Examination Database and Online Paper Forming Algorithm for Mobile Personalized Learning Test

Wanwu Li[1], Lin Liu[2*], Hui Zhang[3], Jinhong Li[4], Zhi Wang[5] ⓘ

[1,2,5] Shandong University of Science and Technology, Qingdao 266590, China
[3] KQ GEO TECHNOLOGIES CO., LTD, Beijing 100176, China
[4] Yantai Institute of Technology, Yantai 264003, China
*Corresponding author: liwanwuqd@126.com

Abstrak

Sangat penting untuk memajukan informatisasi ujian pendidikan jaringan dan pembelajaran seluler. Salah satunya adalah pembuatan sistem database untuk ujian, yang berisi informasi penting. Studi ini bertujuan untuk menganalisis dan memecahkan teknologi kunci termasuk algoritma pembentuk kertas pemeriksaan kendala. Penelitian ini menggunakan metode fuzzy query dan spatial query merancang struktur tabel ujian tunggal dan kertas ujian untuk database ujian. Proses penelitian ini meliputi mengumpulkan dan menyortir set lengkap ujian GIS di universitas-universitas besar di seluruh negeri, merancang berbagai pertanyaan tunggal GIS, dan membangun sistem database ujian. Hasil dari penelitian ini adalah sistem pembentukan kertas acak yang dipersonalisasi dan query dan analisis spasial oleh perguruan tinggi dan daerah untuk kertas ujian untuk pertama kalinya. Ini menggambarkan fungsi yang kaya dan kinerja yang stabil dengan pengujian. Sistem yang dibangun menjadi dukungan teknis yang sangat diperlukan alih-alih ujian berbasis kertas untuk ujian informasi dan ujian ilmiah dari banyak perguruan tinggi dan universitas.

Kata kunci: Database Pemeriksaan GIS, Desain Struktur Database Pemeriksaan, Metode Fuzzy Query, SQL Server

Abstract

It is crucial to advance network education exam informatization and mobile learning. One of them is the creation of a database system for exams, which contains crucial information. This study aims to analyze and solves key technologies including constraint check paper forming algorithms. This study using fuzzy query methods and spatial queries design a single exam table structure and exam papers for the exam database. The process of this study including collect and sort the complete set of GIS exams at major universities across the country, design a variety of GIS single questions, and build an exam database system. The result of this research is a personalized random paper formation system and query and spatial analysis by college and area for exam papers for the first time. It describes rich functions and stable performance by testing. The built system becomes an indispensable technical support instead of paper-based exams for information exams and scientific exams of many colleges and universities.

Keywords: GIS Examination Database, Examination Database Structure Design, Fuzzy Query Method, SQL Server

1. INTRODUCTION

The construction of the examination database systems and online paper forming algorithm are currently in popularity. For the traditional examination papers hand-designed, on the one hand, due to the difference in the examiners, the randomness of the test papers is large, and the breadth, depth, and volume of the test questions are often biased (Narayanan & Adithan, 2015; Smith & Wink, 2011). On the other hand, the question-setting efficiency is low. Therefore, it is difficult for the traditional examination papers to accommodate the requirements of educational informatization, and it is difficult to meet the needs of personalized self-testing in MOOC, online learning, and mobile learning (Chatzi & Kourousis, 2023; Guan, 2017; Makeham & Lee, 2012).

The construction of the examination database system is an important method and means to strengthen examination management, improve the question-setting quality, and realize examination standardization, scientificization and informatization, and it is also the need for deepening teaching reform and promoting separation of the teaching and

examination. This system uses advanced computer technology, database technology, and Internet technology to replace manual work to complete propositions, test papers, test papers, test paper analysis, and result statistics (Yong-Sheng, Z., Xiu-Mei, F., & Ai-Qin, 2015; Y. Zhang et al., 2014). It can not only improve the question-setting efficiency, but also a technical way to realize the standardization and scientificization of the examination. For different learners, setting corresponding automatic topic selection parameters, the automatic forming examination papers with different levels of difficulty and assessment focus is also the key to realizing mobile personalized learning test (Abass et al., 2017; Bhardwaj & Singh, 2011; Hang, 2011).

