maintain. Standardization is the key to solving this problem. Standardization helps developers quickly get familiar with and understand the code of other people in the team, and ensures the change and maintenance of code due to changes in business processes in the future. In the development of the electromechanical equipment integrated configuration system, we developed a set of targeted standardized conventions to help programmers better develop and maintain the system, in view of the characteristics of frequent calls to the system parameters, more attributes and methods defined in class modules, and easy errors when calling optimization algorithms.

The system uses SQL Server 2000 to manage data, overcoming the way that most domestic and foreign systems rely on file management. Establishing a relational database on SQL Server not only improves data security, but also greatly reduces data redundancy, saving hard disk space; At the same time, users can ignore the storage of data, overcoming the trouble of other systems that require users to store and transfer data files regularly, and avoiding the loss of data. SQL Server is used to exchange data with clients, which reduces the memory and CPU consumption of data processing on the server side, and is conducive to improving the real-time performance of data collection.

All data collected by the system are stored on the server side, as shown in Figure 2. The client connects with the server database through ADO to establish a data pipeline, which ensures that the client data is basically synchronized with the server data, and that the client data is real-time and consistent. Remote project management is realized by obtaining data from servers through Internet remote users, which is of great significance for improving the technical level and management level of enterprises.

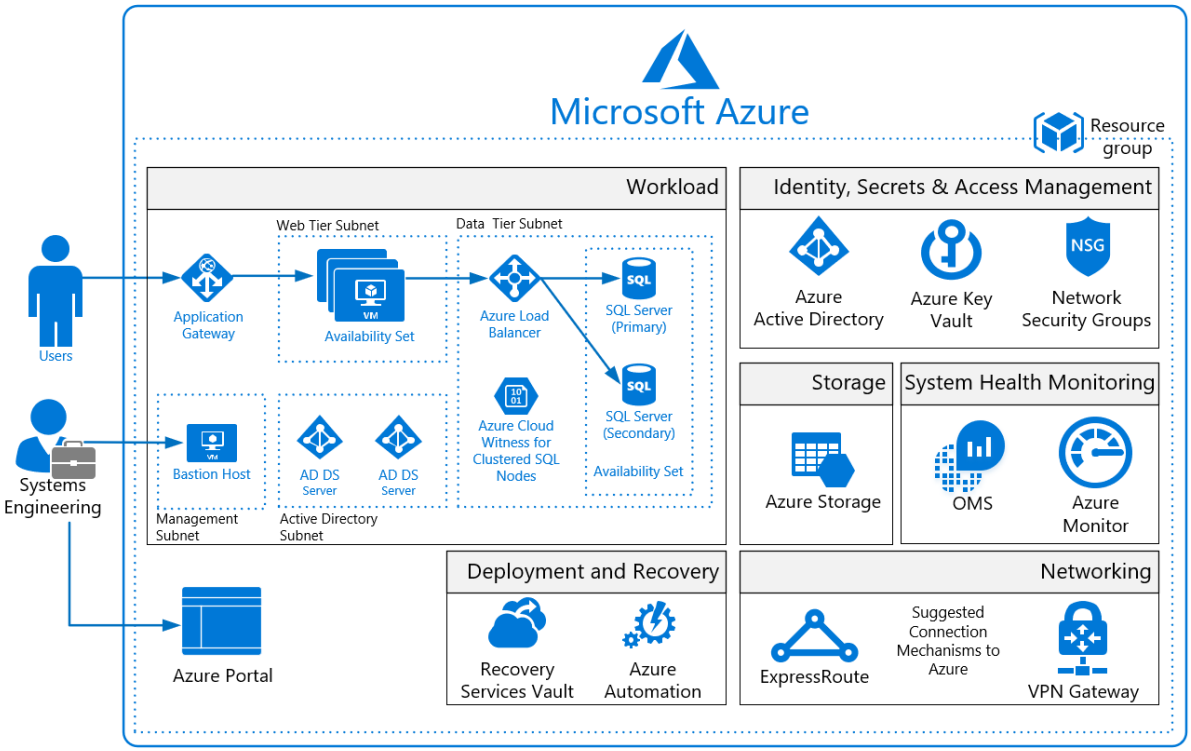

Fig. 2. SQL SEAVER architecture diagram

The storage process is one of the main features of SQL Serer. Almost all applications developed on the basis of SQL Server use stored procedures to some extent. In fact, many administrative tasks in SQL Serer are completed by stored procedures. Stored procedure is an SQL statement compiled at the first execution through syntax analysis and stored on the server. It can be called by the application program by referencing its name. It has the following advantages: (1) reduce network transmission; (2) Faster execution speed; (3) Modular programming; (4) Strict, function based access to tables; (5) Reduce operational errors; (6) Helps improve consistency; (7) Able to handle complex or sensitive things automatically.

