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Retraction

Retracted: Research on Digital Economy and Human Resources Based on Fuzzy Clustering and Edge Computing

Security and Communication Networks

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Z. Wang, "Research on Digital Economy and Human Resources Based on Fuzzy Clustering and Edge Computing," *Security and Communication Networks*, vol. 2021, Article ID 5583967, 8 pages, 2021.

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Research Article

Research on Digital Economy and Human Resources Based on Fuzzy Clustering and Edge Computing

Zhouhuo Wang

College of Economics and Management, Shaoyang University, Shaoyang, Hunan, China

Correspondence should be addressed to Zhouhuo Wang; 2723@hnsyu.edu.cn

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The internationalization of the digital economy is an important part of the development stage of the digital economy. How to improve the internationalization level of the digital economy, promote the international competitiveness of digital enterprises, and accelerate the pace of digital enterprises "going out" has become the current digital economy research field problem that needs to be solved urgently. Aiming at the current deficiencies in the development of the digital economy, this paper combines edge computing and fuzzy clustering technology to carry out research on digital economy and human resources. First of all, through the clustering analysis of the factors of digital economy and human resources, the weight of each factor is obtained. Secondly, edge computing technology is used in the architectural design of digital economy and human resources research. Finally, the simulation test analysis verifies the efficiency of the digital economy and human resources architecture based on fuzzy clustering and edge computing established in this paper. The research is helpful for the development of the analysis of digital economy and human resources.

1. Introduction

The digital economy is based on the digitization of information and communication technology as a key production factor. Through modern information and communication infrastructure, a virtual network is formed, which fundamentally changes the business processes and transaction methods of various industries, stimulates the development of e-commerce, and makes production and operation the digitalization of management activities, and living consumption has also changed the economic structure and economic value [1, 2]. Successive governments have regarded the development of digital economy as an inevitable choice to promote their own economic growth. The digital economy has become the mainstream economic model in the world.

The term digital economy has been mentioned more and more, but it has not yet formed a concept that is universally recognized by the international community and has a rigorous definition in economics [3]. Chinese and foreign scholars have given different definitions of "digital economy" according to their own understanding [4]. Brynjolfsson and Kahan believed that the digital economy is the digitization of information and the corresponding ICT infrastructure. Liu Zuen proposed that e-commerce and the information technology industry that directly supports its development belong to the category of digital economy [5]. Hans-Dieter Zimmerman C pointed out that the digital economy means not only technology but also challenges and opportunities for the business structure and related processes [6, 7]. PK Manoj and K Suppresser believed that the main driving factor for the good development of the digital economy is the adoption of increasingly mature global outsourcing services; especially, in the service industry, there is a positive relationship between the growth of digital service companies [8, 9]. Observing the research results of domestic and foreign scholars on the influencing factors of the digital economy, it is found that the current international judgment of the factors affecting the development of the digital economy lacks a unified standard. The existing research only analyzes the factors affecting the development of the digital economy from a certain angle. After combining through the existing research on the factors affecting the development of the digital economy and the evaluation index system for the development of the digital economy at home and abroad, most studies point out that digital infrastructure, labor capital in the CT industry, government policies, capital investment, information technology, etc., have contributed to the development of the digital economy [10, 11].

The internationalization of the digital economy is an important part of the development stage of the digital economy. Improving the internationalization level of the digital economy and accelerating the pace of "going out" of digital enterprises have become an urgent problem to be solved in the field of digital economy research. In view of the shortcomings of the current digital economy development, this study is helpful for the development of digital economy and human resources analysis. This study combines edge computing and fuzzy clustering techniques to study the digital economy and human resources.

2. Overview of Related Technologies

2.1. Digital Economy and Human Resources. From the perspective of historical development, the research on the connotation of the digital economy at home and abroad, both in essence and in scope, has large differences in the definition of the connotation of the digital economy [12, 13]. In addition, there has not been a unified standard for the evaluation of the development of the digital economy at home and abroad. The measurement research on the development of the digital economy is mostly based on qualitative explanations. For example, scholars John Helitanker and Ron S. Jarmon constructed only an evaluation index system for the development of the digital economy. The paper proposes a method to measure the digital economy, and the existing quantitative research is mostly limited to the use of simple, descriptive, and statistical analysis for quantitative analysis, lacks objective, comprehensive, and systematic quantitative research results, and cannot accurately reflect the current situation of my country's digital economy development in a timely manner [14, 15]. Therefore, based on the combination of the existing research results of the same kind at home and abroad, this article firstly defines the connotation of the digital economy and its development characteristics and builds a digital economy development evaluation index system on this basis and then conducts a review of the development status of China's digital economy. The statistical evaluation also reveals the main problems in the development, provides data support for the correct judgment of the current situation of my country's digital economy development, and plays a role in inducing subsequent similar quantitative research [16, 17]. A schematic diagram of the digital economy research process is shown in Figure 1.

