Lightweight IT Operation and Maintenance Integrated Monitoring Method for APP System

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Abstract. Through the operation and maintenance system, the centralized control of the operation state of enterprise equipment can be realized. In order to solve the problem of unstable monitoring effect of traditional methods, untimely risk early warning and high error rate of early warning information, a lightweight IT operation and maintenance integrated monitoring method for APP system is proposed. Analyze the actual needs of the monitoring function of the lightweight IT operation and maintenance system, design a targeted IT operation and maintenance monitoring function module according to the analysis results, and give the lightweight IT operation and maintenance process. A lightweight IT operation and maintenance database is established based on fuzzy theory, and data with similar characteristics is simulated to minimize the dispersion of sample data. Finally, in order to achieve integrated monitoring of lightweight IT operation and maintenance, and to improve monitoring efficiency and monitoring accuracy, it is necessary to reduce the dimensionality of multi-dimensional data, which is mainly achieved through principal component analysis. The experimental results show that compared with the traditional method, the method in this paper can obtain accurate early warning information in time in monitoring, indicating that its monitoring effect is better, and it has a certain positive effect on ensuring the safe operation of the IT operation and maintenance system.

1. Introduction
The operation and maintenance system can effectively control related equipment in various industries, such as network equipment, power equipment, monitoring equipment and other IT equipment for maintenance and control [1], through the operation and maintenance system, centralized control of the operation status of enterprise equipment can be realized, to achieve unified management, once a problem occurs in a certain link, it can be dealt with in time [2,3]. The traditional operation and maintenance monitoring means mainly rely on manual implementation, and the fault identification and location are realized through manual inspection. However, due to the reasons of manual technology, the operation and maintenance monitoring effect is poor, and it will consume a lot of human, material and financial resources, so the manual monitoring does not have a certain ductility [4]. Under the above background, it is necessary to study an intelligent method to effectively monitor it operation and maintenance problems and improve the effectiveness of operation and maintenance [5].

In view of the shortcomings of manual monitoring, experts in related research fields have conducted in-depth research on IT operation and maintenance management issues, and have obtained certain research results, which have played a certain reference role for operation and maintenance work. Reference [6] designed a software operation and maintenance monitoring system. First, the characteristics of the monitoring system were analyzed, and the system architecture was designed.
according to the analysis results. Analyze the specific implementation plan of the system according to the function of each module in the system, and under the interaction of each module, improve the safety of the system, and then improve the level of system monitoring. Experimental verification shows that the system can ensure the safe operation of software operation and maintenance, but when there are certain interference conditions, the monitoring effect is unstable. Reference [7] designed an IT operation and maintenance management system based on Fiori. From the aspects of improving the level of refined management, improving user service experience and timely warning capabilities, the IT operation and maintenance management system was designed, which not only can improve operation maintenance management efficiency can also meet user experience requirements, and is suitable for application in the field of refined IT operation and maintenance management. However, the system also has some problems, such as untimely risk warning and poor stability, which affect the management effect. In addition, some relevant researchers have proposed a cloud network integrated operation and maintenance monitoring system for operators. The system focuses on the system architecture design, function module deployment, system capacity estimation and other aspects, and designs a monitoring system integrating scene monitoring, data analysis and business processing to provide guarantee for cloud network integrated operation and maintenance. The experimental analysis shows that the system has the advantage of large capacity and can monitor multiple objects and targets at the same time. However, when there is a problem in a certain link, there is a certain error in the early warning information of the system, which will affect the emergency treatment effect.

Although the existing methods have made some contributions in operation and maintenance monitoring, there are still some problems, such as unstable monitoring effect, untimely risk early warning and high error rate of early warning information. Aiming at the above problems, a lightweight IT operation and maintenance integrated monitoring method for app system is proposed.