Figure 3 depicts how the stored procedure is called by a client application. The created stored procedure can be created in VB or SQL Server environment. When executing, it can be executed as long as the stored procedure is declared in VB or the corresponding parameters are input.

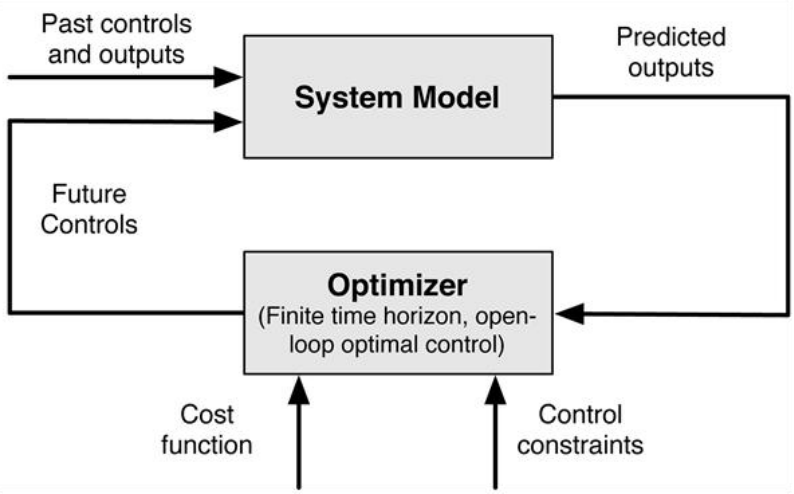

Fig. 3. Schematic Diagram of Stored Procedure Call

B/S software architecture, namely Browser Server architecture, is a change or improvement of C/S architecture with the rise of lnternet technology. Under the B/S architecture, the user interface is completely implemented through WWW browser, and part

of the transaction logic is implemented at the front end, but the main transaction logic is implemented at the server end. The B/S architecture is a new software architecture, which mainly uses the increasingly mature WWW browser technology, combined with the browser's multiple scripting languages, to realize the powerful functions that originally required complex special software, and saves development costs. For software based on B/S architecture, system installation, modification and maintenance are all solved on the server side. When users use the system, they only need a browser to run all modules. However, compared with C/S architecture, B/S architecture also has many shortcomings: the system expansion ability of B/S architecture is poor, and the security is difficult to control. (2) The application system with B/S architecture has much lower response speed in data query than that of C/S architecture. (3) The data submission of B/S architecture is generally based on the page, and the dynamic response speed of data is slow.

In order to meet the needs of these two aspects of the system, we have adopted the mixed software architecture of C/S and B/S in our solution. The mixed software architecture of B/S and C/S is a typical heterogeneous architecture. Internal users directly access the database server through the LAN, external users access the Web server through the internet, and then access the database server through the Web server. The solution organically combines B/S and C/S software architectures, and effectively exerts their respective advantages.

RESULTS AND DISCUSSION

The intelligent building project involves many subsystems with complex functions. Take the construction of a more perfect intelligent community as an example. From the functional point of view, it is necessary to build four major parts: public park service, home comfort anti-theft, community information service and community property management. The public park service and home comfort anti-theft system are all electromechanical control products, while the community information service and community property management system are software systems, but they are also built on the basis of community generic cabling and local area network.

To realize the function of integrated configuration of electromechanical equipment, firstly, an information resource database covering most well-known electromechanical products in the industry must be established. Using this design resource library, designers can query and manage the relevant information of various devices. By setting different permissions, you can limit the management and query functions of each department on the resource library, which enhances the confidentiality and security of enterprise resources. At the same time, designers do not need to manually enter product information when generating reports, which greatly reduces the work intensity. Then, through the design of resource information base, on the basis of in-depth research on the functional characteristics and cost factors of different categories of products, a flexible and stable correspondence between the main category of equipment and the sub category of equipment is constructed.

