Design of Employment Competitiveness Analysis System for College Students based on Intelligent Database

Guoxin Gu*, Ru Zhao, Weifeng Wang

Harbin Institute of Information Technology, Harbin City, Heilongjiang Province, 150431, China

*hxciguguoxin@126.com

Abstract. Currently, intelligent databases have been applied in the field of college student employment, but issues such as data quality and technical limitations exist. This design adopts an advanced intelligent database architecture that can achieve efficient integration and management of multi-source data. It innovatively combines various algorithms to build a comprehensive employment competitiveness evaluation model. Based on the analysis results from the intelligent database, it can provide personalized employment guidance services.

Keywords: only database, employment competitiveness, analysis system

1 Introduction

The traditional employment guidance and service mode for college students mainly relies on manual experience and simple data statistical analysis, which is difficult to meet the complex needs of the current employment market. On the one hand, when collecting and sorting out and analyzing employment data, universities and employment service institutions often face problems such as large amount of data, scattered information, and not timely update, which leads to the inability to provide accurate and effective employment information and guidance suggestions for college students. On the other hand, in the process of job hunting, it is difficult for college students to make a clear understanding of their own advantages and disadvantages and make scientific and reasonable choices of job planning and employment, as well as an in-depth understanding of the needs of the job market.

With the rapid development of information technology, intelligent database technology came into being, and has been widely used in various fields. With its powerful data storage, management and analysis ability, the intelligent database can conduct efficient processing and deep mining of massive employment data, which provides new ideas and methods for solving the employment problem of college students[1]. By building intelligent database of college students 'employment competitiveness analysis system, can realize the college students' personal information, academic performance, practical experience, professional interest and other multidimensional data integration and analysis, real-time dynamic and industry demand, provide college students with

R. Koul et al. (eds.), *Proceedings of the 2nd International Conference on Educational Development and Social Sciences (EDSS 2025)*, Advances in Social Science, Education and Humanities Research 924,
https://doi.org/10.2991/978-2-38476-400-6_2

personalized employment guidance and career development planning advice, help them to better understand their competitiveness in the job market, clear their own advantages and disadvantages, thus targeted to improve their own quality and ability, improve the success rate of employment.

2 Problems Existing in the Application of Intelligent Database in the Field of College Students Employment

2.1 Data Quality Problems

Data quality is the cornerstone of intelligent database applications; its superiority or inferiority directly affects the accuracy and reliability of employment competitiveness analysis for college students. Currently, data quality issues are evident in multiple aspects. In terms of data accuracy, some universities collect student information with errors due to manual input mistakes or poor system integration, leading to data discrepancies. The issue of data completeness cannot be overlooked either. Inadequate data sharing mechanisms between internal departments of universities result in scattered student information, making it difficult to gather comprehensively[2]. Key information such as internship experiences and award-winning situations is often missing, leaving intelligent databases without sufficient data support when analyzing students practical skills and overall qualities. Regarding timeliness, the job market changes rapidly, yet the problem of untimely data updates is widespread. Information about students academic performance and skill certificate acquisition does not get updated in real-time, causing a lag between the data in intelligent databases and the actual situation of students. Recruitment needs from companies may also change frequently, and if intelligent databases cannot promptly obtain the latest job information, they will recommend outdated or no longer available positions to students, wasting their time and effort on job hunting.

2.2 Limitations of Technology Application

In the practical application of intelligent database, there are many limitations in the technical level. The limitation of algorithm model is an important problem. At present, most intelligent database adopts relatively single algorithm model, which is difficult to fully and accurately describe the complex characteristics of college students employment competitiveness.

Insufficient data analysis is also an urgent issue to address. Although intelligent databases can collect and store large amounts of employment data, they often remain at the surface level of statistical analysis, such as simple statistics on employment rates and average salaries for various majors. There is a lack of in-depth mining and analysis of deeper information hidden behind the data, such as trends in talent capability requirements across different industries and the interrelationships among factors affecting students employ ability. This makes it difficult for universities and students to

obtain forward-looking and guiding information from data analysis, hindering the formulation of effective talent cultivation strategies and career planning.

In addition, intelligent databases lack flexibility in handling complex data and diverse needs. Employment data not only includes structured information such as student grades and job requirements but also a large amount of unstructured text data, like internship reports from students and recruitment promotional materials from companies. Existing intelligent database technologies face challenges in extracting these unstructured data, with issues such as difficult data extraction and poor analytical results. Meanwhile, as the job market demands continue to evolve, higher expectations are placed on the functionality and analytical methods of intelligent databases. However, current intelligent databases lag behind in terms of functional expansion and adaptive adjustments, making it difficult to quickly meet new demands.

3 Design Ideas of the Analysis System of College Students Employment Competitiveness based on Intelligent Database

3.1 Overall Architecture Planning

The intelligent database-based college student employment competitiveness analysis system adopts hierarchical architecture design, aiming to realize the efficiency, scalability and stability of the system.

