AI-Driven Intelligent Platform for Freelance Services Management and Monitoring

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Abstract

The accelerated growth of freelance platforms has brought to light several systemic challenges, such as elevated transaction costs, increased susceptibility to fraud, limited transparency, and inefficiencies in the selection of service providers. This study presents the design and implementation of an AI-powered platform aimed at improving the management and monitoring of freelance services. The platform architecture incorporates a multi-criteria risk assessment framework, which evaluates users based on their ratings, transaction history, account longevity, and digital wallet balance. To address issues of contractor reliability and operational anomalies, the system integrates advanced algorithms for automated selection and anomaly detection. A smart contract mechanism, implemented in Solidity and deployed on the Ethereum blockchain via Web3.js, ensures secure and verifiable transactions. For data storage and retrieval, the platform leverages PostgreSQL and MongoDB, while ECDSA cryptographic techniques are employed to reinforce transaction integrity and user authentication. Empirical evaluation indicates that the platform substantially mitigates fraud risks and enhances the efficiency and transparency of interactions between clients and freelancers. The proposed solution demonstrates the potential to support secure and scalable freelance operations and may be extended for deployment within decentralized finance ecosystems and digital commerce environments.

Keywords

Freelance platforms; intelligent order management; risk assessment algorithms; smart contract technology; blockchain-based transactions; fraud detection; automated freelancer selection; Internet of Everything; decentralized digital platforms; secure payment systems

1. Introduction

In today's rapidly developing technology and the growing popularity of remote work, the task of ensuring effective interaction between customers and performers on freelance platforms is relevant. Freelance platforms act as a key tool for customers and performers, providing the ability to quickly search for qualified specialists, organize work and monitor task performance. The development of intelligent systems for analyzing sales and promoting services is becoming an important component of modern freelance platforms. In particular, leading companies in the industry are implementing algorithms that take into account user activity, sales statistics and the quality of services performed. This allows you to increase search efficiency, promote interaction between customers and performers and provide a more personalized experience.

Today, many well-known platforms for freelance services actively use algorithms to optimize user work. However, they are limited in the mechanisms for rewarding the most successful performers in a short period of time, which could stimulate competitiveness.

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The results of the developed platform can become a useful tool for small and medium-sized enterprises looking for high-quality services from remote performers, as well as for freelancers seeking to effectively promote their services. Special attention is paid to innovative mechanisms for promoting orders that increase the efficiency of interaction on the platform and create a competitive advantage.

The goal of the work is to improve the reliability and efficiency of the freelance platform by implementing improved rating systems, a flexible Escrow model, the ability to create group projects, as well as a transparent motivation system for performers. This will provide greater security, convenience and transparency for users, increasing their trust and creating competitive advantages for the platform.

The results of the study can be used to create intelligent freelance platforms that provide automated selection of performers, reduce the likelihood of fraud and improve the security of financial transactions. The proposed mathematical model can also be integrated into financial systems, e-commerce and other platforms with decentralized transactions.

2. Analysis of the subject area

Freelancing, as a phenomenon, is developing rapidly, turning remote work into an important element of the global economy. Freelancers, or specialists working on temporary contracts, occupy a special place in the modern business environment, as they allow companies to attract talent from all over the world on flexible terms. According to Economic Truth, the number of people working on a freelance basis is growing every year, and the development of digital technologies is only accelerating this process.

Freelancing platforms provide interaction between customers and performers, allowing them to find each other, negotiate and conclude deals online. Among the most famous platforms are PeoplePerHour, Upwork, Freelancer, Weblancer and FreelanceHunt. These services offer a wide range of services: from software development to graphic design, marketing and consulting. In addition, platforms provide convenient access to tasks for millions of users around the world, offering both short-term projects and long-term contracts.