With the development of examination informatization, the examination database management system has realized the query of questions and answers, and the online paper forming is gradually improved. In the examination database system, the attribute query of examination questions is realized by fuzzy query, quick search, and other methods. The system converts fuzzy queries into classical SQL queries and uses a classical Database Management System (DBMS) to evaluate fuzzy words as a way to fuzzy query the data (Liu et al., 2022; Mama, R., & Machkour, 2021). Due to the unique spatial relationship of geographic data, the rapid query of geographic data needs to consider the topological relationships between elements, and then achieve fast retrieval of geospatial data based on relational database mapping (Alghamdi et al., 2020; Mishra, 2021; Moon et al., 2015).

The online paper forming can automatically extract examination questions from the examination database by formulating a paper forming strategy, which is fast and efficient, and gives full play to the advantages of online paper forming. The paper forming strategy consists of examination attributes, paper forming parameters, and algorithms (Hameed, M. R., & Abdullatif, 2017; Watts et al., 2011). At present, online paper forming algorithms mainly include random selection algorithm, backtracking algorithm, genetic algorithm, and ant colony algorithm (Peng et al., 2018; Wang et al., 2021; Xiao et al., 2018). The random linear rule paper forming algorithm adopts a structured design, which is relatively simple in implementation and fast in speed, but has a relatively fixed structure and inflexible application (Swart, 2010; Xi & Hang, 2018). Backtracking algorithm, also known as the backtracking heuristic algorithm, is an improvement of the random selection algorithm.

The algorithm records the first state type generated by the random selection algorithm and releases the last recorded state when the search fails, then will generate the new state and test again according to special strategies, and returns the starting point by continuously backtracking the trial until the examination paper is generated or cannot be generated (Demetres, 2009; Pinar, 2013). In theory, the algorithm can traverse the state of every possible state combination, but in fact, it is very difficult to realize all the combination types when the total number of examination questions is large. Especially when the generating of the final examination paper, the number of optional questions with the constraints drastically reduces, subsequently the success rate reduces (Ma, 2012; Nelson et al., 2005). This method is only suitable for the examination database with less total questions and state types of the examination paper, which needs a lot of memory space and has a complex program structure.

Genetic algorithm is a kind of calculation model realized by simulating the biological evolution process in nature, which starts from the initial solution space, and searches the feasible solution space according to the specific fitness function in each generation evolution process. This algorithm is characteristic of high robustness, self-adaptivity, inherent parallelism, and global searching ability. It can solve the blindness of random selection dealing with the paper forming problems, but it is complicated and poor efficient (Kaya a et al., 2014; Nie, 2019; Protopopova & Kulik, 2020). Ant colony algorithm converges to the optimal path through the accumulation and update of pheromone. However, in the early stage

of the search, the lack of pheromone will make the accumulation time longer, the convergence speed is slower, and it is easy to fall into the local optimum (Engin & Güçlü, 2018; L. Zhang, 2021). In order to realize the randomness, scientificity, and rationality of paper forming, it is possible to extract appropriate examination questions from the examination database by analyzing various paper forming algorithms and designing new algorithms based on their characteristics. Adding constraints to the paper forming algorithm and screening eligible topics for paper forming is an important part of realizing personalized online paper forming (Nie, 2019; Sun, 2019).

Although some progress has been made in the study of online paper forming algorithm, there are still shortcomings, such as how to introduce constraints on the difficulty conditions of the test questions, which is where the innovation of this paper lies. The paper first designs the table structure of examination question and the table structure of examination paper for the examination database, and inputs the examination questions accumulated in the teaching for many years into the database to build the examination database system. Then, based on the analysis and research of the current online automatic paper forming algorithm, combining with the random algorithm and backtracking algorithm for improvement and introducing constraints such as the difficulty of test questions, the personalized random paper forming with constraints is realized. Finally, the GIS examination database information management system is developed, which realizes the functions of question fuzzy query, fast retrieval, and examination paper analysis, and provides technical support and implementation methods for online examinations of GIS professional courses, mobile personalized learning assessment, and remote postgraduate examination simulation. In addition, this study realizes the spatial search of past GIS examination papers of different provinces and schools based on ArcEngine platform.

2. METHODS

The examination database of this research includes the single examination database used for online paper forming and the examination paper database that stores the examination of various colleges and universities over the years. The single examination database includes 8 types of examination questions, researcher correspondingly design 8 types of data table structures in the database, which are the data table structure of the choice question, blank-filling questions, true or false, explanation of nouns, short answer, essay question, analysis and application question, calculations. Each type of table structure includes many fields such as identification code, question type, question number, stem, standard answer, difficulty degree, selected or not, the paper to which the question belongs, and the area and city coordinates of the original examination. The table structure of these 8 types of data is similar, which takes Chinese pinyin initials to identify every type.

