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MATERIALS

OF THE XIII INTERNATIONAL SCIENTIFIC-PRACTICAL CONFERENCE «Information Control Systems and Technologies» (ICST- ODESA – 2025)

24th – 26th September, 2025

Львів-Торунь
Liha-Pres
2025

УДК 004:37:001:62
І74

Інформаційні управляючі системи і технології (ІУСТ-ОДЕСА-2025) : матеріали XIII Міжнародної науково-практичної конференціі (24–26 вересень 2025 р., Одеса) / вип. ред. В.В. Вичужанін, 2025. – 300 с.

І74

ISBN 978-966-397-531-3
DOI 10.36059/978-966-397-531-3

Збірник містить Матеріали, прийняті оргкомітетом до участі в Міжнародній науково - практичній конференції «ІНФОРМАЦІЙНІ УПРАВЛЯЮЧІ СИСТЕМИ І ТЕХНОЛОГІЇ» (ІУСТ-ОДЕСА-2025).

Наведені матеріали конференції охоплюють основні напрямки розвитку в області інформаційонних систем управління, інтелектуальних систем і аналізу даннях, моделювання.

УДК 004:37:001:62

ISBN 978-966-397-531-3

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The collection contains materials accepted by the organizing committee for participation in the International Scientific and Practical Conference "INFORMATION CONTROL SYSTEMS AND TECHNOLOGIES" (ICST-ODESA-2025).

The materials of the conference cover the main directions of development in the field of artificial intelligence, development and analysis of big data, blockchain and crypto technologies, control systems in robotic systems, data security and cryptography, ICT in the network and administration, information systems and technologies in Data Mining, intelligent technologies management, mathematical modeling, methodology and didactics of teaching and using ICT, application development, project management. system analysis, software development.

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макровершини якого є результатом простої гомоморфної згортки сильно зв'язаних підграфів орієнтованого графа, що відповідає бінарному відношенню еквівалентності, заданому на множині блоків ЦЗ, зв'язок між якими існує у випадку, коли кількісні показники вкладу високочастотної складової у ці блоки є однаковими; запропонований метод вибору блоків ЦЗ-контейнера дозволив для 52% використаних ЦЗ значно підвищити (на 2-6 *dB*) кількісний показник візуального спотворення ЦЗ – пікове відношення «сигнал-шум» (PSNR) порівняно з випадковим вибором блоків для стеганоперетворення; при цьому візуальна якість стеганоповідомлень, що встановлювалася шляхом суб'єктивного ранжування, для всіх ЦЗ виявлялася кращою.

Розроблений метод вибору блоків має незначну обчислювальну складність, яка для $n\times n$-ЦЗ визначається як $\underline{O}\left(n^2\right)$, що забезпечує перспективу його використання для потокового контейнера.

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UDC 004.89

ЕКСПЕРИМЕНТАЛЬНЕ ДОСЛІДЖЕННЯ З ОПТИМІЗАЦІЇ ШВИДКОСТІ ЗАВАНТАЖЕННЯ ВЕБ-СТОРІНОК

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EXPERIMENTAL RESEARCH ON OPTIMIZING WEB PAGE LOADING SPEED

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Анотація. *Експериментально досліджено вплив методів оптимізації на швидкість завантаження веб-сторінок. Застосовано різні підходи, включаючи кешування, мініфікацію та асинхронне завантаження. Виявлено, що кешування значно покращує продуктивність, знижуючи час завантаження та кількість запитів, що підтверджує його високу ефективність для оптимізації. Дослідження підтверджує важливість комплексного підходу до оптимізації та надає практичні рекомендації для підвищення технічної ефективності та покращення користувацького досвіду.*

Ключові слова*: оптимізація, швидкість завантаження, кешування, продуктивність, інформаційні технології.*

Abstract. *The impact of optimization methods on the loading speed of web pages is examined through experimental research. Multiple strategies were employed, such as caching, minification, and asynchronous loading. The results indicated that caching significantly enhances performance by decreasing loading times and the number of requests, highlighting its effectiveness for optimization. The study highlights the necessity of a holistic approach to optimization and offers practical suggestions for enhancing technical efficiency and user experience.*

Keywords*: optimization, download speed, caching, performance, information technology.*

Web page loading speed is one of the critical factors that determines the overall efficiency and attractiveness of a web resource. It is a key indicator of website performance that directly affects user experience, user satisfaction, and SEO [1]. Pages with multiple components, interactive elements, or multimedia content may load more slowly, highlighting the need to balance design, functionality, and speed. Slow loading times can negatively affect search engine optimization, as search engines consider page speed a critical ranking factor.