Despite the significant development of such platforms, there are a number of problems that hinder their further improvement. Among the main disadvantages are: high risks of fraud, large commissions, lack of motivation, insufficient transparency of transactions, problems with financial transactions, a complex system for promoting services to the top, as well as limited opportunities for cooperation between several performers. Customers cannot always be sure that the performer will perform the work properly, and freelancers often face difficulties in receiving payment for the work performed. In addition, the interaction system on freelance platforms is often focused on individual tasks, which makes it difficult to coordinate large projects that require the cooperation of several performers with different competencies.

The development of freelance platforms is aimed at implementing solutions that increase the security, motivation and efficiency of cooperation between the parties. However, there are still issues that need to be addressed. In particular, these include:

- Unequal competition among performers. Most platforms are based on rating systems, where new or inexperienced performers often find themselves at a disadvantage, even if they are highly qualified. This leads to the fact that the focus shifts to the number of completed tasks instead of their quality.
- Insufficient motivation for long-term cooperation. Platforms often do not offer effective tools to encourage freelancers, which can lead to low quality of services.
- Fraud risks. Open platforms with insufficiently effective user verification mechanisms can become a place for fraudsters, which threatens the financial security of both customers and performers.

- Unsafe financial transactions. Many platforms have problems with transaction security, as well as conflicts over timely payment.
- Limited communication. Platforms do not always support teamwork, which makes it difficult to implement complex projects that require the involvement of several freelancers.
- High commissions. On some platforms, commissions for using the service and withdrawing funds can be quite high, which scares users away.

One way to improve the user experience is to introduce new features, in particular, recommendation systems based on user behavior analysis and new metrics for assessing the quality of work. This will make the process of selecting performers more objective and transparent, reducing the subjective influence of rating systems.

As part of this work, it is proposed to improve the rating system, implement a flexible Escrow system with the division of projects into stages, the ability to create group projects, free top positions, improved communication, a correction and request system, a blacklist, and a transparent motivation system for performers. This approach will allow creating a platform that combines convenience, security, flexibility, and transparency for users, increasing their trust in the system and ensuring equal conditions for freelancers. Such a platform should gain competitive advantages over existing platforms through innovative features and improved user experience.

3. Literature review

The rapid evolution of freelance platforms, combined with increasing demand for secure, efficient, and transparent digital services, has stimulated extensive research in the fields of blockchain integration, risk assessment, and intelligent management systems.

Blockchain technology has been identified as a promising solution for enhancing trust and security in decentralized ecosystems. Hatim et al. [1] introduced a blockchain-based Internet of Vehicles (BIoV) architecture aimed at ensuring data integrity and transparency in smart city development. Their approach highlights the importance of decentralized trust mechanisms, a principle directly applicable to freelance marketplaces seeking to mitigate fraud risks and ensure the transparency of transactions.

In the domain of economic models based on blockchain, Sukkrajang et al. [2] developed a trade distance and pricing model for electric vehicle charging, utilizing blockchain to guarantee secure and verifiable transactions. Their work underscores blockchain's capability to support automated, secure financial operations — a critical requirement for freelance platforms managing payment flows between customers and service providers.

The combination of blockchain with machine learning has been explored to address compliance and monitoring challenges. Shaik et al. [3] proposed machine learning applications for enhancing regulatory compliance within blockchain-based supply chains, demonstrating that intelligent algorithms can substantially improve risk detection and management — a core element in the proposed AI-driven freelance services platform.

Data integrity and trustworthiness remain key concerns in decentralized systems. Ravishankar et al. [4] developed a blockchain-based database to ensure data integrity in cloud computing, emphasizing the effectiveness of distributed ledger technologies in protecting against data tampering. Their findings support the notion that integrating blockchain with freelance platforms can strengthen the reliability of user data and transaction histories.

Nevertheless, blockchain-based systems also introduce new security challenges, as analyzed by Ismail and Reza [5], who identified vulnerabilities specific to blockchain-enabled supply chains. Their research highlights the need for rigorous risk analysis and secure system design — considerations that directly influence the development of intelligent freelance platforms capable of minimizing fraud and operational risks.

The use of blockchain for fundraising and decentralized finance was examined by Hartmann et al. [6], who compared blockchain-based crowdfunding with conventional fundraising models.