2. Analysis of lightweight IT operation and maintenance system

2.1. Monitoring function requirements of lightweight IT operation and maintenance system

With the continuous improvement of Internet technology and computer performance, the applicability of IT systems has been improved, which has attracted a certain degree of attention. In this context, the integrated monitoring of IT operation and maintenance systems is currently urgently needed. Through operation and maintenance monitoring, the operation effect of the IT system is improved, the probability of risks in the operation of the system is reduced, and the stable operation of the system is guaranteed [8]. Lightweight IT operation and maintenance systems can be oriented to a variety of objects, such as substations, communication networks, power systems, etc. This article is mainly for APP systems to study lightweight IT operation and maintenance monitoring issues, so as to improve the performance and operational effects of IT systems, and build a Lightweight, safe and efficient operation and maintenance system provides reference [9]. First, analyze the monitoring function requirements of the lightweight IT system:

The requirements for the integrated monitoring function of lightweight IT operation and maintenance for the APP system can be mainly divided into two categories: on the one hand, the monitoring of the equipment belongs to the underlying monitoring function; on the other hand, the user can log in to the various functional modules of the system on the page, viewing and configuration functions belong to user application requirements [10]. Under the above two levels of functional requirements, this article combines the monitoring requirements of relevant operation and maintenance personnel, and specifically divides the requirements of the lightweight IT operation and maintenance integrated monitoring function for the APP system into the following categories:

(1) First, starting from the basic requirements of APP system operation and maintenance monitoring, real-time monitoring of memory capacity, traffic monitoring, resource utilization and other content;

(2) Since the APP system will contain various APPs, a large amount of data will be generated under the conditions of joint operation. Therefore, a database for the APP system must be established to
transmit, store, and collect the data generated during the operation. In response to this problem, it is necessary to ensure the space utilization rate and data integrity of the database during the operation and maintenance process;

(3) For business monitoring in the APP system, including data exchange, administrator authority setting and IT operation and maintenance personnel work monitoring, etc.

2.2. *IT operation and maintenance monitoring function module design*

According to the lightweight IT operation and maintenance integrated monitoring function requirements for APP system analyzed in Section 2.1, the IT operation and maintenance monitoring function module is designed. Since the monitoring function mainly targets two types of objects, namely administrators and operation and maintenance personnel [11], the targeted monitoring function module is designed by analyzing the role characteristics and permissions of different objects, it is shown in Figure 1.

![Figure 1 IT operation and maintenance monitoring function module](image)

According to Figure 1, in the APP system operation and maintenance process, the administrator can not only query the current alarm information of the system, but also query historical information, and grasp the system operation status through comprehensive analysis of the alarm information. In addition, the administrator can also monitor the system business by obtaining monitoring data, and obtain the system evaluation report through data analysis and statistics, and send it to the operation and maintenance center to facilitate all operation and maintenance personnel to obtain relevant information [12]. In order to improve the system operation and maintenance effect, the administrator can also perform user operations in the system, establish a communication community, and improve the operation and maintenance effect.

In addition to administrators, operation and maintenance personnel are also an effective guarantee for the normal operation of the IT system. The main responsibility of operation and maintenance personnel is to maintain all devices and APPs in the APP system, obtain monitoring views through the monitoring equipment in the system, and obtain alarms. Based on the information, configure the monitoring indicators. In addition, operation and maintenance personnel can also communicate with other staff in the communication community to ensure the circulation of information.

3. *APP system-oriented lightweight IT operation and maintenance integrated monitoring method*

3.1. *Lightweight IT operation and maintenance process*

With the increase and popularization of mobile clients, the scale of malware is gradually growing in the upgrading of computer technology. The escalating attack and defense war in cyberspace continues to strengthen the concealment of malware attack means, which poses a great challenge to the current malware identification methods [13]. Therefore, it is necessary to conduct in-depth research on
lightweight IT operation and maintenance threatened by network attacks. The virtualization of APP system makes the application of hardware resources more flexible, and can transform hardware resources requiring special operations into virtual resources that can take into account several operating systems. The APP system itself has a fixed operating environment, which can be used to manage physical hosts to ensure the parallel reliability of lightweight IT operation and maintenance. The following describes the specific process of lightweight IT operation and maintenance under the APP system, as shown in Figure 2.

![Lightweight IT operation and maintenance flow chart](image)

Figure 2 Lightweight IT operation and maintenance flow chart

In the process of lightweight IT operation and maintenance, users, administrators and operation and maintenance personnel in the operation and maintenance link need to be verified to prevent bad personnel from attacking the system, stealing user information in the system and causing user losses. This paper uses identity authentication to verify the personnel entering the operation and maintenance system. As a means of confirming the user's identity information on the Internet, identity authentication can verify whether the physical identity of the operator is consistent with the digital identity retained in the database, and it is also the key threshold for users to use the equipment [14]. As the first line of defense of network security, identity authentication provides a security guarantee to prevent illegal users from invading and protect the security of users' personal information.