After the new question type is designed according to the teaching need, the data table of question types can be added. For example, the storage format and table structure of blank-filling questions are shown in Table 1.

Table 1. The Data Storage Format of Blank-Filling Questions

T_ID	T_Type	T_Number	T_Content	T_Answer	T_Grade	T_IfSel	T_JIDStr	T_X	T_Y

In addition, aiming at the characteristics that the answer of blank-filling question may not be the only, multiple reference answers can be stored in the data table of blank-filling question. It is considered to be the correct as long as getting one matching when reviewing the examination paper by the platform system. The data table structure is show in Table 2.

Table 2. The Data Table Structure of Blank-Filling Questions

| Name	Code	Type	Width	Decimal
Identification code	T_ID	INTEGER		
Type	T_Type	SHORT		
Number	T_Number	LONG		
Stem	T_Content	STRING		
Answer	T_Answer	STRING		
Difficulty degree	T_Grade	SHORT		
Chosen or not	T_IfSel	LOGIC		
Paper	T_JID string	INTEGER		
X coordinate	T_X	NUMBER	20	2
Y coordinate	T_Y	NUMBER	20	2

The score point matching method is used to review explanation of nouns and short answer questions, therefore the answers of short answer questions are divided into many score point fields. The key-point answer strategy is used for essay questions and analysis and application questions, with a certain number of marks awarded for a correct answer. For a comprehensive question that contains multiple sub-questions, such as calculations, multiple question fields and multiple answer fields are added, with corresponding marks awarded for the results.

3. RESULTS AND DISCUSSION

Results

Examination Paper Database Structure

The examination paper database includes original papers and papers by the online paper forming algorithm. Original papers consist of the original examination papers of universities and the newly designed examination papers. The data table structure of the examination paper database includes field information such as paper number, paper identification code, tested or not, test time, score distribution, and difficulty degree. The E-R relationship diagram of the whole examination database system is shown in Figure 1.
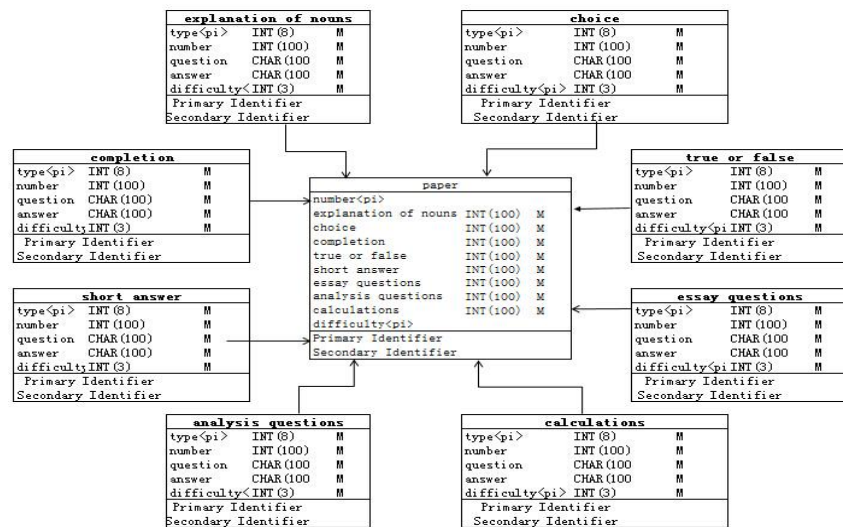
Figure 1. The E-R Relationship Diagram of the Examination Database System

Improvement of the online automatic paper forming algorithm

On the one hand, according to the requirement of the examination, online automatic paper forming technology chooses questions from the examination database by a specific algorithm to form an examination paper in line with the requirements of knowledge distribution, type distribution, cognitive level distribution, difficulty distribution, differentiation degree distribution, time distribution, and score distribution. On the other hand, it is also possible to form an examination paper for personalized learning according to the different stages and levels of personalized learning.