Their findings indicated that blockchain significantly improves trust and reduces intermediary costs, supporting the potential of blockchain to lower operational fees on freelance platforms.

Furthermore, blockchain-based control systems have proven effective in critical security scenarios, as shown by Li et al. [7] in the context of rail transit systems. Their work demonstrates how blockchain ensures real-time data management and security, offering valuable insights into managing real-time order execution and contract fulfillment in freelance environments.

Finally, Ribeiro and Barbosa [8] presented a risk analysis methodology tailored to blockchain-based solutions, underlining the necessity of systematic risk evaluation in decentralized applications. This methodology provides a foundation for designing multi-factor risk assessment models, crucial for securing transactions and interactions within freelance platforms.

The need for secure cryptographic operations [9] and efficient cloud-based data processing [10] further highlights the technological challenges addressed by the proposed platform, ensuring both transaction security and scalable management of freelance service operations.

3.1. Research gap and motivation

While existing studies demonstrate the transformative potential of blockchain and intelligent systems across various sectors, the specific application of AI-driven multi-factor risk assessment models combined with blockchain-based smart contracts for freelance services management remains underexplored.

Current freelance platforms still struggle with high transaction fees, susceptibility to fraud, limited transparency, and inefficient contractor selection processes.

Thus, there is a clear necessity to develop an integrated, AI-enhanced platform capable of:

1. Dynamically assessing transaction risks based on multiple behavioral and financial parameters;
2. Automatically selecting optimal freelancers;
3. Securely managing transactions using smart contract technology.

The proposed platform aims to bridge these gaps by leveraging advanced AI algorithms and blockchain infrastructures to create a secure, efficient, and transparent environment for freelance interactions, contributing to the broader development of intelligent decentralized marketplaces.

4. Mathematical model and algorithms for a freelance services platform

The main function of the software is to filter the search, publication and fulfillment of service orders, as well as ensure secure transactions between customers and freelancers.

4.1. Mathematical model for an intelligent platform for managing orders and monitoring freelance services

The development of a platform for ordering and monitoring freelance services should include tools for assessing the quality of services, analyzing transaction security, and automating the selection of performers. To achieve these goals, it is proposed to build a mathematical model for assessing transaction risk and determining optimal performers, which uses multifactor analysis.

Formalization of the mathematical model. Let:

- Z — a set of orders;
- $F = \{f_1, f_2, \ldots, f_n\}$ — a set of freelancers available to fulfill orders;
- P — a set of transaction parameters between customers and performers;

- $R(f_i, Z_j)$ – the risk rating of the transaction between freelancer f_i and order Z_j, which depends on several factors.

Transaction risk assessment. To assess transaction risk, a risk function can be defined:

$$R(f_i, Z_j) = \alpha_1 \cdot R_h(f_i) + \alpha_2 \cdot R_p(f_i) + \alpha_3 \cdot R_t(Z_j), \quad (1)$$

where:

- $R_h(f_i)$ – the risk based on the freelancer's history of completed orders;
- $R_p(f_i)$ – the risk based on freelancer profile (reviews, rating);
- $R_t(Z_j)$ – the risk associated with the transaction for a specific order (e.g. payment amount);
- $\alpha_1,\ \alpha_2,\ \alpha_3$ – weighting factors that determine the significance of each parameter.

Optimization of the selection of performers. We formalize the problem of selecting the optimal freelancer f^*, which minimizes the transaction risk:

$$f^* = \arg\min_{f_i \in F} R(f_i, Z_j). \quad (2)$$

This task can be solved using linear programming or classification methods (based on machine learning algorithms such as Random Forest or Logistic Regression).