After the server receives the user's operation request, the traditional operation and maintenance system sends the request information back to the browser for processing, and finally displays the processing results to the user, which usually makes the waiting time of the operation user longer and consumes more network communication resources [15]. To solve the above problems, this paper proposes a new identity authentication method, which creatively establishes all operations on intelligent terminals on a unified Ajax engine. The specific identity authentication process is introduced below:

1. Add an intermediate layer between the IT operation and maintenance system server. When the two communicate for the first time, the intermediate layer downloads user operation request information on the smart APP terminal to help the server process some user requests that do not need to load the entire page;

2. Use the Ajax engine to share the user request information in the server, thereby alleviating the server request queuing situation, speeding up the processing and response to user requests, and improving the timeliness of IT operation and maintenance monitoring;

3. On the basis of the above links, test the network environment to ensure the suppression effect of interference factors in the operation and maintenance process.
3.2. Construction of lightweight IT operation and maintenance database

The growing network scale and the rapid development of communication technology have played a certain role in promoting the frequent occurrence of network attacks such as extortion and secret theft. Since such attacks are mostly carried on malware, efficient and accurate detection of malware is a key point of lightweight IT operation maintenance monitoring. Lightweight IT operation and maintenance data is a description of the different state attributes of the equipment under attack during the operation and maintenance process. The database summary contains a large amount of data representing the attributes and content of the attack, and most of the data contains attribute information. The establishment of lightweight IT operation and maintenance database is conducive to the operation and maintenance personnel to quickly and effectively extract relevant information when operating and maintaining the equipment in the APP system, help them quickly locate the fault interval and fault type, and then make rapid judgment, make decisions in the shortest time and reduce the losses caused by faults.

In the construction of lightweight IT operation and maintenance database, fuzzy theory is mainly used to simulate data with similar characteristics in a large number of user samples, operation and maintenance data and other data types to minimize the dispersion of sample data. The specific methods are as follows:

In the process of building a lightweight IT operation and maintenance database, assume that \( D \) represents the normal vector of the data projection space, which can be expressed by formula (1):

\[
D_k = A^s G_k \quad (1)
\]

In the formula, \( A^s \) represents the projection of the data sample; \( k \) represents the data dimension; \( G_k \) represents the high-dimensional data in the data projection space. Then the data cluster center in the data projection space is expressed as:

\[
R_n = \sum_{n=1}^{N} I'_n(x, y) \sin \left( \frac{2\pi n}{N} \right) \quad (2)
\]

In the formula, \( I'_n \) represents the total error value of the data sample; \( R_n \) represents the cluster center constructed on the basis of the sample data; \( n \) represents the total amount of data; \( N \) represents the data type; \( x \) and \( y \) both represent a constant.

On the basis of formula (1) and formula (2), the divergence problem of various data in the database is transformed into a maximization objective function, and the expression is:

\[
F(x) = \left[ \frac{2\pi x}{d} + \phi(x, y) \right] \quad (3)
\]

In the formula, \( d \) represents the fuzzy set of data; \( \phi(x, y) \) represents the consistency between the data.

The optimal projection direction of the data is obtained by solving formula (3), and its expression is:

\[
W(a, b) = \frac{(k - 1)N}{2M} \times f(k) \quad (4)
\]

In the formula, \( a \) and \( b \) represent the coordinates of a certain data in the database; \( f(k) \) represents the intra-class divergence of the data, which can accurately measure the different goals of the maximum and minimized divergence, and the minimum value is the minimization of the intra-class divergence of the sample data. According to the obtained optimal projection direction, a complete data space can be obtained, and all the data in the space are jointly formed into a lightweight IT operation and maintenance database.
3.3. Integrated monitoring of lightweight IT operation and maintenance

At this stage, the business of an enterprise is gradually expanding and involves more data. For this reason, it needs to be managed through an IT system. Therefore, ensuring the normal operation of the IT system is the key to enterprise development. In the operation and maintenance of enterprise IT systems, it is necessary to conduct integrated monitoring of its status to avoid the impact of a certain link failure on the overall operation of the system. Normally, most companies mainly monitor the operation and maintenance conditions through manual methods, but there is a certain degree of subjectivity in the form of manual monitoring, and the judgments made in the monitoring will waste a certain amount of time. Therefore, it is necessary to study a fast and effective method to assist system operation and maintenance. A lightweight IT operation and maintenance database is constructed through Section 3.2. Since there is a large amount of data in the database, it will affect the monitoring effect. Therefore, in the integrated monitoring of lightweight IT operation and maintenance, the data is reduced in dimensionality.

