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Retraction

Retracted: Application of Software Data Analysis Model Based on K-Means Clustering Algorithm

Security and Communication Networks

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets 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 own 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] W. Qiu, "Application of Software Data Analysis Model Based on K-Means Clustering Algorithm," *Security and Communication Networks*, vol. 2022, Article ID 4505814, 7 pages, 2022.

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Research Article

Application of Software Data Analysis Model Based on K-Means Clustering Algorithm

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In order to improve the anomaly detection ability of portable multidimensional control software test data, a software test data anomaly detection method based on K-means clustering is proposed. The abnormal data distribution structure model of portable multidimensional control software testing is constructed. The fuzzy semantic feature reconstruction method is adopted to identify the fuzzy parameters of portable multidimensional control software and extract the feature quantity of associated information. According to the evolution distribution of associated features, the joint combination feature analysis method is adopted to realize the fuzzy clustering center detection of abnormal data of portable multidimensional control software test, and the fusion of abnormal feature distribution is carried out to complete the joint multidimensional feature detection. The K-means clustering method is used for effective data combination control in portable multidimensional control software to extract and detect abnormal features of test data in portable multidimensional control software. Experimental results show that the accuracy of anomaly detection of software test data by the proposed method is always greater than 0.8. *Conclusion*. Using this method to detect abnormal data of portable multidimensional control software test has higher accuracy and better detection performance.

1. Introduction

Computer software is an important part of the information industry and plays a vital role in the national economy, social development, and national defense construction. Its reliability has always been the focus of academic and industrial circles. One of the important ways to improve the quality of the software is to carry out a lot of testing before the software is put into use and discover the defects and even errors in time. Software testing includes many links, such as generating test data, executing the software under test, and evaluating test results [1].

With the increasing scale and complexity of software, the possibility of defects or errors in software gradually increases. On the other hand, people's requirements for software quality are also increasing. Therefore, software testing costs more and more manpower and material resources. The efficiency of software testing can be greatly improved, and the cost of software testing can be reduced if each link of testing can be automated.

According to the different stages of software development, software testing can be divided into unit testing, integration testing, confirmation testing, and system testing [2]. The unit test mainly tests the correctness of the smallest component unit (module) of the program. The integration test will assemble the modules that have passed the unit test and then test the architecture of the assembled modules. The confirmation test mainly checks whether the finished software can complete various functions specified in requirements and specifications and whether the software configuration is correct [3]. The system test puts the software that has completed the confirmation test into the actual running environment and combines it with other systems for testing.

2. Literature Review

With the continuous development of software technology, software testing technology has also been paid attention to. Besides, software testing ideas, testing methods, and testing tools have made great progress. Especially since the beginning of the century, the evaluation of software testing has a certain quantitative standard, and software measurement technology began to get attention. Kotsareva et al. designed the method of process measurement management and pointed out that responsible software development companies need to measure the software testing process [4]. Tochino et al. put forward a software measurement method, scientifically organize the whole process of the software, and also put forward a method that can be used for many times [5]. Ferrer et al. proposed a goal-driven model. This goal-driven model is different from the traditional object-oriented method but adopts the goal-oriented method, combines the software goal with the whole development process and product quality, and measures it step by step. This top-down approach to goal quality definition makes the measurement of the entire software comprehensive and straightforward [6]. Strandberg et al. proposed a method of abnormal feature mining and feature detection for portable multidimensional control software testing based on particle swarm evolutionary optimization control. The fuzzy C-means clustering method is used to mine the abnormal data of portable multidimensional control software testing. Combined with the detection of fuzziness, the abnormal classification and identification of portable multidimensional control software testing are realized. However, this method has a large computational load for the abnormal detection of portable multidimensional control software testing [7]. Dang et al. proposed an anomaly detection method for portable multidimensional control software testing based on fusion scheduling of multisource information resources as a service (MIRaaS). A fuzzy decision algorithm was used to detect abnormal data in portable multidimensional control software testing. The fuzzy detection of this method is not good, and the mining accuracy of abnormal test data is not high [8]. To solve the above problems, this paper proposes a software test data anomaly detection method based on K-means clustering. First, the abnormal data distribution structure model of portable multidimensional control software test data is built, and the abnormal feature distribution fusion model of portable multidimensional control software test data is established. Then, joint multidimensional feature detection is used to realize fuzzy weight analysis and adaptive learning of the test data of portable multidimensional control software, and the K-means clustering method is used to implement effective data combination control in portable multidimensional control software to realize abnormal feature detection. Finally, the reliability and superiority of the proposed method in improving the abnormal detection ability of portable multidimensional control software testing are demonstrated by simulation test analysis.