Risk reduction using smart contracts. Financial transactions are implemented through Ethereum smart contracts, which minimize the risk of fraud by automating payment execution. The smart contract blocks funds until the order is confirmed, and its logic can be expressed through a function:

$$SC(Z_j) = \begin{cases} Payment(f_i), & if\ f_i \text{ executed successfully}, \\ Refund(Z_j), & if\ Z_j \text{ canceled}. \end{cases} \quad (3)$$

Selection of weighting factors. To ensure a balanced assessment and minimize fraud, the following weighting factors were selected:

- $\alpha_1 = 0{,}4$ – the impact of contract performance history. Contract performance history is one of the key factors that indicates the reliability of the contractor. A large number of unfulfilled or canceled contracts indicates a potential risk of fraud or non-compliance. Since this factor directly affects the level of trust, it is given a high priority (40%).
- $\alpha_2 = 0{,}4$ – the impact of the contractor's rating. The rating is based on customer feedback and reflects the quality of the tasks performed. A low rating may indicate unscrupulous behavior of the contractor or low quality of work. Due to the high importance of this criterion, it is also given a weight of 40%.
- $\alpha_3 = 0{,}2$ – the impact of account age. New accounts often have an increased risk of fraud, as fraudsters can create new profiles after blocking old ones. However, account age has a less significant impact on the score compared to other factors, so this criterion is assigned a weight of 20%.

Let's consider additional aspects and weight settings.

- Normalization of weight coefficients: The weights were chosen so that their sum equals 1: $\alpha_1 + \alpha_2 + \alpha_3 = 1$. This avoids distortions in calculations.
- Adaptability of weights: Weights can be adjusted depending on the specifics of the platform. For example, if the platform specializes in short-term tasks, you can increase the weight of the performer's rating.

The selected weighting factors provide an optimal balance between various risk factors, which allows to increase the accuracy of the assessment of performers and minimize fraud on the platform. This approach contributes to the creation of a transparent and secure environment for interaction between customers and performers.

The proposed mathematical model for assessing transaction risks and selecting performers increases the efficiency and security of the freelance platform. It provides transparent interaction between users and minimizes fraud risks through multifactor analysis of transactions and automation of processes via the blockchain.

Let's consider the advantages of using the model.

- Comprehensive analysis: Unlike traditional approaches that take into account only the rating, the model evaluates several factors: the history of completed contracts, rating, age of the account. This significantly increases the accuracy of the assessment.
- Risk reduction: The model can identify suspicious accounts (for example, new accounts or those with a low balance and a high percentage of unfulfilled contracts).
- Selection automation: The model automatically calculates risks and helps customers quickly choose the optimal performer. This saves time and reduces the likelihood of human errors.
- Flexibility: Weighting factors can be adjusted according to the specifics of the platform or specific tasks. For example, for financial projects, you can increase the weight of the risk associated with the wallet balance.

The proposed mathematical model increases the efficiency of the freelance platform, providing automatic assessment of transaction risk and minimizing the likelihood of fraud. This contributes to creating a transparent and safe environment for customers and performers.

4.2. Algorithms for automated selection of executors and smart contract mechanisms

Let's consider algorithms that provide automated selection of performers on a freelance platform, as well as mechanisms for implementing smart contracts for secure financial transactions between the customer and the performer. The algorithms are based on a multifactorial assessment of candidates, which reduces the risks of fraud and optimizes the process of finding the best specialist to perform the task.

Description of the algorithm for automated selection of performers

Automated selection of performers is based on a multifactorial assessment that takes into account:

1. Performer rating R – the average score given by customers for completed tasks.
2. History of completed contracts N_s– the number of successful transactions.
3. Frequency of unfulfilled contracts N_f – the proportion of contracts that were canceled or not completed.
4. Task execution time T_d– the average order execution time.

5. Crypto wallet balance B – the availability of funds as an indicator of financial responsibility.
6. Account age S – the duration of the profile's existence on the platform.

The flowchart displays the sequence of steps performed by the system to automatically select the optimal performer (Fig. 1).

Description of the smart contract algorithm for transactions. Smart contracts are an important component of the platform, as they provide automation of financial transactions and guarantee the fulfillment of the terms of the agreement. The main function of a smart contract is to deposit the customer's funds until the task is completed.

