QUALITY ASSURANCE FOR CSNS OPERATION

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Abstract

Because CSNS (China Spallation Neutron Source) is now in early operation, the focus has been shifted from beam commissioning to reliable operation, therefore, a suite of QA (Quality Assurance) tools is under development. These tools include operation summary system, issue tracking system and alarm information system. This paper presents the design of the QA tools in CSNS and the status of their development.

INTRODUCTION

Currently, operation summary system, issue tracking system and alarm information system have been developed as Web-based QA tools for CSNS operation. All of them are developed based on Java EE [1] backend programming language, PrimeFaces [2] web user interface and MySQL relational database technologies. Operation summary system records operation schedule and breakdown information, it also provides statistical data for reports. Issue tracking system records and tracks issues during machine operation and maintenance. Alarm information system provides alarm history information.

OPERATION SUMMARY SYSTEM

Operation summary system accepts users' input of operation schedule and breakdown information, thus daily summary and statistical report information can be generated accordingly. The system architecture is shown in Fig. 1.
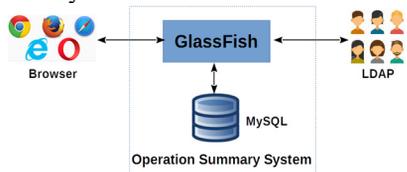

Figure 1: Architecture of operation summary system.

System Design

The system design of operation summary system is as follows:

- During machine operation, users should input each type of machine time, which is preparation, beam operation, machine study, scheduled downtime, breakdown or other.
- The system can automatically calculate daily summary information, which includes total time of each type of machine time for each day.
- The system can generate report for overall machine time and breakdown.
- The system provides keyword search function.
- The system provides web pages as user interface.

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Access Control

The system uses LDAP (Lightweight Directory Access Protocol) for user authentication, and user permissions are divided into anonymous user, normal user, operator-in-charge and administrator. The access control strategy is as follows:

- Anonymous users can only read machine time, breakdown and daily summary information.
- Besides the anonymous user permission, normal users can also generate report data.
- In addition to the normal user permission, operators-in-charge can also create, delete and modify machine time and breakdown entries.
- On top of all operators-in-charge permission, administrators can also change the system configurations.

Machine Time Input and Query

The machine time main page is shown in Fig. 2, it provides input entry, entered data and filter options. Data input dialog is shown in Fig. 3, input fields include type of operation schedule, start time, end time and description. The filter function supports type of machine time, description, data entry person and data entry time. In data display area, modify and delete links as well as modified history and detailed information links are provided. Detailed information is shown in Fig. 4.

Figure 2: Machine time main page.

Figure 3: Machine time input dialog.

Figure 4: Machine time detailed information.

Breakdown Input and Query

The breakdown main page is shown in Fig. 5, it provides input entry, entered data and filter options. Input dialog is shown in Fig. 6, where input fields include type of machine state, system, subsystem, device, start time, end time, description and so on. The filter function supports type of machine time, system, subsystem, description, data entry person and data entry time. In data display area, "create as template", "modify and delete links" as well as "modification history" and "detailed information links" are provided. Detailed information is shown in Fig. 7.

Figure 5: Breakdown main page.

Figure 6: Breakdown input dialog.
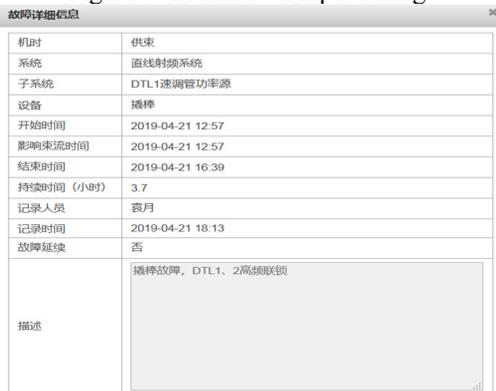
Figure 7: Breakdown detailed information.

Daily Summary

Daily summary page is show in Fig. 8, it displays total time for each type of machine time, which is preparation, beam operation, machine study, scheduled shutdown, breakdown or other, for each day. It can be generated automatically after each machine time or breakdown entry is created, modified or deleted. It can also be adjusted manually by the administrator. In addition, beam efficiency is calculated as follows:

$$\text{efficiency} = \text{beam} / (\text{beam} + \text{breakdown}) * 100\ \%$$

Figure 8: Daily summary page.