3. The Research Methods

3.1. Portable Multidimensional Control Software Testing Anomaly Data Mining and Distribution Structure

3.1.1. Portable Multidimensional Control Software Testing Anomaly Data Mining. In order to detect and mine abnormal data of portable multidimensional control software testing, a feature extraction model of portable multidimensional control software testing was established. The constraint feature quantity reflecting the security level of portable multidimensional control software was constructed, the fuzzy degree of portable multidimensional control software test was detected by combining linear programming and interpolation fitting method, and the overall structural model of portable multidimensional control software test anomaly detection was obtained [9, 10], as shown in Figure 1.

According to the overall structure model in Figure 1, information fusion and process combination control of portable multidimensional control software testing are carried out. The time distribution sequence of the portable multidimensional control software test was carried out in heterogeneous space, and the semantic search method was adopted to obtain the text distribution sequence of the portable multidimensional control software test as follows (1) [11]:

$$
\begin{aligned}
E(a_1, a_2) = {} & \alpha \cdot L(A) + \beta \cdot Y(B(A)) \\
& + \gamma_1 \int_{B(G)} \left|Q - a_1\right|^2 \mathrm{d}x\mathrm{d}y \\
& + \gamma_2 \int_{B(G)} \left|Q - a_2\right|^2 \mathrm{d}x\mathrm{d}y,
\end{aligned}
\tag{1}
$$

where a_1 and a_2, respectively, denote portable multidimensional control software testing data matching coefficient, a_1 denotes the average detection coefficient, coefficient a_2 for the fuzzy degree of detection, $L(A)$ denotes portable multidimensional control the length of the abnormal distribution of software testing, $Y(B(A))$ denotes the distribution features of the software test cases, α for portable multidimensional control coefficient, β is the rough matching set, γ_1 is the one-dimensional joint feature component, γ_2 is the two-dimensional joint feature component, and Q is the weighted component of abnormal data.

Let the membership function at the joint detection node K of the current portable multidimensional control software test data be denoted as $K = \langle K_1, K_2, K_3, \ldots, K_n \rangle$. The spatial distribution sequence of metadata of portable multidimensional control software test data is $\{r_1, r_2, \ldots, r_n\}$, (C, H) is the correlation constraint function of portable multidimensional control software test [12], and the information correlation degree of portable multidimensional control software test is obtained as follows:

$$
\begin{aligned}
C_K &= \frac{(1/\lambda)\sum_{i=0}^{\lambda+1}\left[g_h(e_h - i) - \vartheta\right]^2}{\left((1/\lambda)\sum_{i=0}^{\lambda+1}\left[g_h(e_h - i) - \vartheta\right]^2\right)^{(1/2)}}, \\
H_K &= \frac{(1/\lambda)\sum_{i=0}^{\lambda+1}\left[g_h(e_h - i) - \vartheta\right]^3}{\left((1/\lambda)\sum_{i=0}^{\lambda+1}\left[g_h(e_h - i) - \vartheta\right]^2\right)^{2}},
\end{aligned}
\tag{2}
$$

where λ is the sample category parameter, g_h is the prior feature quantity of the detected data, e_h is the fuzzy sample distribution set, i is the length of the data distribution, and ϑ is the dimension of multidimensional control. Based on the above analysis, the abnormal data mining model of portable multidimensional control software testing is constructed,