British classical political economists first equated the growth of national wealth with economic development [18, 19]. Many foreign research documents equate the quality of economic development with the quality of economic growth. The concept of the quality of economic development is divided into narrow and broad. The former Soviet Union scholar Kamenev explained the meaning of the quality of economic development in the narrow sense. He first analyzed the essence of economic growth and believed that economic growth should be examined in the speed and quality of economic growth. It is believed that the quality of economic growth is the change in the scale of resources used and the efficiency of utilization in the production process of the expansion of total social products under the conditions of economically developed socialism.

2.2. Edge Computing Technology. Edge computing started from a computing platform that IBM and Nokia Siemens launched in 2013 to run applications in wireless base stations and provide services to mobile users. Then, the European Telecommunications Standards Institute proposed mobile edge computing (MEC), then the Edge Computing Industry Alliance (CECC) led by Huawei gave the definition of edge computing, and finally, the world's first "*Edge Computing*" professional book was published. Then, from fog computing, C-RAN, cloudlet, and other computing models to edge computing extended from mobile edge computing [20, 21]. The development process of edge computing is the process of continuously optimizing this new computing model, from edge interconnection to edge intelligence to edge autonomy.

Edge computing should be fully coordinated with cloud computing. Cloud computing is suitable for analyzing and processing various non-real-time, global heterogeneous data, especially in terms of long-term system maintenance and business decision support [22, 23]. In system design, we should pay attention to the complementary coordination between edge computing and cloud computing. Edge computing is useful for analyzing and processing a wide range of real-time and localized data, focusing on intelligent decision-making and execution of local real-time services.

3. Research on Digital Economy and Human Resources Based on Fuzzy Clustering

3.1. Influencing Factors of Digital Economy Development. By comparing the aforementioned three major digital economy development indicator systems at home and abroad, regardless of the definition, theory, scope, and measurement steps of the digital economy, each system points to digital infrastructure, industry labor capital, government policies, capital investment, information technology, and other aspects which play a decisive role in the development of the digital economy [24, 25]. With reference to the existing research on the influencing factors of the digital economy at home and abroad, it can be found that in terms of digital infrastructure, a sound digital infrastructure is the basic condition for the development of the digital economy, and the development of the digital economy cannot be separated from the improvement of the level of digital infrastructure; information technology factors such as capital investment are also decisive factors for the development of the digital economy. The increase in R&D funds can directly lead to the improvement of the innovation