The traditional configuration process is cumbersome and complex, and the design process cycle is long. A complete scheme takes about three designers 1 to 2 weeks to complete. Therefore, it is difficult for the market personnel to give a reasonable quotation or scheme timely and accurately when the developer inquires or consults, which misses the business opportunity. Through the optimization configuration system of electromechanical equipment, it can help designers to design detailed and perfect configuration schemes in a short time, improve their responsiveness to the market, and provide enterprise management with equipment selection, equipment quantity and quotation of the project, so as to understand the scale, investment, cost and other elements of intelligent projects. It has a certain auxiliary decision-making function.

The mechanical and electrical equipment optimization configuration system is divided into two parts: the general configuration module of intelligent buildings and the detailed configuration module of each subsystem. The general design module starts from the overall project, and only needs the market personnel to provide some basic information of intelligent buildings, can quickly configure the number of main types of equipment required for the construction of each subsystem. Determine the approximate scale, equipment quantity and price of the intelligent project in a short period of time to help market personnel better communicate with developers and provide scientific decision-making for enterprise management. The detailed configuration modules of each subsystem are based on the three design standards of "leading type, advanced type and universal type". Different standards have different design requirements, configuration formulas and calculation methods for each subsystem. These configuration formulas and calculation methods are written into the transaction layer of the system in advance. The designers can output a more complete configuration list by simply entering the corresponding parameters. In this way, designers can meet the different requirements of different customers without consulting a large number of data or formulas, or making mistakes in manual calculation, which greatly improves the design efficiency and ensures the specialization and standardization of the configuration scheme.

The six tier architecture built in key technologies is used to realize the function of optimizing the configuration subsystem, as shown in Figure 4. The class module that encapsulates the formula related to the optimization algorithm is classified as the transaction layer. The user interface inputs the parameters into the transaction layer through the user connection layer, and the transaction layer transmits the processing results to the data layer after processing. If the database needs to be queried, the database is connected through the class module of the data connection layer. After the stored procedures in the database process the data, the data is also transmitted to the data layer through the data connection layer. Finally, the data layer returns the data to the user through the user connection layer.

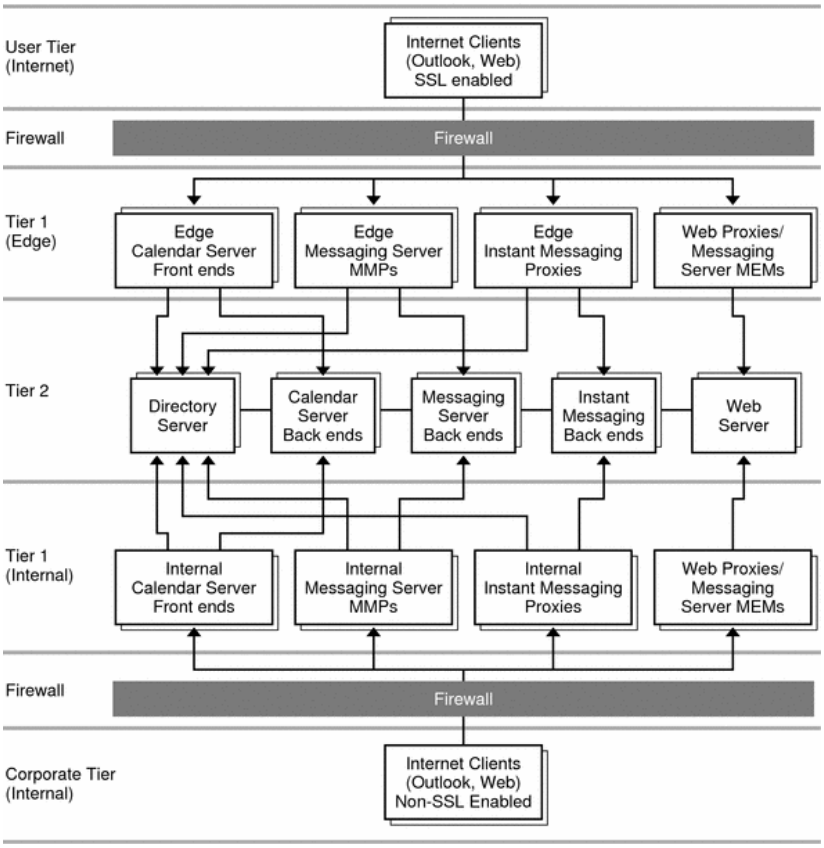

Fig. 4. Implementation of optimal configuration subsystem in six tier architecture

