

DEVELOPMENT OF HUMAN-COMPUTER INTERFACES FOR MONITORING ELECTROMECHANICAL SYSTEMS USING JAVAFX

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Анотація

У роботі розглядається процес розробки графічних інтерфейсів користувача для моніторингу електромеханічних систем. Основну увагу приділено застосуванню принципів людино-машинної взаємодії (HCI) для створення інтуїтивно зрозумілого програмного забезпечення. Використання технології JavaFX та об'єктно-орієнтованого підходу дозволяє реалізувати надійні кросплатформні рішення, що забезпечують візуалізацію даних у реальному часі та підвищують швидкість реакції операторів на критичні зміни в енергосистемі.

Ключові слова: інженерія програмного забезпечення, людино-машинна взаємодія, JavaFX, електромеханічні системи, моніторинг у реальному часі.

Abstract

This paper considers the process of developing graphical user interfaces for monitoring electromechanical systems. The main focus is on applying human-computer interaction (HCI) principles to create intuitive software. The use of JavaFX technology and an object-oriented approach allows for the implementation of robust cross-platform solutions that provide real-time data visualization and increase operators' response speed to critical changes in the power system.

Keywords: software engineering, human-computer interaction, JavaFX, electromechanical systems, real-time monitoring.

Introduction

Modern electromechanical systems and power grids generate vast amounts of data that require continuous monitoring and rapid analysis. As these systems become more complex, the role of reliable software engineering in their management becomes increasingly critical. Effective management relies not only on the accuracy of the underlying algorithms but also on how information is presented to the human operator. Poorly designed interfaces can lead to delayed responses or misinterpretation of data, which is especially dangerous in the energy sector. Therefore, applying the principles of Human-Computer Interaction (HCI) to develop intuitive graphical user interfaces (GUIs) is a vital task. This paper explores the use of JavaFX as a robust framework for building responsive applications tailored for real-time monitoring of electromechanical equipment.

Research results

The primary objective of developing monitoring software for the power engineering sector is to provide operators with a clear, uninterrupted stream of critical data. When utilizing Java, specifically the JavaFX framework, developers can leverage object-oriented programming to create modular and easily maintainable interface components.[2]

One of the key aspects of HCI in this context is minimizing cognitive load [1]. Operators monitoring complex electromechanical drives must process parameters such as voltage, current, temperature, and frequency simultaneously. By implementing JavaFX's advanced charting and animation capabilities, raw data can be transformed into dynamic visual dashboards. For instance, color-coded indicators and interactive graphs allow users to instantly identify anomalies without manually analysing numerical logs.

Furthermore, integrating the MVC (Model-View-Controller) design pattern ensures a clean separation between the user interface and the backend data processing logic. This architectural choice is crucial for software engineering, as it allows the system to scale and incorporate new sensors or electromechanical components without redesigning the entire application. During the development process, careful attention must be paid to accessibility and feedback mechanisms – ensuring that the system provides immediate visual or auditory alerts when parameters exceed safe thresholds. Well-structured, Java-based GUIs significantly improve operator reaction times and overall system safety.

Conclusion

The intersection of software engineering and electrical engineering is fundamental to the modernization of energy infrastructure. Developing specialized software using frameworks like JavaFX provides a powerful means to monitor and control electromechanical systems effectively. By prioritizing Human-Computer Interaction principles [1], developers can create interfaces that not only visualize complex data in real-time but also enhance operator efficiency and reduce the risk of human error. As power systems continue to digitize, the demand for well-designed software solutions will only grow, highlighting the importance of cross-disciplinary approaches in modern engineering.

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