The paper constructs the chain random paper forming algorithm with constraints on the basis of the analysis and study of the current such algorithms. In the specific implementation, the question difficulty field is added to the examination database structure, and the question difficulty is divided into 6 degrees, which are represented by 1, 2, 3, 4, 5 and 6, with the difficulty level and the number of questions as constraints. The system can intelligently adjust the difficulty degree according to the scoring rate. In the implementation of the algorithm, the test questions drawn from the the examination database are stored into the array $T(mi)$. Where mi is expressed as the number of questions that should be drawn for the difficulty level i. The question selection status data is stored into the array $R(mi)$, which provides the basis for the algorithm to search.

The system automatically scans the examination database after gaining the parameter mi and stores the extracted examination questions into a one-dimensional array. A one-dimensional state chain table Vmi is established, in which the elements are used to represent whether the examination question has been selected. When the elements in the chain table all are 1, this type of examination question has all been called and then the table will be emptied and assigned as 0. In this way, the system will determine whether the search is available according to the element value being 0 or not, which is effective to avoid repetition.

By detailed testing, the constructed algorithm is efficient, less resource occupying, moderate difficulty of selected questions, high science and low repetition rate, which can meet the requirements of the online paper forming. After the online automatic paper forming is completed, we can set up the printing template of examination paper, including font, font size, page margin, paper size, etc., and can also use the default examination paper format for printout.

Fuzzy query and fast retrieval

The examination database management system developed in the paper realizes the fuzzy query, whose principle is based on two kinds of technology. Fuzzy query based on SQL uses the SELECT statement to carry out the function, and allows fuzzy words and language operators to appear in WHERE clause of SELECT query commands. WHERE clause is used to limit query conditions in the SELECT command, which can use the string-matching operator "like" and "like function". The wildcard "?" is used to match any single character in the "like function", but the operator "like" supports wildcards "_" and "%". The former represents 1 character, the latter represents 0 - more characters, which greatly enhances the ambiguity of examination query in the system.

The system uses SQL query statements to achieve simple fuzzy query function. Based on the fuzzy comprehensive membership method, this paper firstly defines the degree of membership function, then calculates the value of membership degree and compares it with the set threshold, finally gets the query results. The total value of membership can be calculated by using a variety of different forms of intersection and union operations in fuzzy set operation, so this method is relatively flexible. During specific execution, for each sub-condition in the query statement, the fuzzy query conditions are converted into regular SQL statements to form corresponding precise query conditions, and the existing DBMS are used

to execute precise SQL query. Then, the matching degrees of the items in the result set are calculated according to their operators and membership values, and the option with the highest matching degree is selected as the query result value.

Fast retrieval is the key technology of the examination database management system. Especially for the large amounts of examination questions in the database, the technology can improve the speed of query and retrieval from the mechanism, so it is crucial for the examination database management system. Fast retrieval technology searches the words and phrases based on the special language rules, which is different from the query method suitable for the character pattern such as like statements. With the support of ArcGIS software platform, this system uses the coordinate fields in the database table structure to realize the fast space retrieval, whose principle is to combine Minimum Bounding Rectangle (MBR) method with the R-tree. The paper uses the R-tree method mainly to ensure its space efficiency.

Spatial query based on map

The examination database system constructed in the paper includes not only examination title and answer data, but also map data. Based on the map data, the original examination papers can be displayed spatially, and the examination questions can be analyzed by universities or regions. The map data is generated based on Baidu map (including satellite map), using ArcGIS for vectorization, color matching, and other processing. The process is shown in Figure 2. This system has generated map data of the whole country and some provinces and cities.
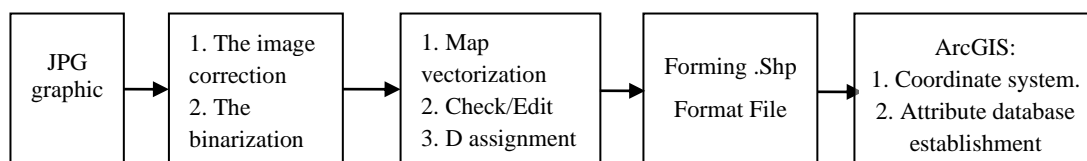
JPG graphic	→	1. The image correction 2. The binarization	→	1. Map vectorization 2. Check/Edit 3. D assignment	→	Forming .Shp Format File	→	ArcGIS: 1. Coordinate system. 2. Attribute database establishment