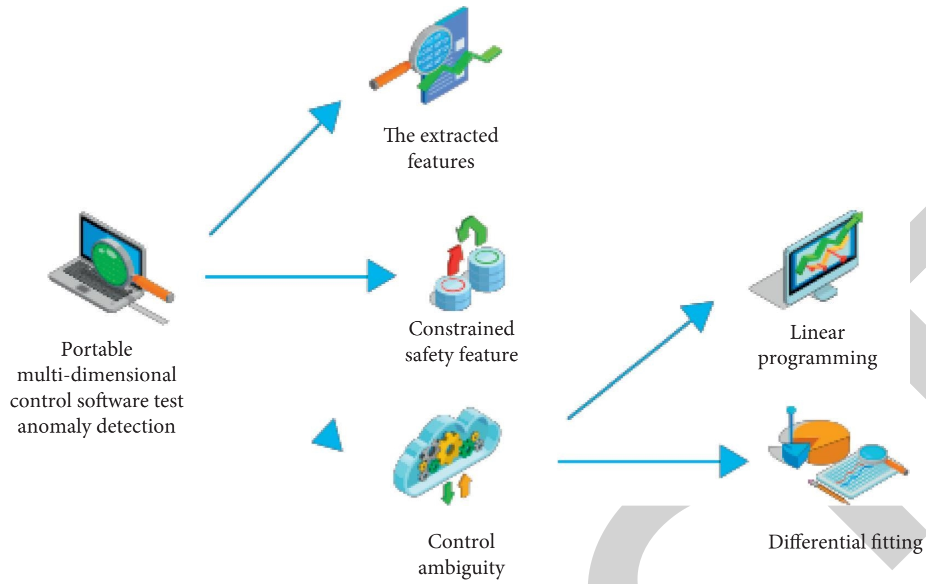

Figure 1: Overall structure model of anomaly detection for portable multidimensional control software testing.

and the abnormal characteristics analysis of portable multidimensional control software testing is realized based on spatial information fusion [13].

3.1.2. Portable Multidimensional Control Software Test Anomaly Feature Location. Fuzzy parameter identification of portable multidimensional control software is carried out by using the fuzzy semantic feature reconstruction method, and the feature quantity of associated information of data in portable multidimensional control software is extracted. The difference degree function of fuzzy semantic feature reconstruction is expressed as follows (3) [14]:

$$Z = \frac{3\sqrt{U}}{dh}\cos i(\mu f(c)) \times \sum_{i=1}^{h+1} c_i \sin\left[\frac{1}{2}\mu f(c)\left(a_3 h + i + \frac{1}{2}\right) + \omega\right], \quad (3)$$

where d is the change information of program modules, h is the distribution length of abnormal data of portable multidimensional control software, μ is the gradient information component, $f(c)$ is the combined parameter of project metadata, U is the edge feature set, a_3 is the defect report parameter, and ω is the correlation coefficient of program modules. Through the correlation and fusion control of defect report and program module, the spatial combination function of abnormal feature distribution of transplanted multidimensional control software test can be obtained as follows:

$$f(l) = v(f_1(t), f_2(t), \ldots, f_n(t)) \prod_{i=1}^{3} f(t_i) = (2\delta)^2 \left|\sum\right|^{(1/4)} \exp\left[\frac{1}{4}(f(t)-\delta)\sum^{(1/4)}(f(t)-\delta)\right]\prod_{i=1}^{3} f(t_i). \quad (4)$$

In $f(t) = (f_1(t), f_2(t), \ldots, f_n(t))$, which is the standardized quantitative parameter set of defect report, v is the special characters removed from the anomaly test, $f(t)$ is the degree of connection between words, $f(t_i)$ is the template detection coefficient, $f(t_i)$ is the defect class function. Semantic attribute distribution detection and generalization learning algorithm are adopted to conduct the association information fusion of portable multidimensional control software test. If $F_k \in Z$ is A repeated or similar defect parameter, the following results can be obtained:

$$W = O(T < W_i < \sigma T) = f(p)(\sigma T)^2 + f(p)(T)^2, \quad (5)$$

where O is the text similarity of the defect report, W_i is the text ambiguity of the defect report, $f(p)$ is the fitness function, σ is the number of shared words, T is the fuzzy test component. (F_k, H_k) and (F_1, H_1) are set as abnormal feature quantities of portable multidimensional control software test data, and the K-means algorithm is used to realize detection optimization of abnormal test data [15].