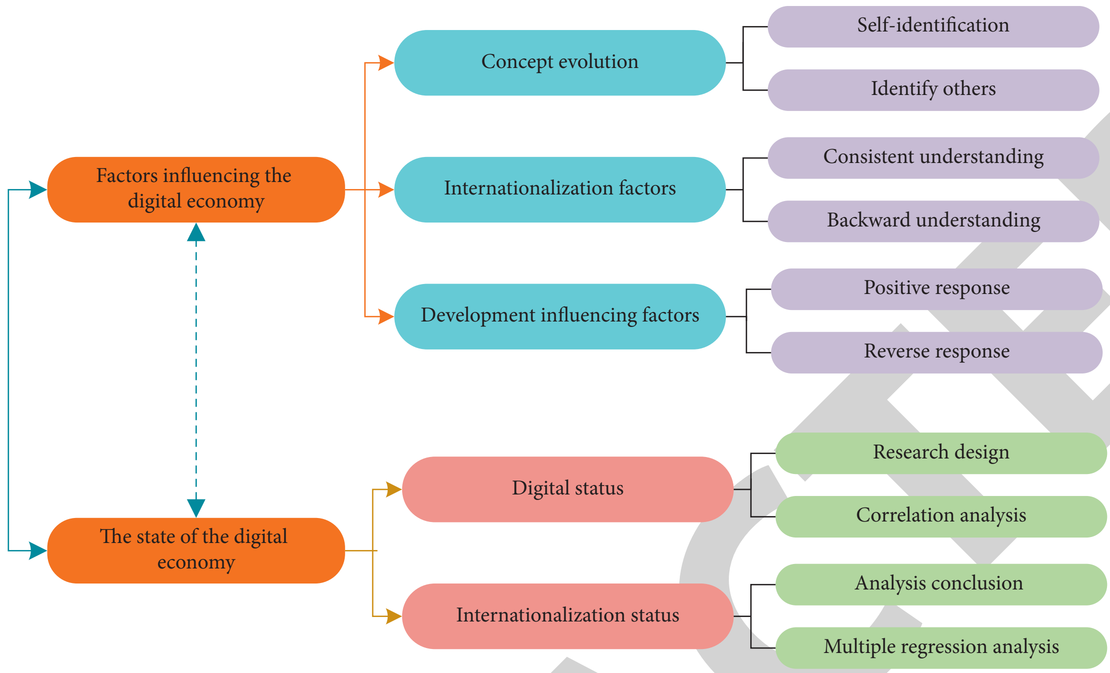

Figure 1: Schematic diagram of the digital economy research process.

ability of the digital industry, thereby bringing about the improvement of the level of the digital economy [26, 27]. Industry labor capital directly determines the level of development of the digital economy. The improvement of labor literacy is a key factor for the rapid development of the digital economy. From this point of view, human capital is also one of the important factors affecting the development of the digital economy.

Government policies are a key factor in the development of the digital economy. Government policies have created a healthy market environment and provided institutional guarantees for the development of the digital economy. In summary, the development of the digital economy is inseparable from key factors such as digital infrastructure construction, capital investment, human capital, and government policies in Jiangsu province. The previous article pointed out that the internationalization of the digital economy is directly affected by the development level of the digital economy, and these decisive factors have an indirect effect on the internationalization of the digital economy by affecting the development level of the digital economy. Therefore, based on data availability, comparability, and representativeness, this article intends to further analyze the internationalization of the digital economy in Jiangsu province from the three aspects of digital infrastructure, human capital, and government policies [28].

3.2. Research on Influencing Factors of Digital Economy Based on Fuzzy Clustering. Clustering is an unsupervised learning process. It is a process of different classifications. Classification is to label things according to specific standards and classify them according to labels. Clustering is based on the similarities between things without specific standards and labels [29]. The traditional clustering algorithm is divided according to certain criteria in the sample. The traditional clustering algorithm has a certain degree of accuracy. In order to solve the problem of uncertainty and certain ambiguity, the concept of fuzzy theory is introduced [30]. In people's practical applications, this phenomenon often occurs. Samples can belong to B or other categories to some extent. Finally, it is difficult to directly classify samples into specific categories. There are one or more standards. The clustering results often fall on the local optimal value, and the effect is not very satisfactory.

Hard C-means clustering (HCM) is a classic clustering algorithm, which is a clustering criterion algorithm based on the sum of squares of errors. The criterion of hard clustering is to seek the best value of (U, V) to satisfy the constraints [31, 32].

$$\begin{cases} v_{ij}(t+1) = v_{ij}(t) + c_1 r_1(t)\left(p_{ij}(t) - x_{ij}(t)\right) + c_2 r_2(t)\left(p_{gj}(t) - x_{ij}(t)\right), \\ m_{ij}(t+1) = m_{ij}(t) + v_{ij}(t+1). \end{cases} \tag{1}$$

The degree of membership is a basic concept of fuzzy mathematics. It is an expression describing fuzzy sets. The degree of membership can be a value in the interval [0, 1], which expresses the degree of membership relationship of element categories.

$$Q = \begin{cases} Y = a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5, \\ a_1 + a_2 + a_3 + a_4 + a_5 = 1, \\ 0 < a < 1. \end{cases} \quad (2)$$

In the fuzzy clustering algorithm, the membership degree matrix is used to obtain the maximum partition cluster, the process of calculating the cluster center and the membership degree matrix, and the final clustering result is obtained after continuous iteration [33]. The flowchart of the fuzzy clustering algorithm is shown in Figure 2.