Figure 2. Map Data Processing

Development of the examination database management system

The examination database management system is developed in the environment of Windows 7 operating system based on Net Framework and ArcGIS Engine 10 development platform. Its system architecture is shown in Figure 3.
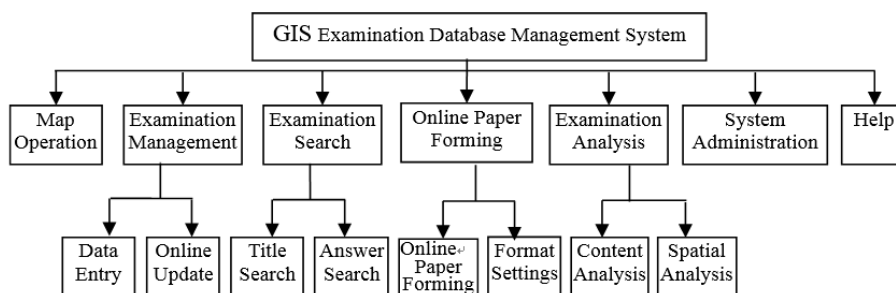

Figure 3. The System Architecture

Implementation of the system function

The system has realized some function. Partly function screenshots of the system are shown in Figure 4.
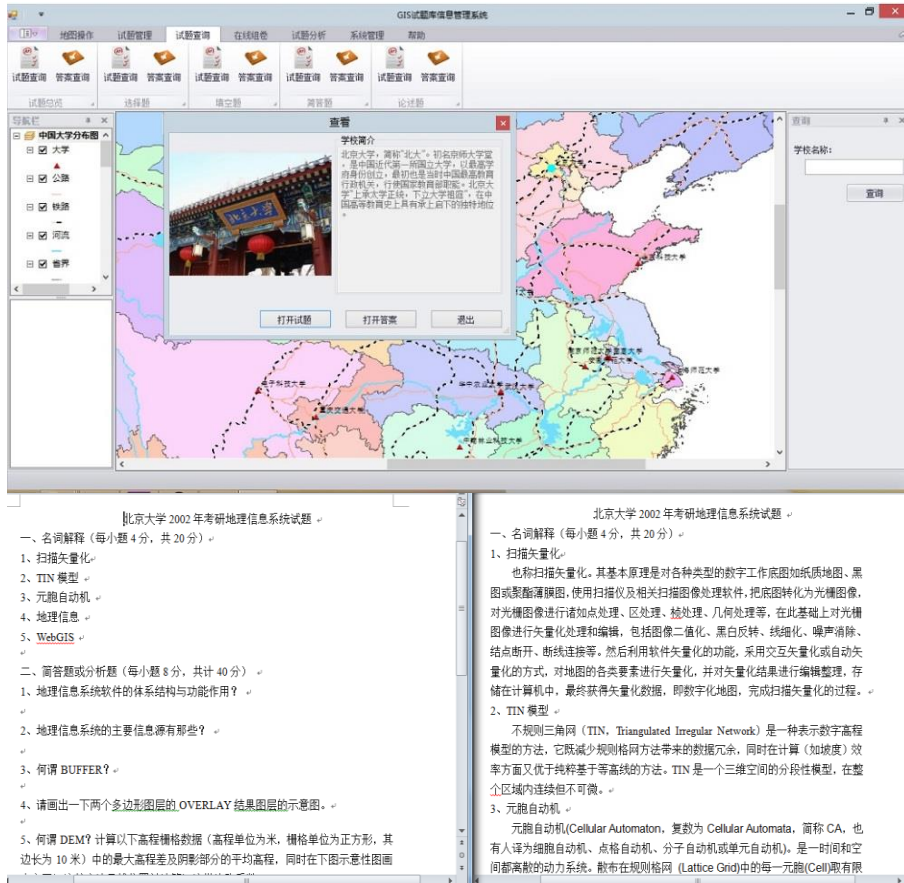
Figure 4. Examination Paper Query Based on Map