3.1.3. K-Means Algorithm. The clustering algorithm is a kind of unsupervised machine learning algorithm. According to the similarity between texts, a kind of text with high similarity is aggregated into the same cluster according to certain rules, and finally, the set of these clusters is obtained.

K-means algorithm, proposed by Stuart Lloyd [16], is a classic clustering algorithm based on partition and is widely used in the field of text clustering. The basic principle of the K-means algorithm is to select several texts from the data set as the initial clustering center, calculate the distance between each data and the clustering center, assign them to the nearest cluster, then recalculate the center of the cluster, and iterate the above process until the criterion function converges or reaches the maximum number of iterations.

The K-means algorithm is simple. And its calculation speed is fast. The clustering effect is also good, but there are also some obvious defects: the initial clustering centers need to be given in advance, but before the clustering result is completed, it is difficult to estimate the appropriate number and configuration of clustering centers. If an inappropriate initial object is selected, not only the efficiency of the algorithm will be greatly affected but also the clustering effect will be affected.

The basic idea of the K-means algorithm [17] is to give a data set containing sample data and give the number of clustering. First, select randomly: then, according to the similarity measurement function, the iterative method is adopted to calculate the distance between the undivided sample data and the center point of each cluster and divide the sample data into the cluster where the nearest cluster center is located. For each allocated cluster, by calculating the average value of all data in the cluster, the cluster is constantly moved and redivided until the sum of squares of errors within the cluster is minimum, and there is no change. The algorithm has a feature that each iteration should judge whether each sample data are correctly divided into clusters. If not, it will be readjusted. After all the data are adjusted, the cluster class center is modified for the next iteration calculation. If each data sample is assigned to the correct class during an iteration, the clustering center will not be adjusted. The clustering center is stable and no longer changes, indicating that the objective function converges, and the algorithm ends. Finally, the clustering result is evaluated [18]. K-means clustering algorithm flow chart is shown in Figure 2.

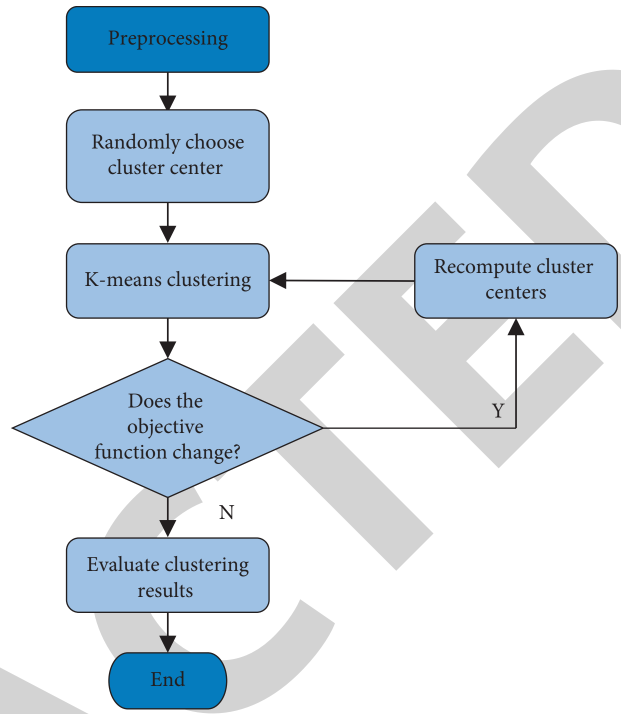

Figure 2: Flow chart of K-means clustering algorithm.