In order to achieve integrated monitoring of lightweight IT operation and maintenance, improve monitoring efficiency and monitoring accuracy, it is necessary to reduce the dimensionality of multi-dimensional data. This paper mainly implements the principal component analysis method. Construct a data observation matrix \( Y \) in the lightweight IT operation and maintenance database [16]:

\[
Y = \begin{bmatrix}
y_{11} & y_{12} & \ldots & y_{1m} \\
y_{21} & y_{22} & \ldots & y_{2m} \\
\vdots & \vdots & \ddots & \vdots \\
y_{m1} & y_{m2} & \ldots & y_{mm}
\end{bmatrix}
\]  

(5)

In the formula, \( M \) represents the observation factor, which can display the status of IT operation and maintenance; \( y_i \) represents the data sampling frequency in the monitoring process.

Standardize the observation factor to obtain the safety factor of the IT system under different operating conditions:

\[
R_0 = \left( R_{0x}, R_{0y} \right) = \left[ \sum_{x=0}^{n} \sum_{y=0}^{n} (x, y) \sum_{x=0}^{n} \sum_{y=0}^{n} (a_0, b_0) \right]
\]  

(6)

In the formula, \( R_{0x} \) and \( R_{0y} \) both represent IT system operation progress monitoring; \( a_0 \) and \( b_0 \) both represent IT system maintenance progress monitoring.

In order to facilitate the calculation, \( R' \) is used to describe the standardized IT system operation and maintenance monitoring data [17], the standardized IT system operation and maintenance correlation coefficient is \( r_{xy} \), which can be calculated by the following formula:

\[
r_{xy} = \sum_{x,y=1}^{n} R_{0n} (x, y)
\]  

(7)

On this basis, the eigenvector of matrix \( Y \) is obtained as:

\[
Y_e = (y_{11}, y_{12}, \ldots, y_{1k})
\]  

(8)

Finally, use the principal component analysis method to obtain \( z \) principal components in the IT system operation and maintenance monitoring, namely:

\[
z_i = \sum_{j=1}^{n} z_{i,j} - 1
\]  

(9)

In the formula, \( z_i \) represents the characteristic value of IT system operation and maintenance;
\( z_{ij} \) represents the principal component contribution rate of IT system operation and maintenance.

On this basis, the main component expression of the monitoring data is carried out, namely:

\[
Z_{n\times m} = \begin{pmatrix}
    z_{11} & z_{12} & \cdots & z_{1n} \\
    z_{21} & z_{22} & \cdots & z_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    z_{m1} & z_{m2} & \cdots & z_{mn}
\end{pmatrix}
\]

(10)

Keeping the principal components in the matrix can complete the integrated monitoring of the lightweight IT operation and maintenance for the APP system.

4. Simulation experiment analysis

In order to verify the effectiveness and universality of the lightweight IT operation and maintenance integrated monitoring method for the APP system proposed in this paper, simulation experiments are carried out. The method of reference [6] and the method of reference [7] are used as comparison methods, and experimental conclusions are drawn through the comparison between different methods.

4.1. Experimental environment and parameter settings

Before the start of the simulation experiment, in order to ensure the validity of the experimental results and the consistency of the experimental conditions, it is first necessary to set the operating parameters of the lightweight IT operation and maintenance system. The specific parameters are shown in Table 1.

| Parameter          | Specification          |
|--------------------|------------------------|
| Smart Meter        | APMB10                 |
| 4G router          | ZLAN8303-7             |
| Video camera       | CS-C5C-3B1WFR          |
| Routing Protocol   | OSPF/EIGRP             |
| Monitoring tools   | VMware ESXi            |

Under the operating parameters of the lightweight IT operation and maintenance system shown in Table 1, the conventional IT operation and maintenance system database is selected as the experimental data source. The selected database contains a variety of configuration item data, including user information, passwords, alarm values, Information backup port, device type, network IP address and serial number and other parameters. With the support of this database, the operation and maintenance monitoring effect is evaluated and relevant conclusions are drawn.

4.2. Results and analysis

On the basis of the above experimental environment and parameter settings, the method of this article, the method of reference [6] and the method of reference [7] are compared, and the following are specifically carried out from three aspects: monitoring stability, risk warning timeliness and warning information error rate. For comparison, the results are analyzed as follows.