CONCLUSIONS

Based on the research on the integrated design process of electromechanical equipment in the engineering design of intelligent building enterprises at home and abroad, and in combination with the basic principles of intelligent building engineering design and the characteristics of electromechanical integration products in the intelligent building industry, this paper makes an in-depth study on the integrated configuration mode of electromechanical equipment in intelligent building engineering design by using key technologies such as client/server, data interface, network database technology, etc. A set of electromechanical equipment integrated configuration system in intelligent building engineering design is developed. The system solves the problems of low efficiency, high error rate, high design cost, long design cycle and poor market response in intelligent building engineering design.

ACKNOWLEDGMENTS

This paper is supported by 2024 Liaoning Provincial Department of Education research team project“Salt tolerant biological nitrogen and phosphorus removal process of high salt and high nitrogen and phosphorus organic wastewater”(No.2024JYTKYTD-13);2024 Liaoning Provincial Department of Education research team project“Research on multi-layered material construction and catalytic oxidation/reduction treatment of environmental pollutants under green and low-carbon goals”(No.LJ222411430018);2024 Liaoning Provincial Department of Education research team project“Research on degradation of pharmaceutical wastewater by aerobic granular sludge at low temperature”(No.LJ232411430002);2025

Liaoning Institute of Science and Technology College Student Innovation and Entrepreneurship Training Program "ProjectResearch and Practice on Pre treatment Methods for Oil Production Wastewater"(No.202511430012）

REFERENCES

[1] WANG, L. AND HUANG, R. X.: A simple model of abyssal circulation in a circumpolar ocean. Journal of Physical Oceanography, **24**(5), 1040-1058 (1994).

[2] WARIPAN, T. AND WATADA, J.: A game-theoretic two-echelon model approach to strategy development of competitive ocean logistics in thailand. Frontiers in Artificial Intelligence and Applications, **243**(2), 2050-2059 (2012).

[3] YANG, Z. L.; BONSALL, S.; WALL, A.; WANG, J., AND USMAN, M.: A modified cream to human reliability quantification in marine engineering. Ocean Engineering, **58**(JAN.15), 293-303 (2013).

[4] YOERGER, D. R.; BRADLEY, A. M.; JAKUBA, M.; TIVEY, M. A.; GERMAN, C. R., SHANK, T. M.: Mid-ocean ridge exploration with an autonomous underwater. Oceanography, **20**(4), p.52-61 (2007).

[5] YOU, S. S.; CHOI, H. S.; KIM, H. S., AND PARK, H. I.: Autopilot control synthesis for path tracking maneuvers of underwater vehicles. China Ocean Engineering, **2**, 64-76 (2011).

[6] CHEN, C. Y.; HSU, R. C.; CHEN, C. W., AND CHENG, M. H.: Numerical model of internal solitary wave evolution on impermeable variable seabed in a stratified two-layer fluid system. China Ocean Engineering, **20**(2), 303-313 (2016).

[7] DRISCOLL, K. A.; VOLKENING, L. K.; HARO, H.; OCEAN, G.; WANG, Y., JACKSON, C. C.: Are children with type 1 diabetes safe at school? examining parent perceptions. Pediatric Diabetes, **16**(8), 613-620 (2015).

[8] HE, P. AND FU, Q.: Collaborative development modes of ocean logistics companies based on fuzzy comprehensive evaluation. Journal of Coastal Research, **94**(sp1), 712 (2019).

[9] LIANG, Z.: Design of automatic matching system for ocean-going cargo in international logistics. Journal of Coastal Research, **93**(sp1), 1105 (2019).

[10] CHEN Y ,MA J ,WANG S.: Spatial Regression Analysis of Pedestrian Crashes Based on Point-of-Interest Data. Journal of Data Analysis and Information Processing, **08**(1):1-19 (2020).