3.2. Optimization of Abnormal Detection for Portable Multidimensional Control Software Testing

3.2.1. Feature Clustering for Portable Multidimensional Control Software Testing. According to the evolution distribution of association features, the joint combination feature analysis method is adopted to realize the fuzzy clustering center detection of abnormal data of portable multidimensional control software testing, build the clustering model of abnormal data of portable multidimensional control software testing, and obtain the item set of big data distribution association rules of portable multidimensional control software testing as shown in the following formula:

$$M = W\left(f(z_1) + f(z_2) + \cdots + f(z_n) \geq T\right) = \int\int_{Z\geq T}\cdots\int f(p_1, p_2, \ldots, p_n)\frac{1}{2}\lambda_1 Z(hf(t)) + \omega, \tag{6}$$

where $f(z_1) + f(z_2) + \cdots + f(z_n)$ for portable multidimensional control software testing coefficient of feature point sampling time window, $f(p_1, p_2, \ldots, p_n)$ denote time matching function. Combined with the method of text similarity and stack trace similarity detection, the statistical information distribution of the portable multidimensional control software test was obtained, and the abnormal data detection function of the portable multidimensional control software test was obtained as shown in the following formula:

$$f(n) = T^i + 10\exp\left(0.5\sqrt{\frac{1}{S_x}\sum_{d=1}^{3}H_d}\right) + \exp\left(\frac{1}{b}\sum_{d=1}^{3}\sin\left(\frac{1}{2}H_d\right)\right), \tag{7}$$

where T^i is the classification domain value of portable multidimensional control software testing fuzzy clustering, b is anomaly detection offset coefficient, S_x is text similarity, H_d is stack control coefficient. According to the difference degree between program module d and program module e, the output of feature clustering to portable multidimensional control software test is shown in the following formula:

$$J = \sum_{j=1}^{3}\frac{j_k}{2}\ln\left(1 + j_p\right) - \sum_{i=1}^{3}e_i g_i, \tag{8}$$

where j_k is the probability density function of spectrum feature alignment of portable multidimensional control software test, and j_p is the probability density function of abnormal detection of portable multidimensional control software test. Therefore, joint multidimensional feature detection is adopted to realize fuzzy weight analysis and adaptive learning for test data of portable multidimensional control software [19], and the K-means clustering method is adopted to carry out effective data combination control in portable multidimensional control software.

3.2.2. Anomaly Detection Output. The feature extraction model of portable multidimensional control software testing is established to improve the abnormal analysis ability of portable multidimensional control software testing. The discriminant function of abnormal data detection of portable multidimensional control software testing in the random vector distribution space is shown in the following formula:

$$f(a) = \hat{f}_j f(j_k) = W + \frac{1}{2}\ln(1 + x_t I_k) + f(m), \tag{9}$$

where $\hat{f}_j$ represents the observation sequence of abnormal data flow of portable multidimensional control software test, x_t is the normalized error, $f(m)$ is the fuzzy membership function, and I_k is the joint error of abnormal clustering distribution of portable multidimensional control software test data.

In the complex defects program module, portable multidimensional control of software test data under the abnormal distribution difference function is of the following type:

$$f(h) = \sum_{y=1} (y_a + y_b) M\left(x^i, x^k\right) - \zeta, \tag{10}$$

where y_a and y_b are the boundary coefficient and template coefficient detected by test data of portable multidimensional control software, $M(x^i, x^k)$ is the ratio of defect repair times to defect repair values of all files, and ζ is the anomaly detection threshold. According to the test feature extraction results of portable multidimensional control software, the distributed attribute fusion of portable multidimensional control software test is carried out, and the training sample set of detection function is obtained as $\{(a_1, b_1), (a_2, b_2), \ldots, (a_n, b_n)\}$. Through semantic ontology fusion, the heterogeneous function of portable multidimensional control software test data K-means clustering is obtained as the following formula:

$$\min \sum_{j=1} \frac{f(p)\psi_j}{f(n)\tau_j}, \tag{11}$$

where ψ_j and τ_j denote portable multidimensional control software testing anomaly detection of confidence level and convolution, based on the analysis of the K-means clustering method of the portable multidimensional control software of data combination control effectively [20], realize portable multidimensional abnormal control software testing data of feature extraction and detection, and measuring process is shown in Figure 3.