$$Z_1 = -0.002Z_2 - 0.0869Z_3 + 1.6Z_4 + 0.385Z_5. \quad (3)$$

In analog-circuit fault diagnosis, membership function is required to diagnose each circuit state in the fault sample, and analog-circuit diagnosis is performed according to the degree of membership. The relationship between the degrees of membership can reflect the status of the diagnostic circuit, and it can also measure the accuracy of the diagnostic results [34].

$$\begin{cases} 1 \longrightarrow \\ 2 \longrightarrow \\ 3 \longrightarrow \\ \\ m \longrightarrow \end{cases} \begin{pmatrix} x_{11} & x_{12} & x_{13} & \cdots & x_{1n} \\ x_{21} & x_{22} & x_{23} & \cdots & x_{2n} \\ x_{31} & x_{32} & x_{33} & \cdots & x_{3n} \\ \vdots & \vdots & \vdots & & \vdots \\ x_{m1} & x_{m2} & x_{m3} & \cdots & x_{mn} \end{pmatrix}. \quad (4)$$

When the difference of the objective function obtained from the previous two runs is less than the given positive number, the clustering ends, and the objective function is defined as follows:

$$h_j = \frac{\sum_{r=1}^{s} u_r y_{rj0}}{\sum_{i=1}^{m} v_i x_{ij0}}. \quad (5)$$

FCM can divide data objects into categories and determine how much each data object belongs to a category.

$$\max h_{j0} = \frac{\sum_{r=1}^{n} u_r y_{rj0}}{\sum_{i=1}^{m} v_r x_{rj0}}. \quad (6)$$

Therefore, FCM algorithm is more suitable for situations with uncertainty and ambiguity. This section will introduce the algorithm in detail.

$$\text{s.t.} \begin{cases} \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1, \quad (j = 1, \ldots, n), \\ \\ v_i \geq 0, \quad (i = 1, \ldots, m), u_r \geq 0, \quad (r = 1, \ldots, s). \end{cases} \quad (7)$$

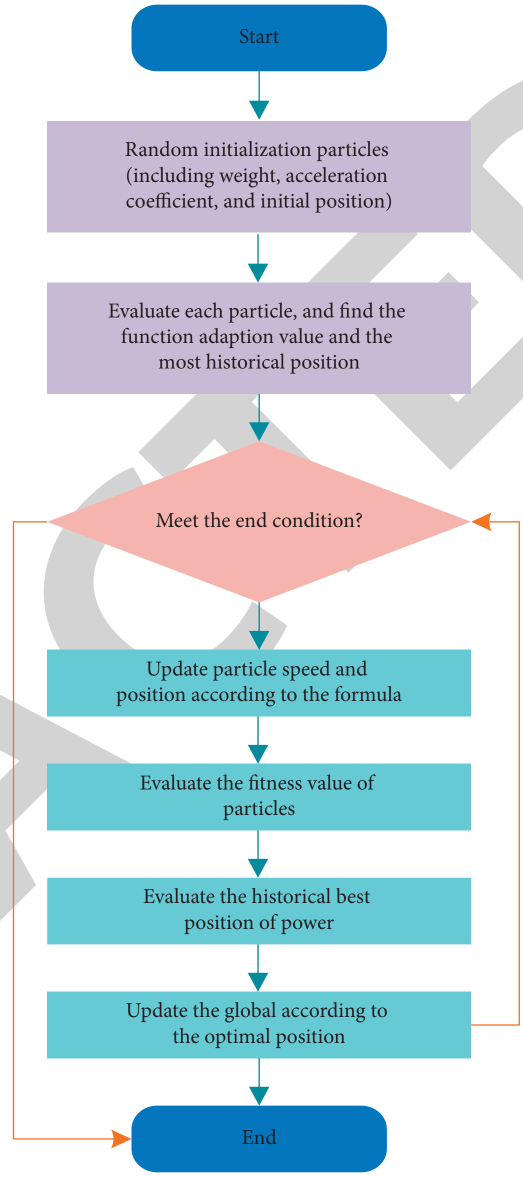

Figure 2: Flowchart of the fuzzy clustering algorithm.