The function of online paper forming should firstly set the parameter of papers to be extracted, then extract examination question from the database to form paper with the formerly designed algorithm according to the set difficulty and quantity, and can set the paper format and print it, as shown in Figure 5.
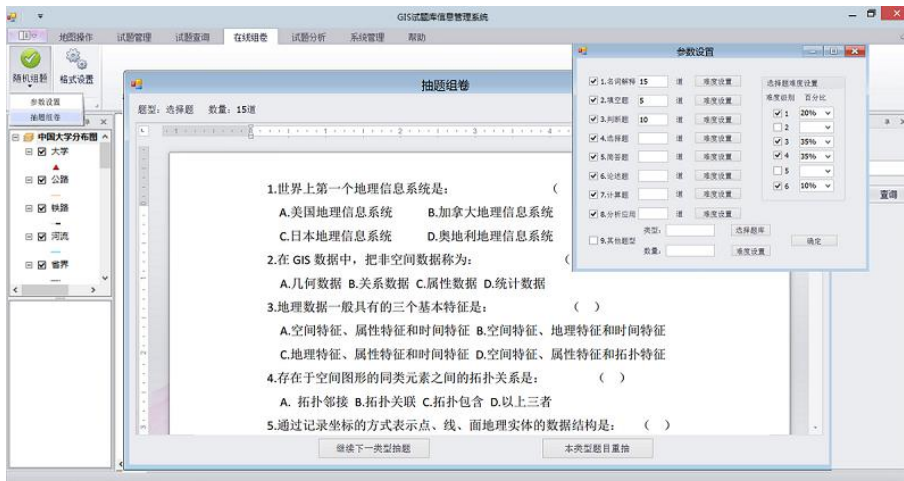

Figure 5. Parameter Setting and Random Paper Forming

Discussion

The system has been on trial widely among the mobile personalized learning groups and has achieved good learning and testing results. At the same time, it is tested for online

paper forming among GIS professional teachers (Code et al., 2020; Sunday & Vera, 2018).

The examination database system has been on trial widely among the mobile personalized learning groups and has achieved good learning and testing results. At the same time, it is tested for online paper forming among GIS professional teachers (Muzaffar et al., 2022; Peng et al., 2018). Comparative analysis with the traditional examination papers hand-designed by teachers, the examination papers formed by online paper forming in this system meet the requirements in terms of quantity, difficulty level, knowledge point assessment, and when the number of questions in the examination database meets a certain requirement, it is better than manual questions (Makeham & Lee, 2012; Narayanan & Adithan, 2015). In the days to come, the capacity of the examination database will continue to be expanded and the application will be furthered.

There are some functions such as, the function of managing and editing examination questions. This module can input and batch import examination questions, and update the examination paper data online and real-time, also can quickly and easily add, edit and delete the data at any time. This module realizes the function of spatial query and attribute query, which can directly and quickly query questions and answers according to geographic location, and also can query different types of questions according to attribute (Peng et al., 2018; Sun, 2019; Swart, 2010). The function of map operating, this system includes map data besides examination database data, which can spatially analyze GIS examination papers based on the map, for example zooming the map, and so on. The function of system management, this module includes system login management and user rights management (Wang et al., 2021; Watts et al., 2011).

The function of online paper forming, based on the examination questions in the examination database, this module can automatically extract and combine examination questions according to user's options and settings, which uses random paper forming method and paper forming method with constraints to form examination paper suitable for the user (Alghamdi et al., 2020; Mishra, 2021). This module can format the newly formed examination paper according to the system default standardized format, and also change the setting value according to the examination paper setup wizard to generate the desired document format. The user can browse, re-edit, save, print and output the generated document (Hameed, M. R., & Abdullatif, 2017; Watts et al., 2011).

The implication of this research is that this platform can increase the flexibility and accessibility of education. Through this platform, tests can be done anywhere and anytime, using their mobile device. Additionally, users can adapt the test to their study preferences, allowing them to focus on the material that is most important to them. However, this research also has some limitations that need to be considered. Firstly, the development of this platform is still in its early stages and has not been thoroughly tested in a real educational environment. Therefore, further research is needed to assess its effectiveness and usefulness. So the researcher recommends for future research in order to be able to continue this research.

4. CONCLUSION

The paper has the following characteristics on the basis of realizing the functions of traditional examination database. It realizes, based on maps, fast query and retrieval of questions and answers. It realizes the random online paper forming with constraints, which can extract the questions according to the difficulty and quantity to form the standard examination paper, also can set the format of examination paper and print online. It realizes the function of examination paper analysis. It not only realizes the statistical analysis of examination paper, but also realizes the spatial analysis based on maps and the statistical

analysis based on location. This function can orientate, query the address and statistically analyze by province for the examination paper.

5. ACKNOWLEDGE

6. REFERENCES

Abass, O. A., Olajide, S. A., & Samuel, B. O. (2017). Development of web-based examination system using open source programming model. *Turkish Online Journal of Distance Education*, *18*(2), 30–42. https://doi.org/10.17718/tojde.306555.