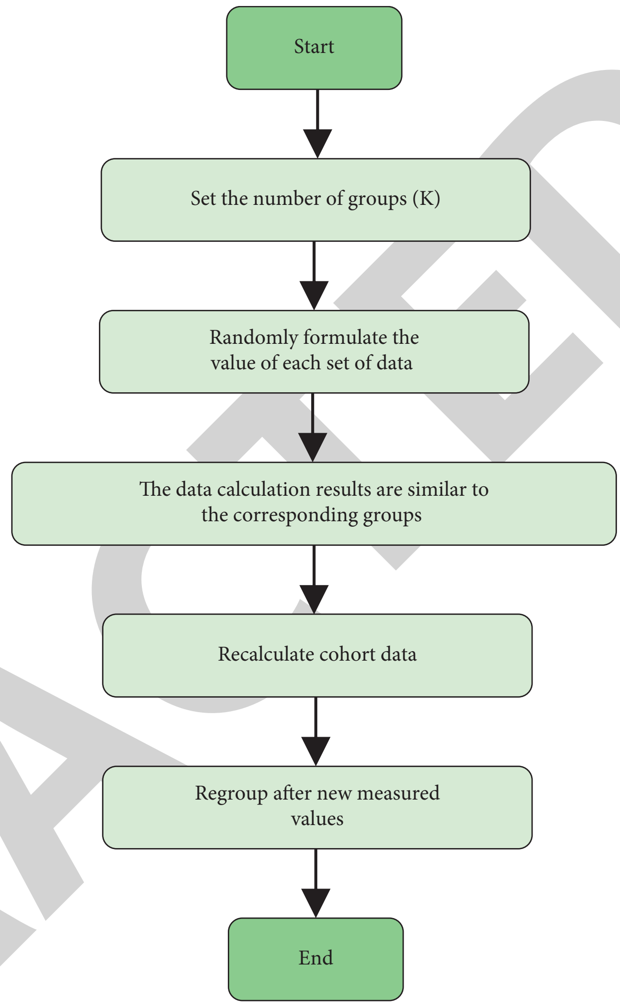

Figure 3: Portable multidimensional control software testing process.

4. Results Analysis

Matlab 7 simulation experiment was used to verify the application performance of the proposed method in realizing the abnormal detection of portable multidimensional control software testing. The parameters of abnormal feature detection of portable multidimensional control software testing were set as 1400, the sequence length of the training set was 400, and the fuzzy matching coefficient was 0.35 [21]. Related parameter settings are shown in Table 1.

According to the above simulation parameter setting, the test anomaly detection of the portable multidimensional control software is carried out, and the detection sequence distribution of original test data is obtained.

Taking the detection sequence of original test data as the research object, the abnormal feature detection of test data of portable multidimensional control software is realized, and the detection results are shown in Figure 4.

Analysis of Figure 4 shows that the method in this paper can effectively detect abnormal characteristics of test data of portable multidimensional control software. The accuracy of abnormal detection of test data of portable multidimensional control software by different methods is tested, and the comparison results are shown in Figure 5. Analysis shows that the method presented in this paper has higher accuracy in anomaly detection of software test data, all of which are greater than 0.8.

Table 1: Parameter setting of abnormal distribution in portable multidimensional control software test.

Detection	Match the sparse	The sparse degree	Semantic relevance	Combined statistical characteristic quantity
Sample set 1	0.168	0.378	0.498	0.044
Sample set 2	0.175	0.389	0.502	0.046
Sample set 3	0.143	0.366	0.497	0.058
Sample set 4	0.169	0.378	0.485	0.048
Sample set 5	0.143	0.386	0.501	0.049
Sample set 6	0.147	0.378	0.526	0.058
Sample set 7	0.155	0.391	0.523	0.052
Sample set 8	0.141	0.379	0.502	0.048
Sample set 9	0.148	0.378	0.498	0.046
Sample set 10	0.138	0.379	0.499	0.053
Sample set 11	0.137	0.389	0.498	0.046
Sample set 12	0.128	0.397	0.518	0.051
Sample set 13	0.147	0.377	0.502	0.046
Sample set 14	0.142	0.385	0.500	0.047