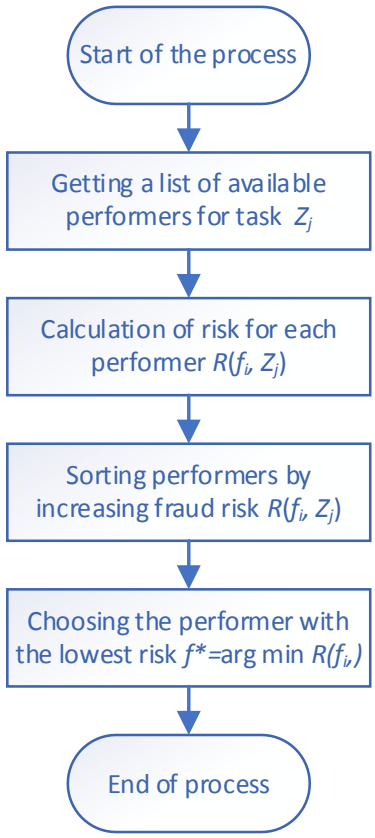

Figure 1: Flowchart of automatic selection of the optimal executor

The smart contract algorithm can be divided into the following stages (Fig.2):

- Contract creation: The customer creates an order Z_j and concludes a smart contract with the executor f_i.
- Depositing funds: The system blocks the customer's funds at a separate address of the smart contract.
- Task execution: After completing the task, the executor sends the result to the customer via the platform.
- Checking the execution: The customer checks the result and confirms its acceptance or opens a dispute (if the task was performed poorly).
- Fund distribution: If the order is confirmed, the funds are automatically transferred to the executor. In case of a dispute, the arbitration mechanism is activated.

Let's consider the advantages of the proposed algorithms

1. Automation of the selection of performers: Thanks to the multifactor model, the system takes into account various parameters and selects the best performer for a specific order. This minimizes the risk of fraud and improves the quality of task performance.
2. Secure financial transactions: Smart contracts provide automatic blocking and distribution of funds, which eliminates the possibility of financial manipulation.
3. Transparency and trust: All transactions are recorded in the blockchain, which makes them immutable and available for verification.
4. Effective dispute resolution: The built-in arbitration mechanism allows resolving disputes between the customer and the performer without the intervention of a third party.