Alghamdi, A., Alanezi, M., & Khan, F. (2020). Design and implementation of a computer aided intelligent examination system. *International Journal of Emerging Technologies in Learning (IJET)*, *15*(1), 30–44. https://www.learntechlib.org/p/217064/.

Bhardwaj, M., & Singh, A. J. (2011). Automated integrated university examination system. *Himachal Pradesh University Journal*, *1*, 156–162. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=6c81336cc2fec7ace9dce5789143f6362ebf9733.

Chatzi, A. V., & Kourousis, K. I. (2023). Are concept map exam papers reliable as assessment tools in nursing education? A quantitative research pilot study. *Teaching and Learning in Nursing*, *18*(2), 293–298. https://doi.org/10.1016/j.teln.2023.01.001.

Code, J., Ralph, R., & Forde, K. (2020). Pandemic designs for the future: perspectives of technology education teachers during COVID-19. *Information and Learning Science*, *121*(5–6), 409–421. https://doi.org/10.1108/ILS-04-2020-0112.

Demetres, C. (2009). Randomized algorithms for the majority problem. *Electronic Notes in Discrete Mathematics*, *34*, 453–457. https://doi.org/10.1016/j.endm.2009.07.075.

Engin, O., & Güçlü, A. (2018). A new hybrid ant colony optimization algorithm for solving the no-wait flow shop scheduling problems. *Applied Soft Computing*, *72*, 166–176. https://doi.org/10.1016/j.asoc.2018.08.002.

Guan, L. (2017). The design of the automatic generative system of examination papers. (pp.). . *In 2017 Sixth International Conference on Future Generation Communication Technologies (FGCT)*, 1–4. https://doi.org/10.1109/FGCT.2017.8103731.

Hameed, M. R., & Abdullatif, F. A. (2017). Online examination system. *International Advanced Research Journal in Science, Engineering and Technology*, *4*(3), 106–110. https://www.academia.edu/download/82493304/IARJSET_2021.pdf.

Hang, B. (2011). The design and implementation of on-line examination system. *In 2011 International Symposium on Computer Science and Society*, 227–230. https://doi.org/10.1109/ISCCS.2011.68.

Kaya a, B., Kaya, G., & Dağdeviren, M. (2014). A Sample Application of Web Based Examination System for Distance and Formal Education. *Procedia-Social and Behavioral Sciences*, *141*, 1357–1362. https://doi.org/10.1016/j.sbspro.2014.05.234.

Liu, J., Liu, H., Chen, X., Guo, X., Zhao, Q., Liu, J., & Kang, L. (2022). Rapid Retrieval of Geospatial Data Considering Semantic Knowledge. *Geomatics and Information*

Science of Wuhan University, *47*(3), 463–472. https://doi.org/10.13203/j.whugis20200058.

Ma, Z. (2012). Ma. Chaotic populations in genetic algorithms. *Applied Soft Computing*, *12*, 2409–2424. https://doi.org/10.1016/j.asoc.2012.03.001.

Makeham, S., & Lee, C. (2012). Making the aural presentation of examination papers student friendly: an alternative to a reader in examinations. *Assessment & Evaluation in Higher Education*, *37*(2), 237–243. https://doi.org/10.1080/02602938.2010.527915.

Mama, R., & Machkour, M. (2021). Fuzzy querying with SQL: Fuzzy view-based approach. *Journal of Intelligent & Fuzzy Systems*, *40*(5), 9937–9948. https://doi.org/10.3233/JIFS-202551.

Mishra, S. (2021). Determining patent filing targets based on patent cost retrieval from Patent Examination Data System. *World Patent Information*, *65*, 102024. https://doi.org/10.1016/j.wpi.2021.102024.

Moon, H. J., Kim, E. K., Yoon, J. H., & Kwak, J. Y. (2015). Malignancy risk stratification in thyroid nodules with nondiagnostic results at cytologic examination: combination of thyroid imaging reporting and data system and the Bethesda System. *Radiology*, *273*(1), 287–295. https://doi.org/10.1148/radiol.14140359.

Muzaffar, A., Ragab Hassen, H., Lones, M. A., & Zantout, H. (2022). An in-depth review of machine learning based Android malware detection. *Computers and Security*, *121*, 102833. https://doi.org/10.1016/j.cose.2022.102833.