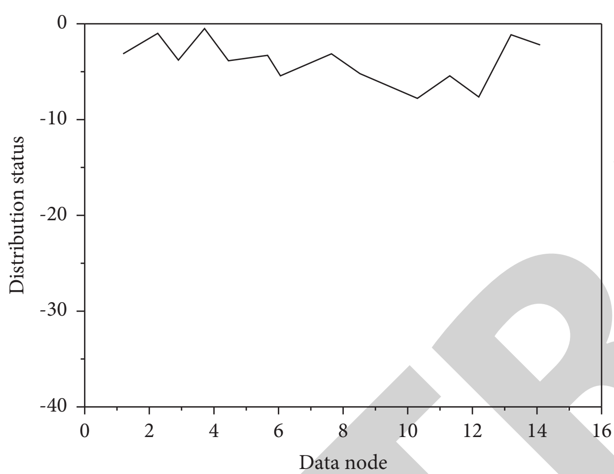

Figure 4: Anomaly detection results.

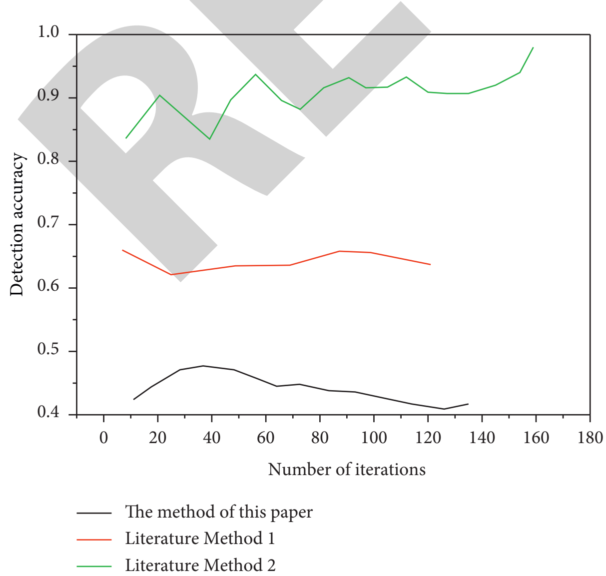

Figure 5: Comparison test of detection accuracy.

5. Conclusion

The operation reliability analysis model of portable multidimensional control software was established to improve the abnormal feature analysis and detection ability of portable multidimensional control software, and a software test data anomaly detection method based on K-means clustering was proposed. The constraint feature quantity reflecting the security level of portable multidimensional control software was constructed, and the fuzzy degree testing of portable multidimensional control software was carried out by combining linear programming and interpolation fitting methods [22]. The K-means clustering method is used for effective data combination control in portable multidimensional control software to extract and detect abnormal features of test data in portable multidimensional control software. Analysis shows that the method presented in this article has high accuracy in detecting abnormal data of portable multidimensional control software testing.

Aiming at the establishment of a software quality measurement framework, the relevant theoretical research is carried out. First, starting from software quality assurance, the test case design method is described, and the possibility of errors and risk cost analysis in the software test design process are analyzed. Analysis shows that the method presented in this paper has high accuracy in detecting abnormal data of portable multidimensional control software testing.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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References

[1] H. Luo, X. Wang, Z. Xu, C. Liu, and J. S. Pan, "A software-defined multi-modal wireless sensor network for ocean monitoring," *International Journal of Distributed Sensor Networks*, vol. 18, no. 1, pp. 28–34, 2022.

[2] M. Privalov, N. Beisemann, J. E. Barbari et al., "Software-based method for automated segmentation and measurement of wounds on photographs using mask r-cnn: a validation study," *Journal of Digital Imaging*, vol. 34, no. 4, pp. 788–797, 2021.

[3] Y. Palopak and S. J. Huang, "Correlation of agile principles and practices to software project performance: an AHP-delphi analysis," *International Journal of Software Engineering and Knowledge Engineering*, vol. 32, no. 2, pp. 257–281, 2022.

[4] A. V. Kotsarev, M. P. Lizorkin, and B. E. Shumskiy, "Results of the athlet/bipr-vver software system (version 1.0) certification/ergebnisse der zertifizierung des softwaresystems athlet/bipr-vver (version 1.0)," *Kerntechnik*, vol. 85, no. 5, pp. 387–396, 2020.

[5] T. Tochino, K. Nishimoto, K. Asaka, J. I. Kani, and J. Terada, "Redesigned tdm-pon system architecture based on point-to-point ethernet transmission and software processing with general-purpose hardware," *Journal of Lightwave Technology*, vol. 39, no. 2, pp. 448–457, 2021.