CHI is a widely used clustering evaluation index, and its calculation is relatively simple. When the number of clusters is unknown, the results of CHI can be used to determine the optimal number of clusters.

$$t = \frac{1}{\sum_{i=1}^{m} v_i x_{ij}}, w_i = tv_i, \mu_r = tu_r. \quad (8)$$

CHI characterizes the separation of the dataset by calculating the sum of squared cumulative distances between the center of each cluster and the mean of the dataset and calculating the sum of squares of the cumulative distances between each point in the dataset and various centers to characterize the tightness within the class. The ratio of degree to tightness is obtained [35].

$$\min \theta$$
$$\text{st.}\begin{cases} \sum_{j=1}^{n} \lambda_j x_{ij} \le \theta x_{ij}, & (i = 1, \ldots, m), \\ \sum_{j=1}^{n} \lambda_j y_{ij} \ge y_{rj0}, & (r = 1, \ldots, m), \\ \lambda_j \ge 0, & (j = 1, \ldots, n). \end{cases} \tag{9}$$

Regarding the situation that a sample can belong to multiple categories at the same time, the existence of the degree of membership is used to reflect the degree to which the sample belongs to a certain category. Fuzzy mathematics can express the fuzzy nature of things and relationships. On this basis, a fuzzy fault diagnosis model can be constructed to enable fault diagnosis to better handle the complex relationship between fault sources and fault symptoms [36].

4. Digital Economy and Human Resources Research Case Analysis

4.1. Case Analysis. In order to accelerate the promotion of high-quality development, it is necessary to further analyze the main factors that affect the quality of digital economy development and to point out the direction for effective measures. There are many research methods on influencing factors, such as factor analysis, principal component analysis, unit root test, and Granger causality test. The sample classification of digital economy research categories is shown in Figure 3.

Based on the researched time-series data and the characteristics of the small amount of data, the fuzzy cluster analysis method is selected for the analysis of influencing factors mainly because the method can be applied to a small amount of time-series data and has a wider application field than the commonly used regression analysis. Figure 3 shows the distribution of sample areas in the digital economy research category. It is a quantitative measure of the relationship between system development and change. This method is more suitable for dynamic process analysis. Based on the similarity of trends between variables, as a way to measure the degree of correlation between variables, through descriptive statistical analysis, it is found that individual samples of the source data collected in this article that affect the development of the ICT industry have missing values and outliers. Before analyzing the data, it is necessary to filter the source data. For the treatment of missing values, it is difficult to directly observe the law of missing data from the sample data, but there is a certain quantitative relationship between variables, or the data may indeed be caused by other variables in the data file. Therefore, this article uses the regression method in the imputation method to fill in the missing values, that is, the variable with missing values is built to predict the missing values based on the existing data and the data of other variables related to it. Data distribution of sample nodes for digital economy research is shown in Figure 4.

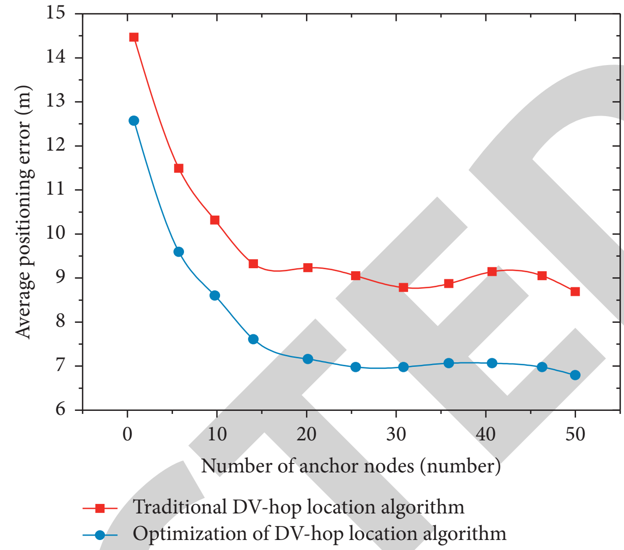

FIGURE 3: Sample classification of digital economy research categories.