Narayanan, S., & Adithan, M. (2015). Analysis Of Question Papers In Engineering Courses With Respect To Hots (Higher Order Thinking Skills). *American Journal of Engineering Education (AJEE)*, *6*(1), 1–10. https://doi.org/10.19030/ajee.v6i1.9247.

Nelson, R. R., Todd, P. A., & Wixom, B. H. (2005). Antecedents of information and system quality: an empirical examination within the context of data warehousing. *Journal of Management Information Systems,* *21*(4), 199–235. https://doi.org/10.1080/07421222.2005.11045823.

Nie, J. (2019). Research on optimizing intelligent test paper forming strategy based on improved genetic algorithms. *Proceedings of the 2019 International Conference on Artificial Intelligence and Computer Science*, 117–120. https://doi.org/10.1145/3349341.3349387.

Peng, K. H., Huang, Y. F., & Yao, J. M. (2018). Comparison of automatic test paper generation for database technology course based on various artificial intelligence algorithms. *Computer System Application*, *27*(3), 210–216. https://ieeexplore.ieee.org/abstract/document/6295121/.

Pinar, C. (2013). Backtracking Search Optimization Algorithm for numerical optimization problems. *Applied Mathematics and Computation*, *219*, 8121–8144. https://doi.org/10.1016/j.amc.2013.02.017.

Protopopova, J., & Kulik, S. (2020). Educational intelligent system using genetic algorithm. *Procedia Computer Science*, *168*, 168–172. https://doi.org/10.1016/j.procs.2020.02.130.

Smith, S., & Wink, D. (2011). Teaching with Technology Free Web Resources for Teaching and Learning [J]. *Nurse Educator*, *36*(4), 137–139. https://doi.org/10.1097/NNE.0b013e31821fd990.

Sun, J. (2019). Analysis and Research on Test Paper Generation Algorithms of Test Item Bank System. *Office Informatization*, *13*(48). https://doi.org/10.21125/edulearn.2019.0498.

Sunday, C. E., & Vera, C. C. E. (2018). Examining information and communication technology (ICT) adoption in SMEs: A dynamic capabilities approach. *Journal of*

Enterprise Information Management, *31*(2), 338–356. https://doi.org/10.1108/JEIM-12-2014-0125.

Swart, A. (2010). Evaluation of Final Examination Papers in Engineering: A Case Study Using Bloom's Taxonomy. *IEEE Transactions On Education*, *53*(2). https://doi.org/10.1109/TE.2009.2014221.

Wang, Q., Deng, X., Cai, W., & Pan, L. (2021). Design and lmplementation of Online Examination System Based on Genetic Algorithm. *In 2011 International Conference on Computer Science and Service System (CSSS)*, *33*(21), 33(21. https://doi.org/10.1109/CSSS.2011.5974429.

Watts, B. V., Groft, A., Bagian, J. P., & Mills, P. D. (2011). An examination of mortality and other adverse events related to electroconvulsive therapy using a national adverse event report system. *The Journal of ECT*, *27*(2), 105–108. https://doi.org/10.1097/YCT.0b013e3181f6d17f.

Xi, J., & Hang, X. (2018). Design of online intelligent examination system based on UML and particle swarm optimization. *Automation & Instrumentation*, *9*. https://doi.org/10.14016/j.cnki.1001-9227.2018.09.121.

Xiao, J., Wang, M., Jiang, B., & Li, J. (2018). A personalized recommendation system with combinational algorithm for online learning. *Journal of Ambient Intelligence and Humanized Computing*, *9*, 667–677. https://doi.org/10.1007/s12652-017-0466-8.

Yong-Sheng, Z., Xiu-Mei, F., & Ai-Qin, B. (2015). The research and design of online examination system. *In 2015 7th International Conference on Information Technology in Medicine and Education (ITME)*, 687–691. https://doi.org/10.1109/ITME.2015.96.

Zhang, L. (2021). An Intelligent Teaching Test Paper Generation System Based on Ant Colony Hybrid Genetic Algorithms. *13th International Conference on Measuring Technology and Mechatronics Automation (ICMTMA)*, 467–470. https://doi.org/10.1109/ICMTMA52658.2021.00107.

Zhang, Y., Han, Y., & Zhou, Y. (2014). The Study on Network Examinational Database based on ASP Technology. *Physics Procedia*, *24*, 2194–2199. https://doi.org/10.1016/j.phpro.2012.02.322.