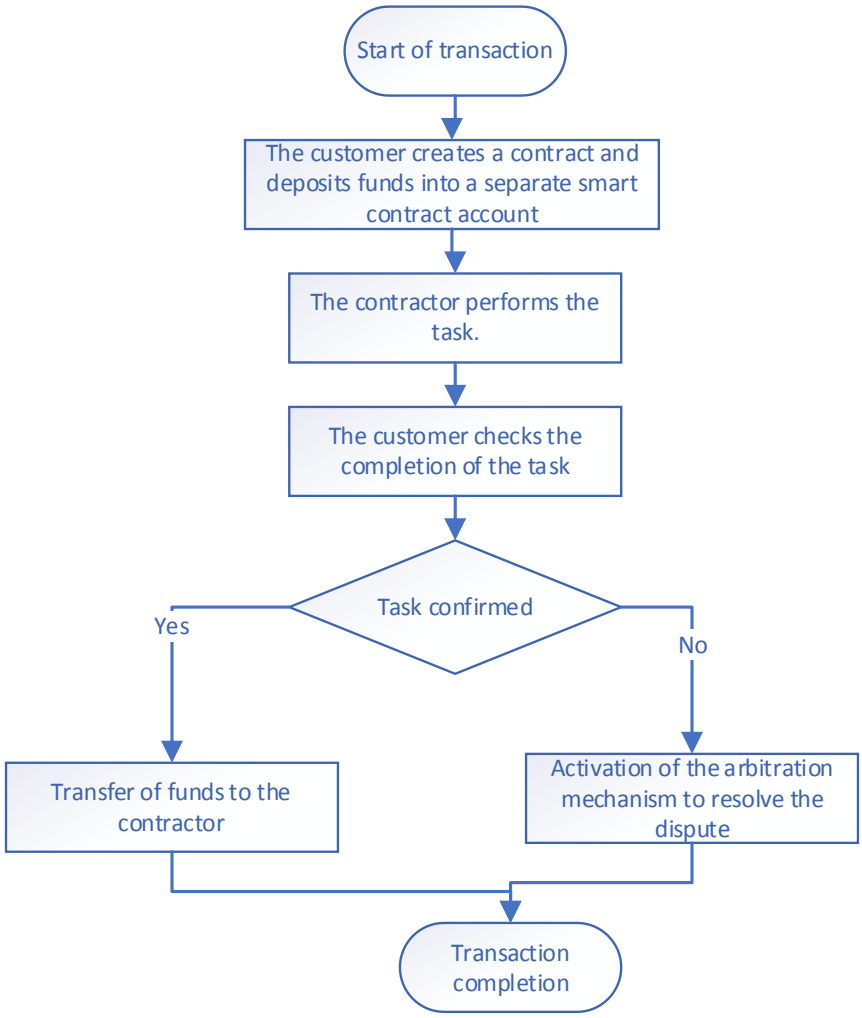

Figure 2: Smart contract operation flowchart

The proposed algorithms for automated selection of performers and the implementation of smart contracts contribute to increasing the efficiency, security and transparency of the freelance platform. They provide convenient interaction between customers and performers, minimizing risks and increasing trust in the platform.

5. Features of development and analysis of software quality

5.1. Software Architecture

The web application development will use monolithic architecture, which is a traditional approach to software development. All system components, such as the user interface, business logic, and database work, are combined into a single, indivisible unit. This means that the application is executed as a single entity, which greatly simplifies its development and support in the early stages.

For the development of a platform for ordering and monitoring the performance of freelance services, a multi-tier architecture was chosen, which divides the system into clear levels according to its functions. Such architecture allows you to create a modular system that is easily expanded, maintained, and highly scalable.

The C4 model is used to graphically describe the system architecture.

The diagram (Figure 3) shows the container model of the system (C4 Level 3). It presents the backend components, including middleware for authentication and authorization, controllers, services, repositories, ORM for working with the database, as well as integrations with cloud services and the database itself.

