

Міністерство освіти і науки України

Харківський національний університет радіоелектроніки

Кафедра комп'ютерно-інтегрованих технологій, автоматизації, робототехніки та  
безпекової інженерії

**I Всеукраїнська конференція  
«Інтелектуальні технології цивільної безпеки та  
робототехнічні системи аварійно-рятувальних робіт»**



**I All-Ukrainian Conference  
“Intelligent Civil Safety Technologies and Robotic Systems for  
Emergency and Rescue Operations”**

**ICSTRO**

2026

**I All-Ukrainian Conference**

February 12 - 13, 2026

Kharkiv

**УДК: 005:004.896:62-65:338.3**

Інтелектуальні технології цивільної безпеки та робототехнічні системи аварійно-рятувальних робіт 2026: матеріали I-ої Всеукраїнська конференція, Харків, 12-13 лютого 2026 р.: тези доповідей / [редкол. І.Ш. Невлюдов (відповідальний редактор)].-Харків: [електронний друк], 2026. – 192 с.

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Intelligent Civil Safety Technologies and Robotic Systems for Emergency and Rescue Operations 2026: Proceedings of I st All-Ukrainian Conference, Kharkiv, February 12 - 13, 2026: Thesises of Reports / [Ed. I.Sh. Nevlyudov (chief editor).] .- Kharkiv .: [electronic version], 2026. - 192 p.

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## WEB3 AND DECENTRALIZED APPLICATIONS. A PRACTICAL LOOK AT BLOCKCHAIN DEVELOPMENT

**A. Taran, S. Sotnik**

Kharkiv National University of Radio Electronics

Ukraine, 61166, Kharkiv, Nauky av., 14

E-mail: artem.taran1@nure.ua

**Annotation:** The work examines the concept of Web3 and decentralized applications (dApps) as a modern stage in the development of network technologies. The basic principles of Web3 functioning, the architecture of dApps and the role of blockchain as a decentralized infrastructure for executing program logic are analyzed. Particular attention is paid to the practical aspects of developing decentralized applications on the Ethereum and Solana platforms, in particular the use of smart contracts, development tools and the features of interaction with blockchain networks. The advantages and disadvantages of decentralized approaches are considered, as well as the main areas of application of Web3 technologies. The results obtained indicate the significant potential of decentralized applications in the formation of new models of digital interaction and software development.

**Key words:** Web3, decentralized applications, dApps, blockchain, smart contracts.

## WEB3 ТА ДЕЦЕНТРАЛІЗОВАНІ ДОДАТКИ. ПРАКТИЧНИЙ ПОГЛЯД НА РОЗРОБКУ З ВИКОРИСТАННЯМ БЛОКЧЕЙНУ

**А. Ю. Таран, С. В. Сотник**

Харківський національний університет радіоелектроніки,

Україна, 61166, Харків, пр. Науки 14

E-mail: artem.taran1@nure.ua

**Анотація:** У роботі розглядається концепція Web3 та децентралізованих додатків (dApps) як сучасного етапу розвитку мережевих технологій. Проаналізовано основні принципи функціонування Web3, архітектуру dApps та роль блокчейну як децентралізованої інфраструктури для виконання програмної логіки. Особливу увагу приділено практичним аспектам розробки децентралізованих додатків на платформах Ethereum та Solana, зокрема використанню смарт-контрактів, інструментів розробки та особливостям взаємодії з блокчейн-мережами. Розглянуто переваги та недоліки децентралізованих підходів, а також основні сфери застосування Web3-технологій. Отримані результати свідчать про значний потенціал децентралізованих додатків у формуванні нових моделей цифрової взаємодії та розвитку програмного забезпечення.

**Ключові слова:** Web3, децентралізовані додатки, dApps, блокчейн, смарт-контракти.

The rapid development of digital technologies has led to significant changes in the ways information is stored, processed, and transmitted [1-10]. This transformation, which has also encompassed the automation of corporate and engineering processes, has created challenges for the existing digital architecture [11-14]. The traditional Internet model (Web2) is based on centralized services that store vast amounts of user data and control access to it. This approach creates a number of problems, including the risk of data breaches, censorship, dependence on a single service provider, and a decline in the level of trust between participants in digital interactions.

The Web3 concept offers an alternative approach in which decentralized technologies, blockchain, and cryptography play a key role. Web3 is focused on creating an open, transparent, and manipulation-resistant digital environment. A central element of this concept is decentralized

applications (dApps), which allow the implementation of business logic without the use of centralized servers and intermediaries. This is precisely why the study of Web3 and the practical aspects of dApp development is a relevant task for modern computer science.

Web3 is considered the next stage of Internet development, based on the use of decentralized networks, blockchain technologies, and cryptographic interaction mechanisms. Unlike Web2, where centralized platforms play a key role, Web3 focuses on the direct exchange of data and values between network participants without intermediaries.

A decentralized application (dApp) is a software product in which the server-side is implemented using smart contracts running on a blockchain network. Unlike traditional applications, dApps do not have a single administrator, and their operation is based on rules embedded in the program code. This approach ensures transparency, immutability of logic, and an increased level of trust among users.