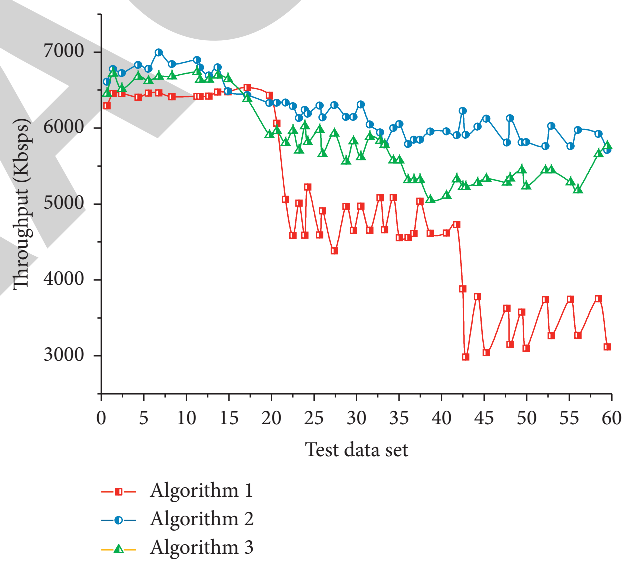

FIGURE 4: Data distribution of sample nodes for digital economy research.

The cluster center and membership matrix are calculated, and the final clustering results are obtained through continuous iteration. In the fuzzy clustering algorithm, the affiliation matrix is used to obtain the largest division clustering. In the digital economy research sample node, the membership function is required to diagnose each state in the fault sample, and the analog-circuit diagnosis is performed according to the degree of membership. The relationship between the membership degrees can reflect the diagnosis status, and it can also measure the accuracy of the diagnosis results. Figure 5 shows the number distribution of digital economy research under different conditions. Classification effects of different algorithms under similar conditions are shown in Figure 6. The performance effect of the

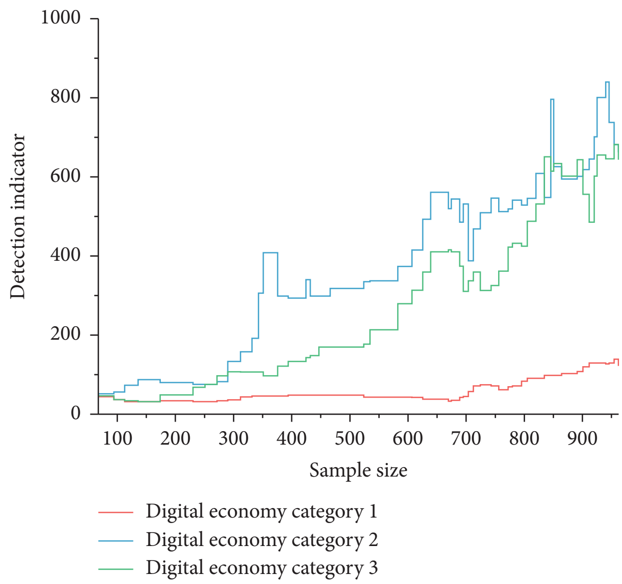

FIGURE 5: The quantitative distribution of digital economy research under different conditions.

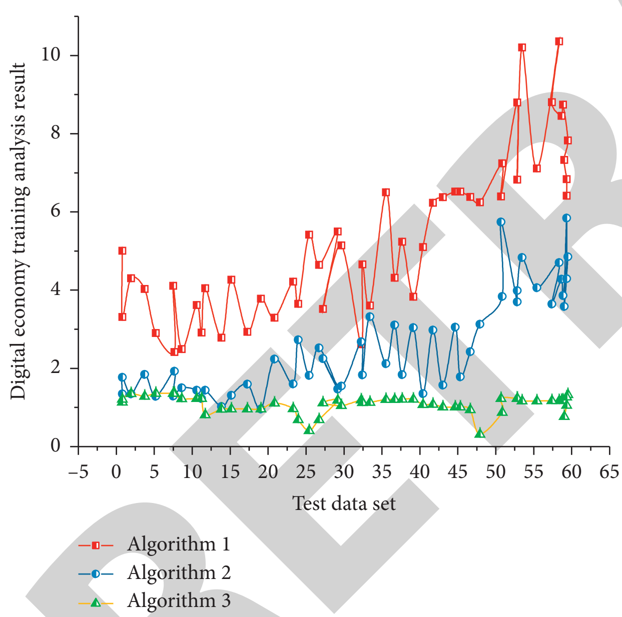

FIGURE 6: Classification effects of different algorithms under similar conditions.

fuzzy clustering method under different conditions is shown in Figure 7.