According to research, most users leave a website if the page takes more than 3 seconds to load, so loading speed affects not only the visibility of a website in search engines, but also the conversion rate and overall effectiveness of a web resource in achieving business goals [1].

Understanding load speed and its impact on user experience helps you make more informed optimization decisions. The optimization of web page speed is crucial for several reasons:user experience. Delays in page loading can lead to user dissatisfaction and a loss of interest. Even a delay of a few seconds can significantly reduce conversions and increase bounce rates; SEO and search engine rankings. Search engines consider loading speed as one of the factors in ranking web pages. Websites that load quickly are more

likely to achieve higher positions in search results, which enhances their visibility and traffic; conversions and profits. For commercial sites, speed has a direct impact on conversions. A fast website encourages more interactions and purchases (Amazon or Walmart note that every second of delay in loading can cost them millions of dollars); reduces resource usage. Fast pages are usually lighter and less resource-demanding, which reduces the load on servers and internet channels, as well as reduces energy consumption; accessibility to a global audience. In many parts of the world, access to high-speed internet can be limited or expensive. Web pages that are optimized for quick loading times enhance content accessibility for a broader audience, even on slower connections.

Optimising web page load speed is an important aspect of modern web development that affects business success, user experience, and technical efficiency. Evaluated how each approach reduces load times, enhances content processing speed, and improves user experience: comparison of web page loading times before and after optimization; the impact of individual methods on various performance metrics; analysis of the effectiveness of the selected approaches in combination; recommendations for further use of optimization methods depending on the specifics of the project. To conduct an experiment evaluating modern methods for optimizing web page loading speed, a test website was selected with the following initial characteristics: the number of requests to the server: 16 HTTP requests; size of the received data: 898 KB; total size of resources: 1.1 MB; full page load time: 1.45 seconds; time to DOMContentLoaded event: 587 ms. The initial metrics were: overall performance: 73; FCP: 2.0; LCP: 2.7 seconds; CLS: 0.037; TBT: 90 ms; Speed Index: 2.3 seconds. FCP and LCP values indicate delays in displaying the main content. The full-page load time (1.45 seconds) exceeds the optimal values, but remains acceptable. The results of the experiment will be compared with the initial values to evaluate the effectiveness of the optimization methods implemented (fig.1).

According to the optimization results (reduced the number of third-party scripts, optimizing images, using lazy-loading for content, asynchronous loading of scripts, using CDN, combining and minimizing resources, caching), it turned out that the greatest positive effect was observed when using caching, which reduced the amount of transmitted data to 13 KB and the number of requests to the server to 9, providing the best overall performance indicator - 98. Resource pooling and minification, asynchronous script loading, and lazy content loading have demonstrated

significant improvements in key metrics such as FCP down to 0.7 seconds and LCP down to 0.9 seconds. The overall performance score for these methods ranges from 86-94. This highlights their effectiveness in addressing issues related to optimizing web page loading speed. The final performance metrics after the implemented optimizations were: number of requests to the server: 9; data size transferred: 12.7 KB; total resource size: 382 KB; full page load time: 663 ms; time to DOMContentLoaded event: 332 ms.

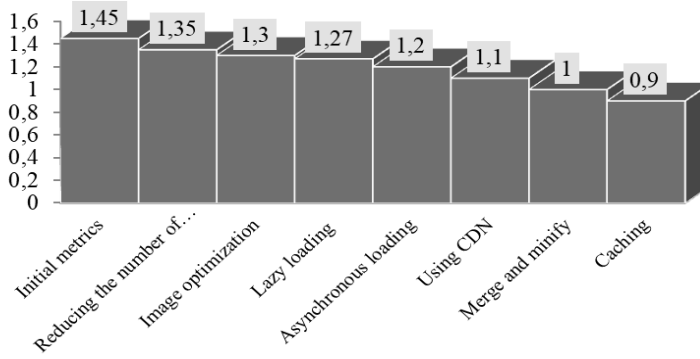

Figure 1. The impact of optimization methods on changes in download speed

As a result of the experimental study of modern methods for optimizing the speed of loading web pages, it was possible to improve the performance of the test web resource. When analyzing the effectiveness of different approaches, it was found that each method makes its own unique contribution to improving the overall performance. The greatest performance gain was achieved through the implementation of caching, which ensured the minimum volume of requests to the server and the maximum speed of access to content.

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