The architecture of a decentralized application differs significantly from the classical client-server model. The main components of a dApp are the frontend, smart contracts, and the blockchain network. The frontend is responsible for user interaction and is usually implemented using standard web technologies. Server-side logic, in the traditional sense, is absent—its role is performed by smart contracts. Interaction between the frontend and the blockchain occurs through specialized libraries and crypto wallets, which allow users to sign transactions with their private key. Thus, the architecture of a dApp ensures a high level of autonomy but simultaneously complicates the development and debugging of the system.

Blockchain is a distributed database where information is stored in sequential blocks linked by cryptographic hashes. Each network participant maintains a copy of the ledger, which prevents centralized interference or data tampering. For dApps, the blockchain serves as a reliable execution environment for program code. Smart contracts ensure the automated execution of program logic according to predefined conditions, eliminating the need for trust in a centralized controlling authority. This makes blockchain particularly suitable for applications where trust, transparency, and security are critically important.

Ethereum is the first mainstream platform to implement the concept of a programmable blockchain. Its core component is the Ethereum Virtual Machine (EVM), which allows smart contracts to be executed independently of the operating system or hardware. Smart contract development is carried out using the Solidity language, which syntactically resembles JavaScript. Specialized frameworks are used for the full development cycle, enabling the compilation, testing, and deployment of contracts. Ethereum has one of the largest dApp ecosystems, encompassing financial services, NFT marketplaces, and decentralized autonomous organizations. A key milestone in the platform's development was the transition to the Proof of Stake consensus mechanism in 2022 (The Merge), which reduced the network's energy consumption by 99 % and laid the groundwork for further scaling [15]. However, the limited throughput of the Ethereum mainnet remains a challenge, which has stimulated the development of second-layer (Layer 2) solutions such as Arbitrum, Optimism, and Polygon. These technologies allow transactions to be processed outside the main blockchain while preserving its security, significantly reducing fees and increasing the speed of operations.

Solana was created with a focus on high performance and scalability. Its key innovation is the Proof of History mechanism, which allows ordering transactions in time without the need for global synchronization. Smart contracts in Solana are called programs and are typically written in the Rust language, although Solana also supports C and C++. This ensures high execution speed and efficient resource utilization but requires deeper knowledge of low-level programming from the developer. Solana is often used in projects where high throughput and minimal fees are important.

Practical dApp development comes with a number of challenges. One of the key aspects is the optimization of smart contracts to reduce transaction costs. Additionally, special attention must be paid to security, as errors in the code can be exploited by malicious actors. An important stage is

testing in special test networks that simulate the operation of the main blockchain. Code audits by external experts are also widely used, which helps mitigate the risks of financial losses.

The key advantages of decentralized applications include the possibility of direct interaction between users, automated rule execution, and reduced dependence on centralized services. Users can interact directly with each other without intermediaries. However, decentralized applications have several disadvantages, such as development complexity, limited performance, and scalability issues. For end-users, dApps are often less convenient compared to traditional web applications.

For a clear comparison of the traditional approach to web application development and the Web3 concept, it is appropriate to consider the generalized characteristics of Web2, decentralized applications, and the Ethereum and Solana platforms, as presented in Table 1.

Table 1 – Comparative Characteristics of Web2, Web3, and dApp Development Platforms

Criterion	Web2	Web3 / dApps	Ethereum	Solana
Architecture	Centralized client-server model	Decentralized model	Decentralized blockchain platform	Decentralized blockchain platform
Data Control	Owned by companies and services	Owned by users	Data is stored on the blockchain	Data is stored on the blockchain
Server Logic	Server applications (API, databases)	Smart contracts	Smart contracts (Solidity, EVM)	Applications (Rust, C)
User Role	Passive service consumer	Active network participant	Signs transactions through a wallet	Signs transactions through a wallet
Transparency	Limited	High	High, public contract code	High, public source code
Security	Depends on the server	Secured by cryptography	High level of security	High level of security
Transaction Speed	High	Lower than in Web2	Medium	High
Fees	None or minimal	Present	Relatively high (from \$1 to \$50+ per transaction during peak periods)	Low
Scalability	High	Limited	Limited without L2 solutions	Higher than Ethereum
Main Areas of Application	Social networks, services, marketplaces	DeFi, NFT, DAO, Web3 games	DeFi, NFT, DAO	DeFi, games, financial services

Table 1 summarizes the key differences between traditional web solutions and decentralized approaches, and illustrates the specifics of using the Ethereum and Solana platforms in practical dApp development.

This study investigates the concepts of Web3 and decentralized applications as the modern stage in the evolution of network technologies. It establishes the fundamental distinctions between the traditional centralized Web2 model and the decentralized Web3 approach, which lie in the methods of data storage, control over information, and mechanisms of interaction between network participants. The architecture of decentralized applications has been analyzed, revealing its foundation on the use of smart contracts instead of traditional server-side logic, which ensures transparency in the execution of program code and immutability of business rules without involving

centralized intermediaries. The practical significance of the research lies in forming a comprehensive understanding of the capabilities and limitations of Web3 technologies for developers and organizations considering the implementation of decentralized solutions. The results indicate the significant potential of dApps in shaping new models of digital interaction, particularly in the financial sector, digital asset management, and the creation of autonomous organizational structures.

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