The lowest data layer is responsible for storing and managing various types of data required for system operations. Data sources are extensive, covering student information, including personal basic information, academic performance, practical experience, awards received, and career assessment results; corporate information, such as company basic information, job position information, employment standards, and corporate culture; as well as employment market dynamics, such as industry trends, salary changes, and employment policies and regulations. To ensure efficient storage and rapid access to data, distributed database technologies are adopted, such as Hadoop Distributed File System (HDFS) combined with NoSQL databases (like MongoDB). The former is suitable for large-scale distributed storage of data, while the latter can flexibly handle unstructured data, meeting the systems needs for storing different types of data.

As the core processing layer of the system, the business logic layer undertakes data processing, analysis, and the implementation of business logic. It receives requests from the application layer, invokes the corresponding data access interfaces to obtain data from the data layer, and uses various algorithms and models to process and analyze the data[3].In the student employability assessment module, through quantitative analysis of data such as students' academic performance, practical experiences, and skill certificates, the Analytic Hierarchy Process (AHP) is used to determine the weights of various evaluation indicators, and the fuzzy comprehensive evaluation method is applied to obtain the comprehensive employability scores of students.In the employment information matching module, collaborative filtering algorithms and cosine similarity

algorithms are adopted. Based on students' personal information, employment intentions, and the recruitment requirements of enterprises, matching calculations are carried out to recommend the most suitable job positions for students.In addition, the business logic layer is also responsible for data interaction with external systems. For example, it invokes the interfaces of third - party career assessment systems to obtain students' career assessment results, and synchronizes and updates data with the educational administration systems and student management systems of universities.

The application layer serves as the interface between the system and users, providing a convenient operating platform for students and universities. For students, it offers functions such as personal information management, job information search and screening, career planning guidance, and viewing of employment competitiveness assessment reports. Students can use the system to understand their employment competitiveness status, receive personalized job recommendations and career development advice, thereby enhancing their job-seeking skills. University users can manage student information, post and manage job information, perform data analysis, and generate reports. Universities can leverage the system to track students employment trends, optimize talent cultivation plans based on data analysis results, and improve the quality of employment guidance services[4]. The application layer employs responsive Web design to ensure a good user experience across different terminal devices (such as computers, tablets, and smartphones). It also ensures user data security and privacy through secure authentication and permission management mechanisms.

3.2 Functional Module Design

The student information management module is responsible for centralized management of various student information. After registering and logging into the system, students can update and improve their personal basic information, such as name, gender, age, contact details, and home address. At the same time, the system automatically synchronizes academic performance information, including course grades and GPA for each semester. This data is directly obtained from the universitys academic affairs system to ensure accuracy and timeliness. Students can also manually enter their practical experience, detailing the internship unit, position, work content, achievements, and upload scanned copies of relevant certificates, such as award certificates and skill certificates. Additionally, students can complete career assessments within the system, with the results serving as important references for career planning guidance and employment competitiveness evaluation.

The employment information matching module is one of the core functions of the system, achieving precise matching between students and corporate job openings through intelligent algorithms[5]. This module first preprocesses students personal information, employment intentions, and job requirements from companies, converting textual information into computable feature vectors. Then, it uses collaborative filtering algorithms and cosine similarity algorithms to calculate the matching scores between students and various job positions. The collaborative filtering algorithm analyzes historical behavior data of students and the behaviors of other students with similar interests to recommend potentially interesting positions to the current student. The

cosine similarity algorithm measures the similarity between student feature vectors and job feature vectors by calculating the cosine value of their angles; the smaller the angle, the higher the similarity, and thus the higher the matching score. Based on the matching scores, the system recommends the most suitable job positions to students and displays them in descending order of score. Students can view detailed information about the recommended positions and directly submit their resumes within the system.

The career planning guidance module provides students with personalized career planning advice and development path guidance. The system analyzes students strengths and weaknesses based on multiple dimensions of data, including personal information, academic performance, practical experience, and career assessment results. It then combines students career interests and employment intentions to develop personalized career planning schemes for them.

4 Data Analysis Model Construction

4.1 Application of Data Mining Algorithm

In the analysis of college students employment competitiveness, the application of data mining algorithms provides a powerful means to extract valuable information from massive datasets. Association rule mining algorithms play a crucial role in analyzing the potential connections between student employment data and various factors[6]. Taking the Apriori algorithm as an example, this algorithm sets minimum support and minimum confidence thresholds to find frequent itemsets in employment data sets, thereby generating association rules with practical significance.

Cluster analysis algorithms can group students or job positions with similar characteristics into different categories, providing clear classification criteria for subsequent analysis and decision-making. The K-Means algorithm is a commonly used clustering method. It randomly selects K initial cluster centers and then assigns data points to the corresponding clusters based on their distance from these centers, continuously adjusting the cluster centers until convergence conditions are met.