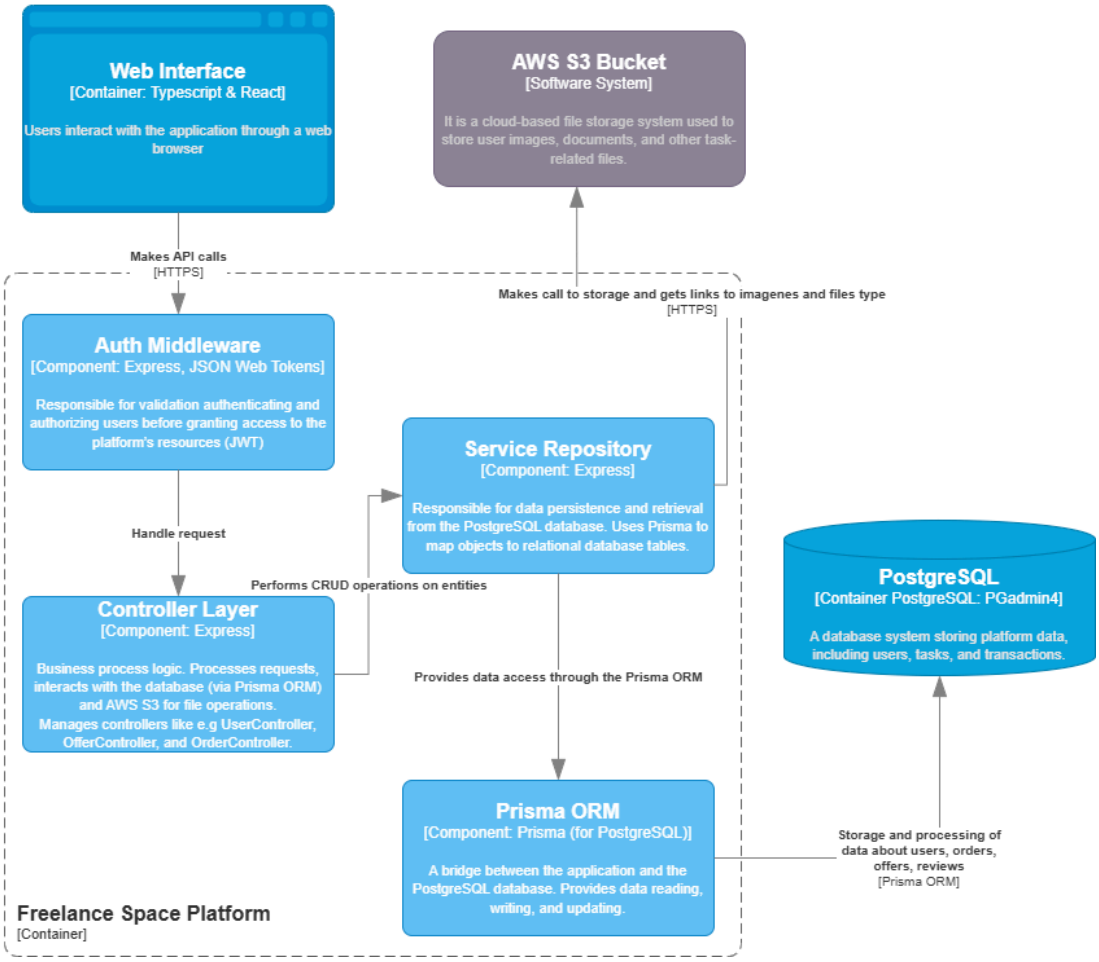

Figure 3: C4 Level 3 Diagram

The system uses integration with several external services to provide additional functionality. In particular, AWS S3 is used to store user images, which receives data via HTTPS using the AWS SDK[3]. This integration ensures reliability of work with cloud services and allows you to easily adapt the solution to different usage scenarios.

One of the main requirements for the system is to ensure its high performance, load resistance and scalability. For this, a clear multi-tier architecture is implemented.

5.2. Data security analysis

The paper conducted a detailed data security analysis, focusing on the use of JWT for authentication and password hashing using the bcrypt algorithm. JWT provides secure token transfer (24 hours is the token lifetime), however, it is important to carefully check the signature and validity of tokens, since insufficient verification can lead to the possibility of token forgery and unauthorized access to data. Using bcrypt for password hashing allows you to reliably protect passwords and guarantees the security of storing passwords in the database, since hashing makes them irreversible.

To protect files downloaded by users, the AWS cloud platform is used, where data is stored in a secure environment with access rights settings. Also, to prevent CSRF (Cross-Site Request Forgery) attacks, the project uses authentication tokens. All these measures help maintain data integrity and minimize the risks of unauthorized access or information leakage.

5.3. Software quality analysis

This section analyzes the metrics used to assess the quality of the developed software. The following metrics were selected as metrics for assessing the quality of the software:

- Speed (Web application page loading time; API request processing speed; Web application page loading).
- Reliability (Resistance to failures when processing large amounts of data; API request processing speed; Web application page loading).
- Security (Protection against cross-site request forgery (CSRF); Protection against SQL injections; Encryption of user passwords).
- Usability (Convenience of the user interface; Logical navigation structure; Clear error messages; Attractive interface design).

For further testing, we will compare several services: Google PageSpeed Insights, Dareboost, Google Lighthouse.

Given the local development of the software and its ease of use, Google Lighthouse was chosen for testing, test results (Figure 4, 5).