[6] J. Ferrer, F. Chicano, and J. A. Ortega-Toro, "Cmsa algorithm for solving the prioritized pairwise test data generation problem in software product lines," *Journal of Heuristics*, vol. 27, pp. 229–249, 2020.

[7] P. E. Strandberg, W. Afzal, and D. Sundmark, "Software test results exploration and visualization with continuous integration and nightly testing," *International Journal on Software Tools for Technology Transfer*, vol. 24, no. 2, pp. 261–285, 2022.

[8] X. Dang, X. Yao, D. Gong, and T. Tian, "Efficiently generating test data to kill stubborn mutants by dynamically reducing the search domain," *IEEE Transactions on Reliability*, vol. 69, no. 1, pp. 334–348, 2020.

[9] C. Coviello, S. Romano, G. Scanniello, and G. Antoniol, "Gasser: a multi-objective evolutionary approach for test suite reduction," *International Journal of Software Engineering and Knowledge Engineering*, vol. 32, no. 2, pp. 193–225, 2022.

[10] C. Magalhes, A. Mota, and L. Momente, "Ui test case prioritization on an industrial setting: a search for the best criteria," *Software Quality Journal*, vol. 29, no. 5, pp. 1–23, 2021.

[11] A. Kushwaha, S. Sharma, N. Bazard, A. Gumaste, and B. Mukherjee, "Design, analysis, and a terabit implementation of a source-routing-based sdn data plane," *IEEE Systems Journal*, vol. 15, no. 1, pp. 56–67, 2020.

[12] M. L. Gillenson, T. F. Stafford, X. P. Zhang, and S. Shi, "Use of qualitative research to generate a function for finding the unit cost of software test cases," *Journal of Database Management*, vol. 31, no. 2, pp. 42–63, 2020.

[13] X. Lin and J. Xu, "Road network partitioning method based on canopy-kmeans clustering algorithm," *Archives of Transport*, vol. 54, no. 2, pp. 95–106, 2020.

[14] H. Yang, H. Peng, J. Zhu, and F. Nie, "Co-clustering ensemble based on bilateral K-means algorithm," *IEEE Access*, vol. 8, Article ID 51285, 2020.

[15] I. Nurlaila, W. Irawati, K. Purwandari, and B. Pardamean, "K-means clustering model to discriminate copper-resistant bacteria as bioremediation agents," *Procedia Computer Science*, vol. 179, no. 21, pp. 804–812, 2021.

[16] Q. Zhang, "Relay vibration protection simulation experimental platform based on signal reconstruction of MATLAB software," *Nonlinear Engineering*, vol. 10, no. 1, pp. 461–468, 2021.

[17] R. Huang, "Framework for a smart adult education environment," *World Transactions on Engineering and Technology Education*, vol. 13, no. 4, pp. 637–641, 2015.

[18] X. Liu, J. Liu, J. Chen, F. Zhong, and C. Ma, "Study on treatment of printing and dyeing waste gas in the atmosphere with Ce-Mn/GF catalyst," *Arabian Journal of sciences*, vol. 14, no. 8, pp. 1–6, 2021.

[19] M. Raj, P. Manimegalai, P. Ajay, and J. Amose, "Lipid data acquisition for devices treatment of coronary diseases health stuff on the internet of medical things," *Journal of Physics: Conference Series*, vol. 1937, Article ID 12038, 2021.

[20] A. Sharma and R. Kumar, "A Framework for Pre-computated Multi-Constrained Quickest QoS Path Algorithm," 2017.

[21] P. Cichosz, "Unsupervised modeling anomaly detection in discussion forums posts using global vectors for text representation," *Natural Language Engineering*, vol. 26, no. 5, pp. 1–28, 2020.

[22] D. Liu, H. Zhen, D. Kong, X. Chen, and H. Wang, "Sensors anomaly detection of industrial internet of things based on isolated forest algorithm and data compression," *Scientific Programming*, vol. 2021, no. 1, Article ID 6699313, pp. 1–9, 2021.