The K-Means algorithm is applied to cluster students based on their employability competitiveness, assuming that students are divided into three categories: high, medium, and low (K=3). After multiple iterations, it was found that students in the high-competitiveness category generally have higher academic performance, rich practical experience, strong overall qualities, and clear career planning; whereas students in the low-competitiveness category are relatively weaker in these aspects. Through such cluster analysis, universities can clearly understand the characteristics of different groups of students with varying levels of competitiveness, thereby providing targeted personalized employment guidance and training services for each category. For students in the high-competitiveness category, more high-quality company recommendations and advanced job information can be provided; for those in the low-competitiveness category, foundational skills training and career planning guidance can be strengthened to help them enhance their employability.

4.2 Machine Learning Model Training

Machine learning models demonstrate strong capabilities in predicting students employment competitiveness and job fit. Decision tree models, with their intuitive decision rules and ease of understanding, are widely used in employment competitiveness analysis[7]. Taking the C4.5 decision tree algorithm as an example, it selects the best features for node splitting by calculating the information gain rate, thereby constructing a decision tree model.

When training a decision tree model, input features include the students major, grades, practical experience, and skill certificates, while the output label is the students employment competitiveness level (high, medium, low). After extensive training with large amounts of student data, the decision tree model can learn the relationship between different characteristics and employment competitiveness. Through such a decision tree model, universities can quickly predict students employment competitiveness and provide corresponding employment advice and guidance.

Neural network models possess powerful nonlinear fitting capabilities, capable of handling complex data relationships and performing excellently in job match prediction. Taking the Multi-Layer Perceptron (MLP) as an example, it consists of an input layer, multiple hidden layers, and an output layer. By adjusting the weights and thresholds between neurons, it achieves complex mappings of input data.

When training an MLP model, student personal information, career interests, and skill strengths are used as inputs, while the requirements of job positions in companies serve as outputs. The model is trained using a large amount of sample data to learn the matching patterns between students and positions. For example, for a student with a strong interest in data analysis who also has Python programming skills and knowledge of statistics, the MLP model can predict a high match between this student and data analysis-related positions.

5 Conclusion

This research focuses on the design of an analysis system for college students' employment competitiveness based on intelligent databases. It aims to address the problems currently faced by the application of intelligent databases in the field of college students' employment and construct a new path to empower employment. Firstly, the existing problems are analyzed. In terms of data quality, the accuracy, integrity, and timeliness of the data are subpar. Factors such as manual entry errors, poor data sharing, and delayed updates affect the accuracy of the analysis. Regarding technology application, the algorithm models are single - dimensional, the depth of data analysis is insufficient, and there is a lack of flexibility in dealing with complex data and diverse demands, making it difficult to excavate in - depth information and meet the dynamic market demands.

To address these issues, a system design plan is proposed. The overall architecture adopts a hierarchical design. The data layer uses distributed technology to store multi - source data. The business logic layer, as the core, invokes algorithms to process and analyze data, realizing functions such as the evaluation of students' employment

competitiveness, the matching of employment information, and also interacting with external systems. The application layer provides an interactive interface for students and universities, is adaptable to multiple terminals, and ensures the security and privacy of data.The functional modules cover student information management, which accurately synchronizes and collects various types of student information. The employment information matching module uses intelligent algorithms, combining collaborative filtering and cosine - similarity algorithms to achieve precise job recommendations. The career planning guidance module provides personalized plans based on students' multi - dimensional data.In terms of constructing the data analysis model, data - mining algorithms such as association rules and cluster analysis are applied to explore the potential relationships in employment data and classify students' competitiveness. Machine - learning models such as decision trees and neural networks are utilized to predict the employment competitiveness and job - matching degree, providing a decision - making basis for universities and students.

References

1. Wang Rongming. Design and implementation of cloud computing-based digital student employment resource management platform for colleges and universities [J]. Value Engineering, 2015,34(18):157-160.
2. Liu Hongchao, Teng Xinxin, Bai Hao. Construction and Application of Intelligent Employment Platform for Universities Based on Big Data [J]. Modern Educational Technology, 2020,30(2):111-117.
3. Lin LiDesign and implementation of college student employment system platform based on computer artificial intelligence [J].Computer knowledge and technology, 2021, 2:158-160 .
4. Wang Yan,Wei Jinpu.The practical way to improve the employment service system of colleges and universities[J].human resources, 2021, 24:128-129.
5. Cui Xiuyan. Design and implementation of intelligent employment recommendation system based on big data analysis and artificial intelligence [J].Journal of Hebei Institute of Software Technology, 2023,2:15-19.
6. Mayreen V. Amazona,Alexander A. Hernandez.Modelling Student Performance Using Data Mining Techniques: Inputs for Academic Program Development[C] .ICCDE 19: Proceedings of the 2019 5th International Conference on Computing and Data Engineering: 36 – 40.
7. S Vignesh,C Shivani Priyanka,H Shree Manju,K Mythili.An Intelligent Career Guidance System using Machine Learning[C] .2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS):987-990.