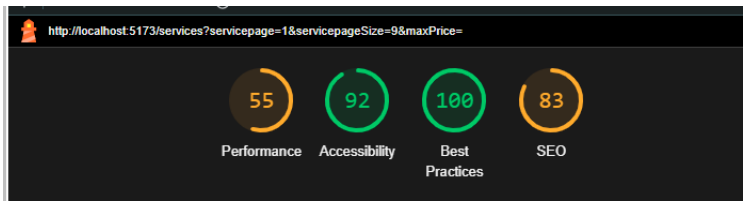

Figure 4: Testing the services page

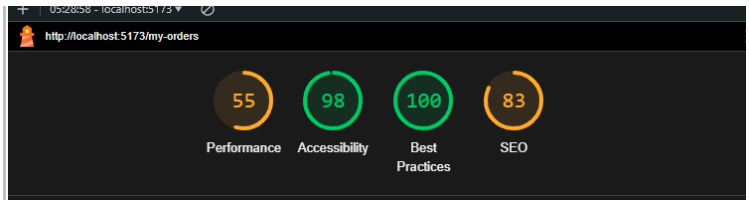

Figure 5: Testing the orders page

Based on the results of the Google Lighthouse analysis, the following performance indicators are given

- Performance: overall score of 55;
- Accessibility: high score of 92 and 98 – means that the site meets many accessibility standards for users with different needs;
- Best Practices: maximum score of 100 – compliance with modern security and technology recommendations;
- SEO (Search Engine Optimization): score of 83 – indicates a sufficient level of optimization for search engines.

After analyzing the test results, we can conclude that the Best Practices and Accessibility indicators are at the highest level. Performance gives an average result, such a performance indicator is normal for modern web applications built on React using client-side rendering, dynamic data loading and complex processing logic. Instead of focusing solely on the overall score, it is important to pay attention to the target audience and the operating scenario. The characteristics of the computer also have a great influence, since it takes a long time to process all systems. In practice, such indicators are acceptable for applications focused on modern devices with good characteristics.

6. Conclusions

As part of the work, an intelligent platform for managing orders and monitoring freelance services was developed and researched using a multifactor transaction risk assessment model and smart contract mechanisms on the Ethereum blockchain. The research allowed us to achieve the set goal and solve the tasks aimed at increasing the security, transparency and efficiency of interaction between customers and performers.

As a result of the work, a prototype of a web platform for freelance was developed, which is aimed at automating the interaction processes between customers and performers. Its goal is to increase the efficiency of cooperation by improving the functionality of searching for services, managing orders, ensuring transaction security and supporting teamwork. This solution is relevant in connection with the growing popularity of freelance services and the need to increase trust in such platforms.

The developed platform takes into account the key challenges of modern freelance services, including fraud risks, large commissions, the difficulty of finding performers and the lack of transparency of transactions. The uniqueness of the proposed solution lies in the implementation of a flexible Escrow system for dividing projects into stages, group project functions, free top positions for performers, and an improved rating system.

The main results of the work are as follows.

1. An analysis of existing freelance platforms showed the shortcomings of traditional approaches to ensuring transparency and security of financial transactions, in particular, high risks of fraud, low automation of the selection of performers, and the absence of mechanisms to guarantee the execution of transactions.
2. A multifactor mathematical model for assessing transaction risk has been developed, which takes into account factors such as the performer's rating, history of executed contracts, crypto wallet balance, and account age. The model allows you to automate the risk assessment process and minimize the likelihood of fraud.
3. Automated performer selection algorithms based on multi-criteria analysis have been implemented. This ensures effective selection of freelancers with minimal risk of failure to complete tasks.

4. A smart contract mechanism based on the Ethereum blockchain has been developed, which automates financial transactions and guarantees payment only after successful order fulfillment. This significantly increases the level of trust between customers and performers.
5. The results of testing and modeling have confirmed the effectiveness of the proposed algorithms and models. Reducing the risk of fraud, optimizing the selection of performers, and transparency of transactions have contributed to improving the quality of order fulfillment and interaction between users.
6. The practical significance of the work lies in the possibility of using the developed platform not only for freelance services, but also in related areas, such as e-commerce, financial services, or project management systems using decentralized technologies.

The developed intelligent freelance platform with a multifactor risk assessment model and smart contract mechanisms demonstrates significant advantages in increasing security, transparency, and automation of business processes. This makes it competitive and promising for practical application in modern digital ecosystems.

Declaration on Generative AI

During the preparation of this work, the authors used AI program Chat GPT 4.0 for correction of text grammar. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the publication's content.

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