The fuzzy clustering analysis method is chosen for influence factor analysis, and it has a wider application area than the commonly used regression analysis method. This method is more suitable for dynamic process analysis. According to the similarity of development trends between variables, as a method to measure the degree of correlation between variables, it is a quantitative measure of the development and change relationship of a system. In the digital economy research sample node, the membership function is required to diagnose each state in the fault sample, and the

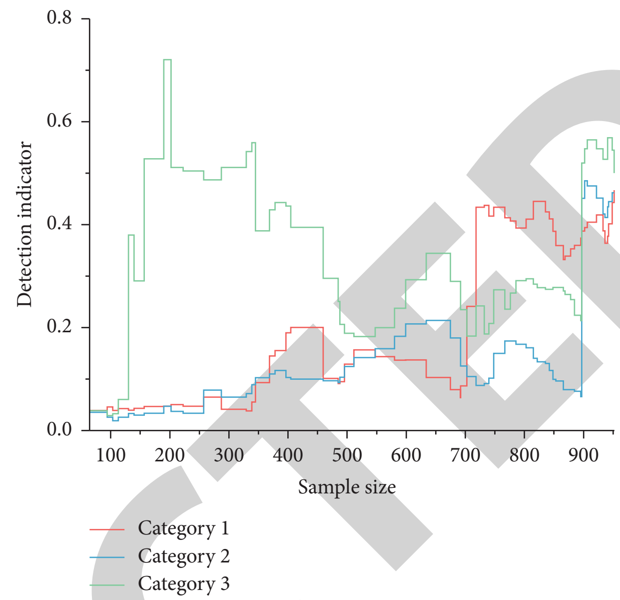

FIGURE 7: Performance effect of the fuzzy clustering method under different conditions.

analog-circuit diagnosis is performed according to the degree of membership. The relationship between the membership degrees can reflect the diagnosis status, and it can also measure the accuracy of the diagnosis results. In addition, the application of digital technologies such as artificial intelligence and cloud computing in the internet should also be popularized by the public. Big data contains great value and should be vigorously explored to realize economic value. Finally, we should find the weaknesses and shortcomings of the current development of the digital economy.

4.2. Feedback Suggestions. First of all, we must increase efforts to build information and communication infrastructure, including internet broadband lines and the number of mobile base stations, increase internet transmission capacity and speed, increase efforts to upgrade the traditional communication infrastructure, and make information and communication network transition to modern networks to ensure the development of infrastructure for the digital economy, ensure the stability of funds, appropriately increase funding sources, reduce the conditions that hinder the entry of social capital, strengthen investment so that social capital can also participate in the construction, and lay a solid foundation for the realization of an information power country and the promotion of the development of the digital economy. In addition, the application of digital technologies such as artificial intelligence and cloud computing in the internet should also be popularized by the public. Big data contains great value and should be vigorously explored to realize economic value. Finally, we should find the weaknesses and shortcomings of the current development of the digital economy. At present, some of China's key digital technologies such as cloud computing and artificial intelligence require foreign assistance. To ensure the sustainable development of the digital economy, it is necessary to prioritize the development of backward areas, such as operating systems and chips. We have seen that Huawei has independently developed chips and operating systems and is speeding up its pace to catch up with developed countries in the digital economy.

5. Conclusion

The construction of digital infrastructure and the advancement of information technology are currently the key factors that restrict the quality of digital economy development. In the future, we should continue to increase the digital infrastructure construction in backward areas, accelerate the innovation and promotion and application of new-generation digital technologies, accelerate the pace of digital innovation, and improve the level of digital technology applications in backward areas. Strengthening the basic research of digital technology, improving the original innovation ability, and promoting the transformation of scientific and technological achievements will help accelerate the conversion of new and old power and high-efficiency development. At the same time, we will strengthen the training of digital technology talents and consolidate the talent guarantee for the development of the digital economy. The internationalization of the digital economy is an important part of the development stage of the digital economy. How to improve the internationalization level of the digital economy, promote the international competitiveness of digital enterprises, and accelerate the pace of digital enterprises to "go global" has become an urgent need in the current digital economy research field problems solved. Aiming at the current deficiencies in the development of digital economy, this paper combines edge computing and fuzzy clustering technology to carry out research on digital economy and human resources. The research is helpful for the development of the analysis of digital economy and human resources.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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