Report Generation

Report for operation schedule, overall breakdown and system-level breakdown of a user specified period can be generated, the report result can be shown as pie chart, bar chart and table respectively, and data in the table can be exported as Microsoft Excel files. The report generation page for overall breakdown is shown in Fig. 9 and the corresponding result page is shown in Fig. 10.
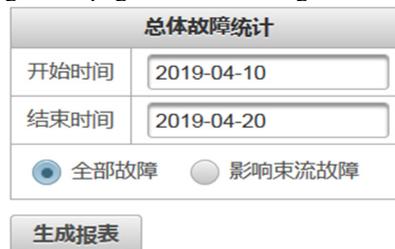

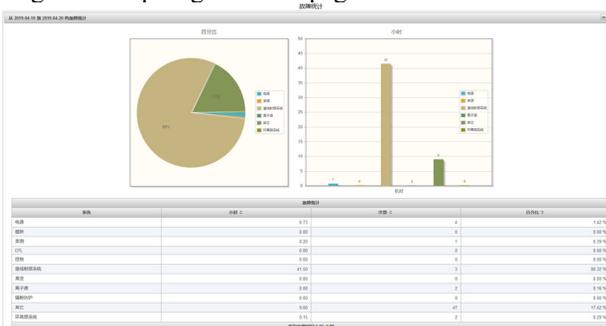Figure 9: Report generation page for overall breakdown.

Figure 10: Report result page for overall breakdown.

System Management

User information can be created, modified and deleted in the page as shown in Fig. 11, it can also be generated automatically according to the LDAP server when a user login for the first time, but the user permissions like operator-in-charge and administrator must be configured by the system administrator.

Figure 11: User management page.

System components can be created, modified and deleted in the page as shown in Fig. 12. The entire system can be categorized into 3 levels: system, subsystem and device. They are used in breakdown entry input, in which system and subsystem are mandatory, and device is optional.

Figure 12: System component management page.

The system behaviour can be configured in the dialog as shown in Fig. 13, the configuration options are as follows:

- Whether to generate daily summary automatically.
- Whether to synchronize user information with the LDAP server.
- Whether to enable data validation for machine time input.
- Whether to enable data validation for breakdown input.

Figure 13: System configuration page.

Data Import

Besides data entered by users one by one, the system also supports batch data import of operation schedule, breakdown and system component tree from a file. The function is implemented using Apache POI [3] and PrimeFaces fileUpload widget. The imported data should be within a Microsoft Excel file and column order must conform a predefined pattern. The user interface in shown in Fig. 14.

Figure 14: Data import page.

Web Service

The statistical report data for machine time, overall breakdown and system-level breakdown can be read by other applications via RESTful API, and the supported data formats are XML and JSON.

Database Design

The database schema is shown is Fig. 15.
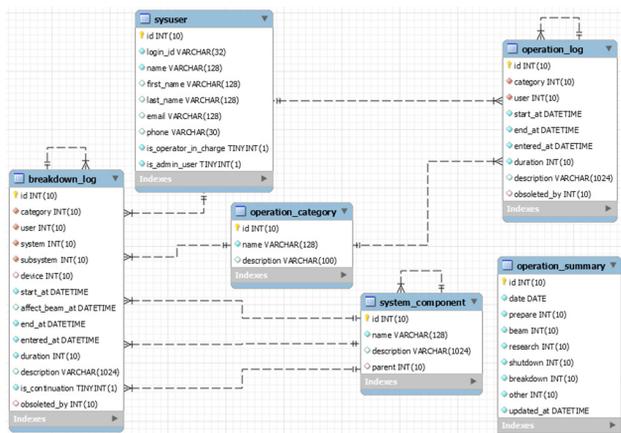
Figure 15: Database schema.

ISSUE TRACKING SYSTEM

Issue tracking system is developed based on Olog [4], it keeps the architecture and technologies of Olog and adds additional MySQL tables, Apache Jackrabbit nodes, Java EE business logic as well as HTML5/CSS/JQuery web pages to meet the requirements of this system. The main page is shown in Fig. 16.
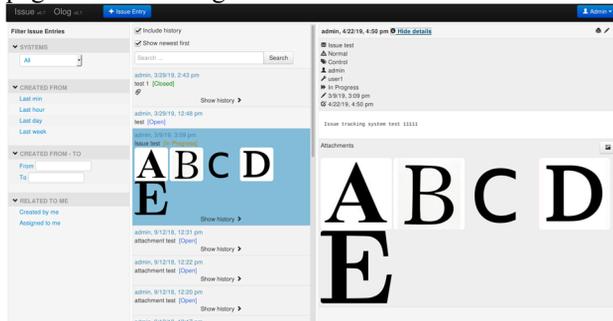

Figure 16: Main page of issue tracking system.

ALARM INFORMATION SYSTEM

Originally, CSNS uses BEAST as alarm server and CS-Studio as alarm information system. However, the response time is very slow when using CS-Studio to search alarm history. Therefore, a web-based alarm information system has been developed, which reads BEAST database directly. In order to improve the performance, it uses PrimeFaces lazy data model, which is a pagination technology and only queries data in the current page from database, thus significantly reducing the time overhead for data loading and page refreshing. The main page of alarm information system is shown in Fig. 17.

Figure 17: Main page of alarm information system.

CONCLUSION

By now, the development of operation summary system has been finished and it is in the pilot run stage, issue tracking system and alarm information system are in demo version of development. The next step is to start operation summary system formally and develop formal version for issue tracking system and alarm information system.

REFERENCES

[1] https://docs.oracle.com/javaee/7/tutorial/

[2] https://www.primefaces.org/

[3] https://poi.apache.org/

[4] https://github.com/Olog