

ABSTRACT

The thesis is presented in 83 pages. It contains 3 appendixes and bibliography of 24 references. 15 figures and 4 table are given in the thesis.

Topic relevance. Nowadays, we observe growth of demand for human productivity improving software that allows to avoid routine activities. Collective development tools and version control systems became popular but they are not interactive regarding to other users which makes collaborative real-time work impossible. So subject associated with real-time collaborative editing in text editors, text processors, office suites, CAD, graphic editors is relevant. To maintain data consistency in such systems additional approaches and methods are need to be used to control data updates and updates broadcasting. This thesis is focused on maintaining data consistency for text editing in network conditions.

Thesis connection to scientific programs, plans, and topics. The thesis was prepared according to the scientific research plan of the Applied Mathematics Department of the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute.”

Research goal and objectives. The goal of the dissertation is to increase the quality and productivity of the personnel in the implementation of parallel editing of documents by reducing the time spent on the processing and formalization of documents.

To accomplish this goal, the following objectives were reached:

- examine and analyze existing approaches and methods for maintaining data consistency in groupware systems;
- consider existing systems that implement collaborative text editing;
- develop a conceptual model of the collaborative editing module;
- develop a mathematical maintenance for maintaining data consistency and implement software prototype of the collaborative text editing module;
- conduct testing of the developed software.

Object of research is methods of applying operational transformations to construct collaborative content editing systems, model of consistency of the system of operational transformations: CC, CCI, CSM, CA models, treeOPT, GOT, GOTO, AnyUndo, COT,

convergence and inverse transformation functions, methods for applying differential synchronization for constructing systems of collaborative content editing, three-way merge algorithm, Dual Shadow Method, Guaranteed Delivery Method, the function of finding the difference between two files, the algorithm for finding the largest common subsequence, methods of application of non-conflict replicated data types for constructing a content editing system, data transmission technology in computer networks, OSI model, datagrams, streaming data, HTTP application protocols, WebSockets, methods for ensuring the security of data transmitted on computer networks, Existing parallel content editing systems encrypt TLS transport layer protocols: Google Docs, Google RealTime API, Google Wave, CoVim, CoWord, DistEdit, ShareDB.

Subject of research is an algorithm for implementing operational transformations for systems of collaborative content editing using text transformation functions and a recursive transformation algorithm for operations in network resources using WebSockets application layer protocols and TLS transport layer protocol encryption. Models of verification (validation of adequacy) of the algorithm. Comparative analysis of algorithms for implementation of operational transformations for systems of parallel editing of content.

Methods of research. To solve the task, the following methods were used: methods of the theory of deterministic processes (for the development of algorithms for maintaining data consistency); methods of algorithm theory and programming (for software implementation of developed algorithms); methods of probability theory and mathematical statistics (for the preparation of pseudo-random test scenarios).

Scientific contribution consists of the following:

- the conceptual model of the module of parallel editing was developed;
- the modification of the algorithm of operational transformation control with server-side operations synchronization was developed;
- A set of operators for plain text editing and their transformations was developed, which allows to express any atomic editing through one operation.

Practical value of obtained results. The proposed conceptual model can be used in the development of collaborative editing systems, and also modified to develop other types of groupware systems. The developed operational transformation control algorithm

can be used during development of groupware systems. The set of text editing operators and their transformations can be used by encapsulating a non-conflict replicated data type.

Approbation of the thesis results. The main provisions of the review of existing methods for ensuring the integrity of data are presented at the 10th Scientific Conference of graduates and postgraduates «Applied Mathematics and Computing» (2018)

Publications. Part of the dissertation material is presented in theses to the 10th scientific conference of graduates and postgraduates «Applied Mathematics and Computing» (2018).

Keywords: groupware systems, collaborative computer assisted work, data consistency, optimistic methods of maintaining data consistency, operational transformation.