4.2.1. Monitoring stability verification

First, the stability of the IT operation and maintenance system is used as an experimental indicator. This indicator mainly refers to whether the monitoring method can effectively suppress the influence of interference factors during the monitoring process, so as to obtain a more stable monitoring result. In this paper, the stability coefficient is used as a measurement index, and its specific value is 0.1-1.
The larger the value, the more stable the monitoring result. On the contrary, the monitoring result fluctuates more. The specific experimental results are shown in Figure 3.

![Figure 3 Comparison results of monitoring stability](image)

By analyzing Figure 3, it can be seen that the stability of IT operation and maintenance monitoring of the three methods shows a continuous growth trend under different iteration times. Among them, the growth trend of reference [6] method is consistent with that of this method. Although the change trend of reference [7] method also shows a growth trend on the whole, when the number of iterations reaches 4, the growth trend gradually slowed down. By comparing the stability coefficient values of different methods, it can be seen that the maximum stability coefficient of the method in this paper reaches 0.9, while the maximum stability coefficient of the method in reference [6] does not reach 0.5, and the maximum stability coefficient of the method in reference [7] does not reach 0.6. Through the above comparison, it can be seen that in the process of monitoring the lightweight IT operation and maintenance system by using this method, it can always maintain a stable trend and play a good supporting role in obtaining accurate monitoring results.

### 4.2.2. Timeliness verification of risk early warning

In the operation of the IT operation and maintenance system, various APPs have a certain probability of being attacked by abnormalities, which will cause certain failures. Therefore, it is necessary to promptly warn the APP risks in the IT operation and maintenance system to achieve the purpose of timely warning. The comparison results of the risk warning time of different methods are shown in Table 2.

| Number of iterations/time | Method of this article | Reference [6] method | Reference [7] method |
|---------------------------|------------------------|----------------------|----------------------|
| 20                        | 0.5                    | 0.9                  | 1.0                  |
| 40                        | 0.8                    | 1.3                  | 1.3                  |
| 60                        | 0.9                    | 1.7                  | 1.8                  |
| 80                        | 1.1                    | 2.0                  | 2.1                  |
| 100                       | 1.3                    | 2.5                  | 2.6                  |

Analyzing the data in Table 2 shows that as the number of iterations increases, the risk warning time of the three methods has shown a continuous increase trend, but through comparison, it can be seen that the growth interval of the method in this paper is small, the span is small, and the risk warning time The lowest value is 0.5s, the highest value is 1.3s, and the method of reference [6] and the method of reference [7] have a longer risk warning time. It shows that the risk early warning of the
method in this paper is timely and can realize effective early warning of APP risk in the IT operation and maintenance system in the shortest time.

4.2.3. Verification of error rate of early warning information
The error rate of early warning information can directly affect the effect of system operation and maintenance. If the error rate is too large, it will mislead the operation and maintenance personnel and affect the processing effect. Therefore, the error rate of early warning information is used as an experimental indicator to compare the monitoring effects of different methods. Select 5 representative APPs in the IT operation and maintenance system to monitor for a period of 3 months, obtain the fault warning information of the APP during the monitoring period, and calculate the average value. The final result is shown in Figure 4.

![Figure 4 Error rate comparison results of early warning information](image)

According to the analysis of Figure 4, there is a large gap between the early warning information error rate of the method in this paper and the two traditional methods. The early warning information error rate of the five apps is less than 1%, while the early warning information error rate of the method in reference [6] and the method in reference [7] is large, especially the gap between the early warning information error rate of the method in reference [7] and the other two methods is obvious. It can be seen that the early warning information of this method is reliable.

In conclusion, through the comparison of multiple indicators, compared with the traditional methods, this method can obtain accurate early warning information in time, which shows that its monitoring effect is good, and plays a positive role in ensuring the safe operation of it operation and maintenance system.

5. Conclusion
With the wide application of cloud computing, virtualization and other technologies, the network structure becomes more and more complex, which affects the use effect of APP system, and brings great challenges to the operation and maintenance staff. It is necessary to study the operation and maintenance of APP system. Therefore, this paper proposes a lightweight it operation and maintenance integrated monitoring method for APP system. The method performance verification stage mainly studies the three aspects of monitoring stability, risk warning timeliness and warning information error rate. It is concluded that the method in this paper has a good application effect, which can effectively guarantee the safe operation of IT operation and maintenance. The next stage will focus on improving the anti-interference issues in the operation and maintenance process to meet the current performance design and operation and maintenance requirements of diversified APPs.
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